THE FIRST TWO YEARS

A STUDY OF TWENTY-FIVE BABIES

VOLUME II

INTELLECTUAL DEVELOPMENT

UNIVERSITY OF MINNESOTA
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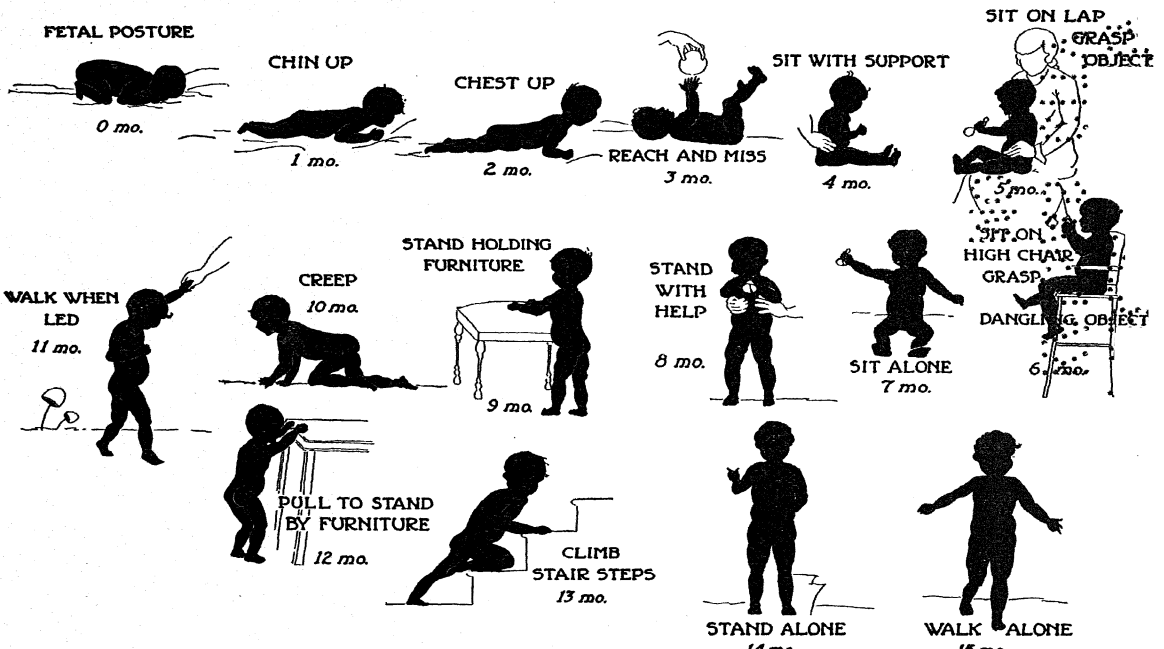
FIGURE 1

THE MOTOR SEQUENCE



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A STUDY OF TWENTY-FIVE BABIES

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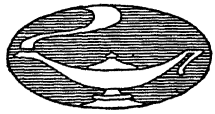

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PREFACE

Students of human and animal behavior ask two very general questions: What *can* the organism do? and What *does* the organism ordinarily do? In seeking the answer to the first question the scientist usually brings his experimental animals into the laboratory: he subjects the paramecium to light, sends the rat through a maze, harnesses the dog to a conditioned reflex apparatus, gives the child a mental test, induces the adult to perform multiplication under distracting conditions, and what not. In short, he takes the organism temporarily out of its ordinary environmental setting and places it under conditions over which he has experimental control.

The scientist who attempts to answer the second question adopts a laissez faire policy toward the animal experimented upon. Equipped with notebooks, camera, and a few portable scientific tools, he pursues his quarry into its native habitat; there he establishes himself as comfortably and unobtrusively as possible and settles down to watch, wait, and record what happens. Thus naturalists have studied the social life of ants and bees, have observed the homing of birds, and have watched the unfolding of life processes in a wide variety of subjects from the amoeba to man.

In the first instance the scientist plays an active rôle in the animal's life; he is, for the moment, an omnipotent and benevolent despot who has the subject under his complete guidance and control. In the second instance he is merely a spectator attentively watching as

long as he may the drama in which his subject is playing the leading part.

Naturally the latter approach has been more often applied to animal than to human subjects. Scientists, like other men, are brisk and impatient; their work must move along at a respectable pace. Few have time to sit through more than a single scene of the human play, no matter how dramatic it is. To watch a single individual from birth to death exacts too great a toll from the observer's life span; indeed, it is extremely unlikely that he will outlive his subject. Nevertheless, the method may be applied to a part of the subject's life with valuable results. It is easiest to apply the plan during babyhood, for then developmental processes are proceeding at a rapid pace, and in the short space of a few months the scientist can observe as large an increment of development as in two or three years at a later age.

The Minnesota Infant Study represents such an investigation; the newborn baby was tracked from the hospital to his native haunt, the modern American home, and there was observed over a two-year period. That the study might yield fairly complete data only twenty-five babies were included. These were examined at frequent intervals with anthropometric, physical, and psychological tests; in addition, a wealth of observational data was supplied by the mothers.

The investigation consumed a tremendous amount of time. For two years the two examiners, Dr. Edith Boyd and the author, spent about two-thirds of their working time in collecting the data; and for the next three years it took most of their time and that of a corps of assistants to analyze the material and prepare it for publication.

In compiling and presenting the data the author has

tried to keep in mind the limitations as well as the advantages of the study. The relation of age to development has been minimized: the group is so small that averages have no normative significance. The order, or sequence, of developmental events, on the other hand, has been stressed as the chief contribution to be made by a study following the progress of a few individuals over a long period.

In the first volume of this report the principle of the sequence was seen to hold for postural and locomotor development. In the present work the applicability of the law to manipulatory, social, vocal, and indeed to all behavior is shown. The data are treated in several ways to bring out pertinent facts about developmental rate during babyhood. Here and there in this and the preceding volume anecdotes and descriptive accounts of the individual babies are interspersed with descriptions of group trends. These not only serve as illustrative material, but they enable the reader to build up a cumulative acquaintance with each baby that will be a background for the more detailed analysis of their personalities to be presented in Volume III.

The tests devised for the study were very simple, and the apparatus and equipment meager and unconventional. Indeed, Dr. Boyd facetiously remarked on one occasion, "Every time I unpack this box of junk I'm reminded of the resourceful housewife who mends everything with a hairpin and a bit of string rather than wait for her husband to take a half holiday and clutter up the whole house with tools in making the simple repairs. Your collection of spools, bottles, and empty boxes do not look very impressive as scientific instruments; but they work." And they work because development proceeds so rapidly during babyhood that it may be dem-

onstrated with the simplest of apparatus and experimentation. Actually it does not need to be demonstrated; it shows up without any experimentation; in fact, it cannot be concealed from the eyes of the observer. The author does not deny that elaborate equipment and refined experimental techniques are excellent aids to the study of babyhood; many problems could not be solved without them. But the student who wishes to travel with the child down a considerable length of the developmental highway cannot burden himself with excess baggage. If he keeps his eyes alert to observe and his wits sharp to record the ever changing events before him, he may dispense with most of his other impedimenta without qualm.

The author takes this opportunity to revoice the appreciation she expressed in Volume I for the assistance and encouragement she has received from many sources: to the mothers for their splendid cooperation; to Dr. Boyd for her indispensible collaboration; to Dr. John E. Anderson for a critical reading of the manuscript; and to Mr. Donovan Lawrence for important technical help.

MARY SHIRLEY

University of Minnesota
August 5, 1931

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PART I

DEVELOPMENT OF SPECIFIC BEHAVIOR TRAITS

CHAPTER I

INTRODUCTION: THE STUDY OF INTELLECT IN BABIES

"Intellectual behavior" may be too high-sounding a term for the simple reflexes and generalized activity of the new-born child. Indeed, those who are accustomed to think of intellect as manifested only by the higher processes of reasoning and abstract thought or by the manipulation of material in verbal terms may question whether the baby under one year exhibits any behavior that may properly be called intellectual. Certainly the beginnings of intellect are hard to discern in the early acts of watching and reaching and the simple manipulation of toys. But with the dawn of comprehension of adult speech, the beginning of intelligible talking, and the development of locomotion about the house, the baby's simple thought processes and his independence of action are apparent even to the most skeptical of observers. In the light of this later development one cannot doubt that the roots of intellectual behavior extend backward into the simplest acts of early infancy.

Lest the reader expect too much, the author hastens to point out at the start that she makes no pretension to a thorough understanding of the broad implications of the term "intellect" or to a comprehensive knowledge of what constitutes intellect in the baby. In this study "intellect" is used as a blanket term to cover almost everything the infant does. Paying attention to people, handling toys, shouting, gesticulating — such bits of be-

havior are the only clues we have to the baby's intellectual life. These acts must be studied objectively by direct observation, for the infant himself cannot help us to an understanding of his mental life by making an introspection of himself and reporting on his content of thought.

The author must also confess an inability to make a critical evaluation of how much each type of behavior contributes to the growing intellect. It is a question whether adaptive behavior and language behavior, to use the terms of Gesell, may not play a greater rôle in intellectual development than do motor and social behavior. But such classifications are broad and arbitrary, and there is much overlapping of categories. In making the study here reported the items of behavior were roughly classified, but no differential weighting was attempted. It was assumed that every type of behavior that developed in all the babies and that persisted and improved over a long period of time or waned only after a considerable interval was a definite step in the baby's progress toward maturity. No items were discarded, and each was weighed only in relation to all the others.

The Method

Whatever contributions this study may make to our knowledge of infancy will be largely attributable to the method used. Certain fundamental problems of development have only one avenue of approach, that of long continued, or frequently repeated, observations of the same individual. A view of the child as a whole and an understanding of the detailed course of child development, its continuity and its rate, are the rewards of pursuing this route.

Thus far the longitudinal road has been sparingly

traveled by students of child development, the reason being, of course, that one can progress much faster and much farther toward an understanding of many fundamental principles by taking a short cut that crosses the lives of many children at the same time than by following a few babies down the long lanes of the months and years. For many years interested parents and relatives were the only ones to undertake such long journeys, the obvious reason being that they were perhaps the only persons who had continuous and easy access to the child over long periods. With all their obvious faults and defects, the contributions of these biographies of children kept by parents and relatives are of inestimable value to the modern student of child development. From them one not only gets an impression of the continuous onsweep of developmental processes, but he also feels intimately acquainted with the child as a person.

The growth of the intelligence-testing movement and the theoretical problem of the constancy of the *IQ* that it has raised has resulted in the practice of making "follow-up" studies, whereby individuals tested or measured at an early age are examined again at a later age. Perhaps the largest and most completely organized follow-up work has been done by Terman and his coauthors (60) in their *Genetic Studies of Genius*. Indeed, so comprehensive is the study and so continuous is the contact that it might be called the first of the "follow-through" studies, if we may designate as follow-through studies those in which the contact is maintained over a long period and observations are made at repeated intervals. These are in contrast to the "follow-up" studies, in which the contact may be broken and reestablished once or oftener during the individual's childhood. In the field of follow-up work Gesell has retested

enough children to enable him to draw up developmental curves.

The present study is, so far as the author is aware, the first of the follow-through studies of babyhood. A few months after it was begun, a similar study was initiated at the University of California, where Bayley and Wolff made repeated monthly examinations of a group of sixty babies. The Minnesota study does not include so many subjects, but the deficiency in that respect is perhaps offset by the greater frequency of the examinations and by the fact that the study was conducted in the homes instead of being confined to the laboratory.

In brief, the general procedure consisted of observations of a sizable group of babies in the hospital and in the homes from the day of birth. Examinations were made daily during the first week of the hospital period and every two days during the second week. During the remainder of the first year the babies were observed at weekly intervals in their homes and at biweekly intervals during the second year. At the age of two years two of the children became regular attendants at the Institute nursery school and entered into the regular program of observations and tests carried out by Institute workers. The remaining seventeen children, whose parents still live in the Twin Cities, are visited four times a year for the collection of anthropometric data and twice for psychological data, and once a year they are brought to the Institute for a mental test. The weekly examinations of the first year were supplemented by the mothers' daily records of food intake and habits of sleep and by their summaries of elimination, developmental items, and general behavior. A more complete description of the observational program and a schedule of examinations for the first two years are

given in Volume I, pages 8–31. The complete list of babies is given in Volume I, pages 210–211.[1]

By virtue of its follow-through character this study for the most part treats the order of development without respect to age. Conducting the observations in the home introduced considerable informality into the examining situation, and the systematic record that was kept of incidental reactions in addition to responses to the tests greatly increases the value of the data as an index to the ordinary course of behavior development. In view of the similarity of this approach to that of the biographical studies, it is not surprising that there are similarities in the results. The course of development, as will appear later, is so consistent from baby to baby that it may be studied more effectively by the careful, continuous observation of one baby than by a cross-section survey of many babies at widely spaced age intervals.

Similarity of the two methods may account likewise for the high consistency of this study with that of Bühler (7). Her method was to observe constantly for an entire day and night the activities of a small group of babies on each monthly birthday. The observations were made without artificial stimulation; the observer merely sat near the infant, watching and recording his spontaneous behavior in his usual daily environment. The present study differs from Bühler's in that simple tests were planned in the hope of tapping the baby's entire repertoire of acts in a brief half hour of examination each week. However, the examining situation soon became a usual part of the baby's routine, and the mother's presence and the familiar home environment

[1] Volume I, which deals with *Postural and Locomotor Development*, was published by the University of Minnesota Press in 1931.

completely robbed the examination of all strangeness. The tests themselves closely duplicated the parents' play stimulation and were appropriate for calling forth the babies' abilities and interests. Responses to the tests were recorded in descriptive terms rather than in terms of arbitrary standards of behavior, and the records of incidental behavior and the mothers' records adequately supplemented the test data. For all these reasons it is likely that this material is almost as free from the unfavorable influences of artificial stimulation as is that of Bühler. It presents the additional advantages, moreover, of being somewhat more controlled and of including a larger number of babies of each age than Bühler's. The qualitative descriptions of infant behavior obtained by the two methods are strikingly similar.

Use of previous literature on the subject. — Since they represent the first and almost the only application of the longitudinal method of child study, the biographies were of great assistance in planning this study and in confirming the results obtained. Many hints as to suitable tests were obtained from the published accounts of Preyer (49), Shinn (52), Major (38), Moore (43), Stern (56), and Fenton (12), and from the unpublished diaries kept by Mr. and Mrs. Harlow Gale.[2] As a source of material on the nature and course of infant development, the complete record of Shinn's observations cannot be praised too highly.

Other literature on infant development was drawn upon in the composition of the examinations and tests.

[2] The writer makes grateful acknowledgment to Mr. Gale for the loan of the diaries so carefully kept by him and Mrs. Gale recording the development of their three children. These records were the source of many ideas for tests.

Some of the test items used are included in Kuhlmann's (30) mental tests for the infant level. Many test objects and procedures were adapted from Gesell's (16) developmental schedules. A few of Watson's (65) methods were tried out. The eye coordination tests were compiled according to Jones's (27) method; the nested box test was taken from the Stutsman (58) examination; and the peg board from Wallin's (62) series.

The test procedures were influenced by the time-sampling method of observation, which was originally worked out by Olson (46) and refined and improved by Goodenough (18) and which is much used at the Minnesota Institute of Child Welfare. The general plan of the examinations and the length of test intervals perhaps need some explanation and justification.

Examination procedure. — For the most part the weekly examinations were about thirty minutes long. At the early ages they were somewhat shorter, because they had to be adapted in length to the tiny baby's small repertoire of responses and to his great fatigability. Each examination was composed of many test items: some aimed to draw out the baby's attentive responses and his social and personality traits; others required manipulatory skill; and still others called for powers of gross motor coordination, postural control, and locomotion.

A time limit was set for each test. Some may argue that the use of time limits is an unwise policy in infant examinations, where the opportunities for adequate motivation are slight and where urging the baby to his best speed is out of the question. If unlimited time were allowed for carrying out an examination, the examiner would probably get a better measure of the baby's abilities at a given age by continuing the stimulus as long as

it seemed effective and by coming back later to tests in which the baby showed no initial interest. But such a leisurely procedure was an ideal that was unattainable in this study. The examiners traveled according to a schedule from home to home, usually examining eight babies a day. The disadvantages of a fixed time limit were offset by the frequency of the examinations and by the fact that all incidental behavior was recorded during the entire examination. If a baby failed to watch, reach, sit, or walk in response to a test, but performed the act spontaneously at some other point in the examination, a record of his successful performance was made, and in the final analysis of behavior items those occurring incidentally were given the same weight as those recorded at the time of the test.

Most of the tests were a minute long; some were 2 minutes, and a few, the choice tests, were 3 and 5 minutes long. In all except the locomotor tests the baby's reactions were recorded at 15-second intervals. The way in which five 15-second records were crowded into a 1-minute test period is really not mysterious. Recorder S[3] started her watch the instant the test materials were presented, glanced at the baby, and in the following 15 seconds rapidly jotted down his initial response; at 15 seconds she glanced at the baby again, wrote the remainder of the interval, glanced at the baby at 30 seconds, and so on, taking her final glance at 60 seconds and at the same time signaling the examiner to remove the test materials. By the time the last observation was jotted down another 15 or 20 seconds had elapsed, during which Examiner B had put away the used materials and got out the next set. Similarly, nine records

[3] S refers to the psychologist who did the record-taking, and B refers to the pediatrician who administered the tests.

were taken in a 2-minute, thirteen in a 3-minute, and twenty-one in a 5-minute test interval.

On the basis of preliminary observations of two babies and of the literature on infant development the various types of responses had been anticipated to some extent, and a system of consistent descriptive phrases was worked out for use in recording. To be sure, the babies far outstripped expectations in the variety of their responses, and new phrases had to be adopted from time to time. The recording code was not inflexible, however. The recorder worked up considerable speed in note-taking by the use of abbreviations and a few symbols. Phrases that were more or less consistent probably had an advantage over a rigid code because they were more easily modified. If a new type of reaction for which no symbol had been worked out suddenly appeared, the recorder was not at her wit's end to devise a new symbol but could, by rapid thinking, hit upon an apt phrase for describing it. Moreover, the subsequent handling of the data was somewhat facilitated, since the original records did not have to be decodified before they were analyzed and interpreted, and they could be read and understood by one unacquainted with the actual record-taking.

Plan of the Report

This treatise on the intellectual development of babies is divided into three parts. Part I presents an account, in the main descriptive, of the course or sequence of development in eye coordination, fine motor skill, speech, social development, and comprehension. The data are derived from the psychological examinations, and in order to understand fully the method by which the developmental items were obtained the reader will need to refer to the descriptions of the examinations.

These descriptions are given in Part II, which includes an analysis of each test item. With as little change as possible from the descriptive phrases of the original records and with very few combinations into larger categories, the different reactions called forth by each test situation are described, and the frequencies of their occurrence are tabulated in percentages for each age level. A point-score value has been assigned to every reaction that seems to have developmental significance as judged by the criterion of increasing frequency of occurrence with increasing age. Reaction by reaction each baby's record is scored, his final score on each test item computed, and finally his score for the entire examination summed. Point scores have always been determined on the basis of the percentage of babies reacting, and the total number of possible points on test items of different time limits have been roughly equated by making the maximum scores approximately proportional to the length of the tests.

This part of the report is a compendium of information that will be of interest to those engaged in research on infant and child psychology. All the data have been included in order that the reader may understand the source of the material presented in Parts I and III and that he may verify or challenge the statements of the latter sections if he cares to do so. Here the large number of patchwork cross sections of the infant's behavior are spread out in full view. In Parts I and III these closely spaced cross sections are gathered up, grouped according to separate traits, and pieced together in chronological order.

Part III is an attempt at drawing all the bits of behavior together again into an orderly meaningful whole. The attempt is partly quantitative; the chapters on de-

velopmental scores and point scores contain data that may throw a little light on the rate and consistency of developmental progress during babyhood. The last chapter, largely descriptive, aims to draw together the results of the studies of the development of both humans and animals and, by coordinating the findings of many investigators in many fields and adding to them the contributions of this study, to suggest a few principles of behavior development.

The term "developmental item," which is frequently used in this report, refers to any definite reaction that was observed to have been developed by at least 75 per cent of the babies studied. The term "item" was chosen in preference to "element" or "unit" because these latter terms imply reactions that are fundamental additions to the existing behavior complex and that cannot be analyzed into smaller components. No attempt was made to observe and record the babies' behavior in terms of component reflexes or reactions of specific muscle groups. Instead, large chunks of behavior were observed in their entirety and recorded in the simple descriptive terms current in studies of infant behavior. The only criterion for discarding a bit of behavior from the list of developmental items was its occurrence in less than 75 per cent of the cases. In the developmental scoring, items not specifically tested for but manifested spontaneously by three-fourths of the babies were included with items tested for and weighted equally with them. The inclusion of spontaneously appearing items, coupled with the frequency of the observations, makes it likely that this account of behavior development in infancy is essentially complete.

CHAPTER II

PROGRESS IN FINE MOTOR COORDINATION

An outstanding advantage of the longitudinal method is that it allows the examiner to observe the course of development of many traits and to study their sequence in the entire developmental scheme. The consistency of the sequence in locomotor development was discussed and its significance brought out in Volume I, pages 166–181. All material on the development of specific traits, which forms the subject of this section, was obtained from the data on the psychological examinations, presented in Part II. The sequence of a given trait is so buried in the details of the tests that it is difficult to follow unless the evidence is assembled more conveniently.

As in the case of locomotor development, proficiency in eye coordination, reaching and manipulating, and vocalization could be measured only in descriptive terms. The only way of deciding that the item "eyes follow tape swung in a circle" represented a higher degree of skill than "watch person" was to compare the ages of appearance of the two reactions. Since age was the only objective numerical measure there was, it was assumed that development in each trait was a direct function of age; differences in the median age of development of two reactions thus served as a crude measure of their relative difficulty.

The topics to be treated in this and subsequent chap-

ters are (1) the sequence of development in a trait as shown by the various test situations, (2) the sequence in supplementary items reported by the mothers, and (3) the spontaneous manifestations of the trait in incidental play as observed by the examiners or reported by the mothers. The method of evaluating the various sources — the examiners' records, the mothers' records, and the incidental items recorded — to obtain the age of development of a reaction is the same as that described for the locomotor reactions in Volume I, pages 32–41. Reactions tested for were considered as established if they appeared more than once at a given examination or if they were noted at two consecutive examinations. The age of the first appearance of a reaction was then taken as the age of development of the reaction. On rare occasions the mothers' reports were used to fill in gaps in the examiners' data caused by examinations being missed. Reactions reported by the mothers were considered established if they were reported six times within two successive weeks or three weeks in succession. Since incidental reactions were noted only when they occurred spontaneously, it was impossible to set up a criterion of consistent reappearances for them; such reactions usually had a wide range in age of development because they were not tested for but were noted only when they occurred.

EYE COORDINATION AND WATCHING

Description of the Sequence

The various steps in eye coordination and the median and quartile ages of their appearance are listed in Table I. Fleeting attempts to follow a slowly moving light were noted in most babies during the first week of the hospital period, and with eighteen of the twenty

TABLE I

MEDIAN AND QUARTILE AGES FOR REACTIONS OF EYE COORDINATION AND WATCHING AS OBSERVED BY EXAMINERS

REACTION	NO. OF CASES	AGE IN WEEKS*			RANK	CASES IN MEDIAN RANK
		Q_1	Median	Q_3		
Follow light	20	2 da.	4 da.	8 da.	1.0	18
Watch person one or two times	23	6 da.	2.0	4.0	2.0	11
Watch object one or two times	23	1.0	3.0	4.0	3.0	9
Follow tape horizontally	23	3.0	5.0	7.0	4.5	11
Watch person three or more times	23	3.0	5.0	7.0	4.5	13
Watch object three or more times	23	2.0	6.0	9.0	6.0	4
Smile at person	23	7.0	8.0	9.0	7.0	10
Follow tape vertically	23	7.0	9.0	10.0	8.0	15
Follow tape in a circle	23	7.0	10.0	13.0	9.0	6

* In this and similar tables reactions that appeared earlier than 1 week are given in days.

babies who manifested it this was the first eye reaction to appear. The next reactions to develop were those of watching a person or an object other than the light. About the time the reactions of watching persons and objects were firmly established, as was indicated by their occurrence three or more times during the examination, the babies began to watch the moving tape when it was swung horizontally before them. The next item to appear was the social smile. Smiling, of course, is not exclusively an eye reaction, but the visual element certainly plays a large part in it. Although in watching a person the baby may look at the body, the hands, or the clothes, in smiling at a person his gaze is definitely focused on the face. The following of the tape with the eyes when it was swung vertically and when it was swung with a circular motion were the last reactions of this group to appear.

Despite the small age range for the entire list of items in the eye coordination series — a range with a median

of only 10 weeks — the sequence within the series is well defined. In the last two columns of Table I the reactions are ranked according to the median age of appearance, and the number of babies who developed the reaction in the same rank order is given. With but two exceptions the reaction of following the light held first rank. Watching person and object alternated more or less in order, although persons usually caught the babies' eyes earlier than did objects. Following the tape when it was swung in a horizontal direction ranked fourth, fifth, or sixth in nineteen cases and nearly always preceded the social smile, which ranked sixth, seventh, or eighth in nineteen cases. The smile in turn usually preceded the reaction of following the tape when it was swung vertically or in a circle; the vertical and circular eye-following reactions frequently appeared at the same age.

So far as the evidence from these tests goes, the course of eye coordination proceeds from fleeting pursuit movements to fixation on an object, and from focusing on an object to consistently following a moving object. The complexity of eye movements varies according to the direction in which the object is moving. These conclusions are in accord with those of Jones (27), who also found that eye movements in the horizontal direction appeared earlier than those in the vertical and circular directions. They are also compatible with those resulting from the more refined work of McGinnis (42), who found that at 6 weeks all his subjects were able to respond with ocular pursuit similar to that of the adult, and that pursuit first appeared in the 3rd and 4th weeks. Hence the conclusions made in this study with respect to sequence are not without support in other literature on the subject.

Supplementary Data Reported by the Mothers

Items of eye coordination recorded by the mothers are given in Table II. Their reports of the ages at which persons and objects were noticed differed very little from those of the examiners. Turning the head from a strong light appeared at about the same time as the focusing reactions. Reacting to a mirror image, looking for fallen objects, noticing distant objects, and looking at pictures with apparent interest were other items recorded by the mothers at later ages.

TABLE II

Age Ranges and Median Ages for Reactions of Eye Coordination as Reported by Mothers

Reaction	No. of Cases	Age in Weeks	
		Range	Median
Notice light	20	2– 9	4.0
Notice object	18	3– 9	4.5
Notice person	19	3–10	5.0
Avert head from light	14	3–10	5.5
React to mirror	22	12–33	18.0
Look for fallen objects	21	17–46	29.0
Notice objects at a distance	20	31–38	33.0
Look at picture with interest	19	32–50	35.0

Spontaneous Manifestations

Watching persons was the babies' greatest distraction during the first three months, and exploratory looking around absorbed their best attention during the early period of sitting on an adult's lap. Quantitative treatment of the amount of watching and looking is presented in Chapter XV. From birth to the age of six months exploration of the visual environment consisted largely of these reactions of watching persons and look-

ing around. Convergence of the babies' eyes to look at near-by objects developed during the first three months. Before 12 weeks most of the babies had noticed their hands. Colored objects seemed to have a high attention value even for babies under three months; three babies unmistakably paid attention to a bright striped sash worn by one of the examiners, and others fixed their gaze on the red-figured sleeve of the doctor's dress as her arms and hands worked close to their faces. Two mothers reported that their babies noticed changes in clothing, especially the change from a house frock to street or evening clothes. Indeed, Winnie at the age of 18 weeks whimpered in alarm when her mother returned from shopping clad in a dark dress, although three hours before she had watched the dressing process with apparent interest; and Harvey at 13 weeks paid attention to the Boy Scout uniform donned by his brother.

At the age of 6 months the reaction of looking out the window or from the front porch to watch people, dogs, and cars pass along the street was another diversion of the babies. They also looked for toys they had dropped from their high chairs, gazing sideward, backward, or upward in whatever direction the toy had disappeared from sight. They began to pay attention to minute objects, such as the button and screw on the tape measure or the crumbs on their high-chair trays. A reaction suggesting daydreaming appeared in James Dalton at 30 weeks, when he stared into space with a most abstracted air. Subsequently other babies exhibited this reaction. A little later interest in sunshine and shadows was noted. Attention was centered on the reflections of objects in the shiny surface of the high-chair tray, shadows were reached for, patted, and fingered. Interest in mirrors was also pronounced at this age. Gradually the

babies became aware that glass, though transparent, is an obstruction, for they pointed at the toy in a glass bottle but did not reach for it with an air of expecting to get it. At 49 weeks one baby peered at her own distorted image in a shiny metal soap box, and another caught sight of the flash of reflected light from the tape measure, which was swinging in the sun. Shortly before the babies' first year the mothers reported such reactions as watching the wind blow the trees, noticing birds in the trees, and following the flight of an airplane.

This study yields little data on the development of space perception. The examiners can only say that if any baby reached for the moon they did not see him do it; reaching for objects a few inches out of range did occur, but usually such reaching seemed more a gesture of request that the object be brought within range than a movement with the expectation of grasping. Neither does this study afford adequate data on color vision, though the recent systematic work of Staples (55) demonstrates that color is an important factor in attention even in earliest infancy.

Summary

According to the observations made in the course of the present study the baby's visual development falls roughly into four stages. Beginning with vague reactions to a moving light or a bright object, the infant soon achieves skill at focusing on persons and objects. He then proceeds to explore the visual environment nearest at hand, and for the first three months his attention is largely confined to the faces and hands of his ministering household, to such toys as they dangle before him or put near his crib, and to his own very interesting fingers. He embarks upon the second stage

when he begins to sit propped up by pillows or on an adult's lap; then his visual horizon widens to include the scope of the room. During this stage eye-hand coordinations are perfected, and sounds become potent stimuli to a visual search for their source. The third stage of development finds the baby's attention fixed upon the remote and the minute. Finally the shadowy, the obscure, the transparent, and the pictured catch the baby's eye, and with this achievement he crosses the last frontier in visual exploration of his environment, for without the use of lenses and other aids to vision the adult can see no more.

By the age of 2 years, it seems fair to conclude, the child can see with his naked eye anything that the adult can see with his. To be sure, he will see things from a very different angle, because his eyes are located at a different level. Furthermore, he will undoubtedly overlook many things to which the adult gives attention — the words on a printed page, for example — just as the adult may overlook the sparkle of dewdrops, the migrations of ants, the motes in a sunbeam, and the colored spots that come as after-images from looking at the sun.

It is not surprising that vision approximates the adult level at so early an age. Sense organs in general are more mature at birth than are motor organs. The eye in particular is relatively larger than are the head and brain, which in turn are nearer adult size at birth than are trunk and extremities. Careful measurements by Hymes[1] indicate that the cornea reaches its approximate adult diameter between the ages of 6 and 12

[1] Charles Hymes. "The postnatal growth of the cornea and palpebral fissure and the projection of the eyeball in early life." *J. Comp. Neurol.*, 48:415–440. 1929.

months and that the lid fissure makes its most rapid growth between birth and 2 years, though it continues growing at a slow rate until the sixteenth year. Furthermore, differentiation of structure within the retina is complete by the end of the first year. The present observations indicate that visual development goes hand in hand with the structural development of the eye and that both are fairly mature at the early age of 2 years.

REACHING AND MANIPULATION OF OBJECTS

Description of the Sequence

Tentative reaching or waving in the direction of a stationary object was observed in a few babies from 7 weeks on; the median age of the appearance of this reaction was 13 weeks for babies in the lying posture and 14 weeks for those in the sitting posture (see Table III). The next reactions in the sequence were those of reaching, touching, and momentarily grasping the object, which were first observed at a median age of 15 weeks. Grasping was not, however, a sure process at this age, and the babies frequently made passes at the objects only to catch their own hands. Playing with their hands and fingers amused them quite as much as getting the object. Indeed, two or three babies who had been straining eye, nerve, and muscle to get an object gave up the task completely and became so absorbed when hand grasped hand that the examiners dubbed this resort to hand play as the first "sour grapes" reaction. Retention of a stationary object and complete thumb opposition appeared simultaneously. Reaching, grasping, and retaining a dangling object, such as the tape measure suspended by the line, developed later than the same reactions to stationary objects.

TABLE III

MEDIAN AND QUARTILE AGES FOR REACTIONS OF REACHING AND MANIPULATING AS OBSERVED BY EXAMINERS

REACTION	NO. OF CASES	AGE IN WEEKS		
		Q_1	Median	Q_3
Tentative reach, lying posture	23	10.0	13.0	15.0
Tentative reach, sitting posture	23	14.0	14.0	15.0
Reach and touch, lying posture	23	13.0	14.0	15.0
Grasp, lying posture	23	13.0	15.0	17.0
Play with hands	23	13.0	15.0	18.0
Retain, lying posture	23	15.0	18.0	18.0
Grasp and retain, sitting posture	23	15.0	18.0	19.0
Thumb opposition	23	15.0	18.0	21.0
Scratch	23	15.0	18.0	21.0
Reach for dangling object	22	16.5	19.0	21.0
Grasp dangling object	22	19.0	21.0	22.5
Put object in mouth, chew	22	18.0	21.0	22.0
Retain dangling object	22	21.5	23.0	25.0
Ring bell	22	21.5	23.0	26.5
Play with toes	22	21.0	24.0	29.0
Transfer object from hand to hand	22	21.0	25.0	29.5
Drink from cup	22	25.0	27.0	30.5
Pat object	22	19.5	29.0	34.0
Drink from bell	22	32.0	37.0	39.5
Point with index finger	22	35.5	42.0	45.5
Take tape out of wooden slide box	21	37.0	41.0	49.0
Open wooden slide box	20	45.0	56.0	70.0
Put tape into wooden slide box	20	49.0	58.0	70.0
Mark with pencil	20	54.0	60.0	70.0
Open round box	20	62.0	62.0	66.0
Take object out of round box	20	49.0	62.0	70.0
Put object in round box	20	58.0	62.0	66.0
Put lid on round box	19	62.0	66.0	66.0
Put circle in form board	19	54.0	66.0	74.0
Pull tapeline out	19	56.0	70.0	79.0
Put lid on slide box	18	70.0	74.0	....
Unscrew jar lid	18	72.0	84.0	....
Complete peg board in less than 60 seconds	16	78.0	78.0	82.0
Put triangle in form board	16	78.0	82.0	....
Build 5- or 6-block tower	16	74.0	84.0	94.0
Put square in form board	16	78.0	84.0	90.0
Nest four boxes	16	78.0	94.0	104.0

The first type of manipulation to appear was scratching the tray, the table, or the examiner's arm, and the second was putting an object into the mouth. Then followed ringing the bell, playing with the toes, transferring the object from hand to hand, putting the cup to the mouth as if to drink, and patting the object. After these stages of manipulation there was a temporary lull, due either to a natural interruption in the processes of fine motor development or to the inadequacy of the tests used. Undoubtedly both factors were partly responsible. The gross motor activities of sitting and creeping absorbed much of the babies' time and interests at this period. Pointing with the index finger and using it to touch the point of the calipers or to poke and pry into holes was the next significant step forward. Then followed the manipulative reactions of opening boxes, marking with a pencil, unscrewing a jar lid, plugging up the holes in peg and form boards, and building with blocks, in the order given in Table III.

The wave of development in the reaching and manipulating sequence sweeps downward from shoulder to hand; the muscles of the arm come under control earlier than do those of the wrist and fingers. In tentative reaching and touching arm and shoulder muscles alone come into play, but in grasping an object it is necessary to curl the fingers and close them around the object after the hand touches it. Grasping in itself is not a new response of the baby; the reflex grasp is present at birth and persists for several weeks. But grasping an object not placed against the palm requires a coordination of arm and hand reactions that is not present in the reflex. Thumb opposition is the first reaction in which the digits act separately, and scratching, which takes the form of a rapid flexing and straightening of the eight

fingers when the hands rest with wrists and thumbs on the table, is a finger-play reaction involving coordination between the muscles in the forearm and hand. It is much later that muscular control moves out to the ends of the finger tips and the forefinger is divorced from the other three for activity of its own. Wrist flexion and rotation were observed in a few babies between 6 and 9 months, but the reaction was not tested for, and it was noted only in those who did it spontaneously. It seems likely that had a test been devised for this reaction it would have entered the sequence somewhere between the early patting and transferring manipulation and pointing with index finger. Manipulation that involves both holding and pulling, such as that required in opening a box, holding and twisting, as in unscrewing a jar lid, or placing with precision, as in block-building and form board work, develops after the pointing reaction. To account for this reaching and manipulating sequence one must go back to the law of anterior-posterior development, which was found to hold for locomotor development.

Supplementary Data Reported by the Mothers

The mothers' reports on the reaction of reaching agreed very closely with the observations of the examiners (see Table IV). The median age for grasping was the same, and the sequence of the items listed by the mothers was very similar. Reaching, grasping, and playing with objects and putting them in the mouth preceded playing with toes, splashing in bath, and throwing objects to floor; these in turn preceded poking and prying at an adult's face, waving bye-bye, attempting self-help by pulling off clothes and eating with the

TABLE IV

AGE RANGES AND MEDIAN AGES FOR REACTIONS OF REACHING AND MANIPULATING AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS	
		Range	Median
Play with hands	22	3–19	13.0
Reach and touch object	21	9–25	14.0
Reach and grasp object	21	5–23	15.0
Play with object	21	12–21	15.0
Put object in mouth	21	9–20	15.0
Play with toes	21	10–29	21.0
Hold bottle for nursing	19	14–45	22.0
Splash in bath	22	12–39	24.5
Throw objects to floor	22	14–46	28.0
Hold spoon for eating	10	16–45	33.0
Poke fingers in adult's eyes	19	32–46	33.0
Pull off adult's spectacles	19	32–49	36.0
Pick up small objects	19	33–49	37.0
Try to pry adult's eyes open	15	35–44	37.0
Wave bye-bye	20	26–50	38.0
Hold cup for drinking	19	26–46	38.0
Try to pull off clothes	18	32–47	38.5
Turn leaves of magazine	14	22–49	38.5
Play pat-a-cake	20	25–50	39.5
Try to put on clothes	14	33–49	40.5
Rub body with soap or towel	14	37–49	41.0
Pull plug out of bathtub	11	33–51	42.0
Pull cork out of bottle	13	33–52	48.0
Pull lid off can	14	34–52	48.0

hands, and "helping" with the bath by rubbing on soap or turning on the water. Finally, toward the end of the first year the mothers observed the simple investigative manipulation of toys, such as pulling lids off cans, dropping beads into bottles, and piling blocks. The sequence in manipulation followed the same order in both the mothers' and the examiners' reports: reactions involving the entire arm; hand reactions, such as splashing in the bath and playing with the toes; wrist actions in-

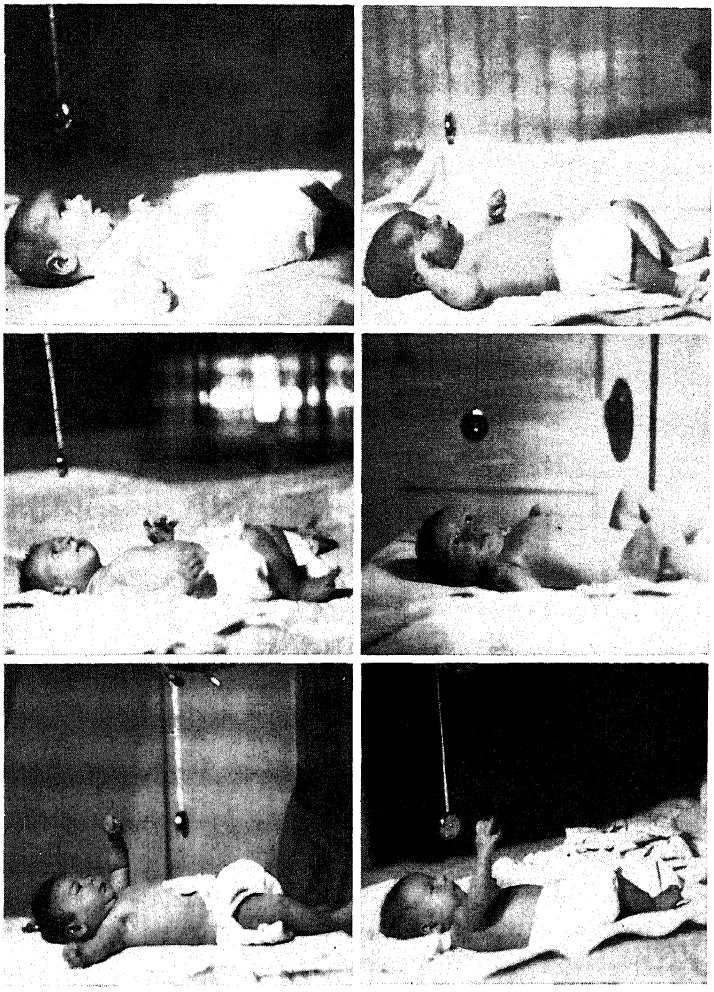


PLATE I. — WATCHING THE SWINGING TAPE

Upper left.—David at 11 weeks. *Upper right.*—Harvey at 6 weeks. *Center left.*—Martin at 7 weeks. *Center right.*—Walley at 6 weeks. *Lower left.*—Virginia Ruth at 8 weeks. *Lower right.*—Fred at 7 weeks.

volved in waving and pat-a-cake; the index finger reaction in poking at adults' eyes; and, finally, complex manipulative reactions. The consistency of examiners' and mothers' findings increases their significance greatly. The sequence found by the examiners might conceivably have been determined by the very nature of the tests, but this could not have happened in the case of items reported by the mothers, for only those reactions that appeared spontaneously were listed in their reports.

Spontaneous Manifestations

Fine motor play can best be described in four categories, according to the baby's stage of development: play prior to the reaching period, a stage lasting roughly from birth to 3 months; play during the reaching period, from 3 to 6 months; play accompanying early manipulation, from 6 to 12 months; and advanced manipulative play, from 1 to 2 years.

Play prior to the reaching period. — In newborn babies a defensive shoulder shrug and arm push was frequently observed when the baby's chest was percussed or measured. Waving the arms in the direction of an object was a common reaction during this period. Batting an object with the closed fist was occasionally observed, but the baby went about it in a hit-or-miss way, often keeping at it blindly until he hit it rather than batting with a definite, coordinated aim. Some of the mothers hung a rattle on the side of the crib, thus offering the babies something to work for. The swinging tape and the doctor's hands were sometimes hit during the examination.

At 5 or 6 weeks Renie May batted a paper-wrapped roll of absorbent cotton that her mother kept on the

side of her bath table. At 7 weeks Sibyl caught sight of the doctor's wrist watch, threw out her right hand in its direction, persistently reached till she touched it, and then clutched and fingered at it with absorbed attention for five minutes. Matthew's mother reported that in his 8th week her son attempted a hand movement and wriggled his nose to remove a fly. In his 9th week she gave him a clean clothespin as a toy, and he clutched it with a reflex grasp for several minutes. In her own words, he "fumbled around until he found his mouth; perfect contentment after that"; at 10 weeks her record reads: "Moved clothespin from hand to hand; played with it, gave a gurgle when he found his mouth." Walley's 3-year-old sister took upon herself her brother's motor training, and at 11 weeks he was taking with both hands a bracelet that she held out to him; at this age he also reached for the doctor's calipers and batted the tape measure three times. At the same age Quentin, whose mother reported no efforts to stimulate him to reach, grasped the doctor's hand and touched her stop watch five times within a two-minute interval. It was during this period also that Martin began to stretch his arms to be taken and to cling to the doctor's dress for support when he was lifted.

The extent to which babies practice reaching spontaneously during this period is probably determined by the amount of stimulation they get from having toys within reach. The practice of having a rattle or a string of beads for the baby to look at and reach for as he wishes is probably a good one. The infant's own hands interest him, but the reaction of chewing the fist, present at birth, might not get such a hold on the baby if there were other diverting toys in view for which he could struggle.

Play during the reaching period. — In their efforts to reach, the babies worked hard with both hands and feet; wriggling of toes and whetting together of feet frequently accompanied reaching and grasping. Scratching, such as has already been described, was the most characteristic play response of this period. Harvey's delight in scratching the plaited tissue-paper heart off his first valentine was so great that his mother could not bring herself to take the fragile plaything from him, despite her older son's insistence that the sentimental token should be put away as a keepsake for the baby.

After the babies had acquired some skill at grasping objects, they sometimes snatched the doctor's pencil as she traced the chest angle or the fontanel. They also reached and took instruments that were lying within range. They delighted in tearing and crumpling the paper that was offered them. Picking at and chewing the clothes, pulling open the shirt front, and rubbing the eyes were other reactions noted at this period. Three babies started their musical career at this early age by hitting and patting the keys when they were allowed to sit at the piano. They also brought their hands down on tables with vigorous strokes that reminded the observer of a pianist playing heavy chords. Rattles, paper, the little hand bell, large wooden beads, and dangling objects such as the tape were favorite toys of the babies at this stage of development.

Play accompanying early manipulation. — Manipulatory skill in the period from 26 to 49 weeks was somewhat overshadowed by the richness of gross motor development; during this time appeared such reactions as sitting alone, creeping, climbing to stand, and walking with help. Nevertheless, the large number of play activities in which the babies indulged revealed increas-

ing skill and assurance in the handling of objects. Pushing or holding one object aside while reaching for another, reaching and getting a toy dangling at the side or behind the head, licking an object as it swung past the mouth, and trying to untangle the twisted strings of dangling toys were noted early in this period. Pulling a string to get a toy tied to it involved hauling with a hand-over-hand motion or letting go and grasping the string again. This reaction was noted in two situations: when the babies were reaching for the dangling toys they not infrequently reached hand-over-hand up the strings and pulled the wire grid down into range; and at 35 weeks when seated on the floor they pulled the tape to them from a distance of two feet. Now and then one pulled the blanket to get the bell when he was lying prone on the floor. A similar motion was used in pulling out the tapeline when it was snapped in.

Pounding spoons on the high-chair tray, throwing toys to the floor, tearing paper, monkeying with magazines, pulling hair, jerking dangling toys, pushing over a stack of blocks, digging into soap with finger nails, pulling at curtains, pulling down window shades, pushing a chair to make it rock, untying nightie-strings, jerking the head off a wooden soldier, mutilating a cardboard box, pulling the rubber tubes off the stethoscope or blood-pressure apparatus, pulling open drawers, pushing open swinging doors, and pulling off table scarves and with them books, lamps, and pictures — these were activities that led the mothers to exclaim, "Oh, the baby is such a little mischief — he's into everything."

Growing skill in the use of the index finger and in fine manipulation was shown in such reactions as poking the finger into the hole of a large bead, touching the stem of the watch, the clapper of the bell, or the point

of the calipers with the finger, putting the finger or hand into a can or cup to get a spool, putting a block in the cup and taking it out, fingering the tape button, picking up a crumb from the high-chair tray, trying to put the plug into an electric switch, attempting to snap the hook of a carriage strap back into its ring, putting the arm through a dangling embroidery hoop, and rubbing the seam of a hinged box with the thumb. One baby scrubbed a box back and forth on the floor as if ironing; another peered through the roll of paper when it was held to her face. At 41 weeks Quentin stood up in his crib and pulled his blanket and stockings off the railing. He tried to put them back in place again and succeeded in hanging up the stockings. At 45 weeks Patty held the lid of the can over one eye and smiled at the examiners as she did so. Two babies had a habit of holding a box to the mouth with the right hand and flipping at it with the fingers of the left as a cornet player fingers his instrument.

There is little evidence that at this period the babies deliberately tried to discover how things worked. A note on Walley at 24 weeks reads, "Took bell in right hand, grasped bell, shook vigorously to ring, but it only rattled; then put it in left, and holding by handle shook and rang it; put it back in right by bell portion and shook to ring; put to left and held by handle, thus ringing it; repeatedly transferred from hand to hand, apparently trying to discover why it wouldn't ring each time." Again at 30 weeks the same baby "put the bell from hand to hand, held it by bell part and shook; seemed surprised that it did not ring." During this period a few babies began to cooperate with the doctor to the extent of transferring an object from the right to the left hand when she began to measure the right.

Pointing at the object enclosed in the glass bottle was an interesting perceptual reaction observed in several babies. As late as 76 weeks James Dalton made an error in perception in trying to pick up the hand of the stop watch. In the box-opening test only one baby was observed to examine the box and lid in an apparent attempt to discover the relation between the two. With these exceptions the manipulation of the babies was hit or miss, and they had little luck in making things work. The simplest of toys, cups, empty boxes, spools, and beads, delighted them during this stage of development.

Advanced manipulative play. — In the second year the babies began to achieve mastery of their simpler toys and to pit their strength against the obstinacy of tight box lids and heavy pieces of furniture. At 66 weeks David threw a ball so hard that he toppled over; and Harvey, at 70 weeks, pulled and tugged at the lid of the jar till he was red in the face. One child caught her dress in the lid of the box but was able to pull it out. The babies became more skillful in using toys in the proper way. They rolled, threw, and bounced balls, ran the tapeline in and out, put a cork in a bottle, slid a pocket comb into its case, and tipped a "mamma" doll to make it cry.

Dramatic play had its beginnings in games of pushing a toy train or animal along the floor, the act being accompanied by appropriate "choo-choos" or growls to indicate that the toy was running. Toward the end of the second year the babies became more skillful in handling the medical instruments. They "helped" in the examination by putting the stethoscope to their ears, squeezing the blood-pressure bulb, sticking the nozzle on the tube of the blood-pressure cuff into the tube of

the manometer, winding the stop watch, winding the tape around the ankle and placing calipers on the foot as if for measuring, and poking fingers into the oil bottle and rubbing them on the toes to help in the toe-greasing process.

SUMMARY

The general pattern of fine motor development is well defined. The eyes first come under control for fixating and later for following objects. Next, random waving gives way to waving in the direction of an object. Successful reaching, grasping, and retaining of an object and thumb opposition follow. Then comes a period of hit-or-miss manipulation, during which skill increases but few new types of handling objects are noted. When the index finger becomes divorced from the other digits for separate exploration, and wrist flexion and rotation begin, the stage is set for the development of such complex manipulation as occurs during the second year. Characteristic and appropriate play activities go hand in hand with advancing manipulatory skills, and fine motor development dovetails neatly with locomotor progress at every stage.

CHAPTER III

THE MOTOR SEQUENCE

Scope of This Study

Before we attempt to say just what the present study has added to our knowledge of motor development let us consider briefly the things it has not added. Only with a clear understanding of the scope of a piece of scientific work may its contributions be evaluated and allocated among the existing body of facts.

There are four or more courses that a student of motor development in infancy might follow. He might set up age norms of development by means of a study of large numbers of babies; he might measure the degree of motor skill possessed by the individual baby; he might devote his attention to the modification of given motor items after they were established and determine the conditions that led to modification; or he might interest himself in the sequence of motor development. In this study the fourth course was followed; a few minor facts relating to the other three were gathered, but they were only incidental to the main objective.

The reason for rejecting the first three methods may be briefly stated. In the first place, age standards of development derived from so small and so selected a group of babies as entered into this study would be valueless for future comparisons. It cannot be stressed too often that the age figures given in this work apply to this group alone and are not to be used as criteria for other groups. Far better norms have already been es-

tablished by Gesell (16), Jones (27), and others, and therefore there is no great need for a normative study at the present time.

A study of the degree of motor skill possessed by each baby could be conducted only if accurate ways of measuring the skill could be devised. This is not beyond the limits of possibility, but it is not an easy task. The difficulty of even estimating degrees of head control and the skill involved in sitting alone and other motor accomplishments is baffling. Although the investigator is able to judge the degree of skill in an older child by putting him through a strict set of performance tests, it is likely that he would have to limit the items in his tests of babies to the things they do spontaneously in order to insure their whole-hearted cooperation. Such a study would entail the establishment of standards of degree of skill. Worth while as the investigation would be, it could be carried out only with the aid of better controlled experimental conditions and more refined examining techniques than were possible in this investigation.

Likewise, a study of the nature and degree of modification that motor skills undergo from their earliest manifestation to their perfection would require more time and more elaborate treatment than was possible in this study. One phase of motor development, walking, has been fairly adequately studied in this way, but techniques for similar studies of other aspects of motor development were not available, so they were not attempted.

There remains the developmental order, or motor sequence, the only aspect of motor development on which this study offers new and reasonably complete data. Before entering upon a description of the sequence and

a discussion of its importance it is necessary to make clear two distinctions: first, the difference between motor activity and motor control and, secondly, the difference between ability and proficiency in the performance of motor acts.

Motor activity versus motor control. — In centering attention on the order of motor development the observer did not fail to take cognizance of the profuse and varied activity present in the babies at birth. It is difficult to define this activity in such a way that the differences between it and the controlled acts that developed later may be readily apparent. The early activities of kicking, waving, and squirming were not uncoordinated, nor were they altogether random and spontaneous. Perhaps the most characteristic earmark of the activity of this period was that it "didn't get the baby anywhere"; it apparently was directed toward no goal, or if it was it did not effect an adjustment to the environment. Controlled motor acts, on the other hand, were successful responses to definite stimuli, and with the development of motor control the baby began to manipulate and manage his environment to a considerable degree. Through the work of Coghill (8), Minkowski, and others knowledge of the motor sequence has been pushed back to the prenatal period, and their work furnishes good evidence that generalized mass activity develops first and that out of it specific reflexes are differentiated. Neonatal activity well repays a quantitative study, as Irwin (26) has amply demonstrated. The motor sequence, however, represents only the development of motor control and not the manifestation of undirected motor activity.

Ability versus proficiency. — The reader must also remember that there is a great difference between ability

to do and excellency in the doing of motor acts. The motor sequence takes into account only the former. It represents the order in which the babies were first able to watch, to reach, to sit alone, and so forth; it is not concerned with the proficiency with which they performed each act. It goes without saying that the babies differed in proficiency at the onset of each new phase of motor development even though the degree of difference could not be measured, and that proficiency increased in individual babies at different rates and to different degrees. But the transition from the inability to reach, creep, or walk to the ability, however feeble, to perform these acts was well marked. The order of these transitions from uncontrolled generalized activity to successfully controlled motor acts comprises the motor sequence.

Sequence not a by-product of the motor tests. — The reader may question whether the motor sequence is not merely a product of the motor tests. That possibility was safeguarded against in two ways; first, by the recording method, by which the observer wrote down in consistent descriptive terms exactly what the baby did in response to each motor test instead of marking them passed or failed; and, secondly, by including in the sequence items that were not tested for but that occurred spontaneously. The consistency with which the items of motor play fit into the sequence is a strong argument against its artificiality.

Sequence of Motor Development

In Volume I, page 166 and following, much was made of the point that motor development in the first two years follows a definite sequence, at least when its various phases — postural control, locomotion, and manip-

ulation — are considered separately. It remains to be seen whether the sequence holds when these different aspects of development are thrown together into one series. Under such treatment the sequence might conceivably break down; granting that the sequence comes about by virtue of the fact that coordinations acquired through the perfection of one motor item are essential components of the item next developed, then the sequence of these items would be a logical necessity. Undoubtedly this is true in such a sequence as that of reaching, touching, grasping, and retaining; it is mechanically impossible for the baby to grasp a toy without having first reached and touched it, although it is not quite clear why the ability to do these three acts does not appear simultaneously instead of at intervals of one or two weeks. It is a little less obvious but still well within reason that chest up succeeds chin up, rolling succeeds swimming movements, and creeping succeeds scooting backward, because coordinations acquired in preceding acts are used in the ones following. If this explanation fully accounts for the sequence within any given phase of development, such as manipulation or assumption of an upright posture, one might expect to find no sequence from one type of motor performance to another where the coordinations acquired in the first motor act seemingly play no part, or an obscure and minor one, in the second. One would not expect that head control would precede reaching in the lying posture, or that reaching, grasping, and holding would precede sitting alone, nor would the sequence of the play reactions of scratching, playing with the toes, bouncing, and rocking, be an obvious inference.

When all the motor items are thrown together, however, the sequence is just as well defined as when each

motor phase is considered separately. To be sure, some items of the manipulatory phase develop simultaneously with items of the locomotor and postural phases, but simultaneity of items does not impair the fundamental sequence. For the most part, the items of one phase dovetail with those of the others. The extent of simultaneity and of dovetailing in the sequence may be seen in Table V. In Figure 1 (frontispiece) the items have been made to appear equally spaced for the sake of a more diagrammatic effect, but since the order of the items rather than the expansion or contraction of their spacing is of most interest, the equality of the spacing does not distort the facts.

Consistency of the sequence. — The tables and charts depict only the order of the medians. To show that the sequence does not break down when it is applied to the progress of an individual baby the data on individual comparisons will be given. There were 42 motor items developed between the median ages of 4 days and 47 weeks;[1] during this period the items were naturally spaced at frequent intervals, and there were only three intervals of three weeks or more during which no new motor item was developed.

In order to obtain a measure of the extent to which individual babies adhered to the sequence, each item was paired with another having a different median, and the number of babies in which the order of the medians was reversed was obtained. With 42 items it would have been possible to compare 861 pairs of items, but items at

[1] The reason for discontinuing the comparisons at a median of 47 weeks was that after this age the motor items were spaced at less frequent intervals. All but two of the locomotor items, standing and walking alone, had been developed at this age. The manipulatory items excluded by this age limit consist chiefly of specific reactions to specific boxes that are hard to analyze into their motor components.

MEDIAN AGES AND PARTS OF THE BODY CONTROLLED IN VARIOUS REACTIONS IN THE MOTOR SEQUENCE

MEDIAN AGE IN WEEKS	EYE COORDINATION	LOCOMOTION	FINE MOTOR REACTIONS	MOTOR PLAY	PARTS OF BODY CONTROLLED
6 da.	Follow light				
2.0	Watch person				
3.0		Chin up			Eyes, head, and neck
5.0	Follow tape H				
9.0	Follow tape V	Chest up		Smile at person	
10.0	Follow tape C				
14.0		Adjust for lifting	Reach and touch		
15.0			Grasp object	Play with hands	Arm and upper trunk
18.0		Sit on lap	Retain object (thumb opposition)		
21.0			Grasp dangling object	Object to mouth	
25.0		Sit alone momentarily	Transfer object from hand to hand	Play with toes	Hands and lower trunk
28.5		Roll		Pat toy	
30.5		Sit alone 1 minute		Rock, shake head	
31.5		Stand with help			
38.0		Some progress on stomach		Suspension bridge	
41.0		Scoot backward		Pat-a-cake Peeka-boo	
42.0		Stand holding to furniture	Point with index finger		Pelvic region, legs, and fingers
45.0		Creep			
45.0		Walk when led			
47.0		Pull to stand by furniture	Open simple boxes		
56.0–62.0				Put fingers in holes	
62.0		Stand alone			
66.0		Walk alone		Run, climb	

the extremes would have been separated by an age range so great that there would have been no overlapping. Consequently a range of 6 weeks was arbitrarily chosen as the limit for comparisons. In all there were 224 pairs of items separated by a median range of 6 weeks or less; items with identical medians were not compared. The average separation of the medians of these items was 3.66 weeks. These 224 pairs embraced a total of 5,019 case comparisons, of which 4,294 were consistent with the order of the median. Thus the number of reversals was 725, or 14.45 per cent.

Generally speaking, the reversals were more frequent on those items that were difficult to define and for which the criteria were somewhat vague, such as tensing to be lifted, early stepping, and straightening the knees in the standing posture, and on those items that were not tested for but were noted when they spontaneously occurred, such as scratching, transferring the object from hand to hand, playing with the toes, ringing the bell, and pointing with the index finger. A partial explanation is that there is less likelihood that spontaneous items occurred in the examiners' presence during the same week the babies were first capable of performing them than that the items tested for were called forth and observed as soon as the capacity developed. Moreover, examinations were occasionally missed; if several new motor items appeared simultaneously at the next examination the observer might fail to note all of them, and thus the possibility of reversals would be increased. Considering all these possibilities for error, the wonder is not that reversals in the sequence are so many but that they are so few.

The sequence was further tested for consistency by running rank order correlations between the order of

items for each baby and the order of the median. These correlations, which are given in Table VI, all lie between .93 and .98, and 60 per cent of them are .97 or above. The consistency of the correlations adds much to their significance, since it shows conclusively that the sequence is as representative of individuals as it is of the group as a whole. From baby to baby the sequence holds with far greater consistency than could be accounted for by chance.

TABLE VI

INDIVIDUAL CORRELATIONS ON THE MOTOR SEQUENCE

BABY	r	BABY	r
Winifred.....	$.95 \pm .010$	Martin.....	$.93 \pm .012$
Fred.....	$.98 \pm .009$	Quentin.....	$.97 \pm .009$
Carol.....	$.96 \pm .010$	Virginia Ruth..	$.96 \pm .010$
Doris.....	$.94 \pm .010$	Sibyl.....	$.93 \pm .012$
David.....	$.95 \pm .010$	Maurice.....	$.95 \pm .010$
Donovan.....	$.97 \pm .009$	Torey.....	$.98 \pm .009$
Harvey.....	$.97 \pm .009$	Judy.....	$.97 \pm .009$
James D.....	$.97 \pm .009$	Peter.....	$.98 \pm .009$
Irene May.....	$.97 \pm .009$	Patricia.....	$.97 \pm .009$
Larry.....	$.97 \pm .009$	Walley.....	$.97 \pm .009$

Harmony with anatomical laws. — The well-known anatomical law of developmental direction[2] — which may be stated briefly as the law that the growth wave which sweeps over the body begins at the head and travels toward the feet — has already been mentioned

[2] This law has been stated by Jackson and Scammon (51, page 267) as follows: "While each part passes through its own cycle of changes these changes as a whole tend to follow what is known as the *law of developmental direction;* for it is generally found that development (including growth and differentiation) in the long axis of the body appears first in the head region of the body and progresses toward the tail region, and similarly development in the transverse plane begins in the mid-dorsal region and progresses latero-ventrally (in the limbs proximodistally)."

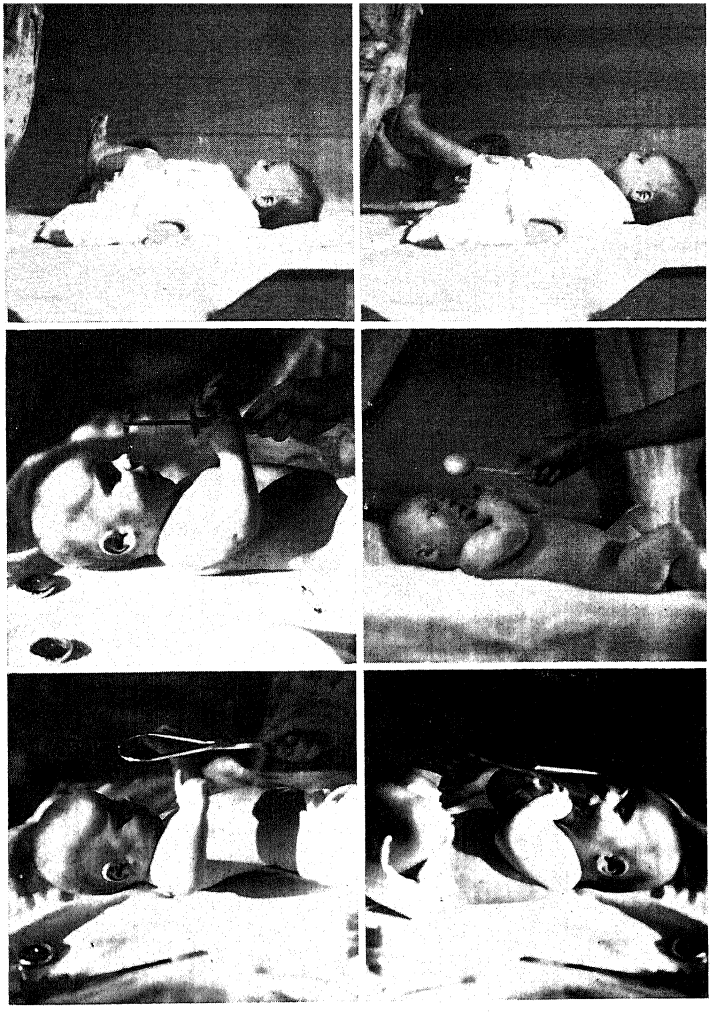


PLATE 2. — EARLY EFFORTS AT REACHING

Above.—Doris at 9 weeks greeting examiners. Note expressive kicking. *Center.*—Open-mouthed excitement in reaching: Matthew at 16 weeks (left); Judy at 14 weeks (right). *Below.*—Matthew at 16 weeks reaching for calipers and putting them to his mouth.

in Volume I, pages 53–58, as being exemplified by the assumption of postural control. From a study of Table V it would appear that not postural development alone but the entire motor sequence is in harmony with this fundamental law of growth. The eye muscles come under control first; a little later control of the facial muscles for smiling and of the neck muscles for head-lifting and head-turning is achieved. Gradually motor control creeps downward to the arm and upper trunk region; with the advent of sitting alone it has migrated down to the lower trunk; and when thumb opposition appears, it has advanced to the forearm and hand. Finally the leg muscles come under control, first for standing erect with help, somewhat later for locomotion in the creeping posture, and still later for walking alone.

Not only is the order of development in harmony with the law of developmental direction, but the speed of development also seems to be graduated from the head downward. Control of eyes, head, neck, upper trunk, and arms follow each other in rapid succession. About the time the ability to sit alone is achieved, however, the rate becomes noticeably slower. Whereas the attainment of a new motor item was a matter of days at the outset, it now becomes a matter of months. These differences in the rate of assuming motor control suggest that the growth gradient that makes for different rates of growth in different parts of the body is also operative, or at least has a counterpart in the development of functional control.

A second interesting feature of the sequence is that postural control of a given part always precedes controlled movements of that part. The baby holds his head erect before he turns it; he sits alone before he sways and rocks in this posture; and he stands before

he climbs or walks. This is probably just a matter of body mechanics; it would be impossible to execute coordinated movements in a given posture before the posture itself could be maintained. The progress from flexion to extension in babyhood is, however, worthy of note. In the newborn baby the dominance of the flexor muscles over the extensors is so great that arms, hands, and legs can hardly be stretched out for measuring. Gradually the extensors begin to oppose this state of flexion, and the early flexed lying posture gives way to more extended postures. It is largely the extensor muscles that are involved in the maintenance of upright postures. Investigators are still pretty much in the dark as to the nervous mechanism of postural control, but whatever the mechanism, it is logical for extensor muscles to come under control for posture before they work together with the flexors to execute directed acts involving a rapid losing and regaining of postural equilibrium.

Maturation as an explanation of the motor sequence. — In order to prevent misunderstandings that might lead to controversy, the term "maturation" must be rigidly defined. In this study it is used to connote the sum total of the growth processes. It is not used in the more restricted sense of the development or maturing of the nervous system alone. The writer favors the definition of Marquis (39), who designates as maturation all development carried out by the interaction of the organism upon its inner environment.

Maturation, defined in this way, appears to be the most satisfactory way of accounting for the motor sequence. To review briefly the arguments set forth in Volume I, pages 166–181, the number of items included in the sequence and the closeness of their spacing cer-

tainly precludes the possibility of a consistent order being established by chance; the consistency of the sequence from baby to baby, not only in the motor functions tested but also in spontaneous play reactions, casts doubt upon the learning hypothesis as an explanatory principle. Finally, the harmony of the sequence with the fundamental law of anatomical growth is a strong argument for the acceptance of the maturation hypothesis.

How maturation functions. — In accepting the maturation hypothesis it is not necessary to settle the question as to whether the motor sequence is a function of growth or whether it is merely a manifestation of growth. It may be that the relationship between body growth and motor development is one of cause and effect, or it may be that the two are merely parallels, the one being the manifestation of growth in body structure and the other the manifestation of growth in body function. But in either case maturation is at work.

The present study does not enable us to say what matures or how maturation operates in bringing about the motor sequence. No doubt the fact that motor control begins at the head and moves toward the feet is partly a matter of body mechanics; to a certain extent it is true that outlying muscles are incapable of making adequate adjustment to peripheral stimuli until the larger, proximal muscles work to bring them directly in contact with the stimuli. It is also true that motor development consists largely of the differentiation of specific movements from generalized mass activity. Neither of these possibilities, however, weakens the sequence itself nor precludes the interpretation of it by the maturation hypothesis, since neither of them is adequate to completely account for a sequence of such remarkable length and

detail. The consistency of the sequence from baby to baby speaks well for its reliability, and its harmony with the accepted laws of growth attests to its validity as a maturing process.

Summary

Progress in motor control follows an orderly sequence beginning at the head and traveling toward the feet. The sequence as determined from the medians of the group holds for individual babies, and it includes, in addition to items specifically tested for, items of motor play that occurred spontaneously. Hence it is unlikely that the sequence is merely the by-product of the tests. The sequence of development strongly supports the maturation theory of motor development. It appears that maturation gives ability to do motor acts and that subsequent practice gives proficiency in doing them.

CHAPTER IV

THE BEGINNINGS OF SPEECH

The two great drawbacks to the study of speech in infants are the difficulty of stimulating vocal responses and the difficulty of recording them. It is comparatively simple to elicit eye coordination, manipulative responses, and motor reactions. Dangle a toy before the baby and he watches and reaches for it; place him prone on the floor and he puts forth his best efforts to creep; talk to him and he may talk back, but he is just as likely to remain silent during the "speech test," only to bubble over into cooing and singing after it is over and the examiner is busy with other tests. When he does "talk," he pours forth sounds that have no equivalents in civilized alphabets and that utterly defy spelling and descriptive phrases. McCarthy (41) has pointed out that even a trained phoneticist with shorthand at her command cannot get a complete written record of what the baby says, much less record the many and varied inflections and tonal qualities that make the baby's jargon eloquent and all but intelligible. She suggests a mechanical recording device such as that used in making sound pictures as the only means of making an intensive study of infant vocalization.

Because of these two handicaps the examiners made no attempt to test for speech during the first year. Whenever vocalization occurred it was noted by jotting down "coos," "babbles," "gurgles," "grunts," "sings," or "scolds," the term being used that best described the sounds if they were too difficult to spell. Syllables were

spelled out; diacritical marks were added if the speech came within the limitations of the English tongue and the recorder's speed of note-taking. Three- and 4-year-old brothers and sisters sometimes unwittingly acted as interpreters between babies and recorder by repeating the sounds. Since the older child had not yet taken on all the inhibitions of adult speech, his version of the babbling was a better imitation than the examiners could have given, and yet it conformed well enough to conventional sounds to be spellable.

Since comprehensible speech began in the second year, a speech test was included in the examination for that year. This was a picture-book test in which the babies were asked to name ten pictured objects. The recording of spontaneous vocalization, both comprehensible and incomprehensible, was continued throughout the second year. During the third year the fifty spontaneous sentences test devised by McCarthy (40) was given to each child at the appropriate ages.

SEQUENCE OF VOCAL DEVELOPMENT

Since vocalization occurred only incidentally, it was difficult to get a record of the first appearance of each new sound. Consequently there was a much wider range in the age of development for the vocal items than in the age of development for reactions that were tested for. The marked discrepancies that frequently occurred between the examiners' records and those of the mothers do not necessarily imply careless recording on the part of either, but simply that the vocal responses which occurred spontaneously during the day and were noted by the mother seldom occurred when the examiners were present.

Description of the Sequence

In Table VII the vocal reactions are listed and the ages of their first appearance are noted.

Vocal grunt. — The earliest vocal sound to be recorded was usually described as a grunt. It was uttered

TABLE VII

Median and Quartile Ages for Vocal Reactions as Observed by Examiners

Reaction	No. of Cases	Age in Weeks		
		Q_1	Median*	Q_3
Vocal grunt	23	2 da.	6 da.	5.0
One syllable	23	6.0	8.0	10.0
Two syllables	23	9.0	13.0	38.0
Talk to person	22	13.0	25.0	31.5
Singing tones	22	15.5	32.0	51.0
Expressive sounds	22	29.5	37.5	46.5
Single consonants	22	25.5	35.0	43.0
First word	20	47.0	60.0	66.0
First imitative word, bow-wow, etc.	19	54.0	66.0	82.0
Name picture in book				
Dog	18	74.0	84.0	....†
Baby	18	82.0	98.0	102.0
First pronoun	18	90.0	99.0	....†
First phrase	18	80.0	101.0	104.0
First sentence	18	86.0	101.0	....†

* Medians have been computed on the basis of the number of babies tested rather than the number of babies who reacted.

† The blanks in this column indicate that 25 per cent or more of the babies did not make these responses before the end of the test at 104 weeks.

in voice tones and probably consisted of a rudimentary vowel, such as short *u* or broad *a*, finished by an *ng*. The examiner did not attempt to spell out these grunts. Some vocalization other than crying was noted in practically all of the babies during the hospital period, and the median age for the development of the grunt was 6

days. The inspiratory crow was heard in a few babies during the hospital period. The most amusingly grown-up sounds uttered by the newborns were the vocal yawn and the vocal sigh, which had all the world-weary inflection given them by adults.

Syllabic vocalization. — During the first three months syllabic vocalization developed. Single syllables were noted first. The earliest syllables were of the type usually called cooing, and they were spelled variously by the examiner as *boo*, *goo*, *hauh*, *aah*, *woo*, *hm*, *xgsoo*, *aak*, *zee*, and *voh*. For the most part they differed from the grunt in having an initial consonant followed by a vowel; sometimes they seemed to be closed by a consonant at the end. The median age for the appearance of the first syllable was 8 weeks. A few weeks later a second syllable was added, often by tacking on a grunt or the vowel *a* or *u* in front of the *goo*. Some of these sounds were spelled *ungoo*, *heuhe*, *umwah*, *hu-hu-hui*, *agoo*, *elow*, and *umaah*. The *kgs* sounds made during this period were often recorded as "gurgles," and the *ch* and *sp* sounds, which accompanied spitting and blowing bubbles, were called "sputter."

The next improvement in syllabic speech came when the baby repeated the same syllable several times in succession. Such conversations consisted of *uggle-uggle*, *erdah-erdah*, *oddle-doddle*, *a-bah-bah*, *hey-hey*, *bup-bup-bup*, *aduh-duhdeh-duhde-ooh*, *aduh-ajuh*, *awooh-awah*, and *lul-lul-luh*. Speech of this sort occurred from 5 months on. During this stage there was little variety in the baby's babbling. Each baby had one or two characteristic phrases of this sort to which he limited himself for an entire examination; indeed, some kept to the same syllables for three or four successive weeks.

Babbling. — At about 10 or 11 months the babies

gave greater variety to their speech by combining two or more dissimilar syllables, which made their talk take on a conversational form. They used such speech-like phrases as *hey yuh*, uttered in calling tones, to which Examiner B frequently answered, "Hey, yourself," and *hahdoo*, which was very similar to the adult "How do you do?" Several syllables came to be combined into word-like groups, such as *whazaeven*, *bahzhay*, *bobumho puey*, and *dahruh*. Later the babies jabbered in sentences, combining several incomprehensible words and uttering them with assertive, interrogative, and exclamatory inflections. "Awee juh bejee?" inquired Don at 62 weeks, and "Bee dus dee nine!" declared Larry at 76 weeks. Such conversational jargon was carried over into and mixed with early comprehensible speech.

Babbling to person. — Sometime between 2 and 6 months speech became a social reaction. The babies babbled definitely to the examiners at a median age of 25 weeks. Reports from the mothers gave a much earlier age for this reaction. The early "babbling back when talked to" recorded by the mothers may have been the crooning goo of the baby, which the mothers had picked up and repeated. The talking to persons noted by the examiners was more like the mothers' item of "shouts or yells to draw attention of adults."

Singing tones. — At about the same age musical tones were noted in the vocal responses. Some babies began to "sing" very early, trilling up and down the scales. From 12 to 16 weeks Nathaniel was described as singing in "liquid trills," and at the same age others hummed or crooned. In some babies singing escaped the examiners' notice till late in the first year; therefore the median age of 32 weeks is not indicative of the wide age range in this reaction.

Expressive sounds. — Inflection and intonation similar to that of adult speech were noted at a median age of 37.5 weeks. Squeals of delight, strong grunts of pain or disgust, grunts with the rising inflection of a question, gutteral barking growls that reminded the examiner of a dog worrying a bone, shouting and calling to attract attention, and calling in scolding or warning tones all fell under this head. It is appropriate and significant that expressive tones and inflection appeared long before the first comprehensible word, for after all it is the expressive element that makes speech important, not the actual words. It is impossible to determine from this study whether the expressive tones were a normal outgrowth of development or whether they were acquired by imitation of adults; the writer, however, holds to the former theory.

Single consonants. — Although consonant sounds in combination with vowels appeared very early, there was a later age at which the babies seemed to single out one or two consonants for practice. Some of the sounds thus uttered in whispering tones and without vowel accompaniments were *x*, *ch*, *f*, and *s*. Several babies developed habits of clucking the tongue against the roof of the mouth and sputtering in the act of blowing bubbles and at times amused themselves with this type of tongue and lip and salivary play.

The first word.[1] — The median age at which the first comprehensible word was spoken in the examiners' presence was 60 weeks. Most of the mothers reported that the babies had a vocabulary of two or three words at 1 year, but speech did not occur so early at the tests as it did spontaneously in the mothers' presence. Many,

[1] The term "first word" always refers to the first comprehensible word uttered in the examiners' presence.

but not all, of the first words heard by the examiners were nouns. "Mamma" was the first word of five babies, and "baby," "there," and "see" were each spoken first by two babies; the other first words were "doll," "pretty," "open," "stocking," "shoe," "here," "hello," "ball," "daddy," and "oh dear." "Here," "there," and "see" were often accompanied by pointing to an object or picture, and thus a limited vocabulary was eked out. The questioning grunt, "hunh?" was also among the early words used by the babies.

Childish imitative words. — Childish imitative words were also used about the time the first comprehensible word was acquired. These words appeared at a median age of 66 weeks; with some babies they were the first words used. The words classified under this heading were: "bow-wow," "meow," "tick-tock," "umhumh" (yes), "hunh?" "choo-choo," "ding-dong,""deedle-dee" (music), "boom," "whee," and "peep" (in peeka-boo). Some babies used these words a great deal, others seldom. Apparently they were picked up from the parents or older children in most cases rather than invented by the babies themselves.

First pronoun. — Pronouns did not appear until late in the second year. In fact only thirteen of the nineteen babies who were tested between 18 and 24 months were heard to use pronouns, and the median age for the development of this item was 99 weeks. "I" occurred five times as the first pronoun, "mine" twice, "me" twice, "it" twice, and "who" and "that" each once.

First phrases and sentences. — Any two or more words that were uttered together but did not make a complete sentence were classified as a phrase. Examples of such phrases are: "mom's pin," "nice doll," "man out," "all done," "all right then," "daddy whoo-whoo"

(in calling father to telephone), "all gone," "hat on," "the car," "I want," and "good boy." From the baby's point of view these phrases often expressed a complete thought. They finished the phrase by pointing or by some other gesture that very clearly completed their meaning. "Man out" meant "I took the man out of the bottle" (screw-cap jar test); "good boy" meant "I am a good boy"; and "hat on" meant "The man in the picture has on a hat." The median age for the first phrase was 101 weeks.

Early sentences, expressions having both subject and verb, usually consisted of only two or three words, such as "Go 'way, Freddie"; "I will"; "I know"; "What is that, hunh?" "Build tower"; "I don't want to"; "I want it"; "This broke"; and "Go beddy." The first sentence was used at a median age of 101 weeks. Only fourteen of the nineteen babies used a phrase before the age of 2 years, and only twelve babies used a sentence.

Supplementary Data Reported by Mothers

Table VIII gives the ranges and medians for vocal items checked by the mothers. According to their reports babbling began in the 2nd or 3rd month and occurred in the absence of people as well as in their presence. Eleven mothers reported cooing to music about six weeks after the onset of babbling. When the mothers' record forms were changed at 32 weeks, an entirely new list of vocal items was included in the check list: yelling to draw adult's attention; squealing or grunting expressive of delight, excitement, scolding, anger, or disappointment; jabbering to persons; jabbering at toys; inventing words to express wants; and repeating syllables after adults, such as *ba-ba, ma-ma.* It is possible that the mothers interpreted "yell" in the first item

TABLE VIII

AGE RANGES AND MEDIAN AND QUARTILE AGES FOR VOCAL REACTIONS AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS			
		Range	Q_1	Median	Q_3
Babble when talked to.....	20	5–12	7.0	8.0	9.0
Babble when no one is around.	19	5–12	8.0	9.0	11.0
Laugh aloud.....	22	8–17	10.0	13.0	14.0
Coo at music.....	11	12–21	13.0	15.0	19.0
Yell to draw attention of adults	21	32–49	33.0	34.0	37.0
Make sounds of delight, excitement, scolding, anger, disappointment.....	20	31–50	33.0	33.0	38.0
Jabber to persons.....	19	33–49	33.0	35.0	40.0
Jabber at toys.....	17	33–50	35.0	38.0	40.0
Invent words to express wants.	15	33–49	36.0	39.0	44.0
Repeat *ba-ba*, etc.....	18	33–49	38.0	41.5	44.0
Repeat words after parents....	8	39–49	...	44.0	...
Say childish word, bow-wow, etc.....	9	40–50	...	45.0	...

as crying for attention, whereas the examiner had meant it to connote shouting or calling. Yelling, expressive sounds, jabbering, inventing words, and repeating syllables were checked by several of the mothers at 32 and 33 weeks, immediately after the new records were given them. Apparently, then, these items were placed on the record blanks a little too late to get the full age range of development.

CONSISTENCY OF THE SEQUENCE

There were marked individual differences in the amount of vocalization and in the ages at which comprehensible speech began. There was, nevertheless, considerable consistency in the sequence. With all the babies, grunting and playful babbling preceded social

vocalization, and inflection and intonation preceded the use of comprehensible words. Nouns, verbs, adjectives, and adverbs occurred as first words, but pronouns were not acquired until long after the first word. Combination of words into phrases and sentences appeared late in the second year. Undoubtedly much is contributed to the development of the baby's speech through conscious training on the part of parents and through spontaneous experiment and imitative practice on the part of the baby, yet there is a consistent underlying course in the progress toward speech that would seem to argue that vocal expression has an instinctive basis and is not free from the trammels of maturation. From a study in which she trained one member of an identical twin pair and used the other as a control, Strayer (57) reached a similar conclusion.

QUANTITATIVE ANALYSIS OF VOCALIZATION

In order to obtain an estimate of the amount of vocalization achieved by each baby, the total number of his incomprehensible and comprehensible words, phrases, and sentences at each examination were counted. In the early weeks vocal play was often recorded in the terms "gurgles," "coos," or "repeatedly says *aah*." In estimating the amount of vocalization from the records, words in which the plural was used, (e.g., "repeatedly babbles") were counted as 5. At best this was a rough approximation, but it had the advantage of making the records consistent. Since the same syllables or words occurred again and again in the course of an examination, the number of different syllables or words were also recorded. Cumulative totals of the different words used in the examiners' presence were computed from examination to examination. These totals of course did

not represent all the words in the baby's vocabulary but only those used by him at the examinations.

Vocalization was recorded at every examination — physical, anthropometric, and psychological. When averages were computed, it was found that the utterances recorded at the anthropometric and physical examinations were much fewer than at the psychological. This was partly because the measurements called forth fewer utterances from the baby and partly because the recorder's attention was so concentrated on taking the numbers dictated by Examiner B that she was unable to listen to and jot down all the baby's jabbering. For this reason Table IX presents only the average amount of vocalization recorded at psychological examinations. The cumulative vocabulary averages, however, include the words used at the anthropometric and physical, as well as at the psychological examinations.

Types of Vocalization

All utterances — Under the heading "all utterances" were enumerated all the coos and grunts as well as all the syllables and words on the records. The medians and averages for all utterances and for different utterances are given in Table IX, and the averages are graphed in Figure 2. In spite of their very saw-toothed contours, the curves for both groups of utterances show a gradual upward trend from birth through the first year. In the second year the curves mount upward at a more rapid rate, until at 102 weeks the average number of utterances during the examination is close to thirty.

The curve for different utterances lags far behind that for all utterances at every age. Throughout the entire two years the babies had a marked tendency to repeat

TABLE IX

Amount of Vocalization Recorded at the Psychological Examinations Given to Babies from 3 to 102 Weeks

Age in Weeks	All Utterances		Different Utterances		All Incomprehensible Syllables		Different Incomprehensible Syllables		All Comprehensible Words		Different Comprehensible Words		Phrases		Sentences		Cumulative Average Vocabulary Used at Examination
	Median	Average	Median	Average	Average	Per Cent*	Average	Per Cent†	Average	Per Cent*	Average	Per Cent†	Total	Different	Total	Different	
3	0.0	.35	0.0	.33	.14	4.0	.09	27.20									
5	1.0	1.31	1.0	.84	.26	19.80	.15	17.80									
7	1.0	1.42	1.0	1.15	.73	51.40	.65	54.70									
9	1.5	2.72	1.0	1.33	2.00	73.50	.77	57.80									
10	2.0	3.31	1.0	1.82	2.27	68.50	1.32	72.50									
11	1.0	2.20	1.0	1.35	1.70	77.20	1.15	85.10									
13	1.5	4.60	1.0	1.75	4.15	90.20	1.55	88.50									
14	0.0	.62	0.0	.43	.18	29.00	.18	41.80									
15	0.0	3.10	0.0	1.21	1.00	32.20	.68	56.10									
18	0.0	3.80	0.0	.43	.05	1.31	.05	11.60	Period of development								
19	0.0	1.76	0.0	.70	.06	3.40	.06	8.57	of reaching								
21	0.0	.50	0.0	.25	.20	40.00	.05	20.00									
22	0.0	1.40	0.0	.73	.20	14.20	.13	17.80									
23	0.0	1.65	0.0	.65	.55	33.30	.30	46.10									
25	2.0	2.33	1.0	1.05	.88	37.70	.27	25.70									
27	0.0	1.33	0.0	.83	.27	20.30	.24	28.90									
29	1.0	4.43	1.0	2.33	2.14	48.30	1.29	55.30									

TABLE IX—*Continued*

30	.5	2.95	.5	1.35	1.25	42.30	.50	37.00												
31	1.0	1.63	1.0	.63	.52	31.90	.26	41.20	Period of development											
33	2.0	3.16	1.0	1.38	1.66	52.50	.61	44.20	of sitting alone											
34	1.0	2.10	1.0	1.05	.55	26.20	.35	33.30												
35	3.0	4.30	2.0	2.00	1.60	37.20	.75	37.50												
37	4.0	5.04	3.0	2.24	1.57	31.10	.81	36.10	.05	.99	.05	2.23								.04
38	1.0	3.40	1.0	1.33	.66	19.40	.47	35.30	.04	1.17	.04	3.00								.09
41	3.5	5.66	2.0	2.05	3.50	61.80	1.44	70.20	.94	16.60	.17	8.29								.24
42	2.5	3.80	1.5	1.65	2.30	60.50	.90	54.50	.05	1.31	.05	3.03	Period of development							.28
45	1.0	4.00	1.0	1.83	.77	19.20	.66	36.00	.00	.00	.00	.00	of creeping							.33
46	3.0	7.00	1.0	2.66	3.14	44.80	1.47	55.20	.70	10.00	.25	9.39								.38
47	3.0	7.45	2.0	2.60	3.85	51.60	1.45	55.70	.37	4.96	.21	8.07								.57
49	3.0	4.84	1.0	2.00	2.00	41.30	1.05	52.50	.00	.00	.00	.00								.57
50	4.5	6.50	2.0	2.72	2.09	32.10	1.41	51.80	.33	5.07	.14	5.14								.71
54	4.0	8.10	2.5	4.35	5.95	73.40	3.30	75.80	.35	4.32	.20	4.59	Period of development							1.04
58	6.0	11.63	3.0	4.36	8.72	74.90	3.63	83.20	1.09	9.37	.45	10.32	of walking							1.33
62	9.5	14.50	5.0	5.21	9.50	65.50	3.21	61.60	1.07	7.37	.50	9.59								1.71
66	7.0	17.30	4.0	7.07	8.54	49.30	4.61	65.20	7.61	43.90	2.00	28.20	.00	.00	1.70	.23				2.42
70	15.0	20.90	6.0	7.89	12.70	60.70	5.45	69.00	6.42	30.70	1.68	21.20	.00	.00	1.42	.05				4.20
74	13.0	16.63	7.0	7.42	11.70	70.30	5.42	73.00	3.31	19.90	1.52	20.40	.26	.16	.26	.05				5.25
78	11.0	16.94	7.0	7.64	8.94	52.70	4.04	64.60	7.70	45.40	2.53	33.10	.00	.00	.59	.12				7.00
82	25.0	18.93	8.0	9.33	9.33	49.20	4.40	47.10	9.06	47.80	4.60	49.30	.13	.13	.33	.13				9.85
86	26.0	24.07	12.0	12.54	12.54	52.00	7.46	59.40	10.92	45.30	4.84	38.50	.00	.00	.15	.15				11.55
90	19.0	21.16	9.0	9.66	4.66	22.00	2.66	27.50	15.25	72.00	6.83	70.70	.17	.17	.83	.50				13.66
94	17.0	23.46	15.0	14.23	3.07	13.00	3.00	21.00	19.23	81.90	11.15	78.30	.23	.23	1.85	1.39				18.00
98	21.0	29.23	12.0	16.61	2.84	9.71	1.77	10.60	26.00	88.90	14.77	88.90	2.62	2.15	1.85	1.54				24.50
102	26.0	29.06	16.0	20.33	5.33	18.30	4.53	22.20	23.86	82.10	15.80	77.70	1.07	1.07	2.40	1.80				32.44

* Percentage based on all utterances.

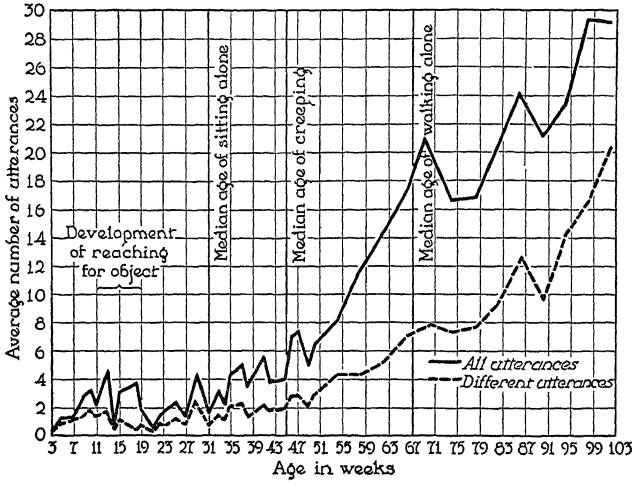
† Percentage based on different utterances.

the same syllables, the same words, and even the same sentences many times during the examination. Except in cases where only one utterance was recorded for a whole examination the number of different utterances was seldom more than half that of all utterances.

The median figures throw light on the extent to which the averages are representative of the group. The large

FIGURE 2

UTTERANCES AT THE PSYCHOLOGICAL EXAMINATIONS



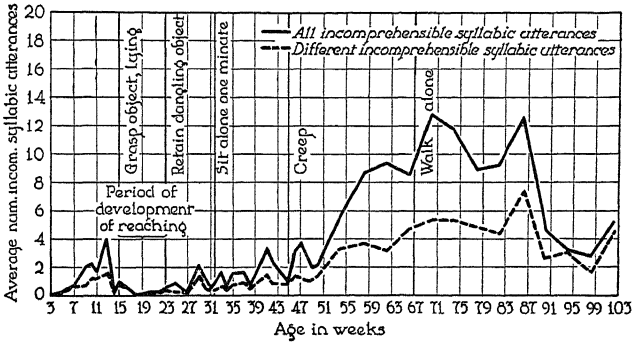
number of medians at zero in the early weeks indicates that up to 6 months (25 weeks) no utterances were recorded for half or more of the babies at most ages. After 6 months the medians approach the averages in magnitude, although in general the averages are somewhat larger because of the very high amounts of vocalization recorded for a few babies.

Incomprehensible syllables. — In the sixth and eighth columns of Table IX and in Figure 3 are given the

averages for incomprehensible syllabic vocalization. When two or more syllables were combined into a word-like unit, such as *erdah* or *whazaeven*, the whole group of syllables was counted as one vocalization. During the first year the amount of syllabic vocalization was low because it was impossible to spell out a large percentage of the utterances and hence they were recorded only as cooing or babbling. Late in the first year, however, syllabic speech began to increase, and throughout the

FIGURE 3

INCOMPREHENSIBLE SYLLABIC UTTERANCES AT THE PSYCHOLOGICAL EXAMINATIONS



early part of the second year it climbed consistently. From 70 to 86 weeks its progress was arrested, and at 90 weeks it definitely began to fall off; comprehensible speech had begun to take its place.

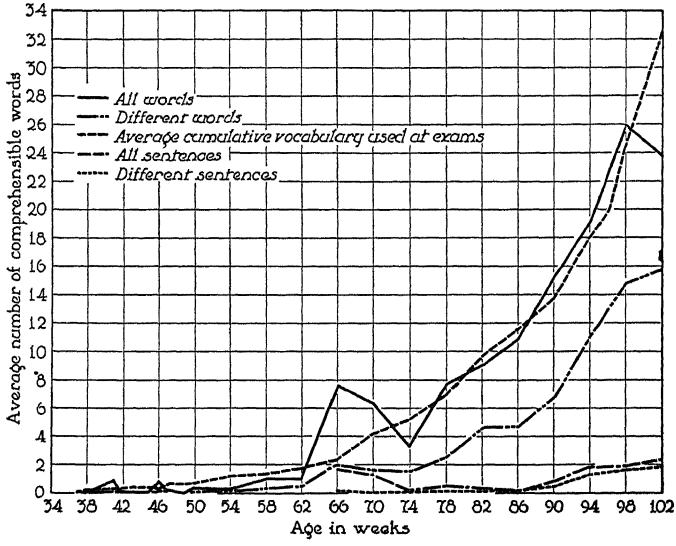
Different syllabic speech was much less than *all* syllabic speech. Again and again during an examination the baby uttered the same syllable and usually spoke it with the same inflection. When the baby persistently used certain word-like phrases in no uncertain tones, it is small wonder that the mother attached meaning to these utterances long before they approximated adult words.

In Table IX are listed the percentages of *all* and *different* syllabic vocalization, based on the averages of all and different utterances. The percentage of utterances recorded as syllables showed little change during the first year. During the first half of the second year syllabic vocalization made up from 60 to 75 per cent of the total utterances, but after 18 months incomprehensible syllables became relatively less frequent as comprehensible speech increased.

Comprehensible words. — The first comprehensible and meaningful word was uttered in the examiners' presence at 37 weeks. (See Table IX, columns 10 and 12, and Figure 4.) From that time until the end of the first year a few words were spoken at each age tested.

FIGURE 4

COMPREHENSIBLE WORDS AND SENTENCES AT THE PSYCHOLOGICAL EXAMINATIONS



At 54 weeks the babies averaged 2 comprehensible words each, and at 66 weeks the number had increased to 7. There was little further improvement till 86 weeks, after which age comprehensible speech increased with great rapidity. It was just at this age that incomprehensible speech started to decrease. Progress in vocalization at this point was also shown by the rapid rise in the curve for different words used and the consequent spurt in the average cumulative vocabularies.

In columns 11 and 13 the total number of comprehensible words and of different comprehensible words are expressed as percentages of the total utterances and of the different utterances. After 50 weeks these percentages rise quite consistently till the end of the period, at which time about 80 per cent of the recorded utterances were comprehensible. This percentage is probably far too high for the comprehensibility of 2-year-olds' speech in general. There are several plausible explanations of it, however. In the first place, a few of the babies whose comprehensible speech was very limited at 2 years became comparatively silent at about that age and did not utter as much jargon as formerly. It is possible also that the recorder had her ear cocked for comprehensible words and thus failed to jot down all the jabbering; moreover, as the babies became more voluble it was increasingly difficult to record all their utterances. A third factor that may account for the high percentage of comprehensibility is the fact that the examiners were so well acquainted with the babies that, like the mothers, they were able to understand more of the babies' speech than a stranger might have understood. Finally, the fact that the examination, which was repeated at monthly intervals, was very familiar to the babies made it possible for them to make

themselves understood with a very small repertoire of words.

Phrases and sentences. — Shortly before 18 months a few babies began to use phrases and sentences (see Table IX, columns 14, 15, 16, and 17). The average number of "all sentences" per child increased after 82 weeks. Many of the sentences were repeated several times, as is indicated by the difference between the average number of "all sentences" and "different sentences." The one baby who talked in sentences at 66 weeks queried "Whas dat?" seventeen times and used only two other sentences. Hence the number of different sentences would seem to be a better measure of the child's early speech than a total of all his sentences. By the second year the babies were averaging more than two sentences during an examination, and three-fourths of their sentences were different.

Length of words, phrases, and sentences. — Week by week tabulations of the length of each incomprehensible word, comprehensible word, phrase, and sentence were made. The length of words was computed in syllables, and the length of phrases and sentences in number of words. Words did not exceed 3 syllables, and phrases and sentences were not more than 4 words long. Sometimes long adult words were reduced by elision to 2 or 3 syllables in the child's pronunciation. Although data were available for computing the average length of response at each week, this refined treatment hardly seemed necessary. Instead, the percentages of 1-, 2-, and 3-syllable words were computed for the entire two-year period, and the same computation was made for phrases and sentences. Part A of Table X gives the totals and percentages and Part B the average length of sentences secured from children at 2, 2½, 3, and 3½ years by means of the McCarthy method.

By far the greatest number of incomprehensible utterances were monosyllabic, and a large majority of the words were monosyllabic. Three-syllable words, whether comprehensible or incomprehensible, were rare. Like-

TABLE X

A. Length of Words, Phrases, and Sentences Used by All Babies up to 104 Weeks

Vocalization of All Babies up to 104 Weeks	No.	Per Cent
Incomprehensible words		
1-syllable	1,203	79.09
2-syllable	275	18.08
3-syllable	43	2.82
Total	1,521	
Comprehensible words		
1-syllable	879	69.81
2-syllable	373	29.62
3-syllable	7	.55
Total	1,259	
Phrases		
2-word	72	91.13
3-word	7	8.86
4-word	0	
Total	79	
Sentences		
2-word	56	53.84
3-word	37	35.57
4-word	11	10.57
Total	104	

B. Comparison of This Study and the McCarthy Study in Regard to Average Length of Sentences Used by Babies from 2 to 3½ Years

Age in Years	This Study	McCarthy Study
2.0	1.72	1.8
2.5	2.71	3.1
3.0	4.16	3.4
3.5	4.45	4.3

wise, practically all of the phrases and more than half of the sentences were of minimum length, that is, 2 words. Three-word sentences were not infrequent, however, and a few 4-word sentences were spoken. At the ages of 2, 2½, and 3 years the average lengths of sentences for the babies of this study as obtained by the McCarthy method, which consisted of eliciting 50 consecutive responses from each child, were practically the same as those reported by McCarthy. The meagerness of the child's speech up to the age of 2 years is to be seen not only in his short sentences but in his short phrases, short words, and short incomprehensible utterances.

Recently Day (11) applied the method of 50 sample sentences to twins. She found that the twins were considerably retarded in language development as compared with singletons in all the phases studied. The mean length of response in twins was approximately one word less than that in singletons at each age. Such retardation was not shown by either of the two pairs of twins in this study. On the contrary, these twins exceeded the average of McCarthy's singletons by a fraction of a word at the age of 2 years and by more than one word at the age of 3½. In both pairs of twins the sex difference also was reversed. Whereas McCarthy and Day both found that girls exceeded boys in length of response at each age, the twin boys in this study were both superior to their sisters in length of sentences used.

Vocabulary as used at test situations. — Individual differences in the size of vocabularies used at the examinations were great. On the average each baby had spoken 36.9 different words in the examiners' presence by the age of 2 years; the range, however, was from 6 to 126 words. Only 274 different words were used by the entire group. A complete list of the words, roughly

classified as to parts of speech and alphabetically arranged, with the number of babies who used each is given in Appendix I. In Table XI are listed all the words used by five or more babies. The column headed "Words tested for" includes all the words the examiners

TABLE XI

WORDS USED BY FIVE OR MORE BABIES

WORDS TESTED FOR AND NUMBER OF BABIES USING EACH			
baby	14	man	9
ball	13	car	7
bow-wow	12	horse	6
doll	12	auto	5
bye-bye	11	dog	5
bird	9	girl	5
kitty	9	house	5
WORDS NOT TESTED FOR AND NUMBER OF BABIES USING EACH			
mamma	15	that	7
hunh?	13	Oh	7
there	12	boy	6
no	11	eye	6
all right	11	shoe	6
hello	10	is	6
bottle	8	all	6
daddy	8	my	5
see	8	mine	5
I	8	pretty	5
tick-tock	7	clock	5
down	7	done	5
Proper names of brother, sister, or playmate	13		

elicited by showing the babies the picture book and other toys. All the words listed under "Words not tested for" were spontaneously uttered by the babies in conversation with examiners or the audience during the examination.

Of the 25 words not tested for only 8 are nouns. The

comparative frequency of "mamma," "daddy," and the names of brothers or sisters perhaps serves as a rough index to the relative frequency of the baby's contacts with different members of his household. The high frequency of the word "hunh?" may be symbolic of the baby's early difficulties in comprehending speech, whereas the "no" of refusal and the "all right" of consent, which have equal frequency, indicate that the baby has a mind of his own with respect to compliance to requests. The only pronouns that appeared with a frequency of five or more were the demonstrative pronoun "that" and the first personal pronouns "I," "my," and "mine," the latter two in the possessive adjective form.

To call further attention to the words that were common to five or more children would lead one to an interesting but perhaps profitless speculation on the rôle of speech in the early thought life of the child that these meager data hardly warrant. That the same words were acquired by five or more babies does suggest, however, that there is a certain community of ideas even among very young children whose social contacts have largely been limited to the home circle. It seems unlikely that such community of ideas as does exist is attributable entirely to training and environmental stimulation, for different families use somewhat different training methods, although most parents din into the baby's ears the words "mamma," "daddy," "bye-bye," and the like. The use of verbs and words of consent and refusal are more likely to arise spontaneously from the child's own needs and desires than from parental coaching. If a careful analysis of the total vocabulary and spontaneous conversation of many young children were to be made, the psychologist might find a lane through

which he could enter that interesting and little-explored field, the child's thought. The work of Piaget (47) in this field is a hopeful beginning.

RELATION OF VOCALIZATION TO OTHER TRAITS

Motor Development

During the early weeks it seemed to the examiners that vocal sound play was temporarily arrested for a week or two before and after a new motor act appeared but was resumed again after the act was fully established. This impression was mentioned in Volume I, pages 132–134, but an evaluation of the data on the point was not made. Considerable support for the hypothesis is given by (1) the average and median number of utterances at the median ages of development of new motor traits and (2) the intercorrelations between developmental scores on fine motor, locomotor, and vocalization items at various ages.

Median and average number of utterances at definite motor stages.—Columns 2 and 4 of Table IX show that the median number of utterances from 5 to 13 weeks always exceeded 1; from 14 to 23 weeks, the period during which reaching for objects was developed, the median number of utterances was always zero. From 25 to 30 weeks both the median and the average number of utterances increased in frequency, but they decreased sharply at 31 weeks, which represented the median age for sitting alone, and remained low at 33 and 34 weeks. From 35 to 42 weeks there was another increase in median utterances, and a momentary slump at 45 weeks, the median age for creeping. After the median age of walking (66 weeks) the median number of utterances increased rapidly and far exceeded pre-walking

records. Since the averages do not show these trends very clearly, the median ages of the development of motor functions are indicated in Figure 2, page 60.

Correlations between motor development and vocalization. — Developmental scores on vocalization, locomotor items, and fine motor coordination were computed for each baby according to the median age of development of each item. The scoring method is fully described in Chapter XVI. The correlations obtained are presented in Table XII. The correlations between

TABLE XII

CORRELATIONS BETWEEN VOCALIZATION AND LOCOMOTION AND BETWEEN VOCALIZATION AND MOTOR COORDINATION

AGE IN WEEKS	VOCALIZATION AND LOCOMOTION		VOCALIZATION AND FINE MOTOR COORDINATION	
	No. of Cases	r	No. of Cases	r
15	22	.04	22	−.03
25	22	−.32	22	.16
35	22	.16	22	.08
45	21	−.32	21	.36
50	21	−.12	21	.60
54	..	..	21	.44
66	..	..	19	.30
74	..	..	19	.38
82	..	..	15	.48

developmental scores on locomotion and vocalization are all low; three of them are negative. These tend to confirm the theory that speech development is held in abeyance at the time when locomotor progress is most rapid. The correlation between fine motor coordination and vocal progress from 15 to 25 weeks, the period of reaching, is also low. From 45 weeks on, a moderate positive correlation holds at each of the ages for which the relationship was computed.

The somewhat meager evidence obtained from this study points to the conclusion that early vocalization is held in check by rapid motor progress and that babbling is a type of play to which the baby resorts when there is nothing better to do or when the novelty of a new type of motor activity has worn off.

Minnesota Preschool Test scores. — Three different measures of vocalization were correlated with the Minnesota Preschool Test scores (21) of 18 months and 2 years: the cumulative vocabulary, the different comprehensible words used per examination from 54 to 104 weeks, and the developmental scores on vocalization. The correlations were as shown in Table XIII. In all cases except one the relationships were fairly high, and all were higher at 2 years than at 18 months.

TABLE XIII

CORRELATIONS BETWEEN MINNESOTA PRESCHOOL TEST AND OTHER MEASURES

MEASURE CORRELATED WITH MINNESOTA PRESCHOOL TEST	18 MONTHS		2 YEARS	
	No. of Cases	r	No. of Cases	r
Cumulative vocabulary.....	17	.63	15	.76
Different words per examination....	17	.63	15	.74
Vocalization developmental score...	17	.15	12	.69

SUMMARY

1. The sequence of vocal development as found in these babies was as follows: (a) vocal grunts, probably reflex in character, present at birth; (b) syllabic vocalization or vocal play; (c) socialized vocalization — babbling to audience and shouting for attention; (d) the use of expressive tones and inflection; (e) of comprehensible words; (f) of pronouns; (g) of phrases and sentences.

2. The total number of utterances, both comprehensible and incomprehensible, varied greatly from baby to baby, but the average amount increased slowly during the first year and rapidly during the second.

3. The total utterances far exceeded the number of different utterances at each age; in other words the babies had a great tendency toward echolalia.

4. Monosyllabic words and 2-word phrases and sentences predominated up to 2 years.

5. Several words were common to the vocabularies of many babies under 2 years. This suggests that a community of ideas exists even at this early age.

6. Developmental scores on vocalization were but slightly related to locomotor scores. After 45 weeks they were somewhat related to developmental scores on fine motor coordination.

7. Vocalization scores were very closely related to Minnesota Preschool Test scores.

CHAPTER V

EARLY SOCIAL DEVELOPMENT

THE BABY PARTY

To obtain a record of the babies' social reactions was desirable for two reasons: first, for the sake of the records themselves, and second, because of the interest of the mothers. Except in the two homes where there were twins the babies did not see babies of their own age, and of course none except the twins had any experience in sharing his toys or his mother's affection. Therefore, to be confronted by another child of the same age was a new situation for each baby. News and anecdotes of the various babies naturally traveled from mother to mother by way of the experimenters, and some of the mothers had become acquainted during their stay in the hospital. This made them eager to see one another's babies.

A thorough study of one baby's social reaction to another baby of his own age would necessitate seeing the babies together more than once. But the difficulties of getting together the mothers and babies from the far corners of the city for even one gathering were great. In the winter such a project would have been very impracticable. Since no other test was scheduled for the 43rd week and since all the infants passed through this age during the summer months, it was chosen as a suitable week for the baby party.

Only the three or four babies who were born within a week of each other were brought together at the same

time. Thus the crowd was small and easy to handle. In some cases the party was held at the home of one of the mothers, and in others it was held at the Institute on the University campus. Since the weather was fine, most of the parties were held out-of-doors on a shady lawn. The mothers and babies were called for in cars and were taken home at the end of the party. The whole affair lasted not more than an hour, in order that the babies might not get too tired.

Each baby was compared with another baby of the same age in a series of six 1-minute tests. During the first minute the babies were seated on the ground facing each other with their feet almost touching. They were within easy reach of each other. At the second minute two identical metal tapes were placed between the two babies; this gave the babies a toy apiece. The tapes were taken away at the end of the minute, and the small hand bell was placed between the babies. Since there was only one bell, it was either shared or it went to the more aggressive of the two. During the fourth minute the mother of a third baby picked up her child and in the view of the two babies seated on the ground fondled and kissed him, blew down his neck, tickled him, and frolicked with him as mothers do. The two babies merely looked on. The next minute the mother of Baby 1 reached down and picked up Baby 2. She then called her own baby's attention to the fact that she was holding a little usurper by saying, "See what a nice baby Mother has," or something similar. After a minute she set the baby down again, and Mother 2 picked up Baby 1 and went through a similar performance. Throughout the entire test two recorders, S and an assistant, took records at 15-second intervals on the behavior of both babies. B sat on the ground beside

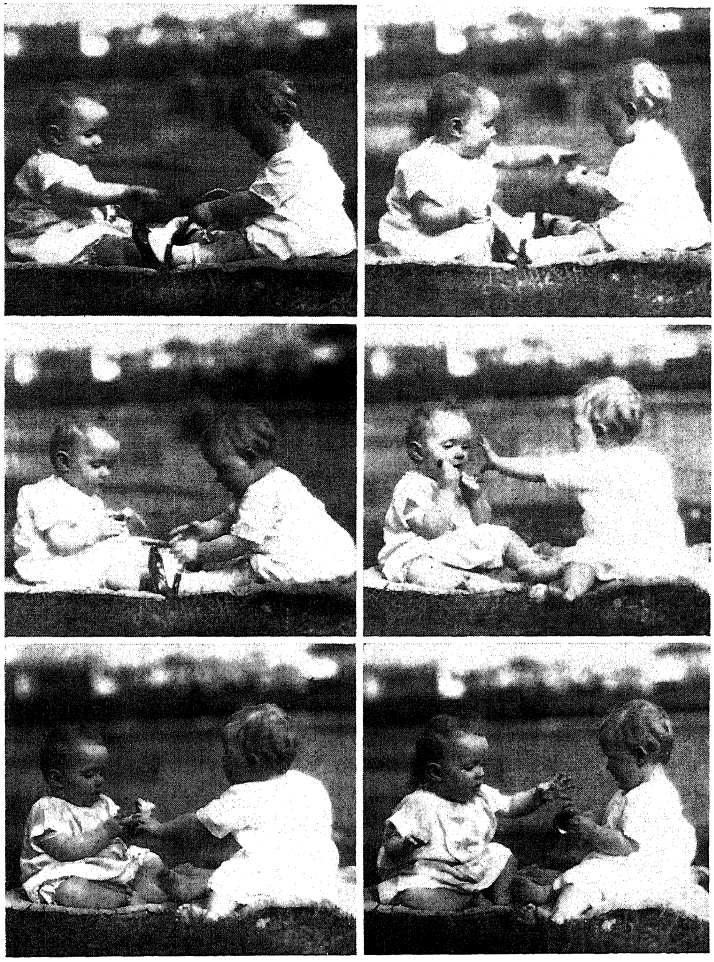


PLATE 3. — GETTING ACQUAINTED AT 43 WEEKS

Above.—Irene May and Judy with a tape apiece. Irene May reaches for Judy's tape (right), and confidently grasps it. *Center.*—She holds both tapes as Judy tries to recover hers (left). Irene May and Judy share a bell. First Irene gets the toy (right). *Below.*—Judy takes it away (left), and Irene wants it back (right).

them, handed them the toys, and was ready to act as umpire in case hostilities should ensue. All the mothers watched the tests. After the examinations the babies were rewarded with orange juice. Byplay between the babies other than that brought forth by the test was also recorded by the observers, and a summary of each baby's behavior was made.

The data obtained from the baby party are presented in Table XIV. The percentages given in the first three

TABLE XIV

SOCIAL REACTIONS OF FIFTEEN BABIES AT THE PARTY TEST

REACTION	PERCENTAGE OF ALL REACTIONS			PERCENTAGE OF BABIES REACTING			
	Test I (No Toy)	Test II (Toy Each)	Test III (One Toy)	At Tests I, II, and III	Test IV (Baby Fondled)	Test V (Baby Taken)	Test VI (Baby Left on Ground)
No attention	27.7	....	4.4	72.2	35.7	40.0	35.7
Attention to other baby	9.6	9.2	20.0	61.1	....	....	....
Attention to adults	20.5	3.4	1.1	66.7	....	....	....
Reach for other baby	9.6	....	1.1	22.2	....	....	....
Manipulate other baby	9.6	2.3	1.1	33.3	....	....	....
Take and manipulate toy	....	56.3	35.6	94.4	....	....	....
Aggressive behavior							
Take toy from other baby	....	9.2	11.1	55.6	....	....	....
Try but fail to take toy from other baby	....	8.0	8.9	33.3	....	....	....
Submissive behavior							
Allow toy to be taken away	....	....	7.8	16.7	....	....	....
Resistant behavior							
Keep toy when other baby tries to take it	....	4.6	3.3	22.2	....	....	....
Cry or fuss	12.0	2.2	5.5	39.0	14.3	26.4	28.8
Jabber in scolding tones	1.2	....	....	5.6	....	....	....
Creep away	9.6	4.6	....	27.8	....	....	....
Attention to mother and baby	....	....	....	....	50.0	13.2	7.1
Smile	....	....	....	....	....	20.0	28.8

columns of figures are based on the total number of reactions made, and the percentages in the last four columns are based on the number of babies making each reaction. During the first situation, when the babies were supposed to get acquainted with each other, they paid most attention to the circle of adults or to the whir of the movie camera. Pulling at one another's toes and reaching for each other's hair was as far as their attentions to one another went. When, in the second situation, the babies were presented with a tape apiece, a great number of reactions were made to the toy. There were some aggressive reactions; one baby attempted to take the toy away from another, a performance in which the aggressor failed about as often as he succeeded. In the third situation, when only one toy was given, there was less contented playing with the toy, more aggression, some resistance, and some submission in allowing the toy to be taken. In all, more than half the babies were successful aggressors in one situation or another, a third of them were unsuccessful, a sixth were submissive, and a fifth successfully resisted their opponent's aggression.

The fourth situation, in which a third mother fondled her own baby while the pair on the ground looked on, brought forth little response from these babies. The examiner had hit upon this test one afternoon when she was entertaining two young mothers and their respective seven- and nine-month-old first-borns. The babies sat on the floor playing. Presently one mother picked up her baby, booed at him, kissed him, and blew down his neck until he squealed with delight. The other baby looked on and soon let out a laugh that, had it been uttered by an adult, would have been described as an amused and indulgent chortle. Later the second

mother fondled her child, and the first baby laughed in tolerant tones. When this situation was presented at the party, however, only half of the babies watched. The others either paid no attention or fussed slightly. Perhaps one reason for the failure of the test was the fact that the mothers themselves were self-conscious about fondling their babies with whole-hearted enthusiasm in the presence of so many other adults.

In the final tests the mother of Baby 1 picked up Baby 2, calling her own baby's attention as she did so; a minute later the test was reversed when Mother 2 took Baby 1. One might expect the reactions of the baby who was left on the ground by his own mother to differ considerably from those of the baby who was taken by a stranger. Of the babies who were taken up, 40 per cent made no objection and paid little attention; almost as many of those who were left on the ground did not mind the sight of another baby in their mothers' arms. About one-fourth cried or fussed in both situations, and about the same number smiled in both.

The story of the party test may best be told in a series of pictures of Irene May and Judy. These two babies were born on the same day and were very nearly of the same size. Irene May is an only child; Judy has a sister four years older. During their first minute of sociability Judy watched and smiled at the examiners most of the time, while Irene May absent-mindedly fingered Judy's shoe and looked around. When the tapes were presented, each took one, but in thirty seconds Irene May reached for Judy's toy; the three stages of strife over the toys are shown in Plate 3. Renie took the bell when it was offered, but just as she was putting the delightful toy in her mouth Judy snatched it and kept it the remainder of the time, even though Renie struggled

for it (see Plate 3). Then Judy was given Renie's wooden doll to play with; after a few moments Judy magnanimously offered it to Renie. Renie was very much upset both at the sight of Judy in her mother's arms and at being picked up herself by Judy's mother. Judy, on the other hand, was not disturbed by either incident.

Little can be concluded from this single study of social behavior. If it had been possible to repeat the test at intervals of three months, a valuable addition to the study might have been made. Owing to the difficulty of getting the mothers and babies together, however, only one other party was held, shortly before the babies were 2 years old. But at this age the children were so independent and ubiquitous that it was impossible to pair them off for observation. Each child played with whatever he saw fit in the way that amused him most. From the few observations made at the earlier party, however, one may conclude that aggressive social behavior has begun by the age of 10 months.

THE COURSE OF SOCIAL DEVELOPMENT

Except for the party no test situations were devised for studying the babies' social development exclusively; the remainder of the information given in this chapter is a by-product of the examinations, and it therefore represents spontaneous rather than elicited responses on the part of the babies. The examinations in themselves served as fairly well-controlled social situations. In his home environment the baby was at ease, the examiners soon became familiar to him, and members of the family — adults or children — were never forbidden to watch the examination, although the examiners took complete charge of the baby; all these facts helped to create

a familiar, friendly atmosphere for the examination and put all the babies on the same social footing. Whenever they responded to the examiners or to other persons watching the tests by smiling, cooing, touching the person, or attracting attention by one means or another, that bit of behavior was recorded and subsequently classified as a social reaction. Similar notes jotted down by the mothers were also included among the social reactions. In addition, there were several items of social significance on the printed records kept by the mothers.

Types of Social Contacts

Contact by sight; watching and smiling. — The first active social response noted in the babies, which appeared early in the 1st month, was that of soberly watching an adult's face (see Tables XV and XVI). Following an adult's movements with the eyes came a little later, and at the end of the 1st month the babies began to be comforted by the presence and ministra-

TABLE XV

Median and Quartile Ages for Social Reactions as Observed by Examiners

Reaction	No. of Cases	Age in Weeks		
		Q_1	Median	Q_3
Watch person one or two times.....	23	6 da.	2.0	4.0
Watch person repeatedly.....	23	3.0	5.0	7.0
Smile at person.....	23	7.0	8.0	9.0
Catch person's hand.....	21	10.5	15.0	17.0
Talk to person.....	21	13.0	25.0	31.5
Play with person's hair.....	21	24.0	28.0	30.0
Draw examiner into situation.....	21	35.0	45.0	58.0
Seek help at tests.....	20	54.0	60.0	70.0
Point out mothers' pictures.....	19	66.0	70.0	....

TABLE XVI

AGE RANGES AND MEDIAN AGES FOR SOCIAL REACTIONS AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS	
		Range	Median
Are quieted by being picked up	19	3–11	4.0
Listen to voice	21	3– 8	4.0
Notice person	19	3–10	5.0
Are quieted by voice	15	2–14	5.0
Are quieted by caress	13	3–11	5.0
Smile when smiled at	22	3–12	7.0
Babble when talked to	20	5–12	8.0
Babble when no one is around	19	5–12	9.0
Recognize father	17	7–28	10.0
Recognize mother	20	5–28	11.0
Laugh aloud	22	8–17	13.0
Recognize stranger	14	8–28	14.0
Recognize friend	12	9–21	15.5
React to mirror	22	12–33	18.0
Stretch arms to be taken	20	14–37	25.0
Respond when own name is called	22	16–38	31.0
Poke finger in adult's eyes	19	32–46	33.0
Yell to draw attention	21	32–49	34.0
Recognize persons by sounds	20	31–49	35.0
Express disappointment if not taken	18	33–50	35.0
Yell in anger	20	32–49	35.0
Jabber or babble to persons	19	33–49	35.0
Are timid or afraid of strangers	10	33–54	35.5
Pull spectacles off adult's eyes	19	32–49	36.0
Try to pry adult's eyes open	15	35–44	37.0
Plaintive cry in disappointment	18	31–49	37.0
Wave bye-bye	20	26–50	38.0
Recognize father or mother at distance	19	32–49	38.0
Play peeka-boo	18	17–51	39.0
Play pat-a-cake	20	25–50	39.5
Know brother's or sister's name	20	18–51	40.0

tions of an adult. Whereas in the hospital period they had cried at being lifted from the crib, they now were quieted by being picked up and held. Apparently the sound of the mother's voice also had a soothing effect.

But these reactions on the part of the babies were passive as contrasted with the reactions of watching and looking, in which they took the initiative.

Watching and following with the eyes developed into smiling in the 2nd month, and soon the babies were expressing their joy in the society of adults and children by cooing, by animated waving and kicking, and by laughing aloud. At 3 months the babies were recognizing father and mother and other persons who assisted in their daily care, and in the 4th month some of them showed that they were aware of strangers by soberly staring instead of smiling or by signs of timidity or distress.

A few examples will serve to make it clear that the babies were actually taking in the situation in their early absorbed watching. Walley at 7 weeks first gazed intently at Examiner S, then looked searchingly at B, turned back to S, then to B, and thus kept up his alternate scrutiny for more than three minutes, transferring his attention from one examiner to the other at half-minute intervals. It was evident that he had discovered a difference between the two countenances, and it is possible that even at this early age he recognized that neither of the persons bending over him was his mother, who cared for him daily. At a later age (18 weeks) Fred showed his appreciation of a fracas by excitedly bouncing and waving his arms and legs in true rooter fashion as he sat propped up in a chair watching his father and brothers scuffle together. Another indication that absorbed watching was coupled with recognition was given by Edith Ann at 38 weeks. At this time a third person, C, accompanied B and S on their daily rounds for the purpose of learning the testing procedure so that she could carry on the work dur-

ing S's vacation. C was equipped with writing board, pencil, and paper exactly like those used by S, and the two recorders stood side by side, watching the baby and taking notes. Edith Ann looked from S to C and back to S time after time as if she perceived that here were two persons, each holding portfolios and doggedly scribbling, where formerly there had been but one.

Social contact through sight, the earliest social reaction to appear, gradually developed into a complex response in which recognition of friends, of strangers, and of entire social situations was manifested.

Contact by touch; manipulation of persons. — During the development of the reactions of reaching and grasping, the babies began to bring their hands into contact with persons, and in their manipulation of adults they showed a very marked developmental trend. At a median age of 15 weeks they caught the doctor's hands and clung to her fingers as she worked about their heads and chests. Reactions of fingering and scratching on her arm and hand and attempts to draw her hand to their mouths followed shortly. During the 24th and 28th weeks they entangled their fingers in the doctor's hair as she leaned over them to make her measurements. Hair-pulling appeared so consistently at this age that it may be considered to be as characteristic of the 6-months-old baby as is play with the toes. Within another two months random hair-pulling had given way to exploration of an adult's features. The babies poked their fingers into eyes and nostrils, tried to pry open closed lips and eyelids, fingered teeth, and snatched off spectacles. Adults were exploited to the babies' delight and no doubt to their edification.

Contact by sounds; social vocalization. — Jabbering apparently directed toward a person was noted by the

examiners at a median age of 25 weeks. A few weeks later the mothers reported that the babies called or yelled for attention, that they recognized an adult by sounds — for example, one looked for his father at the sound of a car stopping in front of the house — and that they expressed anger, disappointment, delight, and excitement by appropriate intonations in their shouts and calls.

Social Interplay

Joining with an adult or child in social play also followed a developmental trend. Smiling and cooing in response to an adult's smile was the first cooperative response, and stretching the arms or otherwise making bodily adjustment to be lifted was probably the second. Some type of cooperative play with an adult, such as peeka-boo, rock-a-bye, waving bye-bye, yelling at adults to "scare" them, begging by squeals and grunts to be lifted to standing posture, was manifested by all the babies between the ages of 6 and 10 months. Babies with older brothers or sisters also responded cooperatively to the overtures of a child. Indeed, the mothers of babies with siblings reported that babies laughed, kicked, smiled, and in general became more excited when children came near the crib than when adults approached. Renie May, however, who was an only child, ignored other children until her 48th week. The mother of Don reported that he seemed to prefer children of about the age of his 11-year-old brother to children of the preschool age. Crying in sympathy when another child cried was noted in four babies between the 9th and 12th months.

Twins became interested in each other at an early age. At 21 weeks Freddie turned and reached for

Winnie, who was lying beside him on the bed. Accidentally he stuck two fingers in her mouth, and she chewed on them, much to his amusement. In their 51st week, according to the mother's report, Freddie was sitting on the bed playing with two safety pins clasped together. He held them out to Winnie, who was sitting beside him. Just as she reached and touched them he jerked them away, and both babies laughed; they continued this for some time. This was the first definite voluntary play shared by babies that was noticed. At 45 weeks Peter held out a toy to Patty and gurgled in tones aimed to call her attention to it. During the second year the twins became more and more cooperative, helping one another in difficulties, prompting one another in the tests, and becoming partners in games and in mischief.

In the latter half of the second year several babies began to cooperate nicely with Examiner B in the measuring process. At her suggestion they lifted their chins, held out their arms, and otherwise complied with her requests. They also liked to "help" with the examination, and they began to imitate the measuring process by entwining the tape around their ankles, placing the calipers on their feet, scraping their feet as if giving the stimulus for a Babinski reflex, and greasing their feet with oil for the walking test. By the second year the babies had progressed from a stage of active or passive resistance to being measured or dressed or bathed to a recognition and understanding of the movements that enabled them to help rather than hinder the processes.

Social Attitudes

Timidity and shyness. — Timidity and shyness swept over the babies in two waves, the first in the 5th and

6th months, and the second at about 18 months. During the two waves very different reactions were manifested by the babies, and they were aroused by different stimuli. The first streak of timidity showed itself in an apprehension of strangers and in a desire for the companionship of the mother. By the 4th month the babies were greeting friends with smiles and gurgles and strangers with solemn stares and sometimes with puckered lips and whimpers. In the latter part of the 4th, the 5th, and the 6th months fear of the examiners was shown by six of the babies. If the mother remained in the room for a few minutes after the examiners arrived, the baby's timidity wore off, and the examiners were able to make the tests. Some showed no alarm while the mother was in the room but became fussy if she left. In the 7th and 8th months the mothers began reporting that the babies cried when they appeared in hat and coat ready to depart. This wave of timidity had spent itself by the 10th month and from then till about 18 months the babies were very friendly. Timidity was not a universal attitude, however, for some of the babies were completely free from it. Similar waves of timidity have been reported by Washburn (63), who found that smiles were less easily elicited between 20 and 40 weeks than before and after this period. Bayley (4) also reports increased crying in response to strangers up to the age of 10 months.

The second wave, which perhaps is best described by the term "shyness," began between the ages of 66 and 86 weeks and lasted for a period of eight or twelve weeks. It was a more common reaction than the early timidity, for it was noted in fourteen of the eighteen babies. It was manifested in burying the head in the mother's lap or hiding the face in the crook of the arm

and then peeking slyly around to see if the examiners were looking, leaning over to make an elaborate examination of the shoes, or hesitating to take the toys as if waiting for permission. Drumming their heels on the floor, clapping the soles of their feet together, and crossing and uncrossing their legs as they sat on the floor waiting for new toys to be brought were ways in which three little boys showed their lack of social poise. In general, these were reactions of coyness or self-consciousness rather than of timidity or fear. To be sure, timidity was also shown by some of the babies at this age, but with the exception of one baby who, according to his mother, looked sheepish when adults tried to make him smile and another who cried when B laughed at her, there was no evidence of shyness or self-consciousness during the early ages.

The temptation to speculate on the coincidence of shyness with the beginnings of speech is great. At this period, when even the most patient parents are urging the babies to talk, to repeat words and rhymes in parrot fashion, and to go through their repertoire before guests, it would not be surprising if the babies developed self-consciousness and negativism. It is possible, too, that babies of this age can understand a considerable amount of adult conversation even though they are unable to express themselves in speech. Such a situation might well lead to a feeling of social inadequacy. Be that as it may, the timidity of the early period, which seems to be an expression of fear, loneliness, and longing for the familiar, is very different from the ostrich-like desire to hide that characterizes the later period of shyness.

Affection. — The earliest signs of affection reported by the mothers were those of patting the breast while

nursing and of cuddling down contentedly when held on the mother's shoulder. In the 7th and 8th months the babies demonstrated their affection by patting the mother's face, clasping her around the neck, laying cheek on cheek, turning their faces to be kissed, hugging, and biting. No doubt many of the wide variety of expressions of affection listed by the mothers were taught the babies by their parents, but those of patting and hugging, which were most commonly reported, were probably spontaneous.

Imitation. — Few results were obtained from the "imitation" tests that were included in the psychological examinations. But in the mothers' reports and in the incidental happenings reported there is considerable evidence that the babies watched the acts of older children and adults and later copied them in their own way. In the 8th and 9th months a few babies coughed when an adult coughed, smacked their lips if their mothers smacked theirs when bringing food, whispered when whispered to, and mimicked facial expressions. Late in the second year, however, imitation of an act did not always immediately follow observance of it. Reactions such as lying down on the stomach to look at a book in the favorite reading posture of an older child or using the tape as if for measuring appeared during this period. The mother reported that Harvey in his 64th week obtained a pair of pliers and spread them open. He placed them first at his head, then at his cheeks, chin, and arm in the measuring position. Walley at 76 weeks spilled a pitcher of cream on the kitchen floor. Before his mother knew what had happened, he had brought the mop cloth from the bathroom and was wiping up the mess. At 86 weeks Larry "helped" shell peas; later in the day his mother found

him playing with jackstones and ball, raking the jacks together and throwing the ball as he had seen his sister do. Although the babies did little direct mimicking in the second year, they did go through the complicated acts they had observed in such a way as to leave no doubt that they were trying to do what they had observed their elders doing.

The Social Sequence

The question as to whether the social development of the babies followed as orderly a sequence as did the motor development may certainly be answered in the affirmative. Social contacts through vision were developed before social contacts through manipulation; these in turn preceded social vocalization, attempts to draw the examiner into the situation, and seeking an adult's help. On second consideration, however, it will be seen that certain phases of the social sequence are determined by the motor sequence. The earliest social reactions are made through the eyes because these organs are the first to come under motor control. Catching an adult's hands coincides with grasping a stationary object; playing with the doctor's hair occurs in the period of grasping a dangling object; and poking fingers into an adult's eyes, pulling off spectacles, and playing cooperative games of peeka-boo and pat-a-cake follow at the time when simple manipulation and control over the index finger are being developed.

Nevertheless, some aspects of the social sequence are unexplainable in terms of motor development. The early wave of timidity in the presence of strangers is not due to motor development, and it would be difficult to establish it as a reaction coming about through early conditioning or training. The outcropping of shyness,

embarrassment, and self-consciousness late in the second year might be attributed to environmental stimulation, but it appeared so consistently in these babies that it would seem more likely to be a normal manifestation of growth. It may be that this lack of social poise is connected with the baby's efforts to take on the language of his peers and that it has its root in his inability to express his emotions and ideas in words. If so, it is the counterpart of the confusion that an adult suffers when he is unable to meet banter with sprightly quips. Although it was impossible to measure and difficult to record in descriptive terms, the transition from the social poise, self-confidence, and self-sufficiency of the 12- to 18-months-old baby to the social inadequacy of the 18- to 24-months-old child was one of the most obvious and most interesting features of this study. If individuals are ever perfectly adjusted to their environment, these babies were at the age of a year; but by 18 months they had sailed out from this haven of peace and contentment on the choppy sea of childhood's inadequacies and disappointments.

Social development in all likelihood has its own sequence just as truly as does motor development. The close similarity between the sequence of this study and that presented by Bühler (7) gives it additional significance. It would be foolish to insist that the trend of social development is as little affected by environment as motor development appears to be, for social contacts are dependent upon environment alone. Although the nature and extent of his social contacts no doubt determine to a certain degree what the baby's social reactions will be, still there are limitations to his responsiveness that are imposed by his general level of development.

SUMMARY

1. Three types of social contacts were noted: first, contact by sight; secondly, contact by touch with the hands; and thirdly, contact by vocalization.

2. Two stages of social timidity were shown: timidity proper, which developed in the 5th and 6th months; and shyness, perhaps tinged with self-consciousness, which appeared late in the second year.

3. Social development appears to follow a definite sequence, which is partly due to the limitations of the motor sequence.

CHAPTER VI

GROWTH IN COMPREHENSION

The reader has probably long since decided that *Intellectual Development* is a misnomer for this treatise; thus far we have spoken only of the babies' dexterity of hand, glibness of tongue, and poise of social reactions and have not mentioned feats of memory, imagination, and reasoning or ability to make adequate and prompt adjustment to new situations. These latter traits are the ones that are usually thought of as part and parcel of the general trait intellect. But they are highly subjective traits, hard to elicit from infants by specific tests because babies are difficult to motivate, incapable of understanding directions, and powerless to express their rudimentary thoughts, analyses, and generalizations in words. Even if suitable experimental situations could be devised, there would still be a wide gap between the babies' mental processes and the adult's recognition of them that could be bridged only by the interpretation of the baby's facial expressions, his gurgles and coos, and his kicking, waving, and reaching. The baby may run through a long gamut of reactions, but it is up to the observer to interpret them, provided he is not satisfied with a mere enumeration of the reactions, and he can interpret only in anthropomorphic terms.

Evidence of Generalization in Infants

In the present study most of the test items were devised with a view to calling forth manipulatory re-

actions, speech, visual attention, or gross motor adjustment, reactions that are fairly easy to observe and record and are unequivocal in interpretation. It is through these reactions that the baby manifests his early intellectual strivings to "get the hang of things," to "see the point," and to weigh and evaluate experiences and modify future behavior in ways compatible with past successes. Generalization from experience and modification of behavior in accord with it assuredly does occur even in very young babies. One 6-months-old infant, who was accustomed to lying quietly in her crib or on the floor for hours and whose parents had made it a rule never to pick her up unless she was smiling, became temporarily "badly spoiled" during a three-day visit to the house of her doting grandmother and aunts. She soon discovered that a little fussing would bring someone to take her up and play with her. The rapidity with which old habits of amusing herself gave way to the new one of seeking attention and the speed with which the old ones were reinstated after she had been left to "cry it out" a few times showed that the baby used some acumen in meeting the two situations. Such generalizations and modifications of behavior are usually termed "conditioning"; yet who can say with certainty that these reactions in babies differ, either in the quality of adjustment they effect or in the type of mental reactions or neural connections they involve, from that manipulation and generalization of experience that in adults is called reasoning, and in scientists, induction. All these terms are merely names, and none of them explains in terms of the nervous activity how generalization and subsequent modification of behavior take place.

To cite another example, one baby of this group not

only showed signs of generalizing from his experiences in early infancy but at the ripe age of 2½ years was overheard to state his conclusion with concise clarity. This baby was Harvey, the second child of his parents; between him and his brother there was a gap of fourteen years. Since he came into a family composed virtually of three adults, very naturally he immediately became the hub about which the household revolved, and he was not long in discovering that he could take advantage of his mother, who hovered over him with anxious solicitude. Before he was 6 months old he found that he could get attention in the middle of the night by lying awake and cooing. Early in the second year, upon the advice of her pediatrician, the mother set about breaking him of this habit; she strapped the covers over him securely and paid no attention to his midnight period of wakefulness. After a night or two, according to the mother's report, Harvey slept straight through without waking. Such rapid readjustment of the baby's habits when it became apparent to him that his mother really meant business seems to partake more of intelligent reaction than of the blind and painfully slow process of unconditioning.

Because of his mother's anxious care and his father's and brother's indulgent play, incidents similar to this were not rare in Harvey's life. When he was 2½ years old his mother had to go to the hospital for a major operation and, unwilling to entrust the care of the baby to the maid, she summoned her parents to take charge of the household. In the hands of the grandparents, who were even more solicitous and indulgent, Harvey's importance no doubt was increased, and out of this experience he crystallized his astute generalization. "I must tell you what a cute thing Harvey said the other

day," his grandmother told the examiners at their visit. "I had put him to bed for his afternoon nap. I guess he wasn't very sleepy, for I heard him talking away to himself for some time. Finally I slipped to the door to eavesdrop, and this is what I heard him say, 'Hahvey can do anything he wants to do any time he wants to do it.' I thought it was so cute I had to tell his mother when I went down to the hospital to see her, and she said, 'Oh, I just hope Harvey keeps that splendid determination all his life. If he does, he'll be a successful man.' "

Herein is illustrated not only the intellectual reactions of the baby but also the subjectivity of interpretation of such reactions by adults. The mother attributed Harvey's expression of independence to his "splendid determination" and dauntless will power, whereas the writer looks upon it as a canny generalization based upon observed experience, and there is no way of deciding which interpretation is right.

The behavior of Fred suggests that he recognized fairly early in his career the truth of the biblical injunction "A soft answer turneth away wrath." Always precocious in his use of language and voluble in his speech, he soon began to utter pat remarks in commenting on his misdemeanors, so that parental ire was mollified by mirth during the administration of justice. Late in their third year Fred and Winnie, under the former's leadership, spent a joyful half hour painting the kitchen wall with the chocolate pudding that was to have been served as the family's dessert. Upon discovering the prank the mother took the twins to task about it, saying, "Oh, children, I didn't know you *could* be so naughty." "No, Mother," came Fred's prompt reply, "I didn't either." And again in his fourth year when

his mother said, "Freddie, you annoy me. You always do things just to get attention," he queried, "Well, Mother, why shouldn't I?"

All reactions that occurred incidentally as well as those that were tested for are subject to errors of interpretation similar to that mentioned in Harvey's case. Furthermore, it is always difficult and sometimes impossible to decide whether a given intellectual process has occurred at all. One marked by as clear a verbal expression as was that of Harvey's can leave one in no doubt as to the fact that cerebration of some kind occurred. But in reactions such as those of recognizing familiar faces, putting the round block in the round hole in the form board test, and understanding verbal directions, which are usually accompanied by facial expression, intonation, and gesture on the part of the adult, it is very hard to say whether the baby's reaction is an intelligent one, whether it is due to chance, or even whether it has occurred at all.

Even though no tests were devised to elicit the reactions of analysis and generalization and the beginnings of abstract intellectual processes as found in the baby, many incidental reactions were noted by both mothers and observers, and some of the behavior items on the record blanks kept by the mothers seemed to involve memory, comprehension, understanding, and the rudiments of reasoning to a greater extent than did others.

Intellectual Reactions Recorded by the Mothers

It is not necessary to enter here into a discussion of test items that throw light on intellectual processes; they will be discussed in detail in Part II. But it is worth while to cite a few items of that nature from the mothers' records and from incidental reactions. The

items have been classified roughly under four heads as memory, comprehension of speech and compliance to commands, self-help, and "seeing the point." Again the reader must be warned against attaching any normative significance to the median ages of appearance of these items recorded by the mothers. There are large variabilities in the reported ages, as may be seen by the wide ranges. Differences in reported ages may be due partly to differences in interpretation of the items and to inaccuracy of observing and recording the items, as well as to true differences among the babies. Some items were omitted by some mothers, and there is no way of knowing how their omission affected the median. It is very possible that differences among the mothers in interpretation were greater in these items than in the more objective items of motor development. Even though the age records are all but valueless, the interesting and significant fact is that many of the mothers watched carefully for this particular type of behavior and recorded it.

Memory.—In Table XVII are presented items gleaned from the mothers' records that seem to involve

TABLE XVII

AGE RANGES AND MEDIAN AGES FOR REACTIONS OF RECOGNITION AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS	
		Range	Median
Recognize father	17	7–28	10.0
Recognize mother	20	5–28	11.0
Recognize stranger	14	8–28	14.0
Recognize persons by sounds	20	31–49	35.0
Show disappointment if left behind	18	33–50	35.0
Recognize parents at a distance	19	32–49	38.0
Recognize objects by sounds	19	33–51	41.0

an ability to remember and recognize persons and experiences; they are presented with their respective age ranges and medians. It is impossible to tell from the records what criteria the mothers used for these different reactions. The coos of pleasure and the excited waving and smiling with which the infant under three months greets parents and other familiar adults indicate that he recognizes them as persons who administer to his needs and who play with him. It is natural that parents should be recognized at an earlier age than strangers. It is impossible to tell whether the baby recognizes a stranger as such unless his face becomes sober or he whimpers upon seeing the unfamiliar face. The baby gives evidence of recognizing an object or a coming event by its sound if, when hungry, he stops fussing at the sound of his food being prepared. A striking reaction indicating comprehension of sound was James's shudder when, at the end of his bath, he heard his mother drawing the dipperful of water for his daily cold rinse. This of course may have been a conditioned response. The baby usually expressed disappointment when left behind by crying after his disappearing parent.

At 35 weeks Fred clearly recognized signs of being taken outdoors by squirming and squealing with excitement when his cap and sweater were put on. Edith Ann's recognition that there was an extra recorder in addition to the two regular examiners at 38 weeks is evidence that she remembered the familiar weekly examining routine. At 11 weeks James recognized his bottle, and at 18 weeks, after having been fed from the bottle one feeding a day for only a week, Harvey recognized the bottle at sight and preferred it to the breast. Maurice, at 66 weeks, appeared not to recognize his

mother when she returned after a nine weeks' absence. Judy at 94 weeks recognized her mother and ran to meet her crying "Muddie" when her mother returned from a month's trip. At the same age Harvey definitely remembered B when he got back from a six weeks' absence, and every nook and cranny of his home was familiar to him after his long visit. He was also able to select the car key from a ring of fifteen others after having seen his father use it for a week in unlocking the car. Don was able at 90 weeks to pick out his father's car from a group parked on the street. Memory and recognition were thus displayed by the babies at very early ages, and apparently the length of retention increased as they grew older.

Comprehension of words; compliance to commands.— Understanding of speech, according to the mothers' records, also began early. Reactions indicative of an interest in and an understanding of adult speech are listed in Table XVIII. Here again little significance should be attached to the ages reported by the mothers

TABLE XVIII

AGE RANGES AND MEDIAN AGES FOR REACTIONS OF COMPREHENSION AND COMPLIANCE AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS	
		Range	Median
Listen to voice	21	3– 8	4.0
Are quieted by voice	15	2–11	5.0
Are startled at sound	19	3–10	5.0
Listen to music	20	3–19	9.0
Coo or stop crying on hearing music	18	12–32	15.0
Respond to own name	22	15–38	31.0
Respond to words	22	14–49	36.5
Pat-a-cake at command	20	25–50	39.5
Know brother's or sister's name	20	18–51	40.0
Know name of object	15	18–46	40.0

for the various steps toward comprehension of speech, but the order of development is logically sound. At the earlier ages the babies began to pay attention to the human voice and apparently differentiated between it and other noises, since voices soon came to have a soothing effect on them, whereas sudden and unusual sounds were disquieting. A little later music also had a quieting influence on the babies. It is logical that the baby should have recognized his own name and turned when it was called before he recognized the names of his siblings, in whose society he delighted, or the names of objects as important to him as his bottle or his toys. The mothers were fairly consistent in reporting the babies' knowledge of their own names as the earlier occurrence; seventeen of the twenty mothers who reported both on knowledge of own name and knowledge of brother's or sister's name recorded the former as occurring at an earlier age, and the other three mothers noted the two responses simultaneously. Likewise, the baby's knowledge of his own name preceded a response to words in seventeen out of twenty-two cases and preceded pat-a-caking at command in eighteen out of twenty cases.

In these reports also it is impossible to tell what criteria the mothers used for each reaction, and it is a dubious question as to whether the babies were responding to the words alone or whether they were reacting to secondary cues of facial expression, gestures, and intonations of voice. It is fairly certain that the mothers did not talk to the babies in flat voices and with faces devoid of expression; such speech would be unnatural and difficult to achieve. Commands to pat-a-cake and wave bye-bye were no doubt often accompanied by gestures. These secondary cues are undoubtedly of

great aid to adults in the understanding of speech; the greater difficulties in comprehension over the telephone, gramophone, or radio exist in part because of the dimming of inflections and the inability of the listener to see the play of expressions on the speaker's face. Since these factors have a significant rôle in an adult's comprehension of speech, there is no reason why they should be wholly eliminated in testing the understanding of infants.

The mother of Fred and Winnie made careful notes on her babies' comprehension from a very early age. At 15 weeks she reported that each baby turned to look when his or her own name was uttered, each looked at the twin when asked "Where's Fred?" or "Where's Winnie?" and both looked at the light when asked "Where is the light?" At 20 weeks they looked correctly at each of the five members of the family seated around the dining table when plied with the questions "Where's Mother?" "Where's Nellie?" and so on. At 25 weeks Winnie complied to the command "Hold your bottle, Winnie," and at the same age Fred knew the words "light," "bottle," and "toes." At 33 weeks Fred's comprehension vocabulary had increased to include "talk," "pat," "Look out of the window," "tree," "Where is Freddie?" (in the peeka-boo game), and his mother added the note "Understands more than I have time to list." In his 36th week he pat-a-caked at command, and in the movie taken at 40 weeks he is to be seen pat-a-caking and vigorously shaking his head "no-no" in response to these two commands. His mother records at 45 weeks, "When his hand is raised to pull Winnie's hair, I say 'Freddie!' in disapproving tones and he stops — generally." From the first, Winnie's comprehension was somewhat more advanced than Fred's. She looked

at the light at an earlier age and complied to commands of greater variety and complexity. At 41 weeks she put out the kitchen light upon command when she was held within reach of the dangling string; at 42 weeks she reached for her doll and shook and patted it till it squawked when she was asked "Can you make your dolly talk?" At 45 weeks her mother wrote, "Seems to have generally better comprehension of ordinary conversation than Fred. I will say, for instance, 'Phil [her older brother] is coming to see you; I hear Phil coming,' and she will at once look toward the door."

Caroline showed similar development in comprehension; she pat-a-caked at her mother's command at 33 weeks; at 40 weeks when questioned "Are you hungry, Carol?" she smacked her lips; and she waved bye-bye when people left. Doris at 31 weeks had apparently begun to understand speech that was directed not to her but to her small brother, for her mother recorded that whenever Billy was told to leave the baby alone she cried if he came near, but when Billy was told, "Yes, you may play with Doris now," Doris laughed and kicked and tried to talk to him. At 39 weeks she was turning to look at the canary in his cage when asked "Where is the birdie, Doris?" and from 52 weeks on she complied correctly to such commands as "Go to sleep," "Don't cry," "Roll over," "Put it down," and "Mustn't touch." Don at 27 weeks would yell to make his parents jump when they asked him to "scare" them. At 41 weeks at his mother's order he would change toys from one hand to the other while being dressed, and at 44 weeks he would hold his stool even after he had started to soil his diaper if his mother said, "Wait till Mamma gets your chair." Beginning with "bouncie-bounce" at 33 weeks, Harvey's comprehension vocabu-

lary gradually grew to include, by 44 weeks, "rain," "no-no," "shoe," "listen," "eye," "bye-bye," "street car," "horsey," "doggie," and "daddy's car."

James's mother carefully observed and recorded at 35 weeks: "After repeatedly telling him, 'Stop scratching, Jimmy,' when I changed him and putting his hands above his head, he now lifts his hands when I say 'Stop scratching.' This does not always happen but has occurred often enough to point toward understanding. It is only when he is being changed that he reacts this way." At 48 weeks the mother knew from similar observations that James understood "Go to bed," "Sit on chair," "Good boy," "Want the kiddy-car?" and "Bath." Renie May's mother listed her comprehension by weeks as follows: "34 weeks, 'no-no,' 'turn over,' and 'how-de-do'; 35 weeks, 'blow your nose'; 39 weeks, 'bye-bye,' 'mother,' 'daddy,' 'open your mouth,' 'come on'; 40 weeks, 'peeka-boo,' 'get up'; 42 weeks, 'sit up'; 44 weeks, 'oh dear,' 'see there,' and 'ouch' [at which the baby pulled her mother's hair]."

These excerpts from the mothers' records have probably been quoted in needless detail, but they serve to show that the mothers did not list words as comprehended until the baby performed some objective and clearly defined reaction in response to them. The examiners themselves did not begin to use verbal directions and commands as a part of the test situations until after the first year. Thus they have fewer records of early comprehension than do the mothers. The mothers' records during the first year and the examiners' observations on compliance to command and comprehension during the second year tend to confirm the generally accepted theory that babies comprehend a good deal of adult conversation before they are able to

talk much themselves. This theory is a logical one, for babies certainly could not use speech appropriately before they were able to comprehend its meaning.

"Seeing the point"; making excuses. — During the first two years the babies performed several reactions in which it was clear that they had "seen the point" and had begun to generalize from their elementary experimentation. The chief scientific discovery on which the mothers were asked to keep records was the fact that objects fall down. According to the records of twenty-one mothers the babies first recognized this simple law of gravity, as manifested by looking down to the floor to locate a toy dropped from the high chair, at a median age of 29 weeks, the age range being from 17 to 46 weeks. Don's experimentation along this line at 37 weeks was noted by his mother as follows, "While he was sitting on the floor he tried to let his toys fall from his fingers as he does when in his high chair; he was surprised that they stayed right where he put them." At 44 weeks Matthew would look for an object he had lost and would crawl under the furniture in order to get a light socket to play with. Hunting for hidden objects became a pronounced reaction in the second year, and it was an idle gesture for the examiner, who wished to get the baby's attention on something else, to merely put the toy on which his attention was centered out of sight behind her back or under a fold of her skirt, for the baby promptly ran around behind her or searched under her skirt until he found it. At 70 weeks Patty went to the couch and lifted S's coat, under which she had seen S hide a doll several minutes earlier.

Several of the test situations, notably those of pulling the string to get the tape and of putting the right block in the right hole in the form board without hesitation

or fumbling, indicated that the babies had discovered how things worked. There were other isolated examples from which it was clear that in the second year the babies were beginning to get a notion of how things were done in the household. Quentin at 78 weeks took a potlid from the cupboard and handed it to his grandmother when he saw her put a kettle of potatoes on the stove to cook. Walley at 76 weeks spilled a pitcher of cream on the kitchen floor while his mother was in the living room; when she came into the kitchen she found him on his hands and knees wiping up the mess with the bathtub mop cloth, which he had brought from the bathroom. James at 90 weeks had an accident on the bathroom floor while his family was at dinner and before they knew of it he had found a rag to wipe up the puddle. When Harvey was 2 years old, he and his parents spent an afternoon calling on some friends, who gave him a mamma doll to play with. Immediately upon getting home he went to his toy cupboard and, taking out his dolls one after another, tipped each trying to make it cry and expressed great disappointment when it did not.

Making reasonable explanations, excusing themselves, and rationalizing their own behavior began to appear in some babies soon after they were able to talk. At 2 years, in answer to his mother, who had suggested in the midst of his very interesting play, "Come on, dear, and go bye-bye with Mother," Harvey replied, "No! Too cold; Hahvey home." Fred and Winnie at 104 weeks saw a strange dog while they were at the drug store. When Fred approached it, the mother said, "Don't pat that dog, Freddie," and Winnie explained the admonition by saying, "That dog might bite." Although these few isolated incidents cannot be taken as

having scientific value in the sense of being typical or representative reactions of babies under 2 years, they do give the reader a notion of some of the capacities of babies, and they help to form a picture of developing intellect.

Self-help. — The fourth category of items seemingly related to intellect is that of self-help. The items from

TABLE XIX

AGE RANGES AND MEDIAN AGES FOR REACTIONS OF SELF-HELP AS REPORTED BY MOTHERS

REACTION	NO. OF CASES	AGE IN WEEKS	
		Range	Median
Avert head from light	14	3–10	5.5
Make defensive hand movement	10	3–13	7.5
Put object to mouth (usually hand)	21	9–20	15.0
Hold bottle	19	14–45	22.0
Hold out arms to be taken	20	14–37	25.0
Hold cup	19	26–46	38.0
Try to pull off clothes	18	32–47	38.5
Feed self with hands*	9	32–51	39.0
Try to put on clothes	14	33–49	40.5
Rub body with soap or towel	14	37–49	41.0
Pull plug out of bath	11	33–51	42.0
Examine hands if wet or sticky	11	32–49	40.0

* Many of the babies were not allowed to do this.

the mothers' records that are classified under this head are presented in Table XIX. Mothers' records on some of these items are scanty because some of the babies were not encouraged or allowed to eat with their hands or help in the bathing and dressing processes. Stockings were usually the articles of dress to be removed first by the babies. At 76 weeks Winnie put on her own stockings after her physical examination, and a few weeks later she helped Fred to put on his. During the second year the babies began to feed themselves with spoons.

At 86 weeks James's mother reported, "Jimmy feeds himself; he eats breakfast almost entirely alone. But we have to help him finish to keep his meals from overlapping." By 98 weeks this baby was also brushing his own teeth. Peter weaned himself of his bottle at the age of 76 weeks. The babies' efforts at self-help show that during the first two years they made considerable progress toward meeting the demands of life in an appropriate way.

Summary

Even though it was impossible to devise situations for testing the more abstract phases of the infant's mental life, such as his memory, understanding, powers of analysis and generalization, and his ability to appease his own wants, nevertheless a considerable body of facts was obtained from the mothers' reports and from incidental observations by the experimenters that make possible a more or less comprehensive description of the baby's mental processes and that may serve as leads for future investigations. Early in the first year these babies were able to recognize members of their family, strangers, and friends, and later they recognized familiar objects. The rudiments of memory of persons and events were present in these reactions. Comprehension of words and compliance to simple commands began to appear at about the age of 6 months and increased at a rapid rate in the last quarter of the first year. Comprehension preceded speech in development. The earliest efforts at self-help were shown in defense or protective reactions, and at about 6 months the babies began to take an active part in feeding themselves. Reactions of self-help in dressing, cleanliness, and bowel and bladder control, which are less vital to the baby than feeding, were slower to appear.

In the matter of generalizing from experience and of rationalizing or explaining conduct the writer sees few differences in kind or quality of reactions between babies and adults, although the differences in degree of response are obviously great. The term conditioning, applied to so much of the baby's learning, implies that the infant's processes of acquisition by experience are of a simpler nature than the learning, reasoning, and induction of adults. Until we have more evidence as to what takes place in the nervous system of both infants and adults when they acquire new reactions and until we have criteria for evaluating the simplicity or complexity of these reactions, it behooves us to remember that calling a baby's reaction "conditioned" in no sense analyzes or explains it.

PART II

THE PSYCHOLOGICAL EXAMINATIONS

CHAPTER VII

EARLY PHYSICAL-PSYCHOLOGICAL TESTS

In testing the babies from birth to 12 weeks it seemed best to combine the physical and psychological tests for several reasons: first, because the babies were too young and weak to undergo two fifteen-minute observations in succession; secondly, because their repertoire of acts was small, and most of their behavior had to be observed and recorded as it occurred spontaneously rather than as it was tested for; thirdly, because the overlapping of physical and psychological traits was particularly noticeable at this age; and finally, because during the first few weeks of the babies' adjustment to extra-uterine life physical data were probably of greater importance than psychological. Since the physical examination was a routine that involved various types of manipulation and stimulation of the baby, it was an easy matter to standardize the procedure so as to obtain psychological data at the same time.

MATERIAL AND METHOD

The Record Blanks

A form for the earliest daily examinations was therefore drawn up to include psychological as well as a few physical items that are symptoms of birth injury in addition to the usual physical reactions tested. The four-page folder was similar to that for the anthropometric measures[1] in that the physical items were

[1] See Volume I, page 199.

listed down the left-hand margin, and the remainder of the sheet was blocked off for recording behavior items. In addition to the blanks left for the name, date, hour, and birth date, space was provided in the heading for noting the baby's posture in the crib at the arrival of the examiners and for listing his clothes. The items contained in this record blank are listed in Appendix 2.

Procedure

Observation and eye coordination. — During the first minute of observation the examiners watched the baby in his crib and noted movements of arms or legs, chewing of fist, facial twitch or grimace, sucking movements, and other activities. Usually the babies were asleep during this period. The watching was continued for a second minute, during which the examiners conversed. The object of this test was to ascertain whether the sound of the human voice in any way influenced the baby's behavior. Respiration was taken during the next minute; for this B let her hand rest lightly on the baby's chest. The first real manipulation of the baby came at the end of this minute, when he was taken from his crib and placed on the examining table. Space was provided for checking any adjustment of head or shoulder muscles that the baby made. While B undressed the baby she dictated notes on skin color, conditions of the cord, vagina, and rectum. The baby was then watched for a minute while he lay undressed upon the table. During this minute eye-following reactions were tested by swinging a bright metal tapeline case horizontally in front of the baby's eyes.

Knee pinching. — B then gently pinched the skin of each knee to see whether the defense kick of the opposite foot described by Watson was present. The baby

was then turned on his stomach, and the turning of the head to free the nose and the lifting of the head or chest were noted.

Observation during the physical examination. — The condition of the eyes was noted while the baby lay on his back. Counting the heartbeats involved holding a stethoscope on the baby's chest, a stimulus that elicited interesting reactions. Swelling of the breast tissue was noted on a four-point scale. If milk could be expressed by gentle pressure the number of drops were counted. Muscle tone, turgor, and subcutaneous fat were estimated on a four-point scale, and the last was measured by lifting a fold of skin over the pectoral region at the junction of arm and shoulder and measuring it in millimeters with a caliper. By palpation the liver and spleen margins were found, and the costal angle was estimated as right, acute, or obtuse. The head was then felt for caput and overriding sutures, and the regional lymph nodes were palpated. Tracings of the fontanelle and the costal angle were made once a week by placing a thin piece of cambric over the area to be traced and outlining it in pencil. Ear examinations were discontinued when it was found that they greatly disturbed the baby, and mouth examinations were made only once a week.

Sounds and taste tests. — In case no loud noise occurred by accident during the examination, B made one at the end by banging the lid of her otoscope case. Taste tests were given once during the first week of life by moistening applicators with solutions of quinine, salt, sugar, acetic acid, and sugar, allowing the baby to suck each for a minute. Given in this order the taste of each article cancels the previous one; the final sugar was given in order to leave the baby with a pleasant taste in his mouth.

The physical examination as described is referred to in the schedule of examinations as the complete physical. In the daily or short physical examinations made at the hospital, percussion of the chest, fontanelle tracings, mouth examinations, and taste tests were omitted. The weekly physical and psychological examinations that were held in the homes were identical with the complete hospital examination except that the items denoting birth injury were gradually dropped and the swinging of the tape in vertical and circular directions was added.

At 13 weeks, when separate psychological examinations were begun, the physical examination blank was cut down to one sheet printed on both sides, and it included only the items on the physical examination proper, with the addition of a blood-pressure test and palpation of the epiphyses and head for signs of rickets. A behavior summary was written at the end of each examination.

The items on the early physical examinations that properly belong among the psychological observations are as follows:

A 1-minute observation of the baby in his crib under no stimulation

A 1-minute observation of the baby in his crib while the observers were talking

A 1-minute observation of the baby undressed on the table

Observation of the baby while his knees were being pinched

A 1-minute observation of the baby lying on his stomach

Eye coordination tested by a tape swung horizontally, vertically, and in a circle

Reaction to sounds

Reaction to taste

Reaction to having arms held at side

In addition to these items the incidental reactions that occurred during the counting of respiration, the heart rate, and other items of the physical examination were recorded and studied for their psychological significance.

DEVELOPMENT DURING THE HOSPITAL PERIOD

The examinations made during the hospital period will be discussed separately from the weekly examinations. Twenty-five babies in all underwent these repeated examinations. The number of babies examined each day was as follows:

Age in Days	No. of Babies	Age in Days	No. of Babies	
Under 24 hours	5	8	7	24
1	16	9	17	
2	17	10	6	20
3	24	11	14	
4	24	12	8	17
5	25	13	9	
6	21	14	1	
7	1			

The total number of babies were not examined on each day because one or two babies contracted impetigo and had to be taken to an isolation ward. Sometimes it happened that a baby was out of the nursery during the doctor's visit, either to be nursed or for a bathing demonstration, and consequently his examination was missed for that day. Most of the mothers left the hospital between the tenth and fourteenth days, and the daily examinations of the babies were not continued in the homes. This accounts for the decreased number of examinations toward the end of the second week.

Reactions Occurring Spontaneously during Observation Periods

The data obtained during the observation periods were classified into several types of reactions, and the frequency of each was tabulated by days. Since developmental trends did not appear in these reactions and since the table by days is long and cumbersome, only the summary for the entire hospital period will be included here (see Table XX).

In 68 per cent of the examinations the babies were sleeping in their cribs during the first minute of the examination, and only 2 per cent of them were aroused when the observers talked in conversational tones during the second minute.

Smiling and grimacing. — Facial mobility was a striking reaction during the hospital period; all but three babies exhibited it at one or more examinations, and it occurred in 40 per cent of the examinations without observable external stimulation. This facial mobility took two forms, smiling and grimacing. The smiling that occurred during this period looked exactly like the social smile, which developed later. The grimace sometimes consisted of a knitting of the brows in a frown; at other times it was a pucker of the mouth as if crying, or a general facial contortion that older children call a "funny face." Since most of these facial reactions occurred during sleep, they were probably reflex in character, but their appearance in a well-coordinated form makes it clear that the motor mechanism for such reactions is fully developed at birth. Many other reflexes such as yawning, grunting, stretching, sneezing, regurgitating, and hiccoughing were observed frequently. Yawning was often accompanied by stretching, as it is in the adult.

TABLE XX

FREQUENCIES OF REACTIONS MADE BY BABIES DURING 2 MINUTES OF OBSERVATION AND 1 MINUTE OF RESPIRATION IN THE TESTS GIVEN FROM BIRTH TO 14 DAYS

(Total Number of Examinations = 195)

REACTION	FREQUENCY OF OCCURRENCE					
	WHEN ASLEEP		WHEN AWAKE		TOTAL	
	No. of Cases	Per Cent	No. of Cases	Per Cent	No. of Cases	Per Cent
Reflex smile	20	10.2	4	2.2	24	12.3
Grimace	26	13.3	9	4.6	35	17.9
Grunt	10	5.1	6	3.1	16	8.2
Yawn	12	6.1	19	9.7	31	15.9
Stretch	41	2.1	20	10.2	61	31.2
Sneeze	3	1.5	6	3.1	9	4.6
Regurgitate	7	3.6	5	2.5	12	6.1
Hiccough	5	2.5	7	3.6	12	6.1
Suck	33	16.9	20	10.2	53	27.2
Chew	5	2.5	4	2.2	9	4.6
Grope with mouth	0	0.0	9	4.6	9	4.6
Chew fist	0	0.0	16	8.2	16	8.2
Take bottle	5	2.5	7	3.6	12	6.1
Jerk	26	13.3	4	2.2	30	15.3
Generalized tremor	5	2.5	6	3.1	11	5.6
Fluttering of eyelids	...	....	16	8.2	16	8.2
Squirm	63	32.1	17	8.7	80	41.0
Wave	3	1.5	25	12.8	28	14.3
Kick	3	1.5	21	10.7	24	12.3
Wave and kick	12	6.1	10	5.1	22	11.2
Push at doctor's hand or instrument	0	0.0	1	.6	1	.6
Random looking	...	....	21	10.8	21	10.8
Watch	...	....	4	2.2	4	2.2
Observers watching (First minute interval)	133	68.2	62	31.8	195	100.0
Observers talking (Second minute interval)	128	65.6	67	34.4	195	100.0

Mouth reactions. — Mouth reactions occurred in great variety. Sucking, in which only the lips and tongue moved, occurred oftenest; chewing differed from sucking in that the jaw also moved and there was some smacking of the lips. In mouth groping the mouth was open, and the head turned from side to side as if seeking the nipple. If the fist came within range, the mouth closed upon it, and sucking and smacking began. Sucking reactions occurred without relation to the situation.

Gross bodily movement. — Jerking, squirming, waving, kicking, and tremor constituted the gross bodily movements of the babies. The type of situation or stimulation had little or no effect upon the amount of stretching or squirming. Nineteen of the twenty-five babies now and then gave sudden jerks; these most frequently occurred at the end of the respiration period when the doctor removed her hand from the baby's chest, but they also occurred when the babies were lying quietly in their cribs, free from any outside stimulus that the observers could detect. Tremor was sometimes a generalized trembling of the limbs and sometimes only a trembling of the jaw, which often accompanied crying. A fluttering of the eyelids was noticed when the babies were just awaking.

Eye coordination was the most advanced reaction observed during this period. Frequently the babies looked around, and even at this early age one of them appeared to watch persons or objects.

Reactions Tested for Specifically

Pinching of knee. — Watson in his discussion of defense reactions present at birth says that if the inner surface of the baby's knee is pinched the opposite foot

is brought up "almost with the regularity seen in the frog reflex."[2]

In the present study this experiment was tried on practically every baby at each examination. A total of 130 of these tests, or 260 reactions, since the baby was pinched on both knees, was recorded. A great variety of responses were made to this situation. A sudden extension or kick of the same foot was very common; a flexion or withdrawal of the same leg also occurred; and a jerk of the body not infrequently accompanied the reaction. In summarizing the results only the fact that the baby reacted with the same or the opposite foot is tabulated, since the various kinds of reactions showed no consistent trends.

Table XXI indicates that in more than one-third of the cases the babies did not react at all to the pinching stimulus. The majority of those who reacted did so with the same leg. Less than one-fifth of them reacted with the opposite leg, and not all of these reacted in the manner described by Watson. Among these babies the reaction of pushing with the opposite foot seldom appeared. This may have been due in part to the fact that the pinch was only momentary in duration, whereas Watson apparently kept pinching until the baby did react in the expected way. The young baby is normally very active; his hands and feet are waving and kicking during most of his waking periods. If Watson prolonged his pinch for as long as a minute, it is hardly likely that his hand could escape being hit by one or the other of the baby's flying limbs.

Pushing with the arm, a defense reaction. — Another defense reaction somewhat similar to those described

[2] *Psychology from the Standpoint of the Behaviorist*, pp. 242–243.

by Watson was noted in about one-fourth of the examinations. When the doctor placed her stethoscope over the baby's heart, the baby gave a slight shrug of the left shoulder and drew in the left arm in a rotary movement so that its wrist or hand frequently touched

TABLE XXI

REACTIONS OF BABIES LESS THAN 2 WEEKS OLD TO THE PINCHING STIMULUS

STIMULUS AND REACTION	NO. OF CASES	PER CENT
Right knee pinched		
No reaction	49	37.6
Reaction with same leg	61	46.9
Reaction with opposite leg	16	12.3
Reaction with both legs	4	3.4
Total	130	100.2
Left knee pinched		
No reaction	46	35.4
Reaction with same leg	46	35.4
Reaction with opposite leg	29	22.2
Reaction with both legs	9	6.9
Total	130	99.9
Both knees pinched		
No reaction	95	36.4
Reaction with same leg	107	41.2
Reaction with opposite leg	45	17.6
Reaction with both legs	13	5.0
Total	260	100.2

B's stethoscope or her hand. Reactions of this sort were noted in all but three of the babies and in 48, or 26.4 per cent, of the 181 examinations.

Reactions in a prone position. — Three different reactions of the baby in a prone position were recorded — turning the head to the right or left, lifting the head so that the chin was free, and lifting the upper part of the

chest free from the table. At birth all the babies were able to turn the head far enough to free the nose for breathing. All but seven babies lifted the head and chin off the table at least momentarily during the first two weeks, but only a few were able to lift the chest. In general, those who did not lift the head were small or premature babies, with the exception of one who had a head injury. The percentages for each reaction tested within the first two weeks are: turn face right, 47.5; turn face left, 40.5; turn face, 88.0; lift head, chin free, 22.4; lift head, chest free, 6.5.

Eleven babies did some rolling and turning from the stomach onto the side during the hospital period. One 8-day-old baby was caught by the camera while he was rolling in such a manner.[3] It was not the larger or more mature babies who did this but rather the smaller or premature babies. The reason for this seems to lie in the fact that most babies, particularly the prematures, assumed the fetal position when they were placed face down on the table. This posture was called by the experimenters the "Mohammedan prayer" position. The babies' knees were drawn up under the abdomen, and the arms were usually flexed and held close to the side. So unstable was this posture that a stretching out of one leg and a slight push with the toes turned the baby completely onto his side. This posture was common during the hospital period and persisted for several weeks in the smaller babies. One baby, who was somewhat spastic during his first four or five days, could be lifted to his feet if a hand were placed at the back of his neck and shoulders. So firmly extended were his muscles that he could stand thus for a few moments supported only by the hand at the nape of his neck. Illustrations

[3] See Volume I, Plate 1, facing page 46.

and descriptions of these hospital postures are given in Volume I, pages 44–47.

Eye coordination. — The eyes were tested for pupillary light reflex and for coordination in following a bright moving object. The pupillary reflex was present in every baby the first time it was tested for. In all but one case this test was given some time between birth and 2 days. Since many of the babies kept their eyes closed the first day, and since a few had inflammation from the silver nitrate solution, the tests could not be given to all of the babies every day.

The eye-following reaction was noted in a few babies consistently from birth on, and in all but five it occurred at least once during the hospital period. Of course, napping or screaming on the part of the baby often prevented testing for his reaction. In more than one-fourth of the examinations the reactions were definitely negative, and in only 40 per cent did they seem to be positive. The following percentages were secured in the eye-following test: eyes closed, 13.9; followed light, 40.3; did not follow, 27.8; doubtful, 18.0. Nystagmus was noted only six times during the 129 examinations, and hemorrhage of the eyeball was observed in only one baby.

Reactions to sound. — Seven babies did not react at all to sounds, and no reaction whatever occurred in 61.5 per cent of the examinations. The usual reaction of the babies who did react was a blink, which occurred in 32.6 per cent of the tests; jerks occurred in 6.5 per cent; none of the babies showed any symptoms of fear at the sounds. Reactions to sounds were much less frequent and clear cut than Watson's reports had led us to expect.

Reactions to restraint of arms. — Another of Watson's

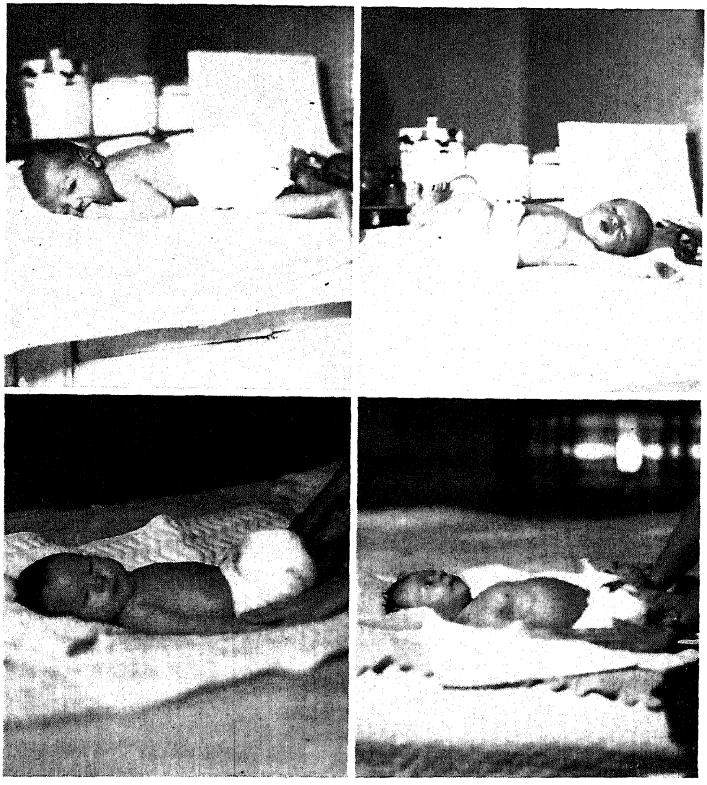


PLATE 4. — COMFORTABLY PLACID INFANTS

Above.—Behavior of the newborn: Quentin at 4 days. *Below.*—No opposition to restraint of arms: Fred (left) and Martin (right) at 7 weeks.

contentions that our data fail to support is that the young baby is enraged by restraint. Only nine babies fussed or screamed when their arms were held down at their sides; no reaction whatever occurred in 77 per cent of the tests; and only 18 per cent fussed or screamed. The remainder of the reactions to this test consisted of smiling, kicking, or grimacing. To be sure, the restraint was prolonged for only fifteen seconds, and the head movements were not restricted. Pratt, Nelson, and Sun (48), using the same interval of stimulation, also failed to get signs of rage from a large percentage of the babies.

Reaction to tastes. — Taste tests were given to fourteen of the babies within the first two weeks. The reactions to bitter, salt, and sour were almost without exception those of rejection, and the usual reaction to sweet was a contented sucking. The different reactions noted were: turning of the head from side to side, screwing of the face or making a wry face, crying or fussing, pushing the applicator out of the mouth with the tongue or slashing the arms so that they hit the applicator and knocked it out, and finally, contentedly sucking. The frequency of each reaction in fourteen cases is presented in Table XXII.

TABLE XXII

FREQUENCY OF DIFFERENT REACTIONS TO TASTES OF FOURTEEN BABIES

REACTION	BITTER	SALT	SOUR	SWEET
Turn head	0	2	3	1
Screw face	14	12	12	7
Cry or fuss	4	5	4	1
Spit or push out applicator with tongue	6	4	4	0
Knock out applicator with arms	1	2	2	0
Suck	5	5	5	12

The bitter taste caused all babies to make a face; salt and sour elicited grimaces from all but two; and crying was common in all three of these tests. Seven babies screwed up their faces, and one fussed at the sugar water, but these reactions usually occurred when the sugar was first given and before the solution had actually moistened the baby's tongue. Some babies kept their lips tightly closed after the first taste, and their mouths had to be pried open gently in order to put in the next applicator. The sucking reaction with which five babies responded to the bitter, salt, and sour tests was usually discontinued soon. It was noted, however, that one baby sucked contentedly on the bitter applicator, although he cried at it; the same baby sucked vigorously on the salt, though he fussed and screwed his face; and a second sucked contentedly on the acid. All but two babies sucked contentedly on the sugar solution.

It is interesting to note that during the first two weeks of testing a few babies were able to slash with their hands skillfully enough to knock away the applicator stick. Since this reaction is somewhat advanced and unusual, the complete record of one baby will be copied. This baby was postmature at birth, and the reaction of reaching for objects was observed in him at the early age of 11 weeks.

WALLEY, aged 4 days.

Bitter. — Made a face when applicator was put in mouth; waved left arm and pushed it out. Doctor put it in again. Pushed it out again in same way after sucking it for 25 seconds. Cried.

Salt. — Made a face. Chewed it 10 seconds. Cried; made a face; chewed it till 45 seconds, then hit applicator with right arm and knocked it out of mouth.

Sour. — Made a face; squirmed; fussed at 20 seconds; sucked; made face and cried at 40 seconds.

Sweet. — Made a slight face, then sucked slowly for the rest of the minute. No waving of hands.

These results agree with those of Pratt, Nelson, and Sun in indicating that the sense of taste is highly developed at birth.

Summary

The reactions that were present at birth or appeared shortly thereafter may be classified under two heads, reactions that occurred spontaneously and reactions that occurred in response to stimulation. Many reactions under both heads were reflex in character; others were pattern responses of a complex type.

Reactions that occurred spontaneously. — The following reflexes or pattern responses are apparently present at birth:

Yawning
Stretching
Sneezing
Hiccoughing
Sucking nipple or fist, or merely sucking movements
Chewing or chewing fist
Groping with mouth
Smiling (usually occurring during sleep)
Grimacing (wrinkling brow, puckering mouth)
Grunting and vocalized yawning
Crying

Under the heading of general body activity these reactions may be listed:

Squirming
Waving and kicking, often accompanied by screaming
Jerking or twitching
Generalized tremor

Tremor of the chin, which usually occurred when the baby was screaming

Fluttering of eyelids, which occurred when the baby was awaking

Reactions that occurred in response to stimulation. — The following responses may be termed defense or protection reactions:

Turning head to free nose when lying with face down (All babies exhibited this reaction at birth.)

Defense kick with the same or opposite foot, or with both feet when the knee was pinched (Although this reaction was seldom noted in the form described by Watson, some reaction was obtained in 63.6 per cent of the cases.)

Shoulder shrug and arm push at an instrument placed on the chest (This reaction was noted in 26.4 per cent of the examinations.)

Thrusting an offending substance from the mouth with the tongue; spitting and spewing out of the mouth

The reactions denoting motor development are as follows:

Turning the head

Lifting the chin or chest from the table when lying with face down

The following reactions denote sensory development:

Following a light or object with the eyes (noted in nineteen out of twenty-four babies some time during the first two weeks)

Blinking at sound (noted in seventeen out of twenty-four babies some time during the first two weeks)

Spitting out salt, sour, and bitter substances, and sucking sweet substance

Development occurring during the first two weeks. — The first two weeks of life saw marked changes in the

baby's general behavior. The reduced activity occasioned by the shock of birth lasted from 24 to 48 hours. The baby's eyes were usually closed, and he seemed to sleep most of the time. This period gradually gave way to a period of greater random activity and somewhat longer periods of wakefulness. The babies who were born limp gradually developed muscle tone, and the babies who were spastic at first gradually became less tense. The babies cried more at examinations during the 2nd week and reached their peak of irritability at 14 days. In short, they ceased to be passive animals and became active ones at some time during the hospital period.

Development of specific abilities and capacities could be observed during the first two weeks, but it was extremely difficult to record it in objective terms. Eye coordination in following an object was somewhat better at the end of the 2nd than during the 1st week. The babies lifted their chins when they were lying on their stomachs more frequently during the 2nd than during the 1st week, and they began to turn their heads from side to side or lift them repeatedly during the minute interval. In the main, however, development was less apparent in specific capacities than in general activity and conduct.

DEVELOPMENT FROM 3 TO 11 WEEKS

Item by Item Analysis

The percentage of babies exhibiting different reactions between the ages of 3 and 11 weeks is summarized in Table XXIII. The figures for the hospital period are repeated for comparison. It will be noted that sleeping during the first and second minute of the

TABLE XXIII

PERCENTAGES OF BABIES SHOWING DIFFERENT REACTIONS UP TO 11 WEEKS

REACTION	ALL HOSPITAL TESTS	AGE IN WEEKS					
		3	5	7	9	10	11
First minute of observation							
Asleep	68.0	52.0	40.0	34.7	22.8	19.2	31.8
Look around	10.8	12.0	15.0	4.3	4.5	7.7	4.5
Watch examiners	2.2	8.0	25.0	30.4	45.5	54.0	22.8
Smile	0.0	0.0	5.0	0.0	4.5	7.7	4.5
Second minute of observation							
Asleep	65.6	44.0	25.0	30.4	18.2	15.4	22.8
Look around	10.8	12.0	15.0	4.3	0.0	7.7	4.5
Watch examiners	2.2	8.0	25.0	30.4	50.0	50.0	18.2
Smile	0.0	0.0	5.0	0.0	9.1	7.7	22.8
One-minute test while baby was on back							
Asleep	....	17.0	0.0	0.0	0.0	0.0	0.0
Look around	....	25.0	15.0	13.0	0.0	0.0	0.0
Watch examiners	....	15.0	45.0	56.5	77.0	81.0	77.0
Smile	....	0.0	0.0	0.0	0.0	3.8	4.5
One-minute test while baby was on stomach							
Turn head	88.0	76.0	80.0	65.3	59.0	54.0	31.8
Lift chin	22.4	32.0	30.0	34.8	40.9	23.0	13.6
Lift chest	6.5	12.0	35.0	30.4	31.8	54.0	54.5
Follow object horizontally	40.3	32.0	60.0	74.4	77.0	77.0	77.0
Follow object vertically	0.0	0.0	5.0	39.1	54.5	42.5	50.0
Follow object in circle	0.0	0.0	0.0	26.0	36.2	38.4	50.0
Push at heart or fat	26.4	8.0	15.0	8.7	9.1	7.7	9.1
Total number of babies examined	24	25	20	23	22	26	22

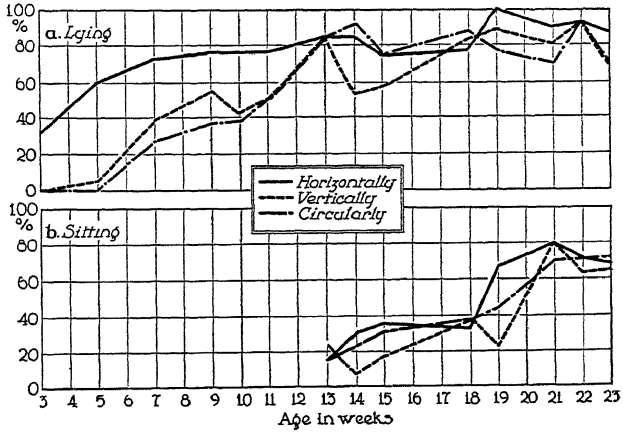
examination became less common as the babies grew older. The percentage of random looking remained about the same, but that of definite watching of the examiners gradually increased. The reaction of smiling at persons did not appear before 5 weeks but remained

about the same in frequency for the rest of the period tabulated. When the babies were lifted from their cribs and placed on their backs on a table, they were more alert and watched objects more consistently.

The babies' reaction of turning their heads to free their noses when they were lying prone became a less frequent reaction only because lifting their chins and chests and propping themselves on their hands became

FIGURE 5

REACTIONS TO THE SWINGING TAPE



more common. The arm push at percussion of the chest was no more frequent during this period than it was during the hospital period.

The eye-coordination reactions recorded when the babies were lying on their backs showed very consistent development during this period. For the most part the curves of eye-following reactions connect fairly well with the curves from 13 weeks on (see Figure 5). Since the number of cases on which each percentage was

based is small, very little reliance should be placed on the accuracy of the percentages. Throughout the whole series, however, 237 tests were made with the tape swinging horizontally, and about the same number were made with the tape swinging in the other two directions. This number corresponds very well with that on which Jones's norms for the same reactions are based. Fifty per cent of the babies were able to follow the tape in the horizontal direction at 4½ weeks, in the vertical at 9 weeks, and in the circular direction at 10 weeks. The horizontal coordination was obtained at an earlier age than that found by Jones (27), but coordination in the other two directions appeared at the same age for these babies as Jones reported for her babies, who were tested in the sitting posture. Coordination in the sitting posture occurred between the 18th and 20th weeks among the babies of this group.

Point Scale for Scoring the Test

After this early physical and psychological test had been studied item by item to determine the course of development of the traits discussed above, an attempt was made to score it by a point system. The items were scored according to the following rules:

Reaction	No. of Points	Total Possible Points
Baby lying prone		
Turn head to right or left	1	
Lift chin from table	2	
Lift chest from table	3	4
Keep chest up for 1 minute	4	
Eye coordination		
Look at tape	1	
Follow tape horizontally	2	
Follow tape vertically	2	6
Follow tape in a circle	2	

Reaction	No. of Points	Total Possible Points
Watching persons or objects other than tape		
Watch persons one or two times	2	
Watch persons repeatedly throughout examination	3	6
Watch object one or two times	2	
Watch object repeatedly throughout examination	3	
Reaching		
Random grasp of object	1	
Finger object	3	6
Reach and grasp object	6	
Smiling		
Reflex smile	1	
Smile once at person	2	3
Smile repeatedly at person	3	
Vocalization		
Grunt vocalization	1	
Syllabic vocalization	2	5
Vocalization in singing notes	2	
Total		30

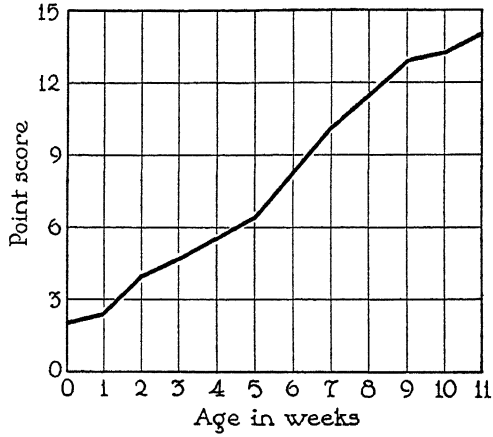
The total number of points scored on each examination was recorded and the average and median scores were computed for each age level. In order to intercorrelate scores at different age levels, occasional interpolations were made for the examinations that were missed. In all the 144 scores only 17 were interpolated. Only actual scores were used in the averages and medians; interpolated scores were used merely for the correlations.

The average and median scores are shown in Figure 6. Although little progress took place during the first two weeks, development after that period proceeded at a rapid rate, according to the curve of the scores. The average score was only about half of the total possible score at the time the test was discontinued. This does not mean that the test was discontinued too early for

the babies to have reached their full capacity on it, but rather that there were too many incidental items that showed enough of a developmental trend to be included in the point score. Furthermore, the items on which development was not yet complete were put

FIGURE 6

AVERAGE POINT SCORES ON THE PHYSICAL-PSYCHOLOGICAL EXAMINATIONS



into the next developmental test. Since consistent progress was shown by the use of this scoring system, its use is justified even though it is a crude measuring scale. Intercorrelations between scores at different ages are given in Table XXIV. The correlations are in general positive, but they do not indicate a very high degree of consistency from age to age.

SUMMARY

The chief function developed almost to perfection during the first twelve weeks was that of eye coordina-

TABLE XXIV

INTERCORRELATIONS BETWEEN PSYCHOLOGICAL EXAMINATIONS OF BABIES FROM 3 TO 11 WEEKS, INCLUDING INTERPOLATED SCORES*

AGE IN WEEKS	AGE IN WEEKS				
	5	7	9	10	11
3	.32	.25	.02	−.16	.02
5		.40	.15	.44	.20
7			.33	.50	.55
9				.23	.26
10					.69

* The correlation between the total scores from 3 to 11 weeks and the scores on the developmental tests at 23 weeks equals .42.

tion. The 12-week-old baby watched persons and objects and smiled at them. Gross motor development proceeded far enough for the baby to lift his chest from the table and sustain his weight in this position for a minute. Reaching, grasping, and prehension were just beginning to develop at the end of this testing period.

Average scores on the entire test show that development proceeded at a rapid rate throughout this period. The status of a baby at any given week had little value in predicting his status in future weeks when the test was repeated, or at still later times when examinations of different types were used.

CHAPTER VIII

TESTS OF DEVELOPMENT

The tests of development, which were given between the ages of 3 and 6 months, with a repetition at 9 months, consisted almost entirely of tests of reaching. During this age period reaching and grasping reactions developed and became perfected almost to the exclusion of development in other channels. It therefore seemed hardly worth while to test for other traits. Variety was given to the reaching tests by using several different toys, each of which could be manipulated and exploited in its own particular way. The baby's attention and apparent interest in the toys furnished additional information on his development. The examination was supplemented with the motor tests that regularly accompanied each psychological examination.

MATERIAL AND METHOD

The top headings of the record blank for this examination were revised to include a wider range of response in the columns formerly devoted to crying, to expand the column for vocalization, and to leave more space for written notes. This revised heading was also used for the abbreviated physical examination sheets (see Appendix 3).

Reaching Tests: Lying Posture

The baby's occupation instead of his posture in the crib at the time of the examiners' arrival was recorded

together with the general information for the test. The examiners approached the baby smiling and talking, and they noted and recorded his initial response to them.

Caliper-reaching test. — The baby was laid on the bed or table, or occasionally left in his crib, and B held out to him the pair of bow calipers during a 2-minute interval. S watched the baby and noted with a stop watch the number of seconds before the baby's attention was fixed, the time that elapsed before he reached, touched, or grasped the object, the hand with which he reached and the number of seconds he retained the calipers, whether or not he pulled them to his mouth, and whether his thumb opposition was complete, partial, or absent. Distraction of the baby's attention was also noted. It might be remarked here that during the early administrations of this test, i.e., from 13 to 18 weeks, S was able to observe and record practically all the items listed, but as the babies became more accurate of aim in reaching and more clever at manipulation, attention, reaching, touching, and grasping were almost simultaneous, and it was only possible to "hit the high spots" in the record-taking.

Eye coordination. — The reaching test was followed by an eye-coordination test in which B swung the tape for 30 seconds in each of the three directions — horizontal, vertical, and circular. S recorded whether the baby followed the tape with head alone, with eyes alone, or with both, and whether he reached for it or grasped it. The 2-minute interval was completed by a 30-second interval in which the dangling tape was suspended within easy range of the baby's hands. This was done in order to show whether, having failed to grasp the object when it was in motion, the baby could get it when

it was hanging still. During each interval S recorded whether the baby's attention to the tape was sustained or intermittent.

Threat at eyes. — In the hand and pencil threat B made a feint as if to strike the baby's face. This was done three times in rapid succession with both hand and pencil. S recorded 0 in 3, 1 in 3, 2 in 3, or 3 in 3, according to the number of times the baby blinked.

Paper test. — B next offered the baby a sheet of thin yellow paper such as is commonly used for making carbon copies. The paper was held so that it did not touch the baby's face or hands, but was within easy reach, and so that it obstructed his vision. This test lasted one minute.

Adjustment for being lifted. — B then held out her arms to take the baby and said "Come"; after waiting five seconds she lifted the baby onto her lap and dictated to S whether the baby made an anticipatory motor adjustment. This test was given twice more during the course of the examination but only at a time when the baby was lying on his back and when B could take him and hold him for a moment.

Reaching Tests: Sitting Posture

Postural control. — B seated the baby on her lap facing straight forward with his back leaning against her abdomen. During the examination she estimated the amount of support he needed by describing where she had to place her hands to keep him sitting erect. The terms used were "arm pits," "middle ribs," "lower ribs," "abdomen," and "hips." The lower her hands were placed the greater the baby's postural control. Head steadiness was rated on a three-point scale as none, partial, or complete.

Repetition of caliper and paper tests. — While the baby was seated on B's lap, the caliper-reaching test, the tape-swinging test, and the paper test were repeated in exactly the same way as they had been given while the baby was lying down. B supported the baby with one hand and held the instrument with the other.

Bell. — Additional tests with the bell and tape were made. B held a small hand bell at arm's length, out of the baby's reaching range, for one minute. The object of the test was to discover whether the baby would misjudge the distance of the toy and would make any effort to get it. The bell was then brought within eight inches of the baby's face and held there in easy range for one minute.

Tape on box tray. — For the next test a flat surface was improvised by B's holding the tray from the instrument case bottom-side up on the baby's lap. The tray was covered with a glazed cotton fabric such as is commonly used to line cheap traveling cases. Since it was held bottom-side up, it had no rim to prevent the tape from sliding off. The tape was laid on this smooth surface, and the baby was allowed to reach for it for one minute. If, in reaching, the baby pushed the tape onto the floor or far out of range, S put the tape back into its original position.

Bell on box tray. — During the next minute the bell was put on the box tray; for both these tests the direction of the baby's attention and the time elapsing before the baby reached for and grasped the object were recorded.

The last two items in the examination aimed to test the baby's gross motor control. The walking test, in which the baby was held erect for the minute interval and allowed to pat his feet or walk down a strip of

paper, and the creeping test, in which the baby was placed on his stomach on the floor, have been described in Volume I, pages 42–52, 59–71.

RESULTS

Caliper-Reaching Test

Types of reactions. — The reactions made by the infants to the caliper-reaching tests were: reaching and missing, reaching and touching, grasping and not holding, grasping and retaining, holding and manipulating, and holding and manipulating with one hand only. It was assumed that the reactions in the order listed represented a graded scale of difficulty. On the original record sheets reaching and touching were not recorded when a more complex reaction such as grasping or manipulating occurred, since the latter implied the former. Retention was recorded only when the baby clung to the calipers for thirty seconds or longer. Manipulation of the calipers consisted of turning the instrument or pulling the bows apart and pushing them together with a click. Putting the calipers to the mouth was not included under this head. Transferring the instrument from one hand to the other or jerking or pulling it with one hand only was called manipulation with one hand. Thumb opposition and drawing the calipers to the mouth were also recorded.

Description of development. — At the earliest examinations the babies did little more than look at the instrument and make waving motions in its direction. If they touched it they fingered it slightly or their fingers curled around it in a random grasp. They caught the projecting straight arm more frequently than the bow of the calipers. But at best reaching was a trial and

error process, and grasping was usually attributable to lucky chance rather than to good aim. At the later ages reaching and grasping became almost simultaneous actions, and thumb opposition occurred frequently; at this stage the instrument was promptly pulled to the mouth and chewed. Still later, skill in handling the calipers became greater, and the babies brandished them about or examined them with care, touching the points with the index finger. In almost no instance did a 6-months-old baby play with the calipers so skillfully that B dared to release her grasp on the handle and allow the baby to manipulate the instrument without help, but by 38 weeks all the babies were able to handle the "toy" alone without courting a black eye or a pinched finger.

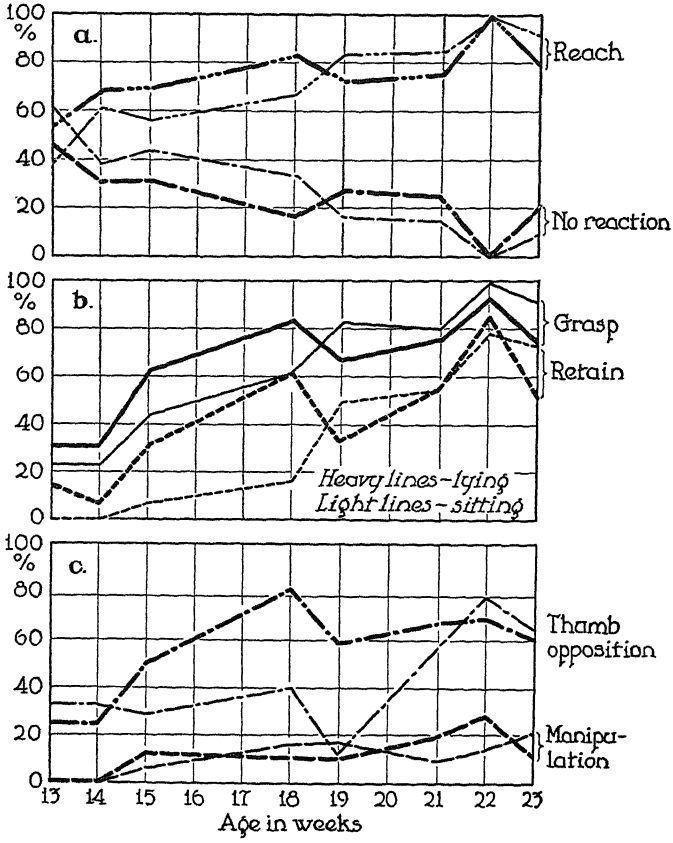
Although progress in the reaching function may be fundamentally gradual, on the surface it appeared to be sudden. To the examiners and to the mothers it seemed that most of the babies loafed along on a plateau of development for several weeks and then suddenly, with no apparent period of practice intervening, climbed the next step and performed on a totally different level of development. Frequently, upon seeing a baby reach and grasp an object with skill for the first time, the examiners were led to exclaim, "Why, that baby never tried to reach before. Now he does it well." The sudden sharp rise in the curves between the 19th and 21st weeks substantiates the observation (see Figure 7).[1]

Development in terms of the percentage of babies reacting. — Development, as has been described, may be seen very clearly by the observer, but it cannot be stated

[1] See the discussion of suddenness of locomotor development in Volume I, pages 166–181.

FIGURE 7

REACTIONS TO THE CALIPERS



in quantitative terms. In order to obtain some numerical measure of development, the percentage of babies displaying each reaction was computed for each age level. Figure 7 presents the cumulative percentages for each reaction; that is, the percentage listed under reach-

ing represents the number of babies who reached plus those who touched, those who grasped, and those who retained.

From a glance at the curves it is obvious that in their progress toward the goal of reaching the babies had their ups and downs, but on the whole they maintained a fairly steady upward course. Indifference to the object, as shown by the percentage of babies who made no reaction, decreased week by week, and the curves denoting reactions climbed correspondingly. The curves for reaching the object start fairly high, a fact that indicates that some of the babies had developed this reaction before the test was begun. Reaching was seldom recorded except when the object was touched, because it was almost impossible to differentiate between a reach that missed and random waving. Consequently, the percentages for the reaching and touching reactions are almost identical. The rapid ascent in the curves of grasping and retaining indicates that this age period saw the beginning and the perfecting of these reactions. Manipulation was beyond the powers of all the babies during the early weeks, and it showed only slight development from 3 to 6 months.

Grasping and retaining the calipers when in a sitting posture developed somewhat later than the same reactions when lying down. By 18 weeks, however, a few babies had begun to grasp and retain the calipers when in a sitting position, and by 19 weeks 50 per cent of them had achieved this degree of skill. It will be noted that at the 19th week the percentage of those retaining the calipers while in a sitting position exceeded the percentage of those retaining them while lying down. The "sitting" curves for grasping, touching, and reaching also crossed the respective "lying" curves at this

age, but this came about only because they represented cumulative percentages and generally "followed the leader," which at this point was the curve for retaining. But the "sitting" curve of "no reaction" likewise crossed the "lying" curve at 19 weeks. This crossing of the curves seems not to be a mere matter of chance. It had seemed to the observers that in the early weeks of the test the babies were more alert when they were lying but that later they were more active and interested when they were in the sitting posture. The data confirmed their impressions on this point and indicated that coordinated reaching in the sitting posture was achieved by these babies at 19 weeks.

Handedness. — The percentage of reactions was computed for each hand separately. In the lying posture very little preference was shown for the right or left hand in touching, grasping, or retaining. Both hands were used in a much larger number of the reactions than was either hand alone. In the sitting posture grasping, retaining, and manipulating with both hands was also the rule, but when only one hand was used there seemed to be a slightly greater preference for the right. It seems likely, however, that at the time when skill in the use of the hands is just beginning to develop the babies are ambidextrous. Only after some degree of skill is acquired with both hands does specialization begin.

Thumb opposition. — During the caliper tests the thumb opposition of the babies who grasped was recorded on a three-point scale as none, partial, or complete. The "lying" curve of thumb opposition, like that of retaining the calipers, rose somewhat slowly, and the babies showed a fairly steady progress throughout the entire period. The "sitting" curve of complete thumb opposition rose suddenly from a plateau level it had

maintained from 13 to 19 weeks to the 75 per cent level at 21 weeks. It was not mere coincidence that high proficiency in retaining the calipers and in thumb opposition were reached at the same age, 21 weeks. The relation between thumb opposition and retention was very nearly one of cause and effect. To cling to the calipers for more than thirty seconds with the curved fingers alone was awkward and difficult, and to draw the instrument to the mouth or manipulate it in any way was almost impossible. With the thumb opposing the fingers, however, retention and manipulation easily became the next steps in the exploitation of the object.

Drawing calipers to the mouth. — There was one act of the babies that occurred frequently within the age limits of this examination, one that neither declined nor increased in frequency with age — the reaction of drawing the calipers to the mouth and tasting or chewing them. The striking thing about the graph for this reaction is that the "lying" curve rises and falls very regularly with the "sitting" curve. In other words, if the baby tasted the calipers when they were offered to him while he was lying down, he did so again when he was sitting. It seems, therefore, that whether or not the baby elected to supplement his diet with the steel instrument was a matter dependent wholly upon his mood or whim at the test rather than upon any underlying developmental scheme.

Development in terms of time required for reacting. — The average time that elapsed before the calipers were grasped tells practically the same story as the percentage graphs. The difference in speed of grasping while lying down and that while sitting is noteworthy. Up to 19 weeks the babies obtained the calipers more promptly when they were in the lying posture, but from

this age on their speed was greater when they were sitting. There was little superiority of the right hand over the left in speed of reaching, a result that confirms the theory that grasping rather than handedness was the function developing at this time. The average time in seconds during which the calipers were retained again indicated that skill in the lying posture was much greater than that in the sitting posture up to the 18th week, but that after this time there was very little difference.

Distractions. — Reactions other than those to the calipers were tabulated separately under the head of distractions. The data for these reactions are given in Table XXV. Striking differences existed between the babies who did not reach for the calipers and those who did. Considerably more than half the babies who did not reach for them were distracted in one way or another, but since the number in the non-reaching group was few, particularly at the higher ages, little significance can be attached to the exact percentage. A large number of babies who did reach were also distracted, the percentages being 40 per cent no distraction and 60 per cent distraction. The percentage of infants who were distracted and who did not reach decreased somewhat with age, and this inverse relation was slightly more apparent in the sitting posture than in the lying posture. The percentage of those who reached in spite of being distracted bore very little relation to age.

Screaming would seem a priori to be the most violent of the distractions, but it did not prevent reaching as completely as one might suppose. The fact that some babies did reach and grasp even though they were screaming may have been due in part to the greater

TABLE XXV

Percentages of Babies Distracted at Caliper-Reaching Test

Reaction	Lying Posture									Sitting Posture								
	Age in Weeks									Age in Weeks								
	13	14	15	18	19	21	22	23	38	13	14	15	18	19	21	22	23	38
Babies not reacting																		
No distraction	7.7	15.4	0.0	0.0	5.5	0.0	0.0	0.0	0.0	15.4	7.7	0.0	0.0	5.5	5.0	0.0	0.0	0.0
Scream	7.7	0.0	6.3	5.9	0.0	5.0	0.0	0.0	0.0	0.0	7.7	0.0	5.9	0.0	5.0	0.0	0.0	0.0
Look around	0.0	7.7	6.3	0.0	11.0	0.0	0.0	4.5	0.0	38.5	23.1	31.2	22.8	11.0	0.0	0.0	4.5	0.0
Total	38.5	15.4	31.3	17.7	22.0	25.0	0.0	18.0	4.3	46.2	30.8	43.7	29.5	11.0	10.0	0.0	9.0	4.3
Percentage based on those not reacting																		
No distraction	16.6	50.0	20.0	0.0	20.0	0.0	0.0	0.0	0.0	25.0	20.0	0.0	0.0	33.3	33.3	0.0	0.0	0.0
Distraction	83.3	50.0	80.0	100.0	80.0	100.0	0.0	100.0	100.0	75.0	80.0	100.0	100.0	66.6	66.6	0.0	100.0	100.0
Babies reacting																		
No distraction	23.1	15.4	25.0	47.2	33.3	30.0	50.0	34.0	83.1	15.4	23.1	18.7	29.5	44.4	40.0	63.9	40.5	83.1
Scream	0.0	7.7	6.3	0.0	0.0	0.0	0.0	13.5	0.0	0.0	0.0	6.3	0.0	0.0	0.0	7.1	4.5	0.0
Look around	7.7	7.7	6.3	17.7	22.0	5.0	0.0	4.5	8.6	7.7	38.5	25.0	29.9	11.0	20.0	14.2	13.5	4.3
Total	30.8	49.9	43.8	35.4	38.5	45.0	50.0	45.0	21.5	22.1	38.5	37.5	41.3	36.6	45.0	35.5	49.5	17.2
Percentage based on those reacting																		
No distraction	42.6	22.2	36.4	42.8	46.2	40.0	50.0	45.0	77.5	40.0	37.5	33.3	41.6	53.5	47.2	63.9	45.0	82.0
Distraction	56.8	77.8	63.6	57.2	53.9	60.0	50.0	55.0	22.5	60.0	62.5	66.6	58.3	46.6	53.1	35.5	55.0	18.0

slashing and random waving of their arms, which caused their hands to come into contact with the calipers by accident. Naturally the observer found it difficult to judge whether or not the reaction under such circumstances was "purposive" reaching, but just as often it was equally difficult to decide whether the quiet and docile baby made an intentional reach or merely a lucky grab. Such errors of judgment were roughly equated by taking all reactions at their face value rather than modifying them by subjective judgment. Fussing and screaming, then, seemed to be less important distractions than watching persons and looking around.

After the above remark on subjective judgment, it may be questioned whether the observer was justified in discriminating between watching and looking around. Subjective judgment did enter into the record-taking to some extent, but the terms "random looking," "looking around," and "watching" designated three different types of behavior that may be described more or less objectively. "Random looking" was a roving of the eyes or a vacant stare into space. In "watching" the baby's eyes were fixed for several seconds on a person or object; if the person or object moved, the baby's eyes followed it. "Looking around" differed from random looking in that the baby seemed to survey the whole room and turned head and eyes to catch new glimpses and get new angles of view. The baby appeared to be making the same sort of orientation that the adult would make upon entering a new room for the first time. This type of looking around was particularly noted during the first few examinations when the babies were seated on B's lap. The sitting posture allowed the baby to view an entirely new world of objects. Only walls and ceiling, chandeliers, the tops of bureaus

and cabinets, and the faces and hands of people were visible to the baby lying in his crib. When he was propped in a sitting position, chairs, tables, beds, rugs, and interesting corners of rooms, as well as the trunks, legs, and feet of persons came into view. The baby's interest in these new objects was very apparent.

For the babies who did not reach when lying down the watching and looking distractions were about equally divided between looking around and watching the examiners. The chief distraction for these babies was that of watching B, because B held the calipers and stood looking down at the baby throughout the test. Watching S, the mother, or an older child and looking around were all minor distractions of the non-reaching group of babies.

Looking around was by far the most important distraction for all the babies in the sitting posture, and for those who did not reach this seemed to be a serious distraction. At 19 weeks the percentage of babies who looked around suddenly dropped, both in the reaching and the non-reaching groups. This sudden decrease in exploratory looking in the sitting posture is coincident with the crossing of the "lying" and "sitting" curves for grasping and retaining the calipers. Apparently the babies had become accustomed to their new visual environment by 19 weeks and were ready to settle down to the business at hand.

An interest in seeing objects at a new angle, rather than a difficulty in holding the trunk upright, seemed to be the factor that prevented the babies from reaching during the first few weeks of this test. Some of the babies, to be sure, both looked around and reached from the first, but even they became less interested in the visual environment at 19 weeks. Another fact that may

in part account for the greater proficiency in reaching in a sitting posture at the later ages is that the "lying" test was the first test of the series, and the babies were perhaps not yet warmed up to their task. The "sitting" test with the calipers came about five minutes later, at the peak of the baby's responsiveness and cooperation. It will be noticed also that among the babies who reached attention proceeded from the general to the particular. The curve for "no distraction," which implies attention to the object, increased at the later ages.

Summary. — The results indicated by the caliper test are as follows:

1. Reactions of reaching and touching were practically established at 15 weeks.

2. Grasping was practically established at 18 weeks.

3. Skill in retaining the object and in manipulating it increased throughout the entire period of the test.

4. Initial skill in reaching, touching, grasping, and retaining was less in the sitting posture than in the lying posture, but progress was more rapid in the sitting posture, and a plateau in the skill of reaching was not attained so early in the sitting posture.

5. Indifference to the calipers as expressed by "no reaction" decreased with age for babies in both the lying and sitting postures.

6. By 19 weeks the skill in grasping while sitting had reached and surpassed that of grasping while lying down.

7. The time required to grasp the calipers also decreased with age, and the babies eventually attained the object more quickly when they were sitting than when they were lying down.

8. The length of time the calipers were retained increased with age, and the increase was more sudden for

babies in the sitting posture than for those in the lying posture.

9. When the babies were in the sitting posture, the cross beam of the calipers was somewhat more easily grasped than the bow.

10. Most children first grasped between the ages of 15 and 18 weeks in the lying posture, and between the ages of 18 and 19 weeks in the sitting posture.

11. By 23 weeks the babies' skill in grasping was the same in both lying and sitting postures.

12. The chief distraction of the babies when they were sitting was looking around. Looking around was probably a voluntary exploration of their visual environment, which was much different from the visual environment when they were lying in the crib or on the bed, and it is likely that this exploration explains the lack of proficiency in reaching and grasping that was noticed in the early "sitting" tests.

13. The development of thumb opposition coincided very closely with the development of retention of the calipers. The relationship is probably one of cause and effect.

14. The reaction of drawing the calipers to the mouth neither developed nor relapsed during the age period studied. Since the percentages for chewing the calipers while in a lying and in a sitting position follow each other fairly closely, it would seem that the whim or mood or internal stimulus that prompted the chewing of the calipers persisted throughout the examination.

Tape-Swinging Test

Description of development. — In the tape-swinging almost perfect eye coordination in each direction was established by 11 weeks (see Figure 5, page 129). Reach-

ing for the object was a more difficult matter. The babies usually made some waving motion toward the tape if they watched it at all, but they did not reach persistently during the earlier ages. Although the eye-following reaction was easier when the tape was swinging in a horizontal direction, reaching and grasping was easier when the tape was swinging vertically or in a circle, for the baby simply extended his arm straight out and caught the tape as it went by. It was easier to catch the tape by the line than by the case. When the tape was obtained, it was almost invariably carried to the mouth and chewed for the remainder of the thirty-second interval.

Development in terms of the percentage of babies reacting. — Curves for the eye-following reactions accompanying the swinging of the tape in each direction are given in Figure 5. The contrast between the babies' proficiency in the lying and in the sitting postures during the early weeks was even more marked in the tape test than in the caliper test, but there was also the similarity that skill in the sitting posture was acquired so rapidly that during the later weeks the infants reacted with as great or even greater frequency when they were sitting than when they were lying.

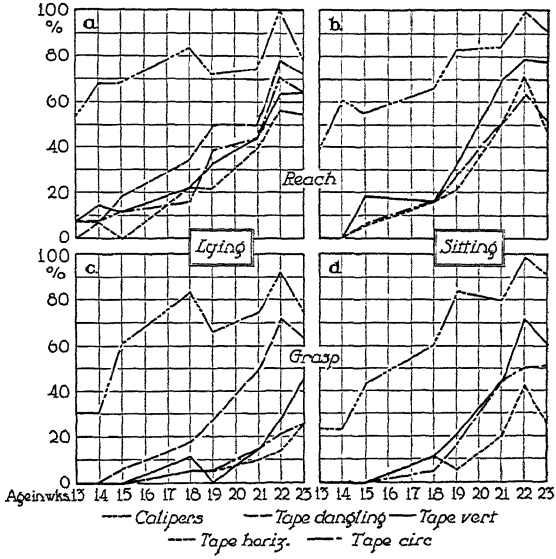
Practically all the babies reacted to the tape test even at 13 weeks when they were in the lying posture, and their reaction consisted of following the moving object with both head and eyes. At 23 weeks the babies were very little more skillful in their watching than they were at 13 weeks. The babies were virtually on a plateau throughout the entire period so far as eye coordination was concerned. Since this particular phase of head and eye coordination was developed at an earlier age, it seems likely that the reactions during

these tests were determined not by the baby's ability to master the tests but by his mood or whim or interest of the moment.

Although head and eye coordination when the babies were tested in a lying posture was practically established by 11 weeks, this skill did not carry over to tests

FIGURE 8

REACTIONS TO THE TAPE



given when the babies were in a sitting position. At 13 weeks not more than 15 per cent of the babies made an effort to follow the objects with their heads or eyes when they were sitting, but progress was rapid, and by the 23rd week 75 per cent showed coordinated following. During the interval between 23 and 38 weeks development went on until the skill was perfected.

The percentages of head-following and eye-following reactions were almost identical, regardless of the babies' positions or the directions in which the tape was swung. Errors in judgment on the part of the experimenter partially account for the similarity of scores, but it seems likely that turning the head as well as the eyes in pursuit of a moving object (acts that are closely allied even in adults) are almost never divorced in infants.

This test gave opportunity for studying both the reaching and the obtaining of the swinging object from the very beginning of these reactions (see Figure 8). The interesting thing to note in this regard is that whereas in head- and eye-following the percentages were very different in the lying and sitting postures, skill in reaching and obtaining the tape developed simultaneously for the two postures. Furthermore, the babies' greater proficiency in watching when they were lying than when they were sitting continued till the end of the age period studied. But their skill in reaching and especially in obtaining the object while sitting forged ahead of their skill while lying down by only a narrow margin when the tape was swung horizontally, but by an appreciable amount when the tape was moved up and down or in a circle. A similar crossing of the "lying" and "sitting" curves occurred at 19 weeks in the caliper test, and the age of its occurrence in reaching the tape was practically the same. The steady ascent of the curves for reaching and grasping the tape indicates that in this examination also the babies were observed in the act of developing reaching. More than 90 per cent made not so much as a random grab at the dangling toy at 13 weeks, while ten weeks later 75 per cent were reaching for the toy, and not more than 10

per cent of them were missing it. The failure of 25 per cent to get it at 38 weeks was due more likely to sloth or indifference on their part than to inability. Grasping the dangling tape was a very much more difficult feat than seizing the calipers. Although 75 per cent of the infants had mastered the caliper-reaching test by 19 weeks, only a third of them were able to get the tape at this age. There were two reasons for this: the tape dangled at each random bump from a small fist, whereas the calipers remained stationary, and the tape was flat and slick and hard to catch by a hand in which thumb opposition was not complete, whereas the slender curving bows of the caliper were easily clutched by curling fingers.

Whether or not swinging the tape in any one direction presented greater difficulties for the infant than swinging it in another can be determined from a study of Figures 5 and 8. For the baby in the lying posture the reaction to the vertical swinging of the tape seemed most difficult at the outset. This was probably due to the necessity of converging the eyes to watch the tape when it was swung in the mid-line and to the greater effort required to rock the head back and forth, as compared to the ease of turning it from side to side or rotating it in a small circle. But by 18 weeks the differences in the difficulty of the three skills had practically disappeared.

It was just as hard to reach for the swinging tape in one direction as in another, a little concession perhaps being granted to the horizontal direction. And to reach for the swinging tape was not much harder than to reach for the dangling tape, although all were considerably harder than reaching for the calipers (see "reaching in a lying posture" in Figure 8). To capture the object in

motion, however, was a real task, beside which getting the dangling tape was easy and getting the calipers was no trick at all (see "grasping in a lying posture" in Figure 8).

Almost the same generalizations apply to the reactions to the tape when the babies were sitting. The horizontal head and eye movements seemed somewhat easier and the vertical movement a trifle more difficult than the circular movement. The vertically moving tape was more often reached for and more frequently obtained than the tape swinging crosswise. Getting the swinging object was again more difficult than getting the calipers (see "sitting posture" in Figure 8).

Distractions. — An examination of the tabulation of the distractions during the tape test indicates again that looking around was the most common distraction of the infant during the first few times he sat up, but that this distraction disappeared as if by magic at 19 weeks. It also appeared that watching the tape was a more absorbing task than reaching for the calipers, since almost none of those who reacted to the swinging of the tape were distracted in any of the ways tabulated. This result confirms the well-known fact that moving objects have higher attention value than stationary ones.

Other distractions which did not fall into any convenient category, such as the baby's watching or playing with his own hands or gurgling, occurred and were noted on the original records. The direction in which the tape was swinging had no effect on the number or type of distractions.

In computing the percentage of reactions to the tape test all reactions were counted in which the infant followed the tape as much as one complete back-and-

forth or up-and-down swing, or through a 270-degree arc in the circular direction. On the original sheets, however, the examiner indicated "sustained" in the column marked "attention" when the baby followed the tape throughout the thirty-second interval, and "intermittent" when the baby followed the tape only in a desultory manner for one or two swings during the interval. Tabulation of the percentage of babies who exhibited sustained attention indicates that although intermittent attention was secured almost as readily when the child was sitting as when he was lying, sustained attention, on the other hand, was much harder to secure when the baby was sitting than when he was lying. Again the rapid rise in the ability of the sitting baby to watch the moving object for thirty seconds came between 19 and 21 weeks. All the evidence points toward the conclusion that by this age the art of sitting on an adult's lap was nearly enough perfected and the greed for looking around at the changed environment was sufficiently satisfied to allow the babies to settle down to concentrated effort at watching and reaching.

Summary. — 1. Eye coordination in the tape test was established before 13 weeks for the baby in the lying posture; in the sitting posture it developed after 13 weeks.

2. Looking around seemed to be the distraction that retarded eye coordination in the sitting posture.

3. Reaching and obtaining the moving object were functions that developed during this age period.

4. The dangling tape was easier to obtain than the swinging tape.

Blinking at Hand and Pencil Threats

In order to determine whether blinking when threatened by a hand or pencil was occasioned by the stimu-

lus or merely coincident with it, the stimulus was given three times in succession. Blinking at the hand threat progressed rapidly with age but did not occur in every case even at 38 weeks (see Table XXVI). Progress in blinking at the pencil was slower than that in blinking at the hand. In fact, almost no progress occurred between the ages of 13 and 23 weeks, but at 38 weeks the babies blinked as readily at the pencil as they did at the hand.

TABLE XXVI

PERCENTAGES OF BABIES REACTING TO THREATS AT EYES WHILE IN A LYING POSITION

No. of Blinks in 3 Trials	Age in Weeks								
	13	14	15	18	19	21	22	23	38
Hand threat:									
0 out of 3..	15.4	0.0	25.0	11.8	5.5	10.0	0.0	0.0	4.3
1 out of 3..	30.8	30.8	18.8	0.0	0.0	0.0	0.0	4.5	4.3
2 out of 3..	7.7	30.8	6.3	17.7	22.0	15.0	14.2	4.5	0.0
3 out of 3..	30.8	30.8	43.8	64.9	66.0	75.0	85.8	73.0	86.0
Doubtful..	7.7	7.7	6.3	5.9	5.5	0.0	0.0	13.5	4.3
Pencil threat:									
0 out of 3..	30.8	46.2	43.8	29.5	50.0	20.0	42.6	18.0	0.0
1 out of 3..	23.2	23.1	25.0	17.7	11.0	20.0	7.1	13.5	0.0
2 out of 3..	0.0	7.7	6.3	23.6	16.5	20.0	14.2	27.0	8.6
3 out of 3..	38.5	15.4	18.8	23.6	16.5	40.0	28.4	36.0	86.0
Doubtful..	0.0	7.7	6.3	5.9	0.0	0.0	0.0	4.5	4.3

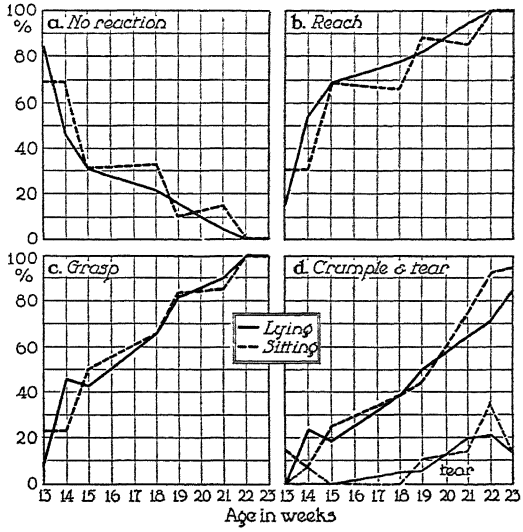
PAPER TEST

Description of development. — The simplest reaction to the paper was that of turning the head and looking around the edge of the sheet. Slightly more advanced was a batting or random waving with the arms whereby the paper was pushed away. Still more effective was a bringing together of the arms, so that the paper was caught and crumpled between them. Seizing the paper

with both hands, crumpling it, and crowding it to the mouth were the most advanced reactions achieved by most of the babies. A few grasped a corner of the paper daintily between thumb and forefinger. Although the paper remained a favorite toy up to 23 weeks, it lost popularity thereafter, so that the characteristic reaction

FIGURE 9

REACTIONS TO THE PAPER



of the 9-months-old baby was to discard it rather than to use it as a toy.

Development in terms of the percentage of babies reacting. — Ability to reach and grasp the paper developed during the period from 13 to 23 weeks (see Figure 9). Development was indicated by the steady decline of the "no reaction" curve and the steady upward trend of the reaching and grasping curves. Manipulation of

the paper in the form of crumpling also developed during this period, but from two to three weeks later than the reaching and grasping abilities. Violent manipulation of the paper resulting in its being torn showed very slight development, and this act did not become universal, as did reaching, grasping, and crumpling. Since tearing the paper occurred in so few cases, it probably should be considered as an expression of mood or personality rather than as a developmental item. It will be noticed from the curves that proficiency in the paper test was about the same in the lying and sitting postures.

Peeping around the edge of the paper was clearly a developmental item, or rather the converse of a developmental item, since this reaction occurred most often in the early weeks before the babies had mastered the art of reaching or pushing the paper aside, and it waned as greater skill in reaching was acquired. When this reaction occurred at 38 weeks, it was an expression of indifference to the paper as a toy rather than of inability to grasp it.

Pushing the paper aside was first recorded during the early ages and again at 38 weeks. Here again the objective records do not tell the whole story. The pushing aside that occurred during the early ages was a sort of random slap or push at the paper that knocked it out of the line of vision. It was a substitute for the more difficult acts of reaching, grasping, and crumpling the paper. At 38 weeks this pushing aside was done to get rid of the object. The paper had completely lost its charm as a toy for most of the children, and it was repeatedly brushed aside and abandoned. Chewing the paper occurred in from 20 to 50 per cent of the cases where grasping occurred. No marked developmental trend was shown in this reaction. It, too, was a re-

action that depended on the whim of the baby at the moment.

Rapid development was likewise shown in the speed of reaching and grasping the paper (see Table XXVII). After the 15th week these two reactions became practi-

TABLE XXVII

AVERAGE TIME IN SECONDS REQUIRED FOR THE PAPER TEST, BASED ON NUMBER OF BABIES REACTING

REACTION	AGE IN WEEKS								
	13	14	15	18	19	21	22	23	38
Lying posture:									
Reach.....	41.0	18.0	10.0	11.0	17.0	7.0	6.0	3.0	3.0
Grasp.....	60.0	29.0	12.5	11.5	18.0	10.0	9.0	4.0	4.0
Crumple..	0.0	22.0	21.0	12.0	29.0	10.0	19.0	10.0	11.0
Sitting posture:									
Reach.....	32.0	22.0	20.0	13.0	10.0	4.0	4.0	1.6	3.0
Grasp.....	40.0	26.0	18.0	15.0	9.0	5.0	4.5	1.5	4.0
Crumple..	35.0	6.0	30.0	30.0	14.0	8.0	6.0	4.0	21.0

cally simultaneous. Little progress was shown in the speed of crumpling the paper; this is probably another indicator that this type of manipulation depended rather on the baby's mood or personality than on his stage of development.

Distractions. — Distractions during the paper test were also tabulated. Although they were common, they did not interfere at all with the manipulation of the paper. If the desire to look around curtailed the skill in reaching for the calipers and tape when the baby was sitting, it acted as a stimulant for reaching the paper. Since the baby's view was practically obstructed by the paper, he was compelled to push or bat it out of his way before he could survey the room. The distractions of watching persons or looking around were

recorded only eleven times for the babies who did not react to the paper test while sitting, whereas they were recorded twenty times for babies who did react to the test.

Discussion. — The reactions to the paper test are interesting in that they show both a rise and a decline. Of all the objects in this series the paper was probably the best liked by the babies; the bell was its only rival as a toy. The period of greatest positive reaction to the paper occurred between 21 and 23 weeks. During this period the paper was not only reached for and grasped but it was most often crumpled, torn, and chewed, and was practically never pushed aside or peeped around. The reasons for the paper's high interest value for babies of this age can only be guessed at. The most plausible guess is that the paper presented stimuli in more different sensory fields than did the tape or calipers. In the first place, it had form and color, but so did all the objects. When it was waved or crumpled it produced crackling sounds, which the babies enjoyed; the bell was also liked for its noise-making quality. When the paper was chewed or brought to the face it gave forth a faint odor and a faint taste, but these qualities, too, were present in other objects. It was extremely light and could therefore be held with great ease, and it was pliable, yielded to manipulation of any kind, and took on different forms as it was crumpled, whereas the calipers, the tape, and the bell continued to look the same no matter how they were maltreated.

Summary. — 1. Reacting to paper was a function that developed between the ages of 3 and 6 months.

2. Paper was one of the babies' favorite toys during this age period.

3. Interest in the paper as a toy waned rapidly be-

tween 6 and 9 months; therefore it is doubtful what developmental significance this item had.

Bell Test

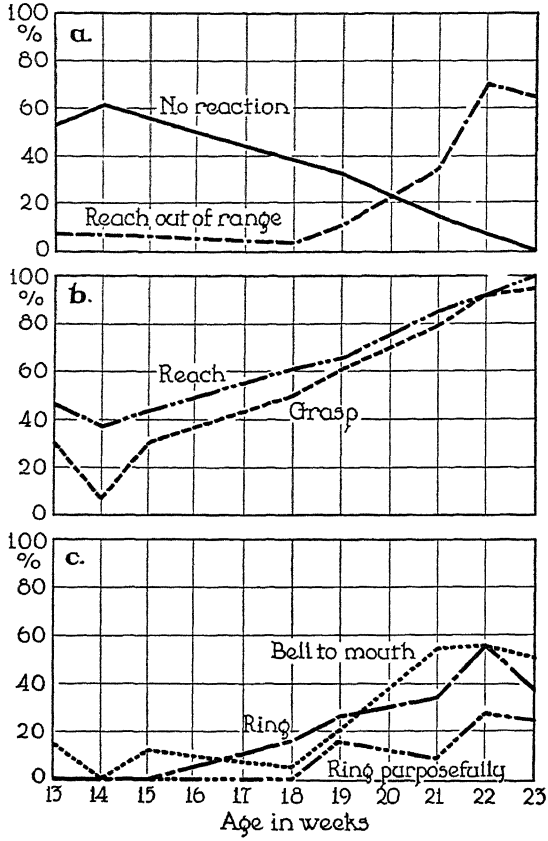
Description of development. — The early reactions to the bell when it was held out of reach were those of looking at the bell and blinking at the sound when it was rung. Later the babies reached and clutched the air; still later they leaned forward on B's lap and made very strenuous efforts to get the toy. The reaching out-of-range test was planned with the hope of getting information on the space perception of the infant. It failed in this, however, since apparently many of the babies reached with the knowledge that the bell was out of range, but with great eagerness to obtain it none the less. Often a baby made one or two clutches into the air and then gave up the attempt. Very frequently, however, a child leaned forward on B's lap, reaching eagerly, or rocked back and forth on her lap, thus somewhat increasing his length of reach. Now and then one clutched B's sleeve or pulled at her arm, clearly demanding her to bring the object closer, and on two or three occasions a baby actually tugged hard enough to bend her arm so that the coveted toy was brought into range.

When the toy was within reach, the bell was sometimes grasped by the handle and at other times clutched by the bell or even by the clapper. Chewing the handle of the bell was a favorite and universal response. Turning the bell so that the handle was held like the stem of a goblet and "drinking" from the bell was a very frequent occurrence. Ringing the bell was the most advanced reaction noted.

Development in terms of the percentage of babies reacting and speed of reaction. — Each type of reaction to the

FIGURE 10

REACTIONS TO THE BELL HELD BY THE EXAMINER



bell clearly showed a developmental trend (see Figure 10). Reaching and grasping reactions were about four weeks ahead of the ringing reaction in development, and purposeful ringing followed about three weeks behind accidental ringing. Greater eagerness to get the bell at

later ages (from 21 to 38 weeks) was indicated by the fact that more babies reached for the bell even though it was out of range. In the bell test progress was also shown by a gradual decline in the average time required to react. At 13 weeks the average time elapsing before the bell was grasped was 47 seconds; at 23 weeks it was 14 seconds; and at 38 weeks it was only 2 seconds. In this test, also, looking around was the chief distraction of those who did not react, as well as of those who did. Chewing the bell became more frequent at later ages.

Summary. — 1. The babies under 6 months reached for a toy that was out of range even though they seemed to recognize that it was beyond their grasp.

2. Reaching and grasping the bell were items that showed a developmental trend throughout this age period.

3. Chewing the bell was an almost universal reaction among the babies who obtained it.

Tape and Box Tray Test

Description of development. — The tape on the box tray proved to be the most difficult of the reaching tests. If the tray were jarred slightly, the tape slid about. The object was a little too large for the baby to grasp with the palm of his hand, and it could hardly be grasped between thumb and finger unless it was pushed to the edge of the tray. To pick up a saucer that had been turned upside down on a table would present about the same difficulties to an adult as the tape did to the babies. In the early weeks the babies were quite powerless to get the tape. Later, when they were able to get it, they usually chewed it.

Inability to get the tape was compensated for by the babies' reaction to the box tray as a toy. In the earlier

weeks a gentle fingering of the tray was the commonest type of reaction to it; between 18 and 23 weeks a persistent and noisy scratching or clawing of the tray was the favorite reaction; and at 38 weeks patting, slapping, or banging on the tray held first place among the incidental reactions.

Development in quantitative terms. — Progress in reaching for this object was slow (see Figure 11). At 23 weeks only about 60 per cent of the babies reacted even to the extent of regarding the object. Not more than 50 per cent consistently reached for it, and fewer than a third of them were successful in grasping the slippery toy. By 38 weeks, however, perfection had been attained. Practically the only manipulation of the tape after it was secured was chewing it, a reaction that occurred in a third of the babies who grasped it. The reactions to the tray as a toy waxed and waned as the baby grew. As proficiency in grasping the tape increased, the reaction of scratching the tray became less frequent. Some progress was shown in the speed with which the babies grasped the tape.

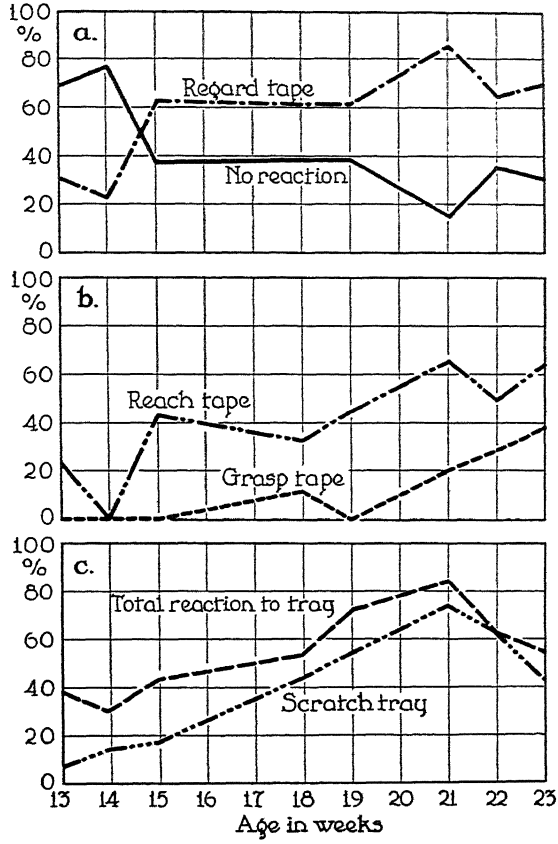
Distractions. — During this test looking around was the favorite distraction of the non-reaching group up to 15 weeks; after this age the babies paid more attention to persons. Screaming occurred in one or two cases at almost every age level. The great difficulty of this test, combined with the fact that it came toward the end of a comparatively long examination, probably accounts for the greater irritability at this point.

Summary. — 1. The tape on the box tray was the most difficult of the reaching tests. Only about half the babies were proficient in this test at 6 months.

2. Lack of skill in the test was compensated for by reactions of scratching and patting the tray.

FIGURE 11

REACTIONS TO THE TAPE PLACED ON THE TRAY



BELL AND BOX TRAY TEST

Development in quantitative terms. — The bell on the box tray presented many of the same difficult features as the preceding test, except that the bell was easier to

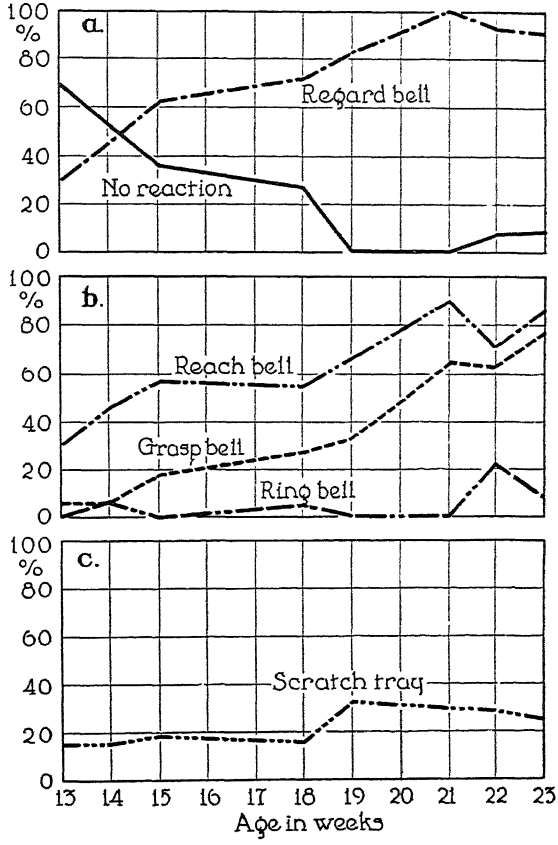
grasp and was a more diverting toy once it was obtained. The reactions to the bell in this test were much the same as those to the bell when it was held.

The decline of the "no reaction" curve and the rise in the curves of regarding and reaching indicate that this test yielded a developmental item (see Figure 12). Grasping the bell developed almost from the zero point to 75 per cent proficiency during the 10-week interval. Ringing the bell occurred less frequently in this test than in the former test with the bell. The reason for this is not clear, unless it be that chewing the bell or reacting to the box tray diverted the energies previously spent on the bell.

Scratching reaction.—Since the bell was easier to get than the tape, the incidental reactions to the box tray were fewer than they were in the tape test. Nor did these reactions show the developmental waxing and waning that they did in the former test. Scratching again was the favorite type of diversion. The scratching was not merely a random and accidental clawing in an attempt to reach and grasp the object, but it was very definitely a type of play that delighted the baby, even though the rasping noises the babies made set an adult's "nerves on edge." Although the author desires above all else to keep this report free from the anecdotal accounts that fill biographical studies and are at once the delight and despair of one who consults the literature on child development, she cannot refrain from recounting the case of one baby, who at 23 weeks cleverly solved the bell-scratching dilemma. Throughout the tape test Martin had scratched the tray vigorously with both hands and had paid very little attention to the tape. When the bell was offered he looked at it, and, apparently deciding it was worth having, he

FIGURE 12

REACTIONS TO THE BELL PLACED ON THE TRAY



scooped it up with both hands, put the handle in his mouth, and holding it thus between his lips gleefully resumed his scratching.

One can only speculate as to the reason for this de-

light in scratching. The simplest explanation seems to be that advanced above with regard to the paper, namely, that scratching presents a large number of stimuli in several sensory fields. The baby gets kinesthetic sensations of movement, vibratory, auditory, and tactual sensations from the box surface. The lid was not the only object that was scratched; often B's hands and arm came in for this sort of investigation, and crib sheets, canvas bath tables, and sometimes toys were explored in this way.

Summary. — 1. The bell was somewhat harder to grasp when it was placed on the tray than when it was held by the experimenter.

2. The reactions to the bell were much the same as those to the bell in the former test.

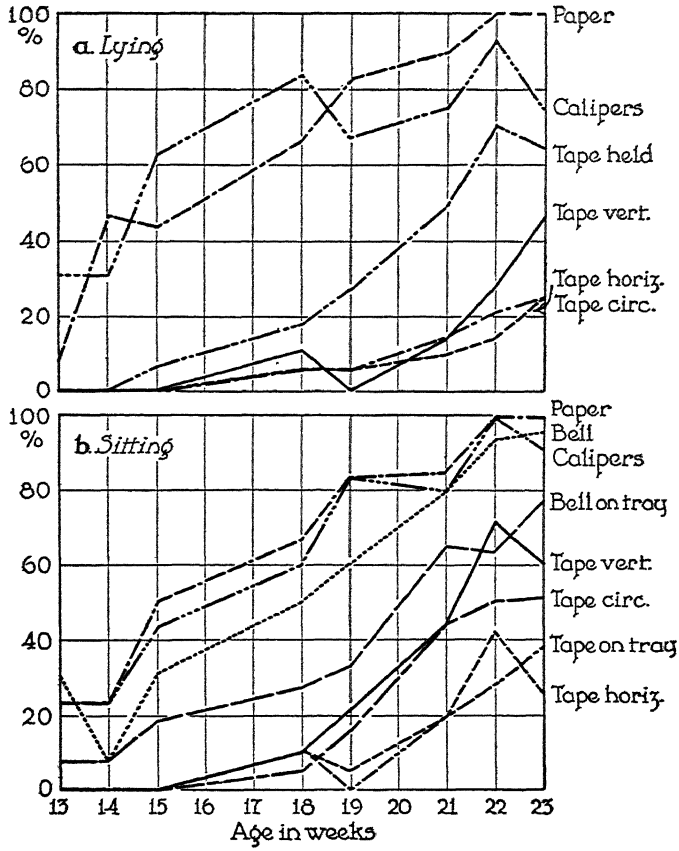
3. Scratching the tray was a favorite reaction.

Summary of the Reaching Tests

Easy-to-get and hard-to-get objects. — In Figure 13 the curves for grasping all the objects are superimposed. The objects fall into two classes according to the difficulty in obtaining them: stationary objects, such as the calipers and paper, and moving or dangling objects, such as the tape. The two groups of objects are clearly defined for both the lying and sitting postures. The objects easy to get in the sitting posture are the bell, the calipers, and the paper, whereas the slippery tape on the box tray falls into the class of hard-to-get objects, along with the swinging tape. The bell on the box tray, however, lies about half way between the two groups of curves. It was somewhat more difficult to get than the calipers, the paper, and the bell when it was held, but considerably easier to obtain than the tape in any of its positions.

FIGURE 13

GRASPING REACTIONS TO ALL OBJECTS



One reaction was noted in the grasping test for which no statistical treatment is possible, and the observers' word must be taken. On several occasions it appeared that babies grasped the object without first regarding

it and gauging the distance for reaching. They reached, seemingly with confidence, and certainly with success, just as an adult having heard someone place an object in front of him would pick it up without looking at it. As soon as the baby touched the toy, the contact of it with his hand usually drew his attention to it, although some manipulation and a great deal of the chewing of the objects were carried on without any visual attention to the object.

Manipulation of the object, once it had been obtained, progressed comparatively slowly during the experimental period. Crumpling the paper was the simplest type of manipulation; it was completely established at 23 weeks but waned considerably before 38 weeks. Retaining the calipers was also a fairly simple type of manipulation that was established in from 60 to 75 per cent of the cases by 23 weeks. Manipulation of the calipers was very difficult and remained at a low level throughout the period. Accidental and purposeful ringing of the bell showed some development, but ringing of the bell when it was placed on the box tray showed almost none.

Discussion

The reactions called forth by this developmental test group themselves quite naturally into six main categories: (1) developmental reactions established before the examination began, prior to 13 weeks; (2) developmental reactions established during the period of the examination, between 13 and 23 weeks; (3) developmental reactions established later than the period of the examination, from 28 to 38 weeks; (4) ambiguous developmental items, proficiency in which waxed and waned during the period of the examination; (5) dis-

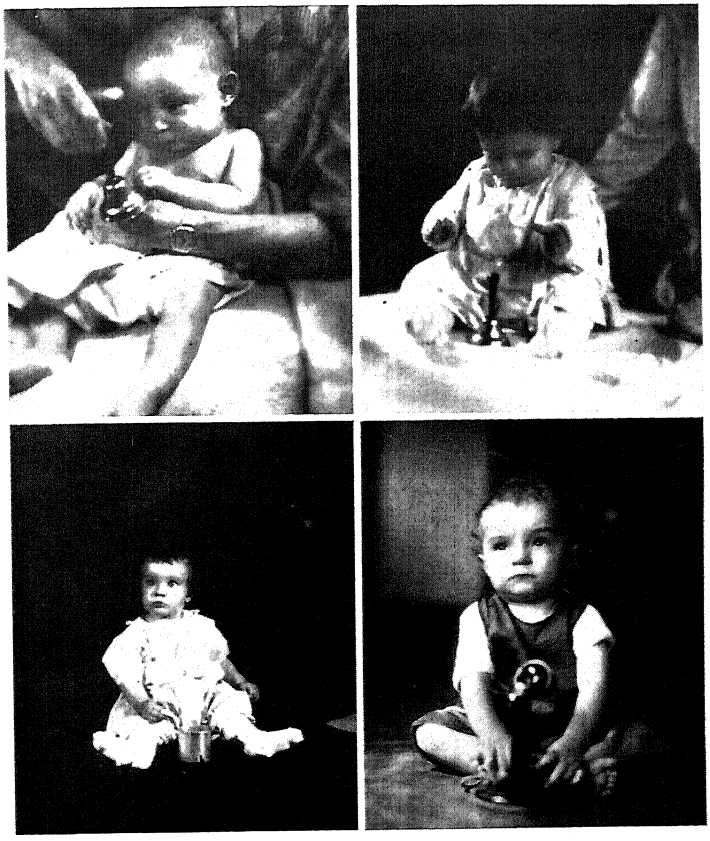


PLATE 5. — SITTING AT PLAY

Above.—Maurice at 12 weeks scratching the bell (left); Edith Ann at 34 weeks with the bell (right). *Below.*—Gesell's cube and cup, Nathaniel at 51 weeks (left); Matthew at 51 weeks with toy telephone (right).

tractions that apparently had developmental significance although they were mere by-products of the examination; and (6) reactions that apparently were independent of development and that seemed to be closely allied to personality or character traits.

Eye coordination as it is seen in the head- and eye-following reaction to the swinging tape is listed in the category of reactions developing before 13 weeks. This was established only for the lying posture prior to 13 weeks. Reaching for stationary objects had begun to develop but was not established to the extent that eye coordination was at the beginning of this testing period.

Most of the reactions established during the period of the test had to do with the grasping function. The reaching function was established practically to completion within this period both in the lying and sitting postures and for the stationary and moving objects. Grasping was completely established for the stationary objects used in this test and was established in about half the cases for the moving objects. Simple types of manipulation, such as holding objects or crumpling paper, were established, and progress was made with the more difficult types of manipulation, such as ringing the bell. Thumb opposition was practically established by 23 weeks. Blinking consistently at a hand threat was developed from 30 to 75 per cent during this period.

Chief among the reactions that had only begun to develop during the examination period but that were practically established by 38 weeks were the grasping of moving objects and the manipulation of all objects. Consistent blinking at the pencil threat also developed during the interval from 23 to 38 weeks.

Of the items the developmental significance of which

is uncertain because they waxed and waned during the experimental period, interest in the paper is a good example. At the turning point (23 weeks) it was impossible to tell whether a child who was indifferent to the paper was retarded or advanced. Reacting to the box tray as if it were a toy was the same sort of function; and scratching the box tray in particular followed this ambiguous developmental course.

The type of distraction varied considerably with age and was therefore of developmental significance. Irritability toward the end of the examination was somewhat more common in the earlier ages. Looking around was a distraction very much more characteristic of the babies from 13 to 18 weeks than from 19 to 23 weeks. Looking at persons was also more common in the earlier ages. The narrowing down of the visual attention from general looking around or watching persons to looking at a single object was of developmental significance. Total distractibility decreased with age.

Reactions showing the degree or amount of attention paid to an object apparently had no developmental significance. Sustained attention to the tape did not progress with age. The hand-to-mouth reaction seemed to be uninfluenced by age. Chewing of objects occurred in about 50 per cent of the babies who reached and grasped any or all of the objects. None of the above items yielded a developmental curve. It is probable that all of the reactions in this category would have had developmental significance at some time in the baby's career. Certainly the inhibition of the hand-to-mouth reaction developed eventually. Perhaps the degree of attention is the only trait in this list to remain a personality trait until adult life, and even this would remain so only in a limited sense. However,

at this stage all these traits seem to be much more dependent on the baby's whim or mood or internal bodily state than upon the nature of the stimuli. It seems, therefore, that in these reactions is displayed the nucleus of personality reactions.

Point Scores on Developmental Test

Method of computing. — After each of the items in the test had been analyzed for its developmental significance, point scores were assigned as follows:

Reaction	No. of Points	Total Possible Points
TESTS IN A LYING POSTURE		
Caliper test		
Reach	1	
Touch	2	
Grasp	3	6
Retain	4	
Manipulate	5	
Complete thumb opposition	1	
Tape test		
Follow with head	1	
Follow with eyes	1	
Reach	1	14
Grasp	1	
Reach dangling tape	1	
Grasp dangling tape	1	
Blinking test		
Each blink	1	6
Paper test		
Reach	1	
Grasp	1	2
Total in lying posture		28
TESTS IN A SITTING POSTURE		
Sitting on lap		
Support at armpits	1	

Reaction	No. of Points	Total Possible Points
TESTS IN A SITTING POSTURE		
Support at middle ribs	2	
Support at lower ribs	3	
Support at abdomen	4	
No support	5	9
Tense for lifting	1	
Stretch arms	1	
Catch examiner's hands to be lifted	1	
Complete head control	1	
Bell test		
Reach	1	
Grasp	1	4
Ring bell	1	
Ring bell purposefully	2	
Tape on box tray and bell on box tray test		
Watch	1	
Reach	1	4
Grasp	1	
Ring bell	1	
Total in sitting posture		38
Total for entire examination		66

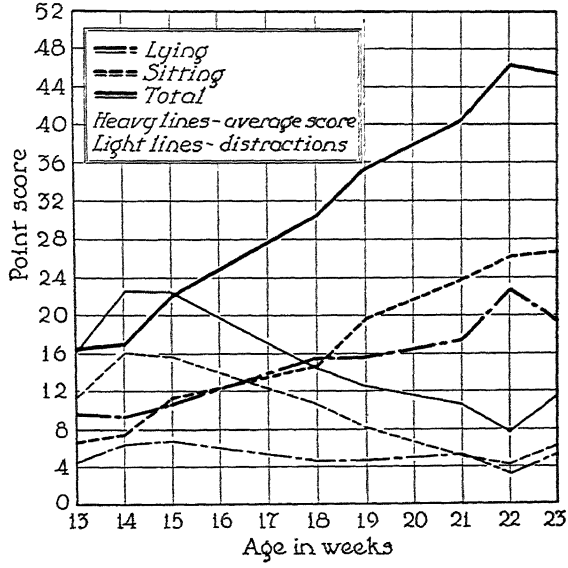
Average scores. — Figure 14 presents the average scores on the tests at each age level. Progress occurred fairly consistently throughout the entire period of testing. The scores on the sitting test yielded somewhat larger increments from week to week than did those on the lying test. It will be noticed that the most rapid improvement in score occurred between 15 and 18 weeks. The averages at 18 and 19 weeks were almost double those at 13 and 14 weeks; those at 22 and 23 weeks were almost triple the initial scores; and by 38 weeks the score was almost four times that at the beginning. The total scores confirm in a measure the notion that 18 and 19 weeks were the crucial ages for

these tests; during these weeks the babies began to "arrive" so far as this test was concerned.

Intercorrelations. — The consistency of the babies' performances from week to week was studied by the correlation method. The results are shown in Table

FIGURE 14

AVERAGE POINT SCORES AND AVERAGE SCORES ON DISTRACTIONS IN THE TESTS OF DEVELOPMENT



XXVIII. Because of the small number of cases all the correlations have very high probable errors, and consequently little dependence may be placed on them. The relation between performance in the lying posture and that in the sitting posture was not so marked as one might expect. In general, the correlations lie below .50. From general observation as well as from the

TABLE XXVIII

RANK ORDER CORRELATIONS BETWEEN TOTAL SCORES ON DEVELOPMENTAL TESTS AT DIFFERENT AGE LEVELS

AGE IN WEEKS	AGE IN WEEKS							
	14	15	18	19	21	22	23	38
13	.58±.13	.04±.21	.56±.15	.34±.18	.12±.21	.81±.07	.48±.15	−.09±.19
14		.57±.14	.73±.10	.31±.18	.30±.19	.87±.06	−.17±.19	.19±.19
15			.24±.18	.55±.14	.68±.10	.32±.21	.08±.17	.44±.15
18				.61±.11	.74±.08	.87±.05	.51±.12	.44±.14
19					.93±.02	.81±.11	.54±.13	.60±.11
21						.61±.12	.49±.12	.51±.12
22							.78±.07	−.03±.19
23								.23±.14
38								

AGE IN WEEKS	CORRELATIONS BETWEEN TOTAL SCORES SITTING AND TOTAL SCORES LYING	CORRELATIONS BETWEEN DISTRACTIONS AND TOTAL SCORES	CORRELATIONS BETWEEN DISTRACTIONS AND IRRITABILITY AND TOTAL SCORES
13	.21±.19	.00±.19	.00±.19
14	.51±.14	−.02±.19	−.66±.11
15	.42±.14	−.12±.17	−.23±.17
18	.65±.10	−.26±.15	−.52±.12
19	.37±.14	−.33±.15	−.34±.15
21	.48±.12	−.20±.15	−.39±.13
22	.37±.16	−.04±.19	−.40±.16
23	.59±.09	−.21±.14	−.55±.10
38	.59±.10		

results cited above it seemed that in the early ages the babies were more proficient when they were lying, probably because they were more distracted when they were sitting. But after the babies reached a high degree of skill in the sitting posture, they often appeared less interested in the test and generally more lackadaisical in the lying posture. In other words, lying down seemed to be a posture of rest and relaxation, whereas sitting was a posture of muscular tonus, attention, alertness, and eagerness. In so far as these observations are correct they tend to account for the relatively low correlations.

Intercorrelations computed on the total scores for different weeks range from −.17 to .93. In general, the correlations between the scores for adjacent weeks are higher than those between weeks more widely separated. If we examine the correlation table row by row, we discover that there is very little consistency among the eight correlations at 13 weeks; the range is from −.09 to .81. This is also true of the correlations at 14 and 15 weeks. From the 18th through the 22nd week, however, the correlations are all above .60. Moreover, all the computations indicate that these were the ages at which the tests were significant. It therefore appears that either the examination or the group was fairly consistent from week to week during the short period that intervened between the time when proficiency in this test was first reached and the time when the test was outgrown.

The fact that these correlations are as large as they are is remarkable when we consider that the test scores were not the same from week to week but were constantly increasing. The amount of consistency present must mean that the rate of development was fairly

constant in each child during the four weeks in question. The lower correlation for the early weeks may be due in part to the fact that the rate of development of individual babies was changing.

Another factor that probably tends to reduce the correlations is that chance played a very large part in early scores. The baby who accidentally caught the object during his random waving scored just as high as the baby who reached with precision and took it. After the reaching reaction was well established (i.e., at about 23 weeks), temperament or personality factors probably had more weight in determining the final score, and correlations correspondingly decreased. As the baby outgrew the test he became increasingly indifferent to some of the objects presented, and his total score became more and more an index of what he wanted to do rather than of what he was able to do.

Distraction scores. — After the papers had been scored by counting the developmental items, they were scored again for distractions. The developmental test blanks were ruled in sections, and each horizontal line marked off roughly thirty seconds of the test. Each of these divisions was counted as one unit. The reactions that were called distractions were: looking around at objects other than the test object presented, looking at persons, clasping or playing with the hands, chewing the fists or sucking the lips, and patting or scratching objects other than the box tray. Peeking around the edge of the paper, scratching the box tray, screaming, and fussing were not scored as distractions because they have been recorded and discussed elsewhere. Neither was gurgling or other vocal play counted as a distraction. The distraction score was

fractionated according to the posture of the baby and was totaled.

The average scores for distractions are also presented in Figure 14. It is obvious that distractions had no developmental significance when the baby was in the lying posture. The average distraction score was very close to five for every week of the test. In the sitting posture, on the other hand, the distractions decreased as the babies grew older, until at 21 weeks the average distractions in the sitting posture were as low as those in a lying posture. This again supports the point made above that at the earlier ages when the baby is in the sitting posture proficiency in the test is sacrificed to diverting distractions.

The total distraction scores were then correlated with the total scores at each age level. The correlations are unanimously low and have extremely high probable errors (see Table XXVIII, page 176). In every case but one (and that correlation is zero) the sign of the correlation is negative, but although they are extremely low and very undependable, the correlations all lie in the expected direction.

Irritability scores. — Partial and total irritability scores were computed for each test by merely counting the number of times screaming, crying, or fussing was checked on the original test blanks. Although screaming denoted a considerably more lusty protest than did crying or fussing, it seemed impossible to assign a definite weight to any of the three degrees of irritability listed. Consequently, the three were counted the same.

Average scores were obtained, but they are somewhat misleading. At no age level were more than eight babies represented in the irritable group, and usually one or

two of these did practically all the fussing. Furthermore, the baby with the high irritability score (i.e., with from 24 to 52 checks out of a possible 56) usually screamed, whereas generally those with low scores (from 1 to 10 checks) just fussed. For these reasons the percentage of babies who were irritable was recorded at each age level, and the average irritability of those babies was computed. But no matter how these scores were dealt with they showed no developmental trend whatever. Again it appears that the irritability of the child depends either upon its whim of the moment or upon its naturally irritable disposition rather than upon any developmental scheme. The latter alternative seems somewhat tenable, since almost 50 per cent of the total irritability score was made by three of the babies. Since this test was not one that would normally irritate the babies and since it was apparently enjoyed by most of them, the significance of the irritability score as a measure either of a temporary mood or of a deep-rooted trend in personality is greater.

However we regard irritability itself, we at least can agree that it is a distraction. The irritability scores were therefore added to the distraction scores for each baby at each age, and the correlations were computed between this summed score and the total score on the test. Table XXVIII (page 176) presents these correlation coefficients. Except in one case (again the zero correlation at 13 weeks) the addition of the irritability score to the distraction score yielded higher negative correlations with the total score. The coefficients range from $-.23$ to $-.66$, and three of the eight correlations are more than four times the size of their probable errors.

Mouth reaction scores. — Two other reactions that

appeared in all the babies were the hand-to-mouth reaction and the chewing and sucking of objects. These reactions were scored by allowing only one point for hand- or object-chewing for each situation in which it occurred during the test. Thus, if the baby put the calipers in his mouth, he was given one point, regardless of how long he chewed them. If he chewed his fist while the tape was swinging horizontally, he was given one point. The chewing was counted only once for each test item instead of two, four, or six times, according to the approximate length of the test, because as soon as the baby got the object and put it to his mouth he continued to chew it until it was taken away and he was offered something else.

Average scores for the chewing reaction increased from .77 at 13 weeks to 4.00 at 23 weeks. It would seem that the chewing of objects did have some developmental significance, since the frequency with which it occurred increased with age. But a part of this increasing frequency of chewing the object came from a greater proficiency in grasping and retaining it. On the other hand, chewing the fist was resorted to by many babies who were not yet able to grasp the object. Chewing the fist often occurred when the baby was indifferent to the object. These scores were not used for further computations.

Conclusions

1. When the tests were scored by a point system, development was shown by an increase in the average test score from one examination to the next.

2. The period of most rapid progress on this test was during the 18th and the 19th weeks.

3. During the period of rapid progress the babies held their ranks in the group with fair consistency.

4. Distraction scores gradually decreased with age.

5. The distraction scores correlated negatively with the total scores on the test.

6. The addition of irritability scores to the distraction scores increased the negative correlation with the total scores.

7. Mouth reactions — the chewing of fists and objects — showed a slight developmental trend during this period.

CHAPTER IX

CHOICE TESTS

Nine examinations given at irregular intervals between the ages of 6 and 12 months were called choice tests. These examinations consisted of three or four subtests in which two or more toys were dangled within easy reach of the baby. These tests were planned in order to discover whether the baby preferred one toy to another and whether he consistently chose his favorite to the exclusion of the others. As the test worked out, however, characteristic choices of objects were not so common as characteristic manipulation of the toys. Consequently, the data from all the choice tests have been treated together for analysis of the types of reaction.

The purpose of this report is twofold: first, to show developmental trends as they were manifested in the choice tests by improved skill in manipulation of objects and, secondly, to study the characteristic behavior traits of each baby as they were manifested by his interest and his manner of manipulating the objects.

MATERIAL AND METHOD

Choice Tests on Familiar and Nonfamiliar Objects

Since the tests were changed more often as the babies grew older, it was not worth while to have the record blanks printed. A four-page folder on which the appropriate headings were written in longhand was used. In

the first choice test an object that was very familiar to the baby, such as his own rattle or toy, was paired with an unfamiliar object, such as the ear specula, or a partially familiar object, such as the cup or tape. The longhand form provided the usual heading, including the setting of the examination and the initials of the recorder. The name and position of each set of objects was written as a heading for each subtest, and along the left margin time intervals of from zero seconds to 5 minutes were listed in 15-second intervals. Thus twenty-one records of the baby's behavior were taken in each 5-minute choice period. At the end of each subtest space was provided for a behavior summary under the headings of activity, attention, manipulation, and distractions. Choice test I contained three 5-minute choices between two objects, and four additional tests of motor development, with the usual behavior summary, notations of observers, and items of interference during the examination appended. Choice test II contained four 3-minute choices among three objects.

Color and Form Choice Tests

The objects used for these choice tests were wooden blocks painted in the four primary colors, red, yellow, green, and blue. There were four forms of the blocks, a cube of one-inch dimensions, a cylinder an inch in diameter and an inch long, a sphere an inch in diameter, and a wooden curtain ring about two and a quarter inches in diameter and three-eighths of an inch in thickness. In the color test the four cylinders, one of each color, were hung up for the first three-minute choice; they were followed by the four cubes, the four spheres, and the four rings. The position of the colors was

varied as each new group was hung up, so that each color was once on the extreme right, once on the middle right, once on the middle left, and once on the extreme left. In the form choice test color was kept constant, and the form was varied within each test. After the intervals of choices and while the baby was still seated in his high chair, the bell was rung and offered to him to see whether he would ring it. This test lasted a minute. The examinations ended with the usual motor tests for rolling, creeping, walking, and pulling to stand by a chair.

Special Apparatus

Throughout the choice tests the baby was in a sitting posture. In most homes he was seated in his high chair, tied oranchored with a strap and, for the first time or two, propped with a pillow at his back. In a few cases toilet chairs were used instead of high chairs. Infrequently, if the family did not have a high chair, the baby was seated on the davenport or in his carriage, and very rarely, if the baby was fussy, he was allowed to sit on his mother's lap. In front of the baby's chair was placed a photographer's screen stand with a heavy metal base and a rod capable of being extended to a height of five feet. A gooseneck extension was screwed into the upright rod, and a heavy wire frame sixteen inches square, strung each way with light steel cross wires two inches apart, was soldered into the gooseneck. This apparatus was likened to a toaster by the mothers and is referred to in the records as the "grid." From this network the objects were suspended. To each toy was tied or sewed an eighteen-inch length of one-half inch cotton tape, and to the other end of the tape was sewed a loose-leaf notebook ring. The objects were

then quickly hung on the grid by clamping the notebook ring at the intersection of the fine wires. When two objects were used, they were fastened six inches apart; when three or four were used, they were fastened four inches apart. The gooseneck was then bent so that the objects dangled about eight inches in front of the baby's nose and about two inches above his high-chair tray. The objects, thus presented, could be handled by the baby, brought to his mouth, and manipulated with ease; they could not fall or be thrown to the floor and could not get out of reaching range. They swung slightly and were therefore somewhat harder to obtain than if they had been stationary.

Arrangement of the Toys

For the first choice test, which was given at 25, 27, and 29 weeks, three groups of toys were hung up for 5 minutes each, and twenty-one reactions to each set of toys were recorded. The toy groups were:

Group 1. cup (aluminum measuring cup), right; ear specula, left

Group 2. tape, right; rattle, left (baby's favorite toy; sometimes a small doll, a toy animal, or a string of spools to replace the rattle)

Group 3. rattle, right; cup, left

In the second choice test, given at 30 and 31 weeks, the four groups of toys, each of which was offered for 3 minutes and from which thirteen 15-second records were obtained, were:

Group 1. cup, right; ear specula, middle; tape, left

Group 2. ear specula, right; cup, middle; rattle, left

Group 3. tape, right; rattle, middle; ear specula, left

Group 4. rattle, right; tape, middle; cup, left

The objects for the color choice test, which was given at 33 and 46 weeks, were:

Group 1. cylinders: blue, right; red, right center; green, left center; yellow, left
Group 2. cubes: green, right; yellow, right center; blue, left center; red, left
Group 3. spheres: red, right; green, right center; yellow, left center; blue, left
Group 4. rings: yellow, right; blue, right center; red, left center; green, left

The same objects for the form choice test, given at ages 34 and 47 weeks, were arranged as follows:

Group 1. green: sphere, right; ring, right center; cube, left center; cylinder, left
Group 2. yellow: ring, right; cube, right center; cylinder, left center; sphere, left
Group 3. red: cube, right; cylinder, right center; sphere, left center; ring, left
Group 4. blue: cylinder, right; sphere, right center; ring, left center; cube, left

Note-Taking Procedure

The records on these tests were kept by both B and S. Both stood (or sat on the floor if the baby was in a low chair) about two feet in front of the baby, and one planted a foot firmly on the metal base of the stand in order to prevent it from rocking or being pulled over in case the baby's play became vigorous. The objects were swung into place in front of the baby, and S started the stop watch. Both observers attempted to record the activity of the baby's right hand, the activity of his left, the direction of his attention, and his vocalizations at each 15-second interval. This was indeed a difficult task. Many of the babies who carried

on two or three activities with each hand within a single 15-second period far exceeded the note-taking speed of the observers, and in consequence the observers formed the habit of glancing at the baby as the watch crossed each 15-second mark and devoting the rest of the interval to writing what they saw, ignoring any acts of the baby in between times. This method was subject to many errors, and it was for the sake of discovering whether the records were at all consistent that two records were kept.

Consistency of the Records

Forty-five of the records taken by B were compared with the corresponding records taken by S. Since notes were taken at 15-second intervals throughout the entire examination and since the activity of right and left hands was recorded separately, there were more than a hundred items for comparison on each record. The records of B were scored in terms of those of S by computing percentages for (1) identical items; (2) items in which the two recorders differed as to the object in the baby's possession; (3) items in which they differed as to the baby's manipulation of the object (i.e., B's record read "chews block," whereas S's read "bangs block on tray"); (4) items omitted by B but included by S; and (5) items included by B but omitted by S. Table XXIX gives the results of this comparison, and a sample page of the notes each observer recorded is presented in Appendix 4.

On the average, more than 70 per cent of the items were identical; the percentage of identical items was practically the same for both groups of records and for both right and left hands. The two recorders differed as to the object held by the baby in less than 5 per cent

of the items, and they differed as to the manipulation of the object in from 6 to 7 per cent of the items. These differences were perhaps due to slight differences in timing and to speed in note-taking. Both examiners used the same watch, but jotting down notes at 15-second intervals became more and more difficult as the minutes wore on, and often a difference of one second in the time at which the two observers glanced at the baby made a difference in the reaction observed.

TABLE XXIX

CONSISTENCY OF THE RECORD-TAKING
(B's Records Scored in Terms of S's)

No. of Records Scored	No. of Items per Record	Percentage of: Identical Items		Difference in Object		Difference in Manipulation		Omissions by B		Extra Items by B
		Right	Left	Right	Left	Right	Left	Right	Left	
22....	126	76.0	73.0	2.6	3.6	6.5	7.8	14.0	12.7	6.0
23....	104	73.7	69.0	4.0	5.9	5.5	7.3	19.7	19.3	5.0
Average...		74.8	71.0	3.3	4.7	6.0	7.5	16.8	16.0	5.5

The largest discrepancy between the records of the two observers was in B's omissions. Several reasons adequately account for the fact that B's records were less complete than those of S. In the first place, S had done the record-keeping from the beginning of the study and consequently had worked up a good speed in note-taking. B, on the other hand, had always handled the baby and therefore had no preliminary training. Furthermore, the baby sometimes scooted down to an uncomfortable position in his chair or jerked at the tapes so vigorously that he pulled the grid out of position. In such cases B stopped her note-taking long enough to rescue the baby or reset the

apparatus. It is not surprising, therefore, that B omitted 16 per cent of the items recorded by S. B's omissions were somewhat offset by 5.5 per cent of extra items that were omitted by S.

In consideration of the complexity of the record-taking and the fact that the notes were kept in long-hand and were written in descriptive terms, 70 per cent consistency is very good. Since the records of S were more complete than those of B, they alone were used in the subsequent analysis of the data.

Methods of Scoring

According to reactions. — Since the baby's method of handling the objects seemed more important than his choices, the various types of reactions were tabulated under the following heads: hold tray of high chair, finger tray, pat tray, scratch tray; reach for object, hold object, swing object, bang object, finger object, reach for rack, no reaction; chew object, hold cup as if for drinking, reach for object with the mouth, chew hand. These categories were somewhat large and indefinite and did not allow for detailed descriptions of each baby's manipulation, but some classifications had to be made in order to permit the material to be handled at all.

The scoring proceeded by counting and recording for each subtest the number of 15-second intervals during which the baby manifested each type of reaction. Each hand was scored separately. Thus the scores: reach, R 1, L 2; hold object, R 9, L 1; bang, R 2, L 1; no reaction, R 1, L 2, indicate that during a 3-minute test, when thirteen records were taken at 15-second intervals, the baby's right hand reached for an object at one interval, held the object for nine intervals (not neces-

sarily nine in succession), banged the object for two intervals, and did nothing for one interval. The scores for the left hand are to be interpreted similarly. The scores for the subtests were summed and the sums converted into percentages, the total number of 15-second intervals of record-taking being considered as the basis for the percentages.

According to appropriateness of manipulation. — Another type of scoring, somewhat less objective than scoring by reactions, since it depended to a greater extent on the interpretation of the scorer, was called "manipulation appropriate to the object." If the cup was held and banged or fingered, the manipulation was not considered appropriate, but if it was held by the handle or held to the mouth as if for drinking the reaction was considered appropriate. Other types of appropriate manipulation were shaking a rattle, talking to or cuddling a doll, and pulling out the tapeline. This type of scoring was used only in the first five tests, in which familiar objects were given to the baby; there was no appropriate manipulation possible for the little blocks used in the color and form test.

According to objects. — In order to determine whether the baby showed a preference for one particular toy, each subtest was scored according to the objects presented. In addition to the two or three test objects that were hung on the rack, the tray of the high chair was also listed as an object, since the babies often reacted to it in a very positive way.

According to similarity and diversity of the reactions of both hands. — The term "similarity" was applied to reactions in which both hands were engaged in reacting to the same object, and it was recorded by counting the number of intervals in which both hands held or ma-

nipulated the same toy. "Diversity," on the other hand, was recorded for every interval in which the baby reacted to two different objects with his two hands. Similarity and diversity were recorded only when both of the baby's hands were engaged in some reaction to an object. If one or both of his hands were lying passively on the tray neither similarity nor diversity was recorded.

According to changes. — Although records of the baby's reactions were taken at 15-second intervals, very often no significant change in his behavior occurred for several intervals. In this case his reactions were scored according to the number of changes in the objects reacted to during each subtest.

According to attention. — The direction of attention was recorded at almost every 15-second interval. This was scored under six heads: attention to the object before it was taken, attention to the object while it was being held, attention to an object that was neither reached for nor held, attention to the examiners, attention to other people who were watching the examination, and looking around the room.

According to length of holding objects. — The length of time the baby held each object before dropping it was recorded in seconds separately for each hand. The total number of periods of holding the objects, and the longest, shortest, and median length of time the objects were held were computed.

According to general summary of reactions. — At the end of each subtest the observer rated the activity of the baby on a three-point scale under the heads random, directed, or purposeful. Attention was summarized as slight, intermittent, or absorbed. Manipulation was classified as exploratory, absent-minded,

or banging, and the amount of distraction from outside sources was recorded as none, once or twice, four or five times, and most of the time.

DESCRIPTIONS OF THE REACTIONS TO THE CHOICE TESTS

Under the item holding the tray were classified all purely passive reactions to the chair tray, such as holding the edge of the tray or letting the hand lie passively on it. Fingering the tray was an exploratory reaction in which the tray was felt or gently rubbed with the fingers. Scratching and patting the tray were active reactions in which the tray served as a toy; these reactions were indulged in probably because the babies enjoyed the noise they made.

Reaching for the object was an active reaction with grasping it as the goal. This reaching was not without variations in quality. Sometimes it was recorded as random reaching; often the baby reached and missed the object repeatedly. Frequently the record read "seized toy immediately," a phrase that implied not only skill but speed. In handling the records it was impossible to take into consideration all these variations under the one head.

Holding the object was in some respects a more clear-cut reaction, but it, too, had many variations. For the most part it was a passive reaction as compared to the active reaction of reaching, and yet it represented greater skill, since repeated reaching meant that the object was repeatedly dropped, whereas prolonged holding meant that once the baby grasped the toy he kept it. Sometimes the object was held by the string and sometimes by the handle, occasionally it rested on the edge of the tray, sometimes it was held to the face or

mouth, and on rare occasions it was held in the mouth. Often the toy was held in one hand and fingered or banged with the other.

Swinging the object, a general category for gentle manipulation of a random character, was an active reaction in which the baby hit the dangling objects and they swung. If the baby hit one object accidentally while reaching for another, swinging was not recorded. Some babies seized the objects and swung them back and forth with great glee. Such reactions apparently were purposeful. Any other gentle manipulation, such as pushing or pulling the object, was recorded under this head.

Banging the objects was a general classification for rough manipulation of a random character. It was an active reaction in which the baby hit the toy on the tray or hit one toy with another. Any other rough manipulation, such as jerking, slashing, or batting the object, came under this head. These reactions were particularly characteristic of some babies.

Fingering the object was a general category for exploratory activity and included all exploration, such as rubbing, feeling, or turning and examining the object.

Reaching for the rack was a very definite reaction in which the baby looked and reached for the rack, which was about twelve inches above his head. This reaction occurred only a few times.

Transferring the object from hand to hand was an advanced type of reaction. Frequently the object was transferred from right to left and back again several times in the space of fifteen seconds.

Reactions with the mouth. — The mouth participated in the babies' reactions almost as actively as did the hands. Chewing the object included also the reactions

of licking. Drinking from an object was a reaction in which the cup was held to the mouth in the proper way, and the baby smacked at the brim as if he were drinking. Often the babies reached with their mouths for a dangling object. This usually occurred before they were successful in reaching with their hands. Chewing the fist was also a common reaction.

Types of manipulation not specifically recorded. — In the general classification it was quite impossible to provide categories for many of the interesting types of manipulation that occurred. They will merely be described here in passing, with no tabulation of the frequency of their occurrence. Most of these reactions occurred more than once and were performed by more than one baby, but they were of too infrequent occurrence to warrant special treatment.

The cup was frequently held with the fist doubled up inside of it. Sometimes it fell off the tray to one side or the other, and the baby got it again by reaching over the side of the tray for it. Sometimes the object, especially the cup, was licked with the tongue as it swung past. Now and then an object was caught between the head and the back of the chair and thus held until the hand could reach for it. The tape was frequently taken out of the mouth, scrutinized, put back in the mouth, taken out and reexamined, and so on time after time during the course of a test. The ring was often held with the arm thrust through it. Frequently the baby reacted to the strings by which the toys were suspended rather than to the toys themselves. The strings were twisted and chewed. Sometimes the baby reached hand over hand up the string, after the manner of a gymnast climbing a rope. A button was sewed to the end of each tape on which a block for the color or form test was

strung. The button was also reacted to as an object; most often it was chewed, but sometimes it was held in one hand or in the mouth while the fingers of the other hand slid the block up and down the string. Now and then a baby found the hole in the block through which the tape passed and investigated it by poking his finger in it.

Often the baby scooted about in his chair or leaned to the side, sometimes so far that both hands held the same arm of the chair. Frequently he lifted the tray of the chair with his feet or knees. Now and then a very active baby would not sit still but climbed and stood upright on the chair. If such activity was persisted in, the examination had to be discontinued.

DEVELOPMENTAL SIGNIFICANCE OF THE CHOICE TESTS

These choice tests were designed to bring out the individual characteristics of each baby rather than to show the development of the group. Consequently it was desirable that the tests lack developmental significance rather than that they possess it, since developmental trends probably would have operated to obscure individual characteristics. If the tests revealed developmental trends, one would expect them to appear in the reactions rather than in the choices made by the babies. A priori one would expect passive holding of the objects to decrease and active manipulation to increase with age. One would also think that the baby's reactions would become more appropriate as he grew older, that his reactions would become more diverse, but that his attention would be more firmly fixed on the objects at hand and less easily distracted by outside sources. Accordingly, an average for each type of reaction at

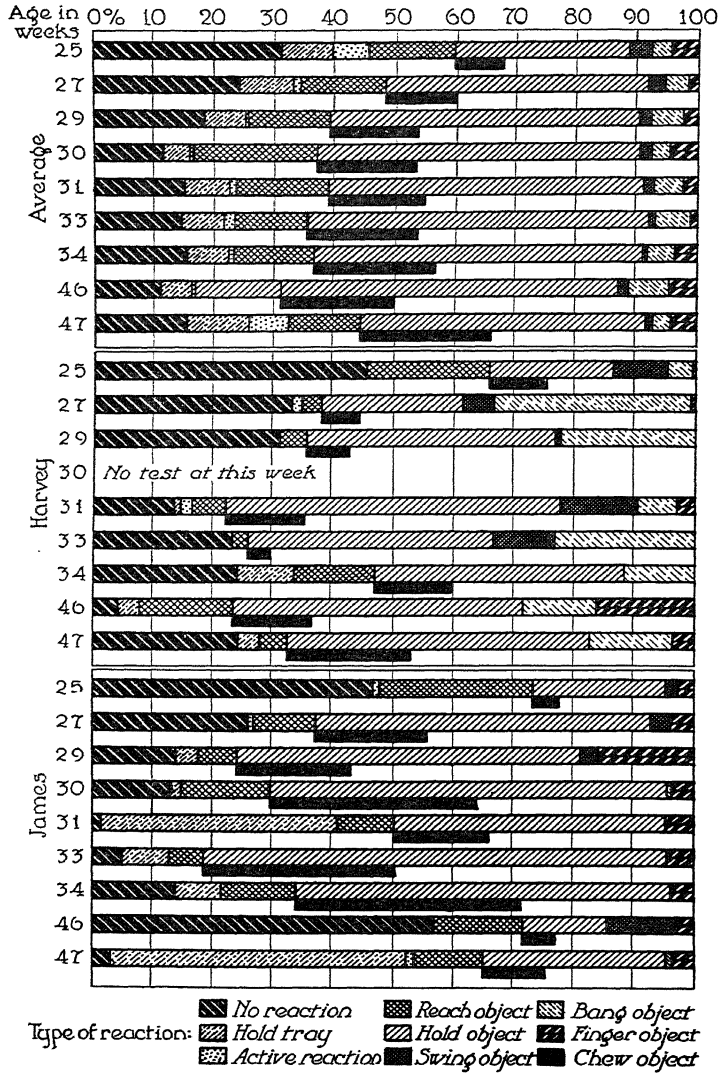
each age level was struck in order to discover whether any reactions had developmental significance. These averages are expressed graphically in Figure 15.

It is apparent from the chart that the reactions have no developmental significance whatever beyond the 30th week. Two types of reactions appear to have developmental significance at 25, 27, and 29 weeks, namely "holding the object," which increased with each successive test, and "lack of reaction," which decreased at each successive test. Passive reactions to the chair tray and active ones as well showed very little change throughout the entire period. The amount of reaching was about the same at each age level; this seems to indicate that the very nature of the test made it necessary for the child to spend from 12 to 15 per cent of his time in reaching for objects. It is possible, on the other hand, that this uniformity of the reaching reaction is a function of the method of record-taking rather than a true measure of the relative time spent in reaching. In the early ages, when the child repeatedly reached and missed the object, an entire 15-second interval was often devoted to reaching. Later, however, if reaching occurred at the beginning of a 15-second interval, it was recorded as if it were the only reaction occurring in that interval because of the limitations imposed by the examiner's speed of note-taking. As a matter of fact, if the length of time actually spent in each act of reaching had been recorded, it might have been found that the amount of time spent in reaching diminished with age. Contrary to armchair predictions, passive holding of the object did not give way to active manipulation of it as the child grew older.

On the surface, chewing of the object seemed to show rather a consistent developmental change, for the

FIGURE 15

REACTIONS TO THE CHOICE TESTS



babies chewed the objects more as they grew older. But chewing the object presupposed holding it. When the amount of chewing was expressed as a percentage of the amount of holding, very little development was shown. In general, the object was chewed about a third of the time it was held. Reaching with the mouth occurred more frequently at 25 and 27 weeks than at any other time. On the average this reaction occurred about one time per baby at each examination.

Similarity and diversity likewise showed slight developmental trends during the early weeks (see Table XXX). The amount of time during which both hands held the same object increased up to 31 weeks, then decreased and remained at the same low level at the four remaining ages. This decrease in the similarity score may be explained in part by the fact that the objects in the earlier choice tests were rather large (the cup, rattle, and tape) and probably could be held and manipulated better with both hands than with one. The small blocks used in the later tests, however, could easily be held in one hand, and they were likely to call forth less elaborate exploration and manipulation. Diversity (i.e., when the two hands were simultaneously reacting to different objects) increased during the early weeks and remained practically constant after 30 weeks.

The frequency of change from one object to another varied less with age than did any other function. Throughout the entire period the babies accepted about one-third of their opportunities to change. Appropriate manipulation occurred so infrequently that one is hardly justified in striking an average. The same statement is true for the transferring of the object from hand to hand. But neither of these reactions showed de-

TABLE XXX

AVERAGES OF REACTIONS TO CHOICE TESTS IN PERCENTAGE

REACTION	AGE IN WEEKS								
	25	27	29	30	31	33	34	46	47
Right and left hands similar	9.6	13.2	13.9	14.8	15.7	6.9	8.9	6.1	8.1
Right and left hands diverse	8.1	9.4	13.4	21.4	16.1	23.4	21.9	28.1	21.2
Changes	31.2	29.4	30.6	39.9	36.4	27.7	34.5	33.3	33.1
Appropriate manipulation	2.9	2.9	2.9	.6	1.1	...	...	...	...
Transfer from hand to hand	.8	.2	.8	.6	.7	.4	.1	.5	.5
Attention									
To object before reaching	1.4	4.6	5.8	12.3	7.1	10.1	9.1	10.0	9.2
To object while holding	5.1	11.5	14.9	20.8	18.2	19.3	19.0	17.0	16.0
To object not held	2.1	3.2	2.7	8.6	9.8	9.6	7.6	4.6	5.2
To examiners	11.0	15.7	18.1	18.1	14.9	17.1	20.9	20.2	19.7
To audience	2.3	2.0	4.0	6.1	3.1	10.7	15.0	8.4	10.1
Look around	4.5	8.0	11.8	10.9	16.9	18.3	22.7	14.5	14.8
No record	72.0	48.9	38.7	21.6	28.6	14.2	10.2	21.7	17.7

velopmental trends. The length of time an object was held increased during the early weeks, and then, like the other functions, showed no change during the rest of the testing period.

The same lack of developmental significance after the age of 30 weeks was shown in the records of attention (see Table XXX). Attention to the object before it was reached for and while it was being held increased with age up to 30 weeks and remained constant thereafter. From 30 to 34 weeks there was a slightly greater tendency to pay attention to objects that were neither reached for nor held than there was previous to these ages. The amount of attention paid to the examiners varied little after the first test, whereas the amount of attention paid to the audience and the amount devoted to looking around increased rather consistently up to 34 weeks. By 46 weeks the examination probably had lost some of its attention and interest value for the babies. Again the experimenter's memory of the attitudes of the babies in the last two tests led her to expect their indifference to show up more clearly in the data.

Finally, almost no developmental trends appeared from the analysis of the summaries written at the bottom of each subtest (see Table XXXI). Random and directed activity gave way slightly to purposeful activity at 30 and 31 weeks. Manipulation became somewhat more exploratory and less absent-minded or inattentive as the babies grew older. The amount of distraction from outside sources changed little with age, and attention, according to the ratings, became more absorbed as the babies grew older.

Developmental Significance of Handedness

Another a priori assumption that the data failed to support was that the babies showed greater proficiency

TABLE XXXI

SUMMARY RATINGS ON CHOICE TESTS IN PERCENTAGE

REACTION	AGE IN WEEKS								
	25	27	29	30	31	33	34	46	47
Activity									
Random	37.5	25.8	20.0	9.7	11.1	20.3	37.5	13.9	6.9
Directed	51.7	55.0	61.5	58.5	51.5	59.0	52.5	58.5	76.5
Purposeful	8.9	19.0	18.5	30.3	37.4	20.3	10.0	37.8	16.7
Attention									
Slight	28.6	19.0	17.0	4.4	9.7	16.2	25.0	13.9	18.0
Intermittent	28.6	39.6	37.0	29.4	29.1	35.2	35.0	27.9	12.5
Absorbed	42.9	41.4	46.1	60.5	61.0	48.5	40.0	58.5	69.5
Manipulation									
Exploratory	23.2	36.2	35.4	54.5	46.0	59.0	44.0	34.8	57.0
Absent-minded	48.2	34.5	43.0	23.5	25.0	23.5	47.5	34.8	32.0
Banging	19.6	24.1	21.6	14.7	29.2	11.7	8.7	30.6	11.1
Gentle	5.3	1.7	3.1	...	...	...	...	...	...
Chew	...	...	...	23.5	16.6	36.5	22.4	47.5	54.0
Distractions									
None	64.2	62.0	71.0	93.0	87.5	88.0	87.5	86.0	85.0
1 or 2	19.6	22.4	21.6	7.3	9.7	10.3	6.2	8.3	13.9
5 or 6	5.3	8.6	4.6	0.0	2.8	0.0	6.2	5.5	0.0
Most of the time	10.7	5.2	3.1	0.0	0.0	1.5	0.0	0.0	1.3

with the right than with the left hand. This greater efficiency, it was thought, would show up in a greater number of passive reactions with the left hand and a larger proportion of active reactions with the right. The relationship was not a simple one, however. At the time the tests were given and later during the analysis of the records it seemed that in the early weeks the skilled hand grasped and held the objects for a long time, whereas the unskilled hand made passes at the objects that resulted in swinging or banging. As the baby grew older he seemed to use the skilled hand for exploratory manipulation and the unskilled one for holding the object. Finally, when the child outgrew the test and found it boresome, he held and manipulated the objects much less than he did at the earlier ages, when he was highly interested.

The averages in percentages for the two hands separately, which are presented in Table XXXII, give a little evidence that such development of handedness occurs. In the early weeks slightly more reaching, swinging, banging, and fingering was carried on with the left hand and somewhat more holding was done with the right. Changes with the left hand occurred somewhat more frequently, and the length of the holding period was greater for the right hand.

Even though the results are not so outstanding as the experimenter had expected them to be from her observation, the possibility that handedness is a developmental item of importance cannot yet be ruled out. Two factors may account for the fact that the average scores confirm the observations to so slight a degree. In the first place, there was one baby who was definitely left-handed at the age of 2 years, and there were others who showed a tendency toward a preference for the

TABLE XXXII

AVERAGES OF THE VARIOUS TYPES OF REACTION TO CHOICE TESTS IN PERCENTAGE
(Each Hand Separately)

REACTION	AGE IN WEEKS																	
	25		27		29		30		31		33		34		46		47	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
No reaction	18.0	14.4	11.2	13.2	8.8	9.8	4.4	7.4	6.8	8.1	5.4	8.8	7.9	8.1	4.9	6.1	7.1	8.1
Passive reaction to chair tray	3.6	5.3	4.4	4.4	2.6	2.8	3.3	1.6	3.1	4.5	3.9	3.3	3.4	3.8	4.3	1.0	5.8	5.3
Reach for object	6.6	8.1	6.7	6.6	5.9	7.3	9.9	10.8	7.7	7.9	6.6	5.9	6.5	6.9	7.0	8.3	5.0	6.9
Hold object	14.9	12.8	23.4	18.1	27.7	24.1	28.4	24.8	27.1	25.1	27.8	27.8	28.2	26.2	27.6	28.5	26.3	21.2
Swing object	1.5	2.0	1.3	1.9	.6	1.2	.7	1.0	.9	.8	.5	.6	.4	.3	1.5	1.2	.4	.7
Bang object	1.5	1.6	1.7	1.6	2.4	2.5	1.1	2.1	3.1	2.3	2.4	3.3	2.2	2.3	2.6	2.9	.6	2.1
Finger object	2.5	3.0	1.2	1.6	1.7	1.7	1.8	1.9	1.1	1.0	.9	.4	1.1	1.3	2.1	2.3	1.2	2.5
Changes	13.2	17.6	12.8	16.6	14.1	16.2	19.6	20.8	18.5	17.8	13.4	12.7	15.4	19.1	16.0	17.0	15.3	17.3
	AVERAGE TIME OF HOLDING IN SECONDS																	
Median	29.2	26.5	44.1	32.1	37.2	39.4	36.8	27.8	25.3	26.6	47.7	34.0	44.7	26.5	24.4	28.0	32.4	34.9
Longest	126	93	173	129	185	161	119	119	116	104	133	132	125	119	125	136	133	112

left hand. In such cases the right hand should be considered the unskilled hand. In the second place, it must be remembered that although the babies were equal in age at the time of these tests, they were far from equal in skill at reaching. Even though all the babies may have passed through the same stages of skill with the two hands, each baby set out from his own level of proficiency and traveled at his own rate of speed. These two factors would very effectively mask any developmental trends inherent in the data. A careful scrutiny of the series of records for each baby is the only method for obtaining evidence on this point.

The position of the object, however, predetermined to a great extent which hand reacted to it (Table XXXIII). The object at the extreme right was more often reacted to by the right hand, and that at the left was more often reacted to with the left hand, whereas the objects in the middle were reacted to about equally with both hands. The tendency, then, was to react with the convenient hand, and this tendency increased as the babies grew older. In the early weeks the babies reacted about twice as often with the convenient hand as with the inconvenient, and at 46 and 47 weeks they reacted almost four times as often with the convenient hand. Adults, on the other hand, probably reach more frequently with the preferred hand, provided the object is not entirely out of range of that hand.

Developmental Significance of the Choice of Objects

Preference for toys. — A priori it seemed logical that development would be shown by the refinement of the baby's reactions to the object. It did not seem logical that development would influence the baby's choice of

TABLE XXXIII

INFLUENCE OF THE POSITION OF OBJECT ON THE HAND REACTING TO IT

AGE IN WEEKS	OBJECT AT EXTREME RIGHT		OBJECT SECOND FROM RIGHT		OBJECT SECOND FROM LEFT		OBJECT AT EXTREME LEFT	
	Right	Left	Right	Left	Right	Left	Right	Left
25	56.9	30.9	...	...	...	...	24.3	53.2
27	65.6	29.7	...	...	...	...	35.2	64.4
29	83.0	42.6	...	...	...	...	30.4	66.3
30	83.1	26.1	49.3	47.5	...	...	26.0	93.0
31	80.9	31.1	40.5	55.6	...	...	26.3	51.9
33	119.5	35.8	97.7	86.8	64.0	93.9	8.1	59.3
34	94.3	38.6	94.1	68.1	55.3	86.2	15.9	66.1
46	98.8	27.3	73.9	86.5	63.5	69.4	38.0	132.1
47	94.0	23.0	75.6	68.5	57.3	79.2	30.4	88.5

objects unless one object was more difficult to hold or manipulate than another. The evidence presented in Tables XXXIV and XXXV confirm this assumption. The average amount of reaction to any given object changed slightly from age to age, but the changes were not great nor consistent enough in direction to have developmental significance.

There was some agreement among the babies in their preference for certain of the objects in the test series and their indifference to others. At each age level and in each subtest in which the cup was presented to them the babies played with it most of the time. They much preferred it to the ear specula, perhaps because it was larger or more familiar. They also preferred it to their own rattles or similar toys with which they played every day. In general the tape was preferred to the rattle and was second only to the cup in value as a toy.

It is difficult to make any generalizations to account for the apparent preferences. If the babies had been choosing on the basis of familiarity, the rattle would have been their most frequent choice. If they had been choosing on the basis of bright colors or noise-making qualities, the rattle would also have been the most preferred toy, since the aluminum cup was dumb and dull in comparison to a musical pink rattle. Large size could hardly have been the basis for choice, since the rattle was usually as large as the cup, and the tape was always much smaller. The most plausible conclusion is that choice was based on the qualities in the object that made it good for chewing or licking. Rattles were somewhat hard to get into the mouth; usually they were round and offered no surface for biting. But the flat, slick tape was a bitable object; indeed, the whole of it could be put in the mouth. And the cup offered a thin

TABLE XXXIV

AVERAGES OF REACTIONS TO THE OBJECTS IN SUBTESTS I TO IV IN PERCENTAGE

TEST	AGE IN WEEKS				
	25	27	29	30	31
Subtest I					
Cup	40.7	37.6	52.0	35.1	34.7
Specula	10.7	18.6	23.2	16.6	13.5
Tape	....	....	....	24.3	20.3
Tray	13.7	16.5	9.6	4.3	12.6
String	0.0	0.2	0.0	0.0	0.0
Rack	0.0	0.0	0.1	0.0	0.0
More than one toy	0.9	1.1	0.3	8.4	4.5
No reaction	34.0	26.0	14.6	12.6	14.3
Subtest II					
Rattle	30.3	25.8	26.2	23.3	16.3
Tape	26.2	37.6	47.5	....	....
Specula	....	....	....	23.1	23.3
Cup	....	....	....	37.0	35.1
Tray	15.8	10.6	9.5	5.2	4.5
String	0.1	0.2	0.2	0.6	0.8
Rack	0.0	0.0	0.0	0.0	0.0
More than one toy	1.0	0.8	1.7	2.6	3.6
No reaction	26.3	23.9	15.0	10.0	16.0
Subtest III					
Cup	36.2	54.5	47.0	....	....
Rattle	20.8	20.1	26.4	19.7	23.2
Tape	....	....	....	34.4	36.0
Specula	....	....	....	15.3	11.3
Tray	12.1	4.0	8.7	8.2	11.3
String	0.0	0.0	0.2	0.0	0.4
Rack	0.0	0.0	0.2	0.0	0.0
More than one toy	1.7	1.7	2.4	6.8	3.8
No reaction	29.1	19.8	15.0	16.1	13.8
Subtest IV					
Rattle	....	....	....	16.0	17.5
Tape	....	....	....	23.2	24.0
Cup	....	....	....	58.1	30.0
Tray	....	....	....	3.8	3.6
String	....	....	....	0.0	1.1
Rack	....	....	....	0.7	0.0
More than one toy	....	....	....	2.4	5.4
No reaction	....	....	....	9.8	17.8

TABLE XXXV

AVERAGES OF REACTIONS TO COLORS AND OBJECTS IN PERCENTAGE

COLOR	AGE IN WEEKS					
	33			46		
	Right	Left	Both	Right	Left	Both
Blue.....	8.5	7.1	15.6	8.7	7.6	16.5
Red.....	8.8	7.1	15.9	7.5	10.7	18.2
Green.....	7.4	9.8	17.0	8.9	7.9	16.9
Yellow.....	11.8	10.5	22.2	9.0	12.9	21.9
OBJECT	AGE IN WEEKS					
	34			47		
	Right	Left	Both	Right	Left	Both
Sphere.....	6.7	7.0	13.6	10.8	8.9	19.7
Ring.....	15.5	12.2	25.8	8.7	9.0	18.0
Block.....	7.7	9.9	17.6	6.9	6.2	13.2
Cylinder.....	6.2	7.1	13.3	5.7	8.1	13.8

brim for chewing or drinking and a handle to thrust the tongue through.

Preference for colors. — Although thirteen weeks intervened between the first and second presentations of the color test, there was no reversal or alteration in the choice of colors. Indeed, the distribution of percentages among the four colors was almost identical for the ages 33 and 46 weeks (see Table XXXV). This indicates that the basis of choice, whatever it may have been, did not change during the interval between the two tests. Yellow was consistently the favorite at both ages. Red increased very slightly in popularity, but it shared almost equally with green and blue. The preference for yellow was undoubtedly due to its greater brightness. The colors were not matched in intensity because such colors are expensive and are obtainable only in paper form. The colors used in this test were

from a good quality of enamel paint that adhered to the small wooden blocks even after prolonged and repeated chewing by the babies.

In a recent well-controlled investigation of color preference in infants Staples (55) found that babies at the ages of from 6 to 9 months reached more often for red and yellow than for blue and green. By the paired comparison method she found that babies of these ages consistently reached for red in preference to yellow, green, or blue, for yellow in preference to blue or green, and for blue in preference to green. Since she used paper discs matched in brightness, her results are considerably superior to these from the standpoint of research on color vision.

Preference for forms. — The preference for forms was not so consistent as that for colors at the two age levels. The ring, which held first place by a large margin at the age of 34 weeks, was slightly less preferred than the sphere at 46 weeks. The block and cylinder were less popular than the ring at both ages. Here again the "chewability" of the objects was probably the reason for the choice. The ring was more easily grasped at the early ages, and once it was caught it was suitable for chewing. The age-old teething ring now has scientific evidence to back it up! But the sphere probably presented the greatest number of qualities that made it delightful to chew. It was easily grasped in the whole fist and had no harsh corners or edges to cramp the fingers. Furthermore, it was so small (one inch in diameter) that the whole of it could be held in the mouth and rolled about with the tongue.

Summary. — The tests as a whole, therefore, had practically no developmental significance, either in the reactions they called forth or in the choices they elicited.

If the tests were to be used as an instrument for measuring the individual characteristics of each baby, lack of developmental significance was to be desired. The tests did meet this requirement. It remained to be seen whether they served as a good instrument for measuring individual characteristics.

INDIVIDUAL CHARACTERISTICS MEASURED BY CHOICE TESTS

In his interest and attention during the choice tests and in his manipulation of the toys that were hung before him each baby differed from every other. These differences were much easier to observe than they were to record. To get just the right descriptive phrase for each reaction of each baby would have taxed the vocabulary of a Shakespeare; to write four such phrases each minute of a twelve-minute test would have required the speed of a shorthand expert. In both these accomplishments the observer was sadly deficient; her best efforts consisted in jotting down the most apt descriptive phrase that occurred to her at the moment, in the hope that it would serve to recall the baby's reaction when she worked up the data later. For this reason considerable classifying of reactions had to be done as they were recorded. Later, in order to treat the material statistically, more classifying was necessary. Needless to say, classification works to obscure individual characteristics; therefore, any particular characteristics that stand out in spite of the classifications must be strongly individualistic.

Descriptions of Individual Reactions

Included in Figure 15 (page 198) along with the chart for the average of each type of reaction are two samples

of the individual charts that were made out for each baby. The characteristic reactions of individual babies appear very clearly on these charts, but since it is impossible to include all of the charts, the reactions of each baby will be described briefly.

WINIFRED. — The reactions of Winifred showed a strong developmental trend at the first three ages tested; it was manifested in decreased reactions to the chair tray and increased holding of objects. Her activity was usually random or directed but seldom seemed purposeful, even though her attention was absorbed. Her manipulation was gentle, and frequently she played with the objects absent-mindedly. She chewed the objects somewhat less than the average baby. Her tests at 31, 33, and 34 weeks were missed because of illness in her family. In her final test at 47 weeks boredom was indicated in numerous reactions to the tray.

WILLIAM FREDERICK. — Fred, the twin brother of Winifred, likewise showed a slight developmental trend by decreased reactions to the tray and increased reaching during the first three tests. In the earlier tests he held the objects somewhat less frequently than the average baby in the group, but active reactions, particularly those of swinging and banging, were more pronounced in him than they were in the others. He was almost free from chewing reactions during the early ages, but he developed them before the last two tests. His activity was usually classified as directed and sometimes as purposeful. His attention was generally absorbed. During the first test he was very deliberate and lackadaisical. Gentle manipulation soon gave way to banging, and banging in turn to exploratory manipulation.

The development that took place during the first three tests with these twins is perhaps to be explained by the fact that they were premature babies and had not caught up with the rest of the group at 25 weeks. They were not quite able to keep their balance in the high chair and reach at the same time. This probably accounts for their greater attention to the tray at the early ages.

CAROL. — Carol was more proficient than the average at the beginning of the choice tests, and as a rule she was eager and interested throughout the tests. She made very few reactions to the tray, and she reached for and held the objects more frequently than did the other babies. She chewed the objects about as much as the average baby. Her activity was never described as random, but always as directed or purposeful, her attention was absorbed, and her characteristic manipulation was chewing. At 46 weeks she climbed to a standing posture in her high chair between the subtests while the objects on the rack were being changed.

DORIS. — At the outset, Doris was also superior to the group in reaching and holding. Banging was her characteristic manipulation, and she chewed the objects very frequently. Her activity was usually random or directed, and her attention was intermittent.

DAVID. — David was likewise proficient in the test at the beginning and showed no development as he grew older. He surpassed the group in the amount of time spent in reaching and holding the object. His manipulation was generally gentle and exploratory. His activity and attention were usually good. The amount of chewing increased somewhat as he grew older.

DONOVAN. — A very marked developmental tendency during the first three tests was shown by Don in his increased holding of objects. His manipulation was chiefly random activity and banging. He did considerably less chewing, and the amount of chewing decreased rather than increased with age. A severe illness during his 30th and 31st weeks made it necessary to skip several records.

HARVEY. — The reactions of Harvey were the most unusual and individualistic of any of the babies observed (see Figure 15, page 198). He had a somewhat larger percentage of refusals to react than the average, but he surpassed all babies in the amount of swinging and banging of toys. His characteristic reaction was to seize one toy and jerk and swing it back and forth, hitting the other toys with it and thus mak-

ing them swing, until the strings of all the objects were hopelessly twisted and tangled. All the while he watched and smiled with glee. He did very little chewing of objects.

JAMES D. — A strong developmental trend was shown by Jimmy in the early weeks. At three later ages of testing the large percentage of no reactions and passive reactions to the tray probably indicated a lack of interest in the tests. His manipulation was characteristically gentle and deliberate. The chewing reaction increased up to 34 weeks but was on the wane at the time of the last two tests. His chart presents an interesting contrast to that of Harvey (see Figure 15).

IRENE MAY. — Irene May showed great inability during the early weeks by a high percentage of no reactions and a large number of passive reactions to the tray. In her case development apparently did not cease before 34 weeks. Her manipulation was rough and random, and she chewed objects about as much as the average baby.

LARRY. — Although Larry showed no developmental trend in the early weeks, he reached considerably more than the average of the group, a fact that seemed to indicate that he was a bit unsteady in his holding of toys. His manipulation was usually gentle and exploratory, and he chewed the objects very little until the last two tests.

MARGARET. — The reactions of Margaret showed a slight developmental trend; her manipulation varied as to type, but chewing the objects predominated.

MARTIN. — Great apathy toward the toys characterized the reactions of Martin. In the early weeks he did not take the toys at all; later he took them and held them with practically no manipulation and no chewing. Martin's indifference to the toys is to be accounted for by his great physical energy and his delight in muscular activity. He was one of the children who were most difficult to keep sitting in the high chair. He wriggled free from straps and bands with which the examiners tied him in the chair or slumped down in his seat and paid no attention. He often reached and jerked at the rack. At these ages his only delight was in strenuous play

that exercised the large muscles of the body. Incidentally, he was the first baby to creep and one of the first to walk alone. (See Volume I, pages 148–150.)

QUENTIN. — In great contrast to Martin, Quentin was a very docile and quiet baby. He was similar in many respects to Larry in that he showed no developmental trend, but his more frequent reaching indicated slight unsteadiness rather than inability. He frequently reached and held and dropped two or three objects during every fifteen-second interval. His manipulation was gentle, and he was very persistent and very absorbed in his attention. His activity was never random but always directed toward the object. He had a high percentage of chewing reactions.

VIRGINIA RUTH. — Virginia Ruth's early reactions seemed to indicate that development took place in the early weeks, but her first few tests were marked by lack of interest and irritability. In general her reactions consisted of the passive holding rather than the manipulation of objects. She paid very little attention to the tests and frequently spent most of her time in watching her mother and sisters, who usually observed the tests. She did much less chewing of objects than did the other babies.

SIBYL. — Sibyl, who was very proficient at reaching and who was, in general, somewhat in advance of the other babies, showed very few characteristic reactions to the choice test. She frequently lacked interest in the test and watched the examiners while she absent-mindedly fingered the toys. Chewing reactions were pronounced.

MAURICE. — Maurice was very lazy and apathetic during most of the tests. Like Virginia Ruth he often fussed so much that the test had to be discontinued, and like her he did very little chewing.

TOREY. — Torey showed a marked developmental trend in the early weeks. He did more reaching than the average and also manipulated the objects a great deal, usually in a gentle way. His activity frequently seemed purposeful, and his attention was usually absorbed. His chewing reactions in-

creased with age. He was a very friendly baby; on one occasion it is recorded that he tried to get the examiners' attention by repeated "achs" and gurgles, but since they ignored him completely he at last began to play with the toys. At another test he watched the examiners and "played to the galleries" with affable smiles and chuckles.

JUDY. — A very slight developmental trend was shown by Judy. Her manipulation consisted mostly of banging and chewing. Toward the end she was indifferent to the test.

PETER and PATRICIA. — Both Patricia and Peter showed some developmental trends in the early weeks. Both were very indifferent to the test and were lazy and apathetic throughout. Peter held the object most of the time, but Patty spent most of her time in passive reactions to the tray. Both babies manipulated the objects but little, although in comparison with the amount of time she held the object Patty's amount of manipulation was rather great. She chewed the objects much less than did her brother. At one test Patty seemed absorbed in watching the shadows of the swinging objects as they moved across her polished chair tray, and scratched at them as if trying to pick up the phantom toys.

WALLEY. — No developmental trend whatever occurred in the records of Walley. His reaction was chiefly holding, and his manipulation was gentle and often seemed purposeful. He, too, was somewhat advanced and showed considerable indifference toward the end of the period.

EDITH ANN. — Edith showed no development in the early weeks. Her chewing reactions were infrequent and her manipulation was often banging.

MAX. — The records for Max were incomplete. Several times he became so active and obstreperous in his high chair that the test had to be discontinued.

SUMMARY

Babies showing no development during the choice test. — Since only nine babies showed development of skill after the beginning of the choice tests, the previous

records of the eight babies showing no development were looked up to see whether they were superior in reaching at the beginning of the choice tests. The test of development, which was discontinued at 23 weeks to be replaced by the choice test at 25 weeks, consisted largely of items on reaching and grasping. Therefore the babies' scores at 23 weeks could be taken as an index to their skill in reaching at the beginning of the choice tests. The scores at 23 weeks for the nine babies who subsequently showed development on the choice tests ranged from 27 to 49 points, with an average of 38, whereas the scores of the eight babies who showed no development in the choice tests ranged from 52 to 67 points, with an average of 56. The two tests were thus consistent in picking out the individuals who were slow in the acquisition of skill with the hands.

Individual differences in manipulation of the toys. — In types of reaction each baby differed to a certain extent from every other baby, whereas each baby was more or less consistent with himself in his reactions from time to time. As has been stated above, this consistency is revealed much less in the charts and the summaries of the individual babies than it was during the tests and in the original records. Much of the individuality and personality of the baby was lost in the record-taking. Furthermore, it was impossible to reconstruct the baby's total behavior and attitude during the tests even though every single one of his reactions was recorded, classified, and analyzed. And, finally, it was extremely difficult to add to the baby's specific reactions to the test the sum total of his traits and achievements that were not specifically tested for but that occurred spontaneously and undoubtedly influenced his performance in the test.

Babies who lacked proficiency at choice tests. — There were three types of babies whose performance in the choice tests was rather poor, the active babies, the irritable babies, and the indifferent babies. The active babies, Martin and Max, found the choice tests too tame for them. Martin usually made no protest at going through the tests, but he disliked to sit still for the 15-minute test. Max was so active that several of his tests had to be discontinued, and consequently his records were too incomplete to be worked up. The irritable babies also failed to be interested in the tests. Tests frequently had to be discontinued because of fussing and crying on the part of Matthew, Virginia Ruth, and Maurice. (See Volume I, page 165.) From the first these three babies were the most irritable of the group, and as they grew older they all displayed negativism. Incidentally, they did very little chewing of objects. The third group of babies who did not respond well to the choice tests were babies who were somewhat slow in general and who seemed to show no interest nor curiosity in the manipulation of toys. Patricia, Peter, and Irene May were examples of the indifferent babies.

Babies proficient in the choice tests. — The babies who were proficient in the choice tests fell roughly into two classes: a class that was proficient but more or less indifferent, of which Sibyl and Walley were good examples, and a class, to which Carol, Larry, and Quentin belonged, consisting of babies who were very eager and interested in the examination and worked steadfastly and consistently from test to test.

DISCUSSION

In recent years psychologists have talked rather frequently and rather glibly of "patterns of response" and

"behavior patterns," but very few of them have worked out any patterns that characterize either the individual or the group. The reason is obvious enough; patterns of response are much more difficult to observe, to record, and to describe than are isolated reactions, and patterns of response in adults are infinitely more complex than they are in children or animals. To piece together the isolated reactions of an individual into his pattern of response is a task so complicated that as yet neither statistical devices nor machines have been invented for doing it. But the human observer can see the totality of response or the patterns of response of another individual and can in a more or less adequate way describe them.

In such charts and summaries as the foregoing, one can only hope to convey the fact that behavior patterns do exist even in very little babies and that the behavior of each baby at each moment is consistent with his own behavior pattern. Although the pattern is elusive and all but vanishes when one tries to anchor it by percentage tables, the writer is firmly convinced that it is not a will-o'-the-wisp.

The difficulties in dealing with reaction patterns of young babies are twofold: first, the difficulty of integration, which has been discussed above, and secondly, the difficulty of interpretation. The banging of objects done by a baby is very different from the banging that is done by an adult. Indifference on the part of a baby is, as we have seen, characteristic of both a lack of skill and a high degree of skill. The carrying over of any adult interpretations to the behavior of the baby is to be warned against. But in spite of the difficulties it involves, the working out of patterns of response for all the babies is the thing most worth while in a study that

extends over a long period of time. Through the analysis of subsequent tests and of incidental reactions that occurred during all the tests the writer hopes to get other data that will further confirm and establish the theory that personality behavior patterns appear in babies at birth or shortly afterward and show a consistent and logical development throughout the first two years of the child's life.

Conclusions

1. Development of skill in reaching and holding dangling toys was shown by reactions to the choice test only between the ages of 25 and 29 weeks. 2. After 29 weeks the choice tests did not measure development. 3. Handedness was of doubtful significance as a developmental item. 4. The choice test elicited characteristic reactions from each baby. 5. The choice test failed to elicit characteristic choices from each baby. 6. Tests of this sort are suggested as a method for studying personality patterns.

CHAPTER X

TEXTILE TEST AND INSTRUMENT BOX TEST

The purpose of the examination given at 35 weeks was to discover whether the babies had any fears, dislikes, or peculiar reactions to textiles and fur. In addition to the textiles the tape was used to test the baby's ability to draw a toy within reach by pulling a string to which it was fastened. A mouth organ was also used in this examination.

The fabrics used in this test were a heavy blanket-like flannel, dark gray in color, a dark brown satin crepe, a dark brown panne velvet, a light green oilcloth, a piece of squirrel fur dyed brown, and a gray knitted piece of Germantown yarn. Except for the oilcloth, all of these fabrics were of dark neutral colors. Each piece of fabric was made into a thin pad three inches wide, four inches long, and about a quarter of an inch thick. The baby was seated on a blanket on the floor, and one fabric at a time was handed to him and taken away at the end of 2 minutes. Both B and S took records on this test; usually they sat on the floor in front of the baby or in a chair. No attempt was made to keep the record at 15-second intervals, but each major change in the baby's reaction to the textile was recorded, and S jotted down the time in seconds at which each change occurred.

Following the textile test, a tapeline was drawn out of its metal case to a distance of twenty-four inches.

The tapeline was placed on the floor within easy reach of the baby, with the metal case two feet distant. The baby's attention was called to the tape case by swinging it before it was laid down or by tapping it with a pencil. The object of the test was to see whether the baby would get the tape case by pulling the line that was within reach. Two minutes were allowed for this test. A harmonica was then blown by B and handed to the baby. The 1-minute motor tests on the back, stomach, and walking completed this examination. The bell-ringing and the sitting tests were discontinued because all of the babies had acquired proficiency at these tricks before 35 weeks.

Reactions to the Textiles

All reactions to the textiles were classified under three main heads: reactions of attention, manipulation of textiles, and vocalization. Subclassifications were made under each head to characterize the type of reaction made. Computations were then made of the percentage of babies exhibiting each type of reaction, the average number of such reactions made, and the average time spent in each reaction (see Table XXXVI).

Reactions of attention. — The reactions of attention were three: attention to the object as a toy; attention to the audience, i.e., to the examiners or to other persons who were watching the examination; and looking around. Attention to the textiles was relatively slight. Far greater attention was given to the examiners and to looking around, a fact that indicated the babies' lack of interest. It was clear that the babies were not interested in the test. They did not actively dislike it, but they apparently considered it pointless and seemed nonplussed that the examiners, who usually gave them

TABLE XXXVI

Percentages of Babies Reacting to the Textile Test Given at 35 Weeks

Textile	Attention			Manipulation of Textiles													Vocalization	
	Attention to Toy	Attention to Audience	Look Around	No Reaction	Reach and Take	Drop or Hold	Feel with Mouth	Shake or Pat	Make Face or Push Away	Purposeful Feeling	Chew Object	Chew Fist	Transfer from Hand to Hand	Draw Examiner into Situation	Try to Escape	Smile	Incomprehensible Syllable	Repetition of Incomprehensible Syllable
Blanket.....	4.7	76.5	28.5	47.6	95.2	85.7	33.3	71.5	9.5	19.0	28.5	0.0	28.5	4.7	23.8	14.3	23.8	9.5
Satin.....	9.5	68.0	28.5	42.8	76.5	81.0	28.5	62.0	0.0	33.3	47.6	9.5	19.0	4.7	14.3	19.0	33.3	...
Velvet.....	9.5	47.6	33.3	47.6	90.5	81.0	38.1	38.1	4.7	14.3	52.4	14.3	9.5	4.7	19.0	14.3	38.1	...
Oilcloth.....	23.8	28.5	19.0	33.3	100.0	100.0	28.5	57.2	14.3	33.3	100.0	4.7	42.8	0.0	4.7	14.3	42.8	9.5
Fur.....	23.8	42.8	9.5	38.1	95.2	85.7	68.0	76.5	23.8	33.3	33.3	4.7	42.8	4.7	23.8	14.3	23.8	4.7
Knitted wool...	19.0	52.4	38.1	38.1	100.0	85.7	42.8	47.6	9.5	14.3	47.6	9.5	42.8	9.5	52.4	4.7	47.6	9.5
One or more....	47.6	100.0	68.6	100.0	100.0	100.0	90.5	100.0	47.6	81.0	100.0	19.0	76.5	19.0	85.7	42.8	...	...
	Average Number of Seconds Spent on Each Textile*																	
Blanket.....	15.0	59.0	42.5	30.3	15.2	35.3	34.5	35.6	12.5	12.5	28.3	0.0	16.0	20.0	59.0			
Satin.....	7.5	57.1	48.3	60.5	23.0	51.3	12.5	23.7	0.0	14.3	27.3	35.0	12.5	20.0	46.6			
Velvet.....	15.0	50.5	63.5	52.7	16.0	50.6	18.4	31.0	20.0	35.0	40.2	59.0	7.5	35.0	52.5			
Oilcloth.....	18.0	40.0	33.7	8.8	12.4	62.6	35.3	25.0	36.6	14.7	53.6	5.0	18.1	0.0	30.0			
Fur.....	27.0	30.0	45.0	18.1	16.4	27.9	32.1	32.4	21.0	21.4	19.7	45.0	15.0	15.0	30.0			
Knitted wool...	26.2	34.1	33.7	28.7	20.8	41.4	16.1	25.7	9.0	25.0	31.1	16.0	16.3	15.0	41.3			
One or more....	39.0	149.2	106.1	86.3	95.2	234.8	66.9	102.5	27.8	34.3	117.2	82.2	37.9	30.0	71.1			

* These computations are based on the number of babies reacting.

such interesting playthings, should have become so stupid in their choice of toys. The little flat pad that was handed them was dull in color, it had no noise-making qualities, and usually it was not good to chew. After attempting a few of these reactions the baby usually dropped the pad or held it passively and looked inquiringly at the examiners. This test was the only one given throughout the two years to which all of the babies were indifferent.

Of the six textiles it will be noted that considerably more attention was given to the oilcloth, the fur, and the knitted wool than to the blanket, the satin, and the velvet. This was true both in the percentage of babies reacting and in the average length of their attention. These three textiles were perhaps more arresting and differed more from the bedclothes and mothers' dresses with which the babies were familiar than did the others.

Manipulation of textiles. — Thirteen different types of manipulation were observed. "No reaction" was a complete ignoring of the textile. This failure to react to the textile was not necessarily the only reaction the baby made. Frequently he took the cloth at first but soon dropped it and ignored it during the remainder of the 2-minute interval. If the pad was abandoned and ignored at any time during the test, "no reaction" was recorded, along with any other positive reactions that the baby made to the textile. All the babies ignored one textile or another for at least a part of the 2 minutes it was offered. Almost half the babies registered no reaction to the blanket, the satin, and the velvet, whereas only one-third of them ignored the oilcloth, and 38 per cent failed to react to fur and knitted wool. On the average, 3.5 "no reactions" were recorded to the entire

set of textiles, and the babies ignored the textile toys some 86 seconds of the 12-minute test.

The reaction of reaching and taking the textile when it was offered was about the least the baby could do. The oilcloth and the knitted wool were accepted by all the babies, the blanket and the fur by all but one, and the velvet by all but two of the babies. The reaching and taking reaction occurred on the average slightly more than once for each textile, and throughout the examination about 95 seconds were consumed in this reaction.

Dropping or holding the textile was a purely passive reaction that indicated no interest in the toy and no effort to explore it. This reaction was manifested by every baby. It occurred most frequently in response to the oilcloth, probably for two reasons, first, because the oilcloth was slippery and somewhat hard to hold, and second, because it was a favorite toy, and if it was dropped it was picked up and held again. The babies spent on the average about 4 minutes in these passive reactions.

One of the most interesting reactions to the textiles was putting it to the mouth and taking it out immediately; apparently the baby was feeling the textile with his mouth. This reaction was made by 90 per cent of the babies to at least one textile. It occurred most frequently with the fur; two-thirds of the babies tasted the fur experimentally, whereas only about one-third tasted the other objects. Not only did the babies taste the fur once and spit it out, usually making a face as they did so, but they repeated the performance again and again and averaged two tastes for the fur. Coming as it did after the oilcloth, which the babies had found very good to chew, the fur probably received more

exploration with the mouth than it would have if it had followed the blanket. About 1 minute of the entire test was consumed in the tasting reaction.

Another type of reaction exhibited by all the babies was that of shaking or patting the textile. This reaction was made without any apparent interest in the tactile sensations derived from the toy. Instead the babies treated the pad as roughly as a puppy might have done. It was scratched, wooled and worried, squeezed, wadded up, and sometimes thrown aside. The blanket and the fur were most often subjected to this treatment, perhaps because they were the least chewable of all the fabrics. A total of 1 minute and 40 seconds was spent in this diversion.

Pushing the pad away or making a face after tasting it were reactions that indicated that the tactile sensation was definitely unpleasant to the baby. Not quite 50 per cent of the babies registered this reaction to one or more of the textiles. The fabric most disliked was fur; oilcloth, strangely enough, ranked second. Some 27 seconds were spent in reactions denoting dislike.

All reactions indicating apparent interest and pleasure in the tactile sensations were classified under the head of "purposeful feeling." The babies indicated their interest in a variety of ways, by rubbing the pad on the face, brushing it across the lips and chin, and examining it with pleasure. In all, 81 per cent of the babies exhibited this reaction to some textile, but not more than 33 per cent of the group accorded this reaction to any one textile. Satin, oilcloth, and fur received the most favorable attention, velvet following closely. About 30 seconds were spent in this reaction.

Chewing the object differed from the experimental tasting or feeling with the mouth in that the latter was

exploratory, whereas in the chewing reaction the baby settled down to several seconds of sucking and munching the cloth. At this age the object-to-mouth reaction was at its height, and none of the textiles escaped being chewed, no matter how distasteful they were. The babies did show some discrimination in their textile diet, however. The blanket and the fur were chewed least, whereas the slick green oilcloth was chewed by every baby; an average of 53 of the 120 seconds the oilcloth was in the baby's possession were spent in sucking this delectable object. For almost 2 minutes of the entire 12-minute examination the babies diverted themselves by chewing the object.

Chewing the fist or sucking the thumb or finger was indulged in by a few of the babies who were particularly bored by the test. This reaction was always more frequent when the babies were tired, uninterested, or shy.

Another reaction, somewhat more active than holding the object, yet not indicative of interest in the tactile sensation, was that of transferring the pad from one hand to the other. This reaction occurred somewhat more frequently with the oilcloth, the fur, and the wool, but it took up a relatively short portion of the testing interval.

Attempting to draw the examiner into the situation was a reaction manifested by a few of the babies. This reaction was of a social nature. One baby attempted to get the examiner's attention by gurgling and shouting, another by holding out the pad for the examiner to take, one by rubbing the pad on the examiner's arm, and one by catching and holding the examiner's hand. These social reactions were relatively infrequent during the textile test, however.

The most positive dislike for the examination was expressed in attempts to escape from the situation. In the less active babies this reaction took the form of squirming about and reaching for other toys or of yielding to other distractions, such as cocking an ear to listen to a radio that had been started downstairs. The more active babies, however, frequently made good their escape and had to be held on the examiner's lap in order to be kept in the room. The active Martin, indeed, tossed aside the knitted wool to crawl after a toy pistol.

The smiling observed at this test was sometimes a social response, and sometimes it was evidence of pleasure in the textile. The oilcloth elicited somewhat more smiles than any other textile.

Vocalization. — The vocalization occurring during this examination was totally incomprehensible. From 33 to 50 per cent of the babies "talked" during each textile test. Some directed their jabbering at the textile; others "talked" to the examiners. On the whole, less vocalization was directed toward the fur, which received the largest amount of purposeful feeling.

Special reactions to textiles. — Several reactions made by the babies are worth describing in detail. One of these was rubbing the textile on the bare leg or foot. This reaction was indulged in apparently for the tactile sensations it aroused, and such reactions have been classified under the head of purposeful feeling. One baby rubbed the textile pad back and forth on the floor as if he were ironing with it. An interesting variation of experimental tasting was seen in James. His record on the oilcloth test reads, "A dozen times he samples by tasting each corner; at last he finds a satisfactory corner and chews the pad throughout the rest of the test."

The most interesting reaction to fur was noticed in Doris. Time after time she put out her hand to touch the fur and then withdrew it. At last she gave it a little poke with her right forefinger, and thereafter she spent the time touching and withdrawing, sometimes waving her hands between times as if to free them from the tickling sensation. Her hesitancy to touch the fur seemed to indicate not fear but extreme caution. In connection with the incident her mother related that a kitten had been brought to the house two weeks before and that, although Doris had not been scratched or bitten by it, she had seemed afraid of it. She liked her mother's fur coat, however, and delighted in patting and rubbing it when her mother put it on.

Sibyl seemed to express dislike for the textiles by trembling and shuddering after she touched them. This reaction she made to blanket, velvet, and oilcloth. The fur and wool elicited no shudder, but she soon dropped them to reach for her own more interesting toys.

Summary. — Little interest in tactile sensations derived from textiles was manifested by babies of 8½ months. For the most part the small pad was treated as any other toy and was held, dropped, shaken, transferred from hand to hand, or chewed. The babies showed considerable discrimination in the textile they selected for chewing; the oilcloth was a universal favorite, and the blanket and fur were chewed by only a few babies. Smooth slick objects were more succulent to the baby's palate than fuzzy ones. The most positive tactile reactions were made to the fur, which elicited the largest amount of experimental tasting, pushing away, and purposeful feeling. Lips and tongue were perhaps more sensitive to the tactile sensations than the fingers.

Reactions to the Tape

From the beginning the shiny metal tape was a favorite toy with all the babies. All reached for it eagerly and chewed it with relish. It was, therefore, a very suitable toy for testing the baby's ability to pull a string in order to get a toy at the other end.

TABLE XXXVII

Reactions to the Tape Placed beyond Reach

Reaction	Percentage Reacting	Average No. of Reactions	Average Time of Reaction in Seconds
Attention			
To the tape case	50.0	.65	34.2
To the tapeline	5.0	.05	15.0
To the audience	15.0	.15	23.5
Look around	20.0	.20	30.0
None	30.0	.35	16.3
Manipulation of the tape			
Reach and take line	90.0	1.10	10.3
Play with line	40.0	.65	34.4
Pull line, attempt to get case	20.0	.25	21.7
Get tape case by pulling line	70.0	.70	9.2
Correct manipulation of tape	10.0	.10	10.0
Random play with tape	60.0	.80	31.4
Transfer from hand to hand	15.0	.15	16.6
Chew tape	90.0	1.60	57.3
Smile	10.0	.10	...
Try to escape	10.0	.15	25.0
Drop or hold tape	95.0	2.00	58.8

Attention. — It will be noted that the tape compelled considerably more attention than did the textiles (see Table XXXVII). Furthermore, it was the metal case on which the babies fixed their attention rather than the line. Their eyes were on the goal.

Manipulation of tape. — All but two of the twenty babies picked up the tapeline shortly after it was put

in place. All these pulled the tape toward them by the string, and fourteen were successful in getting the tape case. The four who failed got the string tangled around their toes or drew the tape under a fold of their clothing and thus lost sight of it. There was some preliminary playing with the tape string before the case was drawn in, and a few of the babies obtained the tape apparently by accident. Martin, the early creeper, crawled to get the tape. After having obtained the tape, two babies played with it and successfully pulled out the tapeline to a greater length. Most of the others played with it in a random way, holding and dropping it or transferring it from hand to hand. All the babies who got the tape subsequently chewed and licked it. One baby accidentally set his lone tooth down on the button of the tape, and the line rolled up.

The almost universal success in obtaining the tape by pulling the string indicated that at the early age of 35 weeks the babies were beginning to use tools to help them get toys that were out of reach. The fact that they pulled the string, which was near at hand, when their attention and interest were focused on the tape, is evidence that they vaguely sensed the relation between the two.

Investigation of the Instrument Case at 38 Weeks

From an early age the babies had manifested great interest in the instrument case, from which the examiners drew forth interesting toys. Martin was particularly intrigued by the large black box, and as soon as he was able to creep he repeatedly wriggled out of the regular test situation and made a raid on the case. Having noted the babies' delight in the box, the ex-

aminers decided that it might be used as a test of the baby's ingenuity and curiosity or, in a word, of his meddlesomeness.

Accordingly, each baby was seated on the floor in front of the open instrument case and was allowed to exploit it freely for five minutes. During the interval a record was made of every significant change in the baby's activity. This test was used to supplement the retest developmental examination at 38 weeks.

The tray of the box, which was open for the baby's inspection, contained a stethoscope, a pair of straight calipers, a pair of bow calipers, a tape measure, a box of pencils, a bell, a harmonica, and a roll of paper. In addition, the box had two brass clasps, which the babies were fond of fingering. Although the box was only twelve inches high, most of the babies were too little to see into the tray when they were seated a short distance in front of it. Most of them grasped the edge of the box and pulled themselves up sufficiently to peer into the tray and examine its contents.

Reactions to the box. — Many of the reactions made were to the box itself rather than to its contents. Some of the play was random fingering or patting of the box (see Table XXXVIII). More explicit reactions were those to the metal fasteners, which were fingered and flipped against the box, thus making a jangling noise. An average of more than 1 minute of the 5-minute test was spent in exploring the fasteners and lock of the box. Pulling themselves up to peep into the box was recorded for half the babies. A few of the boys were tall enough to see into the box without pulling themselves up.

Reactions to the toys. — The babies who were too short to see into the box were only able to make a random grab for an object. Some apparently located the toy

TABLE XXXVIII

REACTIONS OF THE BABIES INVESTIGATING THE INSTRUMENT CASE AND THE PERCENTAGES OF BABIES SELECTING INDIVIDUAL TOYS

REACTION	PERCENTAGE REACTING	AVERAGE NO. OF REACTIONS	AVERAGE TIME OF REACTION IN SECONDS
Random play with box	31.8	1.40	56.4
Finger fasteners of box	72.7	2.90	83.4
Pull self up to look in box	50.0	1.10	30.4
Reach for toy at random	68.1	1.90	41.2
Reach for one toy, get another	27.2	.40	20.0
Hold or drop toy	95.4	4.60	84.1
Obtain toy	59.0	1.20	31.5
Throw out toy	22.7	.30	18.0
Random play with toy	72.7	3.50	76.2
Correct play with toy	50.0	.90	25.4
No reaction	50.0	.60	14.5
Attention to persons	47.2	.90	46.6
Chew object	68.1	3.18	89.7
Put toy back in box	47.2	.59	30.0
Smile	4.5	.04	...
Squirm, try to escape	18.2	.47	36.2
Try to draw examiner into situation	16.6	.23	25.0
Play with toy, examine it	16.6	.18	18.3
Transfer object from hand to hand	16.6	.16	8.3

TOY SELECTED	PERCENTAGE REACTING	AVERAGE TIME OF REACTION IN SECONDS
Stethoscope	68.3	104.4
Tape	22.6	59.0
Pencil box	31.8	100.7
Tongue blade box	18.2	43.5
Bell	63.6	80.0
Roll of paper	4.5	75.0
Harmonica	4.5	30.0
Straight calipers	13.6	36.6
Bow calipers	22.6	51.0
Pictures	4.5	205.0
Some toy	100.0	78.5

they most wanted when they pulled themselves up and peered into the tray, and after they sank back to a sitting posture they reached in the right direction. Thus they sometimes reached for one object but got another. Almost 60 per cent of the babies were successful at one time or another during the test in getting the object for which they were reaching. Some of them pulled out toy after toy indiscriminately without stopping to play with them, their object apparently being to empty the tray of its contents and get all the toys in easy range on the floor. Matthew's method was to take out a toy, taste it, throw it to the floor, take another, taste it, and so on, until he had sampled all of them.

Once the object was obtained, it was patted and shaken and played with in various ways. Half the babies were able to manipulate correctly a toy that had been taken. Correct manipulation included ringing the bell, pulling the calipers apart or pushing them together, and opening the pencil box. One baby, David, even held the tube of paper and looked through it as if it were a telescope. Chewing or licking the object was the most common reaction to the toys. About half the babies put back a toy they had taken from the box.

Selection of the toys. — Every baby was able to get at least one toy out of the box. The stethoscope was most frequently obtained, perhaps because it was one of the larger objects. The bell, an old favorite, was also obtained by a large percentage of the babies. Pencil box, tape, and bow calipers followed in frequency of preference.

Individual differences. — Although practically all the babies were delighted at the chance to explore the box, they showed marked individual differences in their ways of investigating it. Seven babies took out one instrument after another and played with each only a

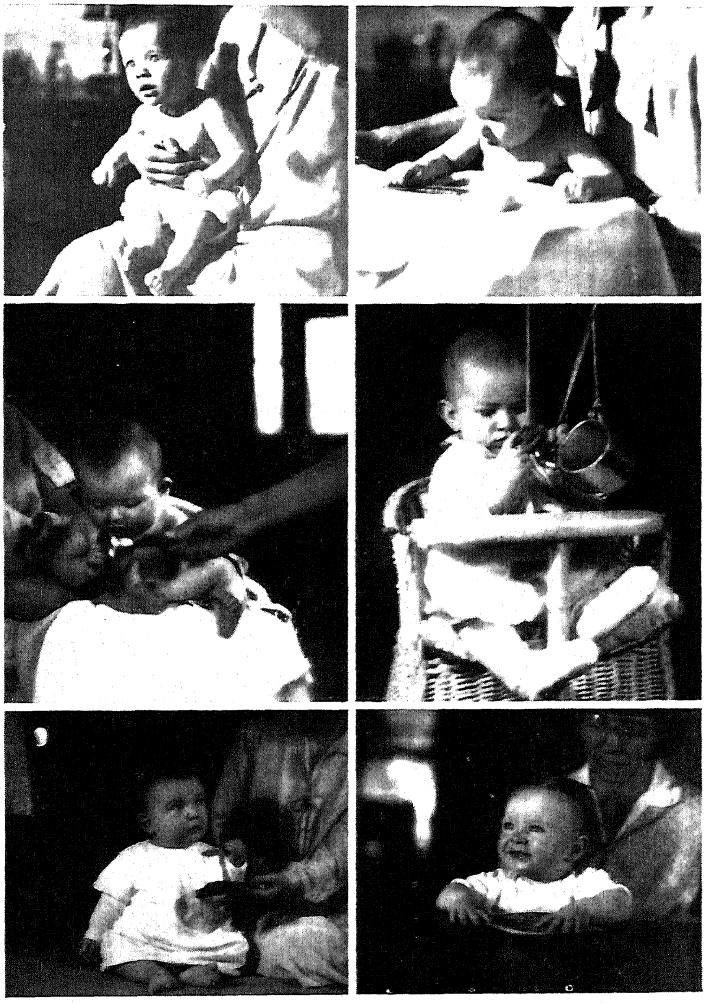


PLATE 6. — VARYING INTERESTS IN TESTS

Above.—Sitting tests: Nathaniel at 21 weeks following tape and fingering box. *Center.*—Sibyl at 19 weeks grasping bell (left). Choice test: Larry at 31 weeks (right). *Below.*—Not interested in textiles: Maurice at 35 weeks (left); patting a picture: Don at 42 weeks (right).

moment; with them investigation was the thing. Six babies took out only one toy and contentedly played with it the rest of the 5 minutes. Two of them spent most of their time playing with the fasteners of the box and were very little interested in its contents. Four, who were generally slow in motor development and who had been dubbed "lazy" babies by the mothers and examiners, did not pull themselves up to look in the box but sat stolidly in front of it and contented themselves with pulling out whatever came to hand.

Summary. — The results obtained from this test of curiosity and investigative manipulation are far too few to be conclusive. The marked individual differences in the manner of exploiting the box, however, are suggestive that a similar experiment on a larger scale might yield important data on personality.

Conclusions

1. A group of six textiles, flannel, silk, velvet, oilcloth, fur, and knitted wool, failed to interest the babies.
2. Fur was the fabric most disliked; it was also most frequently felt with the lips or mouth.
3. Lack of interest was displayed by the large percentage of distractions and attempts to escape.
4. A successful drawing in of the tape by pulling the line was accomplished by 70 per cent of the babies.
5. Developmental scores could not be worked out for the textile test because it was given at only one age.
6. When, at 38 weeks, the babies were allowed to explore the instrument case for 5 minutes, they spent about one-fourth of their time playing with the metal fasteners of the box.
7. Marked individual differences were shown in the ways in which the babies exploited the box.

CHAPTER XI

BOX TESTS

An increased skill in the use of the hands developed parallel to the motor skills of sitting alone and creeping. The activities of reaching and grasping and the elementary forms of manipulation were established before 6 months; their course of development was adequately traced by means of the tests of development described in Chapter VIII. Proficiency in grasping and retaining stationary and dangling objects was achieved by 23 weeks. After the babies outgrew these tests, it was important to supplant them with interesting material that would arouse their curiosity and elicit from them investigative manipulation. Blocks, peg boards, form boards, and other standard preschool testing materials were too advanced for babies under a year. The choice tests, which made use of familiar objects, such as rattles and cups, were successful in arousing the interest of most babies but gave them little opportunity to display their manipulative skill.

In searching for material that the babies would enjoy, the examiners took a cue from the 6-month-old's penchant for powder cans and spools. It was decided to use such homely equipment as boxes and tin cans, into each of which was to be placed a stub pencil, a spool, or a similar object dear to the baby's heart. Boxes with a variety of openings were selected, so each required a different type of manipulation. The inside objects not only served to arouse the baby's curiosity when

the box was opened but also endowed the box with a pleasing rattle when it was shaken.

Box 1 was of light wood, about the size of a cigar box; it had contained a pound of fancy figs. The lid was hinged so that it opened back, but the box could be opened in another way also. When the hinged lid was held shut, the bottom of the box could be lifted off in the same way as the lid of a stationery box. The hinged lid, however, was the opening that was demonstrated to the baby. Inside this box was a brightly colored compact case, which, when opened, disclosed a mirror.

Object 2 was a bottle 3½ inches in height, 1½ inches in diameter, and 1¼ inches at the mouth. Inside was placed an empty wooden container for pencil leads, which was ¼ inch in diameter and 1½ inches long. The lid of this tiny container pulled off easily. A cork was placed lightly in the mouth of the bottle.

Box 3 was a nickel-plated soap box, 4 x 3 x 2½ inches, with nicely rounded edges. The lid of this box was hinged on, and it was held closed by a tight spring. The adult opened this box by clasping it in both hands, placing the thumbs on either side of the seam that marked the lid, and exerting a gentle outward push. The box also flew open if it were dropped a distance of a foot or two onto the floor. This box contained a blunt stub of a red pencil.

Box 4 was a little wooden box 4 x 3 x 1 inches such as watches are sometimes packed in for mailing. The lid of this box slid in and out in a groove, like the lid of a chalk box. It worked so easily that when the box was held with the lid perpendicular to the floor and the unguarded end down, the lid slid out. A metal tape measure was placed in this box.

Box 5 was a round wooden box, about 3 inches in di-

ameter and 1½ inches high, which had originally contained thumb tacks. The lid of this box pulled off easily. Inside was a small compact case that was somewhat harder to open than the first compact because it had a spring catch.

Object 6 was a sample-size syrup can 2¼ inches in diameter and 3½ inches high. The lid fitted onto a flange in the rim of the can. An empty spool was placed inside.

Box 7 was long and narrow, 8 x 2½ x 1½ inches, of heavy white glazed pasteboard lined with white satin. It had been a jeweler's box for a strand of beads and was likewise a hinged box. Inside was an unsharpened yellow pencil.

All seven boxes rattled when shaken. The round box, the bottle, and the can rolled across the floor, and the soap box and the grooved wooden box could be opened by dropping. When the round wooden box or the can was vigorously shaken, the object inside bounced against the top and sometimes knocked the lid off. The harmonica was the eighth item in the test.

Procedure. — For this test the baby was seated on a blanket on the floor. B, who sat beside him, took a box, shook it to attract his attention, opened it slowly, displayed the object inside, closed the box, and set it in front of the baby on the floor. When the hinged boxes were offered the side that opened was placed nearest the baby. Each box was offered to the baby for two minutes. It was then removed, and another was demonstrated and offered. S recorded the baby's reactions, describing briefly each significant change in his manipulation and noting the length of time spent in each type of activity. After the seven boxes had been submitted to the baby, the harmonica was blown in demonstration

and offered to him for a minute. The motor tests given at the end of the examination were those of sitting alone, pulling to stand by a chair, creeping, and walking.

Reactions to the Boxes

Although each box required a different type of manipulation to be opened successfully, much of the unsuccessful manipulation was similar. In making out a system for classifying the reactions to the boxes, the experimenter endeavored to use general categories that could be carried over to the subsequent tests. The reactions are summarized in four ways in Table XXXIX. The first four columns of figures give the percentages of babies manifesting a given reaction to one or more of the seven boxes. From these figures one may get an idea of the number of babies who were capable of making the reaction. The next four columns give the average percentages of babies reacting in a given way to each box. From these figures one may discover how many babies chose to make the reaction to each box. The third group of four columns gives the average number of times a given reaction was made to the entire series of boxes, the average being based on the number of babies who made the reaction. These computations show how frequently the babies reverted to a type of activity they had already tried; it may be said that these figures indicate the babies' tendency to persevere in a given mode of attack. The last set of four columns represents the average time in seconds spent in each type of reaction; these averages, too, are based on the number of babies reacting and show how long the babies persisted in a given reaction.

Reactions of attention. — Attentive reactions were classified under the headings of attention to the demon-

TABLE XXXIX

Reactions to the Box Tests

Reaction	Percentage Reacting to One or More Boxes				Average Percentage Reacting to Each Box				Average No. of Reactions				Average Time of Reaction in Seconds			
	Age in Weeks				Age in Weeks				Age in Weeks				Age in Weeks			
	37	41	45	49	37	41	45	49	37	41	45	49	37	41	45	49
Attention																
To demonstration	95.2	100.0	94.6	90.0	61.2	75.9	70.7	79.1	4.5	5.2	5.3	5.5	...	...	...	...
Reach for box at demonstration	62.0	23.5	47.4	25.0	18.3	8.6	7.5	4.3	2.0	2.5	1.1	1.2	...	...	...	...
To audience	95.2	88.2	94.6	90.0	44.9	51.5	53.3	33.1	6.5	7.9	7.0	4.1	124.9	126.0	118.4	64.7
Look around	71.4	58.8	31.5	50.0	18.3	18.0	5.9	11.4	2.6	3.1	1.5	1.9	54.0	43.0	21.6	28.1
Random manipulation																
No reaction	90.5	76.5	94.6	80.0	36.7	20.6	28.5	23.1	4.3	3.4	2.8	3.0	84.5	49.0	45.4	43.5
Take box immediately	100.0	100.0	100.0	100.0	87.8	91.6	93.3	84.9	8.0	8.0	8.6	7.2	142.4	129.2	144.5	110.3
Passive hold	100.0	100.0	100.0	100.0	87.9	92.9	88.8	81.2	22.5	23.3	23.2	20.7	347.6	353.5	339.8	285.8
Random play	100.0	100.0	100.0	100.0	93.9	98.7	94.8	92.1	24.1	26.1	23.0	23.8	374.6	380.2	182.4	338.7
Transferred from hand to hand	71.4	64.9	52.6	45.0	21.7	24.4	11.9	10.1	2.7	1.8	2.1	1.7	27.8	12.7	18.0	12.8
Chew box	100.0	94.2	100.0	95.0	74.2	72.2	70.6	58.2	15.3	16.0	16.4	13.8	248.1	239.0	238.7	194.6
Open by accident	95.2	94.2	100.0	100.0	30.7	32.3	30.0	27.1	2.5	2.4	2.3	2.1	26.1	25.6	26.3	21.5

TABLE XXXIX—*Continued*

Investigative manipulation																
Examine; no attempt to open	46.0	82.5	63.1	75.0	33.2	22.4	17.2	18.6	2.8	2.3	2.5	2.4	49.1	34.0	34.1	35.0
Open purposefully, but incorrectly	14.3	5.8	15.7	30.0	2.0	.8	2.2	7.9	1.0	1.0	1.0	5.1	13.3	15.0	13.3	45.0
Unsuccessful attempt to open	0.0	17.6	15.7	45.0	0.0	2.5	2.2	8.6	0.0	1.3	1.3	2.0	0.0	25.0	20.0	29.0
Unsuccessful attempt to close	0.0	11.7	31.5	55.0	0.0	1.8	4.5	12.1	0.0	1.0	1.3	3.0	0.0	15.0	20.0	40.4
Open successfully	23.8	35.3	47.4	75.0	4.7	5.2	9.0	17.2	1.4	1.0	1.3	1.7	17.8	14.1	17.2	25.2
Close successfully	0.0	5.8	10.5	45.0	0.0	.9	1.5	7.1	0.0	1.0	1.5	1.8	0.0	5.0	17.5	19.0
Take inside object out	57.0	64.9	73.6	80.0	12.9	18.2	16.5	20.8	1.6	2.1	1.8	2.3	21.2	27.7	22.5	21.0
Put inside object in	4.6	17.6	21.0	55.0	.7	3.5	4.5	14.3	1.0	1.6	3.2	3.4	15.0	13.3	37.5	33.0
Lack of interest																
Chew hand	9.5	11.7	5.2	5.0	2.0	2.6	.7	1.5	2.0	2.0	1.0	2.0	72.5	52.5	15.0	30.0
Try to escape	46.0	58.8	79.0	95.0	14.8	13.1	32.3	39.9	5.2	3.5	7.3	6.0	102.7	68.0	118.0	89.2
Seek help	0.0	0.0	10.5	5.0	0.0	0.0	1.5	1.4	0.0	0.0	1.0	2.0	0.0	0.0	15.0	25.0
Draw examiner into situation	28.5	35.3	36.8	55.0	4.6	10.9	8.2	9.4	1.3	3.0	2.3	1.7	22.5	45.0	28.5	22.3
Give up; discouraged	9.5	17.6	21.0	45.0	1.4	2.6	4.5	11.0	1.5	1.0	4.2	5.6	50.0	35.0	77.5	88.8
Want to keep box	0.0	0.0	0.0	30.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	1.5	...	...	...	...
Smile	62.0	47.1	63.1	55.0	15.6	13.8	17.4	10.7	2.4	2.5	2.8	1.7	...	...	...	...

stration, attention to persons, and looking around. Almost every baby paid attention to some of the demonstrations (see Table XXXIX). At each age tested about 75 per cent of the babies watched the demonstration of each box in the subtests. A few were always so eager to get the toy that they reached and took the box from the demonstrator. Watching the examiners or other persons present during the test was the babies' greatest distraction. Looking around or staring vacantly into space had ceased to be characteristic of the babies, although at each age level several babies reacted thus to one or more of the boxes and a few babies to each box.

Random manipulation of the boxes. — The line labeled "no reaction" in Table XXXIX gives the percentages of babies who ignored the box as a toy at some time during the 2-minute test interval; it should not be interpreted to mean that the babies failed to react to the box at all. Although at each age most of the babies ignored one or more boxes, at no age was the percentage who ignored all the boxes a large one. By far the most common reactions were taking the box immediately after it was offered, passively holding or dropping it, and playing at random with it. During the test given at 37 weeks the babies dropped the boxes many times, apparently because of lack of skill in holding them; most of the boxes were a little large and unwieldy for the babies' hands. Each of these reactions occurred in all the cases at each age and in more than 80 per cent of the cases at the presentation of each box. Random play included shaking, scratching, patting, fingering, waving, rolling the box, crawling with it, pounding it on the floor, pushing it, and putting it in and out of the mouth. The box was treated as a toy, but the manipulation was not exploratory. Transferring the box from hand to

hand and chewing the box were also nonexploratory reactions. The former reaction was rather infrequent, but the latter occurred with high frequency at each age. Both of these reactions decreased at the age of 49 weeks.

At each age most of the babies opened one or more boxes by accident. If the slide box was turned end down, the lid fell off; if the can was vigorously shaken, the top came off; and if the soap box was dropped, it usually flew open. These accidental successes occurred in about 30 per cent of the cases each time a box was presented, and the number did not increase with age. In general, there was a tendency for these nonexploratory reactions to give way to investigative manipulation at 49 weeks. This tendency was shown not only in a decreased percentage of babies making the nonexploratory reactions but even more clearly in the average number of such reactions made by each baby and in the average time spent on them. (See the last eight columns of Table XXXIX.)

Investigative manipulation of the boxes. — The simplest type of exploratory manipulation was the baby's examination of the box with interest but without attempt to open it. This reaction was made by a large number of babies to one box or another, but on the average it decreased in frequency at the later ages.

Purposeful but incorrect opening of the box occurred rather infrequently at each age, but it reached its highest frequency at 49 weeks. It was sometimes difficult to distinguish between purposeful opening by the incorrect method and accidental opening. In both instances the boxes were opened by being rattled or shaken or dropped. In their accidental successes, however, the babies seemed surprised that the box opened, and although they usually picked up the inside object when

it dropped out, they did not seem to connect their random play with the opening of the box. In purposefully but incorrectly attempting to open the box the babies seemed to be working with an end in view. It was a trial-and-error performance, to be sure, but it was similar to that of an adult confronted with a baffling mechanical puzzle who tinkers with this and pries at that in the hope that something will happen. An illustration will best explain this interesting type of reaction. At the age of 49 weeks two of the babies, Nathaniel and Walley, dropped the soap box, and as usual it fell open. They observed this and apparently made the generalization that all boxes opened when they were dropped. At least they acted upon this assumption and thereafter threw each box; if the box did not open by this method the first time it was dropped, they continued throwing it in expectation of success. If the box did not open after he had thrown it several times, Walley became discouraged and gave up the task.

Under the heading "unsuccessful effort to open the box" were classified all poking and prying at the lid or turning of the box to examine its hinges that did not result in success. "Unsuccessful effort to close the box" included all failures to put the lid on again. In all cases it was more difficult for the babies to close the box than to open it, consequently the greater number of failures recorded. The fact that both types of unsuccessful reaction occurred more frequently at 49 weeks than at the earlier ages does not indicate that the babies became less skilled as they grew older but that they made more efforts to open the box and that some of these efforts were failures.

Only a few babies were able to open successfully one or more boxes at each age, and still fewer were able to

close them. The number of babies who reacted successfully was greatest at 49 weeks. Taking the inside object out of the box occurred with increasing frequency at each age; putting it in again was a less frequent response than taking it out, but this reaction also increased with age.

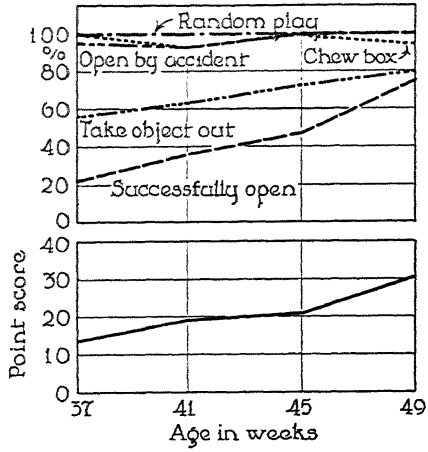
Reactions denoting lack of interest. — Although chewing the box was a frequent reaction at each age, chewing the hand or fist occurred very rarely. Attempts to escape were infrequent at the early ages but were made by 40 per cent of the babies during the test given at 49 weeks. There are two possible explanations of this: first, that the babies were growing somewhat tired of the boxes and, secondly, that by this time nearly all of them were creeping and thus were much better able to get away. Seeking help, attempting to draw the examiner into the situation by offering her the box or by attracting her attention in other ways, and giving up in discouragement all occurred most frequently at 49 weeks. In Figure 16 is plotted the data presented in the first four columns of Table XXXIX. The chart shows that the random play reactions and the reaction of opening one or more boxes by accident occurred in all the babies at each age and that the successful opening of one or more boxes and the removal of the inside object increased in frequency at each successive age. When the reactions to the entire series of boxes are considered, they have marked developmental significance.

Reactions to individual boxes. — The results obtained by averaging the reactions to all the boxes gives the general trend of development in these tests. It is evident that the babies had achieved little success in opening the boxes by 49 weeks. Consequently it was decided to carry over a part of this test into the second year. To

have retained all of the boxes in the new tests, however, would have made the examination too long and would have given it too little variety. It was decided to retain only the wooden slide box and the round wooden box. The reactions to these boxes over a period of nine months, from 37 to 74 weeks, were tabulated in detail,

FIGURE 16

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON THE BOX TESTS



and the successful reactions are shown graphically in Figure 19, page 302.

Random play, which characterized the reactions of practically all the babies up to 49 weeks, gradually dropped off in the second year. Successful opening and successful closing increased correspondingly at each age, as did the manipulation of the inside object. Attempting to escape and giving up in discouragement also decreased with age.

Of the seven boxes, the wooden hinged box was the one most easily opened; 55 per cent of the babies were able to cope with it successfully at 49 weeks. The slide box was second in difficulty, and the bottle ranked third. The other four boxes varied little in difficulty. The can was almost never opened successfully, perhaps because it was so easily opened by being shaken. There were more efforts to put the lid on the can than to close any other box. Twenty-six per cent of the babies worked assiduously at this task at 45 weeks, and 35 per cent of them attempted it at 49 weeks. To put the lid on the can was really very difficult; there was not only a "right-side-upness" to the can but one to the lid as well. Sometimes the baby first laid the lid on the bottom of the can; dissatisfied with this he turned the can right side up and placed the lid over the opening, but with the flange down. To get the lid on right side up and to press it neatly into the opening required persistence as well as precision.

Point Scores on the Box Tests

After an analysis of the frequency of each type of reaction to each box, a point scoring system was worked out. Scores were given to each of the reactions included under "Attention" if each occurred. Only the best reaction of those listed under "Manipulation" was scored; points were given for both successful opening and successful closing.

Reaction	No. of Points
Attention	
Attention to demonstration	1
Reach for the box during the demonstration	−1
Look around	−1

Reaction	No. of Points
Manipulation	
Random play with the box	1
Accidentally open boxes 1, 2, 3, 5, or 7	2
Accidentally open boxes 4 and 6	1
Successfully open any box by an incorrect method	3
Unsuccessfully open or close any box	3
Successfully open boxes 1 and 4	4
Successfully open boxes 2, 3, 5, 6, or 7	5
Successfully close any box	5
Other reactions	**Additional Points**
Examine the box with interest, no effort to open	2
Put the inside object in the box	3
Take the inside object out of the box	2
Investigate the inside object	4

Negative points were given to the distraction of looking around and to interference during the demonstration, a reaction that decreased with age. A score of 1 point for random play served the purpose of giving a blanket score of 1 to each baby and thus prevented zero scores. Weights were assigned to the other items according to their difficulty, as judged from the percentage of babies making the reaction.

The total point scores on all the boxes increased with age in a satisfactory way. (See Table XL and Figure 16.) Great progress in terms of point scores was shown in the manipulation of the wooden hinged box, the slide box, and the can. With regard to the other boxes the average scores made a less marked increase with age. Although the average point scores rose consistently at each four-week age level, individual babies showed great

TABLE XL

AVERAGE POINT SCORES ON THE BOX TESTS

OBJECT	AGE IN WEEKS			
	37	41	45	49
Wooden hinged box	1.76	3.50	3.95	5.80
Bottle	2.09	2.59	2.89	3.75
Soap box	1.95	1.70	2.58	3.95
Slide box	2.48	3.82	3.42	5.50
Round box	1.62	2.53	2.42	3.20
Can	2.48	3.31	4.05	6.60
White box	1.76	2.25	2.47	2.16
Total	14.14	19.70	21.78	30.96

inconsistency in progress. Four babies made no progress at all, to judge from their point scores; others reached their highest score at 41 or 45 weeks and declined in the final test. Indeed, there was only one baby whose manipulation improved in each test. The great inconsistency of the babies on this test is shown by the following coefficients of correlation between point scores at the four ages:

WEEKS CORRELATED	r	NO. OF CASES
37 and 41	.70	15
37 and 45	.08	16
37 and 49	.00	17
41 and 45	.14	11
41 and 49	−.06	14
45 and 49	.24	16

REACTIONS TO THE HARMONICA

The reactions to the harmonica were classified in categories similar to those for the box tests. In the majority of cases the reactions were those of unsuccessful holding and dropping of the toy and random play with

it. Chewing the object occurred in more than 80 per cent of the cases at each age. At each age a few babies made unsuccessful efforts to blow on it, but only four babies were able to make music on it at the last test. Like the opening of some of the boxes, this reaction was too difficult for the babies under a year. The toy brought forth from several babies the social reaction of seeking help or attempting to draw the examiner into the situation. Unable to blow it themselves, the babies repeatedly offered it to B to be blown again, sometimes even putting it to her lips.

Discussion

Designed to measure increased skill of manipulation, the box test was successful in that it called forth a great variety of responses, but it was unsuccessful in that it was impossible to scale these responses to get a consistent measure of the babies' progress in manual skill. Correct manipulation, resulting in the opening of the box, differed from one box to another. Although every box was opened by some baby and all but two babies opened one or more boxes at some age, no baby opened all the boxes during a single test.

There are several reasons why the box test yielded inconsistent results and why it proved to be less valuable as a test of manipulative skill than the examiner had anticipated. Chief among these is that factors other than manipulative skill played an important rôle in the baby's reactions. His interest in the toy and his curiosity about the inside object had to be stimulated in order to start him investigating the box. Furthermore, he had to see through the problem and get an idea of what was expected of him. The examiner had to rely upon the demonstration to convey these ideas to the

babies. At these ages verbal instructions were out of the question. Then, too, the way in which the baby exploited the box depended upon his mood or whim at the moment and upon his long-established behavior tendencies as well as upon his ability to see through the problem. It was characteristic of some babies to drop, shake, or pound the box and of others to tinker with it investigatively. Finally, the babies' great delight in creeping and climbing at these ages frequently diverted their interest from the boxes.

Fred seemed to regard the boxes as toys and played with them at random, making no attempt to open them until he was 49 weeks old, and then he opened five of the seven with no apparent effort. Harvey played with the boxes in a random way; his attention was centered on the examiners, and he rattled the boxes to get their attention and smirked at them as if he expected admiration and approval. Martin, the physically active baby, paid little attention to the small boxes but continually escaped and crept to the examiners' instrument case, which he delighted in exploiting. Torey, who was socially inclined, repeatedly abandoned the test to climb and stand on B's lap and laugh up into her face.

It is doubtful whether any other test of manipulation would have served better as a means of studying the babies' progress in manual skills. The same difficulty of making them comprehend the task, of interesting them enough to attempt the problem, and of maintaining their absorption until they carried it through, oblivious to the dictates of pre-existing personality traits and ever-present distractions, would have had to be met with any other test material. It would be very difficult to devise a test that would measure one particular skill unmodified by individual traits for these ages when the

babies' interests were becoming more and more diversified.

Conclusions

1. The test with boxes, given at four-week intervals from 37 to 49 weeks, called forth many types of manipulation, the most common of which were random play and holding or dropping the boxes.

2. Exploratory manipulation of the boxes increased with age; this developmental trend was shown in the reactions classified as purposeful but incorrect opening, unsuccessful opening or closing, and successful opening or closing.

3. Chewing the box, a frequent type of manipulation, decreased somewhat with age.

4. Point scores on this test yielded averages that increased with age. The babies were very inconsistent in their point scores from one test to the next.

CHAPTER XII

PICTURE TEST AND ODOR TEST

In order to cover as wide a range of activities and interests as possible, psychological examinations were varied each week in the latter half of the first year. The choice tests and the box test called for fine motor skill. Up to 42 weeks, however, none of the test material had been chiefly visual in its appeal. Noise-making and manipulative qualities had characterized all the toys offered to the babies. At about 10 months parents began to give the babies picture books and to point out to them the pictures in magazines. Some parents naturally devoted considerable time to this picture play with their babies, others very little. In general, the babies had not shown much interest in pictures before 10 months.

A picture test was worked out in the hope of discovering at how early an age babies looked at pictures, whether they seemed to recognize that a picture represented an object, and whether they showed any symptoms of treating the object in the picture as three-dimensional. The pictures were cut from advertisements in current periodicals and were pasted on heavy white glazed cardboard with a 1-inch margin of white surrounding the picture. The pictures varied in size and shape, the smallest being a circle about 4½ inches in diameter, and the largest, a rectangle 5 x 12 inches.

Picture 1 represented a rose plush davenport and chair on a black background. Picture 2 showed a mother

holding a baby in her arms in a circular background of green. Picture 3 was of three colored toothbrushes, actual size. The likeness was almost perfect. Picture 4 was the trade-mark of the Premier vacuum cleaner, a blue checkered vacuum bag on a bright red circular background. Picture 5 depicted the corner of a tiled bathroom. The colors were blue, dull gold, and green, and the picture itself had little meaning. Even an adult had to look twice to discover what was represented. The corner of the room presented the optical illusion of a convex or concave corner. Picture 6 was merely an orange-colored poster with black lettering — the title cut from the outside cover of Harper's Magazine. Picture 7 represented three colored fountain pens; like those of the toothbrushes the illustrations were full sized. Picture 8 showed a brawny camper on a lake shore scouring up his skillet with a can of Old Dutch Cleanser. Picture 9, the only one in black and white, represented a man's sport oxford. Picture 10 was of a bright red automobile.

The next object presented was a small mirror taken from a discarded purse. A current copy of the *Literary Digest* was also included as an item in the test. This magazine was chosen as the most convenient size for the baby to handle. It was followed by a small policeman's whistle. Three small bottles, each containing one ounce of an odoriferous liquid, completed the equipment. The first contained tincture of asafetida, the second banana oil, and the third white rose perfume.

Procedure

The baby was seated on B's lap before a low table, a card table in most cases. Each picture was laid on the table in front of the child and left for a minute. If the

child pushed or dropped the card to the floor, B picked it up and placed it on the table again. Usually she made some comment as she presented each picture, such as "See the mamma and the baby," "Look at the pretty toothbrushes," or "This is Daddy's shoe." The small mirror was offered in the same way as were the pictures. The magazine was placed on the table, and B turned two or three pages to attract the child's attention. The whistle was blown and then given to the baby for a minute. This was followed by the three odors, asafetida, banana oil, and white rose perfume. Each bottle was uncorked and held near the baby's nose for a minute. In case the baby objected so violently to the odor that he fussed or fought at B's hands each time she brought the bottle in range, the test was discontinued before the 1-minute interval was over. The usual motor tests, sitting by a chair, standing by a chair, lying on stomach, and walking, completed this examination.

Reactions to the Pictures

In the first two columns of figures in Table XLI are presented the average percentages of babies reacting to each of the ten pictures; in the next two are recorded the percentages of babies who made the reaction to any one or more of the ten pictures. In other words, the first two columns give the frequency of the reaction, and the second two show that many more babies were capable of making the reaction than consistently manifested it in response to each picture. The fifth and sixth columns give the average time in seconds spent in each reaction throughout the entire six hundred seconds of the test, this average being based on the number of babies who made the reaction. The last two columns show the average percentages of the total time spent in

TABLE XLI

REACTIONS TO THE PICTURE TEST

REACTION	AVERAGE PERCENTAGE REACTING TO EACH PICTURE		TOTAL PERCENTAGE REACTING TO ALL PICTURES		AVERAGE TIME OF REACTIONS IN SECONDS		PERCENTAGE OF TOTAL TIME SPENT IN EACH REACTION	
	42 Weeks	50 Weeks	42 Weeks	50 Weeks	42 Weeks	50 Weeks	42 Weeks	50 Weeks
Attention								
Passive attention	24.8	20.9	68.5	76.4	40.8	34.6	4.0	3.6
Look at examiners or audience	41.0	48.5	89.5	100.0	71.9	66.5	9.2	9.1
Look around	22.5	7.2	79.0	42.9	38.1	20.3	4.5	1.2
Manipulation of picture								
No reaction	10.0	12.8	52.5	57.0	30.2	46.5	2.3	3.7
Reach and take	58.0	59.5	100.0	100.0	67.2	69.7	9.7	9.6
Passively hold or drop	71.5	58.5	100.0	100.0	169.0	98.7	24.4	13.6
Pat, scratch, or finger	52.5	56.5	100.0	100.0	95.0	90.7	13.7	12.5
Wave, scoot on table	49.5	47.5	89.5	100.0	82.0	79.3	10.7	10.9
Throw as in a game	16.3	26.3	63.1	66.6	35.9	85.4	3.3	7.9
Turn it over	28.4	36.8	89.5	90.5	28.2	45.2	3.7	5.7
Point out part on picture (eye, wheel, etc.)	9.5	20.2	42.0	90.5	35.4	35.4	2.1	4.4
Chew or lick	16.8	9.5	63.1	42.9	27.8	27.0	2.5	1.6
Chew fist	.5	2.4	5.3	14.7	7.0	14.3	...	...
Kiss picture	0.0	.5	0.0	4.8	0.0	15.0	...	...
Smile	7.9	4.7	21.0	19.0	...	...	...	...
Squirm, try to escape, or pat table	36.8	46.6	95.0	85.8	73.3	126.0	10.0	14.9
Draw examiner into situation	.5	3.8	5.3	9.5	15.0	73.5	...	1.0
Push table	...	...	26.3	38.1	...	...	...	...
Try to keep it	...	...	0.0	4.8	...	...	...	...

each reaction. The reason for averaging time on the basis of the number of babies who reacted rather than the total number of cases was that for some of the rare reactions manifested by only a few babies the average on the basis of the total number of cases would have been misleadingly low.

Reactions of attention. — Three different attentive reactions were noted. The first was casual and passive looking at the picture. Two-thirds of the babies manifested this reaction to one or more of the pictures at 42 weeks, and slightly more than 75 per cent of them reacted similarly at 50 weeks (see Table XLI, columns 3 and 4). Since looking at the picture was what the examiners wanted the babies to do, this reaction was considered a good and correct response. When looking was the only response made by the baby, it was very difficult to ascribe such a passive act to interest in the picture. Such looking was often a mere casual glance rather than an intent and rapt gaze. Although a few more babies gave attention to the pictures at 50 weeks than at 42, they spent less time thus. About a half minute, or 4 per cent of the entire ten-minute test, was spent in this way.

The reaction of watching the examiners was very common during the picture test. Practically all the babies did so, and more than one minute of the ten was consumed in this way. The reaction of looking around occupied fewer babies and consumed less time at 50 than at 42 weeks. This slight decrease in inattentiveness does not in itself signify greater attentiveness to the pictures.

Passive manipulation of the picture. — Lack of reaction to the picture was common at both ages, but it was slightly more frequent and more time-consuming at

the later age. The simplest possible reaction was that of reaching and taking the picture. Reactions of lifting the card and of rubbing it on the head were included in this category. All the babies made these reactions, and they spent about 10 per cent of the entire test time in this way. Passive holding or dropping of the card was also a universal reaction at both ages. This reaction signified no interest in or attention to the picture. At the earlier age the babies spent about one-fourth of the test time in this reaction, but at 50 weeks they spent only 14 per cent of their time thus. This decrease in passive reactions to the pictures was counterbalanced by an increase in active reactions. Scratching, patting, and fingering the card were considerably more active reactions, but they did not represent any real visual exploration of the picture. Sometimes the babies were rather rough in their manipulation of the card, and they shook it, rubbed it vigorously, sometimes turned down a corner, or crumpled or folded it. All the babies made such reactions, and the amount of time so spent was practically the same at both ages tested. These reactions, therefore, fail to have developmental significance. Other very common reactions to the card as a toy were waving it, pushing it, and scooting it across the table. These, too, failed to show developmental trends, since they were performed by almost all the babies and consumed about 11 per cent of the testing time at both ages.

Active manipulation of the picture. — Of the active reactions one of the most interesting was the invention of a game in which the baby scooted the picture off the table and dropped it to the floor for the examiner to pick up. In some cases the first dropping of the picture might have been accidental, but frequently the baby

repeated the process throughout the whole test, apparently taking great delight in having the examiner stoop to get the card. About two-thirds of the babies played this game at each age; however, they spent somewhat more time thus at the later age. This game probably was not a new one for some of the babies. Many of the mothers reported that the babies threw spoons and rattles from their high chairs in order to get parents or older brothers and sisters to pick up the toys for them. One baby played this game so persistently with the pictures that B at last held him down near enough to the floor to pick up the card himself. This sport pleased him as much as having her pick up the card for him.

Another investigative reaction to the card was that of turning it over. Since this reaction occurred with equal frequency at the two ages, it denotes no developmental trend. It consumed only a small portion of the total test time. Sometimes this reaction appeared to be exploratory; the baby seemed to be looking for the other side of the object pictured.

The clearest evidence of interest in and attention to the picture lay in the reactions of pointing out parts, such as an eye, the hub of the wheel, or the foot. This pointing was spontaneous on the part of the babies. They were not asked to point out parts, although after they had done so B sometimes remarked, "Yes, that's his eye." Since pointing was done by only 42 per cent of the babies at 42 weeks and by 90 per cent at 50 weeks, it may be considered a developmental item.

Chewing or licking the picture was a common reaction, but it occurred somewhat less frequently at 50 than at 42 weeks. Chewing the fist was done by only a few babies. One baby kissed the picture of the mother

and baby. Since this occurred at the later age, it probably signified some recognition of the picture. It is certain that he had been taught this reaction, because at the earlier age his mother had directed him to "kiss the baby" in the mirror.

Smiling occurred with almost equal frequency at both ages. Squirming, patting the table, and trying to escape were reactions made by practically all the babies at both ages, but somewhat more time was spent in attempts to get away at the later age. Seeking help or attempting to bring the examiner into the situation was the reaction of one baby at 42 weeks and of two at 50. Desiring to keep the picture or fussing when it was taken away was a reaction made by only one baby.

Perhaps the most energetic reaction denoting lack of interest in the test was that of vigorously shoving away the table on which the cards were placed. More than one-fourth of the babies made this reaction at the earlier age, and 38 per cent did so at 50 weeks. This reaction, too, was a sort of game invented by the baby, and he took great delight in it. It was an early furniture-moving reaction and has been referred to in Volume I, pages 142–144.

Reactions to individual pictures. — Some pictures seemed to interest the babies more than others. The pictures that elicited the greatest number of pointing responses at 42 weeks were the auto, the three toothbrushes, the man cleaning his skillet, the mother with the baby, and the Harper's Magazine cover. At 50 weeks the picture of the three toothbrushes was the most favored, and the others in order of popularity were the auto, the man cleaning his skillet, the three fountain pens, and the mother with the baby. In general, the pictured automobile interested the babies most.

Pictures in which human faces were represented were more interesting than pictures of things, with the possible exception of the three toothbrushes and the fountain pens. The attention value of the three toothbrushes was perhaps greater than that of the davenport or the shoe because these brushes were represented in full size and in three bright colors. Two babies scratched or picked at the brushes with opposed thumb and fingers as if to pick them up, and one tried to bite the red ball in the vacuum-cleaner picture. These were the only instances in which the pictured object was treated as if it were real.

Whether or not the babies recognized that the picture represented some object, they at least did not mistake the picture for the object, except in the two cases mentioned. Some of the patting and scratching of pictures, reactions that occurred most frequently in response to the toothbrush picture and that were made by 50 per cent or more of the babies to each picture at both ages, might have been done for the sake of assuring the young observer that the object before him was flat and slick and uniformly hard and cool rather than possessed of contours, warmth, roughness, fluffiness, or other qualities characterizing the objects themselves. Any effort to interpret the babies' reactions leads one far afield into the realm of speculation. The only thing certain is that reactions of the type described occurred in the frequency mentioned in Table XLI.

Point scale for scoring the picture test. — After the frequency of each reaction was obtained, a point-score system was worked out as tabulated on the next page. In scoring by the scale the highest reaction was scored, i.e., the one on which the baby obtained the most points. If he scored 4 for pointing out parts, he received

Reaction	No. of Points
Reach for the card	1
Turn the card over and examine it	2
Throw the card to the floor as in a game	3
Point out parts of the picture	4
Draw the examiner into the situation	2 additional

no additional credit for any reaching, examining, or throwing of the card. The social reaction of drawing the examiner into the situation was always given extra credit. The highest possible score for any one picture was, therefore, 6 points. The average scores for each picture are given in Table XLII.

TABLE XLII

Average Scores on the Picture Test

Picture	Average Score	
	42 Weeks	50 Weeks
Davenport	1.24	1.10
Mother with the baby	1.68	2.10
Toothbrushes	1.84	2.43
Vacuum cleaner	1.15	2.38
Tile bath	1.37	2.10
Harper's cover	1.90	2.29
Fountain pens	1.37	2.62
Man and skillet	1.63	2.76
Shoe	1.58	1.86
Auto	1.58	2.62
Total	15.50	22.20

With the single exception of the first picture, the point scores for all increased at 50 weeks, and the total score showed almost a 50 per cent gain in the 8-week interval. The picture scoring highest at the earlier age was the Harper's cover, and the toothbrushes and the

mother with the baby ranked second and third, respectively. At 50 weeks the largest number of points were scored on the man and skillet, and the next largest scores were on the auto and the fountain pens.

Reactions to the Mirror

The reactions made to the mirror were very similar to those made to the pictures. A tabular summary of these reactions is given in Table XLIII. Great interest in the mirror was indicated by the fact that at each age only one baby failed to respond to this test. The reactions denoting attention and those of lifting, patting, and dropping the mirror hardly need be com-

TABLE XLIII

Reactions to the Mirror

Reaction	Percentage Reacting		Average Time of Reaction in Seconds	
	42 Weeks	50 Weeks	42 Weeks	50 Weeks
Attention				
Passive attention	21.0	23.8	11.5	10.6
Look at examiner or audience	26.3	14.3	6.6	22.0
Look around	0.0	0.0	0.0	0.0
Manipulation of mirror				
No reaction	0.0	4.7	0.0	5.0
Reach, lift, and take	68.5	90.5	13.0	8.9
Pat, scratch, or rub on head	31.5	33.3	11.5	11.0
Passively hold or drop	68.5	62.0	16.0	16.9
Look at it	36.8	19.0	13.4	15.8
Drop, as in a game	0.0	19.0	0.0	15.5
Turn mirror to look at back	63.1	62.0	10.8	13.8
Look in it and point at image	52.5	52.5	13.7	15.7
Chew or lick	84.2	57.3	27.7	24.5
Try to escape	15.7	9.5	14.3	22.5
Bring examiner into situation	5.2	14.3	5.0	13.0
Kiss image	10.5	23.8	12.5	13.0
Average point score	2.2	2.9	...	...

mented upon. In the reaction of looking at the mirror it was impossible to determine whether or not the baby was paying attention to the mirror image. It was a passive reaction in which he apparently was regarding the object as a toy.

The three most interesting reactions to this test were turning the mirror over to examine the back after having seen the image in the mirror, looking and pointing at the mirror image, and kissing the mirror baby. About two-thirds of the babies scrutinized the back of the mirror and did so more than once. Particularly at the later age they looked at the mirror and peeped around its edge or turned it over two or three times. It is recorded that Sibyl seemed definitely to be trying to discover where the baby went when she turned the mirror over.

Many babies took great delight in the mirror baby and smiled vainly at their own images, although it was not their first contact with a mirror. Reacting to the mirror image is an item that also occurs in the Gesell developmental schedules, which had been given to all the babies. Furthermore, several of the mothers had drawn the baby's attention to his image in the large looking-glasses about the house. The mirror was kissed by only two babies at 42 weeks and by five at 50 weeks.

Point scale for scoring the mirror test. — The same general plan was adopted for scoring the mirror as for scoring the pictures. The reactions were weighted thus:

Reaction	No. of Points
Reach and take the mirror	1
Drop the mirror, as in a game	2
Look and point at the image	3
Kiss the image	4
Draw the examiner into the situation	2 additional

This scoring method resulted in a slightly increased average score at 50 weeks.

Reactions to the Magazine

At the ages tested the babies were little interested in the magazine. About two-thirds of them took it and patted, scratched, waved, or dropped it (see Table XLIV). The game of throwing the magazine to the floor was played by a few babies at each age. One-fourth of the babies turned the pages of the magazine at 42 weeks and one-third did so at 50 weeks. Tearing a page from

TABLE XLIV

Reactions to the Magazine

Reaction	Percentage Reacting		Average Time of Reaction in Seconds	
	42 Weeks	50 Weeks	42 Weeks	50 Weeks
Attention				
Passive attention	5.2	0.0	7.0	0.0
Look at examiner or audience	10.5	9.5	6.0	9.5
Look around	5.2	9.5	15.0	25.0
Manipulation of magazine				
No reaction	26.3	23.8	29.4	21.0
Reach and take	63.1	62.0	12.6	13.4
Pat or scratch	63.1	66.7	16.8	20.3
Passively hold or drop	52.5	23.8	20.3	9.2
Wave, scoot on table	63.1	38.0	11.5	14.5
Drop, as in a game	15.7	23.8	17.7	20.6
Turn over	10.5	14.3	9.5	9.0
Turn pages	26.3	33.3	26.2	20.6
Close	5.2	4.7	8.0	15.0
Tear off page	15.7	19.0	22.7	15.8
Play with torn bits of paper	5.2	4.7	15.0	15.0
Chew or lick	31.5	9.5	18.3	22.5
Try to escape	31.5	38.0	26.2	23.0
Bring examiner into situation	0.0	4.7	0.0	15.0
Average point score	1.3	1.6	...	...

the magazine occurred at both ages, and one baby amused himself at both ages by playing with torn bits of paper. Attempting to escape was more frequent in the magazine test than in the mirror test — another indication that the babies found little pleasure in the magazine.

Point scale for scoring the magazine test. — The items that were given points were:

Reaction	No. of Points
Drop to the floor, as in a game	1
Turn over the magazine	2
Turn the pages	3
Tear off a page	1 additional
Draw the examiner into the situation	2 additional

The highest possible score was 6 points, since the first three items were scored according to the highest. The low average scores and the very slight increase at 50 weeks are added evidence of the babies' lack of interest in this test. The average number of points scored on the magazine test was 1.3 at 42 weeks and 1.6 at 50 weeks.

Reactions to the Whistle

The whistle was very different from the toys that preceded it in this examination. Whereas the pictures, the mirror, and the magazine appealed almost solely to the baby's visual attention, the noise-making qualities of the whistle commanded auditory attention as well. Furthermore, it was a smooth, shiny nickel object like the tape, the kind of object the babies delighted in chewing. It elicited somewhat different reactions from those called forth by the pictures (see Table XLV).

Reactions of reaching, taking, passively holding, and

TABLE XLV

REACTIONS TO THE WHISTLE

REACTION	PERCENTAGE REACTING		AVERAGE TIME OF REACTION IN SECONDS	
	42 Weeks	50 Weeks	42 Weeks	50 Weeks
Attention				
Passive attention	10.5	4.7	11.0	7.0
Look at examiner or audience	10.5	9.5	22.0	15.0
Look around	5.2	0.0	7.0	0.0
Manipulation of whistle				
No reaction	10.5	9.5	7.5	27.5
Reach and take	89.0	86.0	12.4	9.6
Passively hold or drop	84.2	71.5	20.1	22.7
Pat, shake, or wave	73.6	57.3	16.4	14.2
Put to mouth, but do not blow	31.5	38.0	14.8	8.8
Drop, pound, or rattle; do not treat as whistle	26.3	19.0	13.8	23.3
Put to nose and snort; blow, whistle not in mouth	5.2	9.5	7.0	12.5
Blow whistle, making noise	5.2	23.8	23.0	37.8
Chew	73.6	66.6	20.9	20.6
Try to escape	5.2	4.7	12.0	4.0
Seek help	10.5	14.3	10.0	9.0
Average point score	.68	1.38	...	...

shaking the whistle were made by the majority of the babies at each age. The whistle was also popular as an object to be chewed. The most frequent of the more active reactions to the whistle was that in which the baby put the whistle to the mouth in a more or less correct way for blowing but did not blow it. This reaction was a step in the right direction. About one-fourth of the babies at 42 weeks and one-fifth at 50 made noise with the whistle by dropping it, pounding it on the table, or shaking it so that the ring that was attached to it rattled against the metal. Putting the whistle to the nose and snorting or making a noise of blowing a

correct "wheeh, wheeh" with the whistle not in the mouth happened once at 42 weeks and twice at 50 weeks. Only one baby was able to blow the whistle at 42 weeks; five babies accomplished it at 50 weeks. That a successful blow was not accidental was indicated by the fact that those who did blow it did so more than once during the interval. At 42 weeks they averaged 2 successful blows and at 50 weeks, 2.4. The reaction of escaping was rare in this test; linked with the small amount of inattention and lack of reaction, this indicated the high interest value of the whistle.

Very interesting attempts to draw the examiner into the situation were made. At 42 weeks two babies held the whistle out to B as if asking her to blow it again. Peter performed his gesture of holding the whistle up to B's face with an "ah." At 50 weeks two different babies offered the whistle to B to be blown, and one baby held the whistle out to her 3-year-old brother. The babies' gestures clearly indicated a desire to have the whistle blown again, because the whistle was held toward B's face and put to her lips rather than into her hand.

Point scale for scoring the whistle test. — Only three items were given point scores for the whistle:

Reaction	No. of Points
Put whistle to mouth without blowing it..	1
Successfully blow whistle.....	3
Seek help.....	2 additional

Blowing the whistle was a difficult test. Ten of the babies were unable to score on it at 42 weeks, and six did not score at 50 weeks. The highest possible score was 5, but no score higher than 3 was made. The aver-

age score, .68 at 42 weeks, was doubled to 1.38 at 50 weeks.

Consistency of the point scores. — When point scores on all the items in the examination were summed, the average point score at 42 weeks was 19.7 and at 50 weeks, 28.2. The scoring method, then, had some validity, since the individual scores as well as the average increased with age, that is, the scores conformed to the developmental trend. The rank order correlation between scores at 42 and 50 weeks was .45±.13. For the picture scores alone the correlation was .38±.14. Although these correlations were not high, they at least indicated some consistency between the scores on the original test and those on the repetition of the test eight weeks later.

Reactions to Odors

Like the textiles, the odors brought forth some interesting reactions from the babies, but none that appeared to have developmental significance (see Table XLVI). Comparatively little passive attention to the bottle and very little looking around occurred during the test. For the most part, the babies were interested and reacted in positive ways to the odors.

Although the babies were allowed to reach for the bottle and take hold of it, they were not permitted to hold it without the examiner's aid because of the danger of drenching themselves and the furniture with the ill smelling contents. More than half the babies reached for the first bottle, the asafetida, but fewer reached for the other two. The reactions of holding to the bottle and of patting it occurred, but they were not common. One of the most interesting play reactions was that of poking the index finger into the mouth of the bottle and

TABLE XLVI

REACTIONS TO ODORS

REACTION	PERCENTAGE REACTING TO:					
	ASAFETIDA		BANANA OIL		PERFUME	
	42 Weeks	50 Weeks	42 Weeks	50 Weeks	42 Weeks	50 Weeks
Attention						
Passive attention	0.0	4.7	0.0	0.0	0.0	4.7
Look at examiner or audience	0.0	0.0	10.5	4.7	5.2	9.5
Look around	0.0	0.0	0.0	0.0	0.0	4.7
Manipulation of bottle						
No reaction	10.5	0.0	5.2	9.5	5.2	4.7
Reach and take	52.5	38.0	15.7	28.5	26.3	23.8
Pat	26.3	9.5	15.7	14.3	10.5	4.7
Hold	5.2	4.7	10.5	9.5	0.0	19.0
Put finger in its mouth	26.3	33.3	26.3	33.3	58.0	28.5
Put cork in its mouth	0.0	0.0	0.0	0.0	0.0	4.7
Turn head away	15.7	19.0	21.0	28.5	5.2	23.8
Push it away, or otherwise express dislike	63.1	47.6	68.5	76.5	68.5	52.5
Hold nose near it and sniff	36.8	86.0	36.8	52.5	36.8	62.0
Try to put it in mouth	13.6	71.5	58.0	47.6	47.3	52.5
Put cork in mouth	0.0	0.0	0.0	0.0	0.0	4.7
Fuss when not allowed to take it	0.0	0.0	0.0	0.0	0.0	4.7
Try to escape	5.2	4.7	10.5	0.0	21.0	14.3
Smile	0.0	0.0	0.0	0.0	10.5	9.5

flipping it out, thus making a little popping sound. At 42 weeks one-fourth of the babies did this with the first two bottles, and more than half did it with the third. In all, 43 per cent of the babies amused themselves in this way at 50 weeks. Sibyl was skillful enough at this age to put the cork back into the bottle. David snorted into the top of the bottle, thus making a whistling noise.

Three reactions indicated attention to the odor. Two of these, turning the head and pushing away the bottle, were reactions of avoidance and apparently signified a

dislike of the odor. Turning the head was the less positive of the two, and it occurred with about the same frequency in response to all the odors. The babies who turned away turned repeatedly from the two bad odors, but only once from the perfume. Other expressions of dislike that were tabulated along with pushing away the bottle were making a face and rubbing the nose and fussing. These reactions also occurred with great frequency in response to all the odors; about two-thirds of the babies responded in this way to each.

The positive reaction to the odors consisted in the baby's leaning toward the bottle and breathing in the odor. Sometimes this reaction was accompanied by real sniffs; more often the baby opened his mouth to get a larger draught of the odor-laden air. This experimental smelling reaction was accompanied by a most rapt and attentive facial expression. There could be no doubt that the baby was experiencing the new odor with interest, if not with pleasure. This experimental smelling occurred with exactly the same frequency for each odor at 42 weeks, but at 50 weeks it was most common for asafetida. Trying to bring the bottle to the mouth was also a positive reaction; at the later age it, too, occurred most often in response to the asafetida.

The babies' reactions to the odors were more experimental than indicative of positive likes or dislikes. Most of the babies reacted to all three odors alike, either accepting them all or rejecting each in turn. Motion pictures taken of Don and of Doris at 42 weeks are illustrative of the babies' reactions. The pictures show Don first reaching for each bottle. Although he failed to get them, he got a whiff of their contents, and he spent the remainder of each test smelling with equal interest asafetida, banana oil, and perfume. Doris, on the other

hand, at the first whiff of asafetida turned her head and pushed at the bottle. She repeated this reaction with both the banana oil and the perfume, apparently under the impression that each odor was bad. But after three or four rejections of the perfume, the sweet odor penetrated her nostrils, and she then drew near the bottle and smelled the perfume with interest during the remainder of the time allotted.

The results of the test with odors were inconclusive in so far as the question of marked dislike for bad odors or preference for perfume was concerned. What they did show was that babies are interested in smells of different kinds. It is not unlikely that odors play an important rôle in their amusements and diversions. Even in adult life a long-forgotten smell is capable of calling up haunting childhood memories and of reinstating old familiar scenes. Perhaps the odoriferous environment of babyhood has more significance than has ordinarily been attached to it.

Conclusions

1. In interest in and attention to pictures, as manifested by pointing at objects in the picture, the babies showed considerable development between the ages of 42 and 50 weeks.

2. At these ages the babies found the mirror an interesting toy. A few appeared to be puzzled by the phenomenon of the mirror image.

3. In general, the babies were not interested in the magazine and made little effort to leaf through it in search of pictures.

4. The whistle amused the babies at these ages, but few were able to blow it.

5. A point-scale system for scoring these items resulted in a score that increased at the later age. The scores were moderately consistent at the two ages.

6. The babies manifested interest in odors, but positive likes and dislikes were an individual matter.

7. Active smelling of the odors was usually accompanied by a rapt facial expression and frequently by the baby's opening his mouth to get a better draught.

CHAPTER XIII

EXAMINATIONS GIVEN FROM 54 TO 74 WEEKS

After the age of a year, examinations were made at intervals of 2 weeks. The anthropometric and the psychological examinations alternated, so each came once in four weeks. Since the psychological tests were so far apart, it was deemed unnecessary to have as large a number of alternate tests as had been given from 9 to 12 months. Consequently only two psychological tests were made out for the second year; one was given at 4-week intervals from 54 to 74 weeks and the other at 4-week intervals from 78 to 102 weeks. These tests were supplemented by the Minnesota revision of the Kuhlmann tests, which was given at 18 months and at 2 years by the regular mental tester of the Institute.

Since the psychological tests were not changed from one examination to the next, an attempt was made to put into the test a wide variety of items, some of which would be easy enough for the year-old baby to perform and some of which would be difficult enough to serve throughout the period up to 18 months. An effort was also made to devise tests that would call forth the child's best efforts along many different lines, his fine motor coordination, his recognition of pictures and objects, his attempts at talking, his tendency to imitate, and his locomotor ability.

Material and Method

The record form used for the tests beyond a year were mimeographed sheets. The method to be used for each item in the test was briefly described, and the remainder of each sheet was divided into three columns. The narrow one at the left contained the name of the experimental object and the time marked off in 15-second intervals. The next column was wide enough to allow the recorder to write a brief description of the baby's activity during each 15-second period, and the third, somewhat narrower, was used for spelling out his speech (see Appendix 5).

Picture test. — The first test item in the examination was the recognition of pictures. The baby sat on B's lap, stood at her knee, or sat beside her on the floor while she showed him the pictures in a homemade picture book. Most children's picture books are either devoted to pictures of only one type, such as *Our Barnyard Friends*, *Jungle Folk*, or *Mother Goose People*, or the pictures are complex or contain objects or scenes unknown to the year-and-a-half-old baby. For this reason drawings of familiar objects were traced upon typewriter-sized sheets of linen. The drawings, one on a page, were simple in outline, uncomplicated by background or shading, and colored appropriately with crayons. They represented a blue and orange sectored ball, a teacup, a collie dog, a galloping horse, a white cat, a cardinal perched on a twig, a green sedan, a bungalo with a red chimney, a little girl holding a flower, and a young man wearing an overcoat and hat. Most of the drawings were traced from children's picture books or advertisements, but were somewhat simplified in coloring and treatment. As each page was turned, B said, "See the picture. What is it?" If the baby made

no vocal response, the question "What is that?" was repeated once or twice. The baby was allowed to look at each picture for fifteen seconds. He then helped to turn the next page.

Mother's picture test. — The second situation was that of pointing out the mother's picture. A photograph of each mother was taken by the photographer of the Institute. Each picture was $3\frac{1}{2} \times 4\frac{1}{2}$ inches. All the mothers posed standing in front of their homes and at a uniform distance from the camera. Some wore coats and hats, and some merely wore house dresses, depending upon the temperature on the day the picture was taken. The pictures were mounted five in a row on long heavy cards. Mothers wearing hats and coats were mounted together, and those wearing house dresses together, so that the baby had to discriminate among several women similarly dressed. A small portion of the home was visible in the background, but the sections of brick or stucco wall visible in the pictures were so much alike that the examiners, who were, of course, very familiar with the exterior of the homes, could not have identified any mother by her background alone. The card on which his own mother's photograph was mounted along with four others was put on the floor in front of the baby, and the instruction "Show me Mother's [or Mamma's] picture" was given. Inquiry was first made as to whether the child knew his parent by the name Mother or Mamma. The baby was given a minute for this test, and records were taken at 15-second intervals. The directions were repeated if necessary. If the baby pointed out his own mother before the time was up, he was occasionally told, "Now this is Mrs. A, and this is Mrs. B," the examiner pointing to two other women whom she had named and then asking,

"Now can you show me Mother again?" and after compliance, "Now point to Mrs. A." Now and then as a supplement to this test a card was shown on which his mother's picture did not appear, and the baby was asked to point to "Mother." The babies' bewilderment at this test indicated that they had not merely built up a habit of pointing to the picture by its position on the card.

Manipulation tests. — The next six items were a series of manipulation tests. The baby was seated on the floor, and each object was demonstrated and presented to him for a minute, while the observer took records of his responses at 15-second intervals. The first and second objects were the wooden slide box with a tape inside and the round wooden box containing the compact case, both of which had been used in the box test. The third item consisted of six one-inch cubes stacked up in a tower for the demonstration. The fourth object was an empty pickle jar with a screw cap, inside of which was a comic rubber "traffic cop" doll. The cap of the jar was unscrewed, and the doll was poured out in the demonstration of this object. Next, a red rubber ball was bounced and rolled to the baby, and finally the Gesell three-block form board was presented with only the round block to be fitted in place. The correct response for this last test was not demonstrated.

Imitation tests. — The next six items were called tests of imitation merely for the sake of giving them a name. The use of each object was demonstrated as before, and it was handed to the child, who was allowed to keep it only 30 seconds. The objects were a pocket comb, with which B combed her own hair before giving it to the baby; a small police whistle, which B blew and handed to him; a stub pencil and a piece of paper, on which B

wrote the baby's name in demonstration; a clean handkerchief, with which B made a gesture of wiping her nose; a storybook, from which B read a rhyme; and the stethoscope, which B put in her ears and then gave to the baby.

Parts of doll. — The next item given to the baby was an eight-inch doll. After he had played with it a moment he was asked to "Show me the dolly's eye." If the child failed at first, the command was repeated twice more. In the same way the baby was asked to point out in turn the doll's nose, ear, hand, and foot.

Locomotion. — The motor tests consisted of a standing test, which was similar to the old sitting test in that three trials were given unless the baby stood alone for a minute. This test was discontinued as soon as the baby could stand alone. A 1-minute test of stair-climbing was given to babies in whose homes there were stairways. The walking test was given as usual, except that the time limit was cut down so that the babies walked only about ten steps.

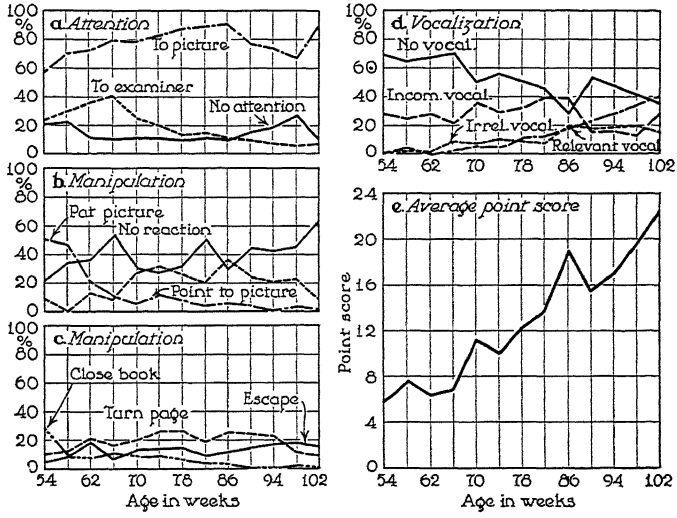
Reactions to the Pictures

Since the picture test and the mother's picture test were retained throughout the entire second year, the data for the whole period will be treated in this chapter. The reactions made to the pictures were classified under the usual headings — reactions of attention, manipulation of the picture book, and vocalization. Although vocalization, consisting of correctly naming the object, was the response asked for by the examiners and therefore the response that should be considered correct, all other reactions were recorded and subsequently considered both for their possible developmental significance and for the light they might throw on personality traits.

Attention. — Attention to the picture was a reaction in which the babies looked at the picture and manifested some interest in it. Sometimes, to be sure, the attention was merely a fleeting glance, but the baby's gaze was focused on the picture at least momentarily. Throughout the entire period from 54 to 102 weeks the large

FIGURE 17

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON THE PICTURE BOOK TEST



majority of the babies paid good visual attention. At the beginning of the second year an average of 58 per cent of the babies were looking at the picture (see Figure 17, section a). The curve rose gradually and reached its highest point at 86 weeks, after which it declined, though it showed another rise at the final age, 102 weeks. This decline after 86 weeks may have been

caused by too great a familiarity with the pictures and a consequent lack of interest in the test. At 102 weeks a few of the babies, who had been absent during several weeks of the summer, were again tested; to them, of course, the pictures were fresh and interesting, a fact that may account for the rise in the attention curve.

Attention to the book as a toy was recorded when the baby played with the book, crumpling the pages, fingering the fasteners, or flipping at its pages. The percentage frequency of this response was low at each age level. It should be noted that this type of attention, as well as attention to the audience and looking around, did not necessarily preclude attention to the picture. Sometimes the baby looked at the picture, named it, and then spent the remainder of his time fingering the pages, glancing at the experimenter for approval, or looking about the room. In such cases all types of attention the baby showed during the interval were recorded.

Attention to the examiners or audience occurred more frequently than any other distraction at all the ages tested. This reaction increased in frequency between the ages of 54 and 66 weeks, after which it gradually declined to the end of the second year. This decline was simultaneous with a marked increase in interest in the pictures, which was manifested by pointing and by more success in naming the pictures.

Looking around occurred infrequently in all the tests. Entire lack of attention to the pictures was also of rather infrequent occurrence; there was a sharp decrease in the percentage curve of this reaction at the 62nd week, after which it maintained a level until 86 weeks, when it increased again as attention to the picture decreased.

Manipulation. — At each week several babies made no manipulative reaction to the book. Manipulation

was, of course, not an essential part of the correct response, since all that the examiner asked was that the picture be named. The curve for "no reaction" shows several rises and dips during the period from 54 to 102 weeks, but no developmental trend is observable (see Figure 17, section b).

A manila cover was fastened over the loose-leaf drawings with paper clips of the brass, pronged-button type. The babies occasionally fingered these fasteners, sometimes poking and prying at the button side of the clip and sometimes turning the book over to work at the prongs. None of them ever succeeded in getting a button out, but their manipulation was gently exploratory. This reaction occurred infrequently in the group, although one baby played with the fasteners fairly consistently. The average frequency was never higher than 2 per cent, and the reaction showed no developmental trend.

Of all the types of manipulation, that of patting, rubbing, or fingering the picture most clearly showed a developmental trend. On the average, half the babies made this reaction to each picture at the outset, but the number dropped off rapidly at first and then more slowly, the reaction being practically eliminated at 90 weeks.

The curve for the reaction of pointing to the picture followed a rather interesting course. The average frequency rose between 54 and 70 weeks, remained more or less on a level from 70 to 86 weeks, and then declined rather sharply till the end of the year. This curve followed a similar course to that for attention to the picture. Their correspondence seems to indicate that the maximum interest in the pictures came at 86 weeks.

The reaction of turning the pages of the book in-

creased slightly during the early weeks of the second year and declined slightly toward the end, but its general trend was really not developmental (see Figure 17c). The reactions of closing the book, throwing it aside, and pushing it away, which were grouped together, showed a definite tendency to decrease in frequency with increase in age; from 86 to 102 weeks they occurred very rarely. The escape reactions of the babies, such as squirming, creeping or walking away, or amusing themselves with other toys, were of about the same frequency throughout the entire second year. The flatness of the curves for the reaction of turning the pages and that of escaping indicates that they were characteristic of certain babies. If one of the babies who usually participated in page-turning or one who consistently fled from the test was absent for a week, the curves fluctuated accordingly. Smiling was also among the reactions that showed little or no variation from week to week.

Vocalization. — Developmental trends were clearly shown by all the vocal responses. Lack of vocalization had great average frequency throughout the entire period, and although its curve presents a saw-tooth contour, the trend is definitely downward as age increases (see Figure 17d).

All vocalization was classified as follows: incomprehensible syllables, such as *dah*; repetition of incomprehensible syllables, such as *doddle doddle*; words that were comprehensible but either incorrect in the situation, such as *bow-wow* for horse, or irrelevant to the situation, such as saying *mamma* upon hearing the mother singing in the kitchen; and, finally, comprehensible and relevant responses that were meaningful in the situation. Since none of the babies talked plainly at the early ages and only two were entirely un-

derstandable at 2 years, the examiners were often in doubt as to whether the response was comprehensible. The babies' words were spelled to imitate their sounds as closely as possible, and a response was considered comprehensible if it sounded at all like the correct word. The following list gives all the variations in spelling and the various words that were considered as comprehensible and relevant responses.

Ball: ba, bah, ball

Cup: duh, tuh, tup, 's cup, tish, dish, o'ange juice, milk, milk in, wa-wa (water), f'ower (floral design on cup)

Dog: bah-hah, bow-wow, booh-wooh, wow-wow, bee-ow, dah, dom, dug, dog, tail, eye

Horse: hoosey, 'orsie, hah, hasee, ahkie, hawkee, horses, eye, Baby (name of grandmother's horse)

Cat: diddy, ditty, titty, kitty, moo, mew, mee-ow, bie (bite)

Bird: boo, buh, bir, bur, birk, birn, bedee, biddie, büddie, birdie, boord, boot, eye

Automobile: aut, au-o, auso, aowto, tah, tar, gar, cawh (car), choo-choo, bye-bye, papa and daddy (papa or daddy's car), daddy bye-bye, wide, ride

House: d'ause, 'ouse, hou, house, timney (chimney)

Girl: guh, geh, gull, girlie, gal, dir, dirl, doll, dolly, bahbee, beebee, baby, boy, Mahdee (Marjorie, a sister), Baba (Barbara, a sister), 'Rene (Irene, a playmate)

Man: ma, mah, man, daddy, my dahdie, taddy, bapa

One baby used the word "bige" or "pige" for page, one frequently said, "What's that, hunh?" and another demanded "more." These responses were considered as comprehensible and relevant.

Incomprehensible responses were common during the entire period, and they increased up to 86 weeks, after which they decreased rather sharply in frequency. The repeated incomprehensible syllables remained at a constant and low frequency throughout. Both types of

comprehensible responses increased gradually, but those of the incorrect and irrelevant type reached and maintained a level after 86 weeks, whereas the relevant and meaningful responses increased steadily until, at 102 weeks, 40 per cent of the babies were naming all ten pictures.

Reactions to individual pictures. — During the administration of the test it was obvious that some pictures were of much greater interest to the babies than others. The total number of tests given between 54 and 102 weeks was 178. The total number of reactions definitely indicating interest in the different pictures is presented in Table XLVII. Obviously there was no reason for

TABLE XLVII

REACTIONS TO INDIVIDUAL PICTURES

PICTURE	POINT TO PICTURE	SMILE AT PICTURE	TOTAL VOCALIZATION	INCOMPREHENSIBLE VOCALIZATION	REPEATED INCOMPREHENSIBLE VOCALIZATION	COMPREHENSIBLE IRRELEVANT VOCALIZATION	COMPREHENSIBLE RELEVANT VOCALIZATION
Ball.....	26	6	84	39	10	21	14
Cup.....	29	11	82	34	12	18	18
Dog.....	44	16	125	51	15	22	37
Horse.....	37	15	107	49	16	29	13
Cat.....	37	11	96	48	10	23	15
Bird.....	44	10	107	52	9	15	31
Automobile....	36	14	109	51	5	13	40
House.....	25	6	105	61	12	17	15
Girl.....	43	19	128	59	12	19	38
Man.....	48	7	101	44	10	10	37

putting these computations on a percentage basis, for there was a possibility of each reaction being made at each test, or 178 times during the entire period. The reaction of pointing was made most often to the pictures of persons and animals; the picture of the man ranked

first in eliciting this reaction, and those of the dog, the bird, and the little girl ranked in order. The picture of the automobile ranked with that of the horse and cat, and the three pictures of inanimate objects, the ball, the cup, and the house, were least often reacted to in this way. The picture eliciting the most smiles was that of the girl, and next in order were the pictures of the dog, the horse, and the automobile. Those of the man, the ball, and the house ranked low in eliciting smiles.

Vocal responses also clearly showed the babies' great interest in animals and human beings and in the automobile. The picture of the girl called forth the largest number of vocal expressions, and that of the dog was a close second. The pictured house outranked even the little girl in the number of incomprehensible expletives it elicited, but this probably was because the correct word for house was so little known. The picture of the horse received the largest number of comprehensible but irrelevant replies; it was usually called "bow-wow." The cat also received a good share of the same replies. In eliciting relevant and meaningful names the picture of the automobile outranked that of the girl, the man, or the dog. These four pictures, along with that of the bird, were named more than twice as often as those of the cup, the cat, the house, the ball, and the horse.

From this limited experiment it seems that babies in the second year find pictures of human beings and animals — and here we beg to stretch the latter term to include the automobile — more interesting than those of inanimate objects. Of the ten pictures that of the little girl was perhaps the most favored, but those of the dog and the automobile followed hard at its heels in interest value.

It is an interesting comment on our machine-age civ-

ilization that the automobile was named most often, whereas the horse was named least, and that the automobile was synonymous with daddy in the vocabulary of more than one of these babies. The reason for the association between daddy and car is obvious. One or more cars were owned by all but two of the families, and almost daily the baby saw the father depart and return in the automobile. Horses, on the other hand, were rarely seen by the babies. Nowadays they are used almost exclusively for delivering milk, and not only is their presence on the street rare but they are seldom pictured in popular magazine advertisements with which parents often amuse their children. Automobiles move and make noises, and to the baby these two capacities are probably the most important of animate qualities. One baby even attributed facial characteristics to the automobile, pointing to the hood of the car and remarking, "nose."

Point scale for scoring the picture test. — After a study of the curves for various types of attention and manipulation (see Figure 17, a, b, and c), it was decided that none of these had developmental significance, i.e., none of the curves rose consistently with advancing age, and therefore they were not worthy of point scores. Vocalization, on the other hand, did show a developmental trend, and point scores were assigned to it as follows:

Reaction	No. of Points
Repeated incomprehensible vocalization	1
Incomprehensible vocalization	2
Comprehensible but irrelevant vocalization	3
Comprehensible and relevant vocalization	4

Some more talkative babies made more than one response to a picture: i.e., responses to the car were,

"ja bye bye," "daddy," "ride"; to the man in the picture, "man"; and, to his gloves, "got dirty hands." To have given 4 points for each comprehensible word in such cases would have penalized the less talkative baby who nevertheless had complied with the examiners' instructions to name the picture. It was ruled, therefore, that the baby be given a score for only the best response to each picture. Hence the highest possible score was 4 on each picture, or 40 on the entire ten. The success of this point-score method is clearly shown in the rapidly rising curve (see Figure 17e). At 54 weeks the babies were scoring on the average less than 6 points on the entire test; at 102 weeks they were averaging 22 points, more than half the total possible score.

Needless to say, individual differences in the scores were great and fairly consistent. Only one baby achieved the highest possible score, 40, although seven others frequently scored above 30. At every age one or more babies made zero scores. Consequently the range in scores was always great. The consistency of the point scores from week to week is shown by the following correlations:[1]

Weeks Correlated	No. of Cases	r
70 and 74	17	.64
74 and 78	17	.29
78 and 82	13	.46
82 and 86	12	.72
86 and 90	12	.80
90 and 94	9	.88
94 and 98	11	.73
98 and 102	13	.75

Although the correlations were based on a small number of cases, they were fairly consistent from 78 weeks

[1] Cases at successive ages were so few and zero scores were so frequent previous to 70 weeks that no correlations were worked.

on. The correlations could not be considered reliability coefficients because the factor of development made for large differences in scores from week to week. They did, however, give satisfactory evidence that in the matter of speech development individual babies held their rank in the group to a considerable degree and that the methods of recording and scoring the tests were consistent.

Evidence as to the validity of the vocalization scores was found by correlating the scores on the picture-book test, indicating elicited vocalization, with the scores obtained on spontaneous vocalization. The latter term was used to designate any talking, comprehensible or incomprehensible, that occurred in response to the mother's picture, the manipulation, the imitation, and the choice tests. All spontaneous utterances recorded during the entire test were classified and scored according to the scheme described above. The correlations between spontaneous and elicited vocalization were based on a larger number of cases, since the scores on both were obtained each week. Correlations are as follows:

Age in Weeks	No. of Cases	r
54	9	.86
58	5	.78
62	11	.42
66	13	.85
70	18	.69
74	19	.70
78	18	.56
82	14	.58
86	14	.60
90	12	.75
94	12	.81
98	13	.23
102	19	.55
All ages	20	.82

The usual recorder was away on a vacation during the testing periods at 98 and 102 weeks, and the substitute was unable to get records of both elicited and spontaneous vocalization.

These correlations are in general above .60 and are fairly consistent in magnitude. They indicate that the babies who were talkative during the picture test also talked spontaneously during the remainder of the examination. These correlations are hardly reliability coefficients, since the data for the two variables were obtained under different conditions; nor are they true validity coefficients, because when two records are taken at the same test by the same recorder neither is an independent nor an outside criterion of the other. Nevertheless, they, too, indicate the consistency of the data to some extent, and indirectly they attest the great individual differences in the acquisition of speech.

Reactions to the Mother's Picture

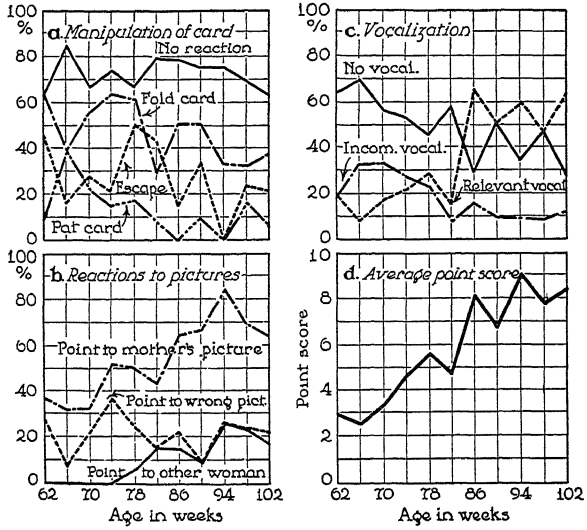
Unfortunately the pictures of the mothers were not ready for use at the beginning of the second year. The delay was occasioned by the fact that this situation was not thought of until after the rest of the test material had been planned and assembled, and when it was decided upon, unfavorable weather and the press of other work delayed the photographer in making the pictures. Records for 54 and 58 weeks are therefore lacking.

The correct response to the mother's picture was the simple one of pointing. This motor act was well established before the end of the first year. Failure in the test may therefore be attributed to any one of a number of things — failure to comprehend the directions, failure to recognize the picture, or lack of interest in the situation — but not to the lack of the motor skill of pointing. The unsuccessful reactions were classified under headings similar to those used for the picture book and were studied for possible developmental significance. The frequency of each response, in terms of percentages, is given in Figure 18.

Manipulation of the picture. — Since records were taken at 15-second intervals throughout this 1-minute test, it was possible to record several different reactions of each baby. Consequently the percentage frequencies of each type of manipulation totaled more than one

FIGURE 18

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON THE MOTHER'S PICTURE TEST



hundred. "No reaction" to the mother's picture, therefore, does not mean that the baby ignored the picture throughout the entire 1-minute test but that during the interval he ignored it at least part of the time. From Figure 18a it will be seen that a large percentage of the babies paid "no attention" to the picture and that the percentage fluctuated little with age.

Holes had been punched in the cards on which the

pictures were pasted for the purpose of joining two together with button clips, but it was finally decided to fasten them together with adhesive tape rather than with clips. The holes remained, however, and a few babies with a penchant for poking their fingers into holes reacted to the cards in this manner. Poking the fingers into the holes of the card was of rather infrequent occurrence, however, and was limited to two or three babies.

Random patting and rubbing of the card occurred with moderate frequency in the earlier weeks of the test, but it decreased very consistently toward the end of the second year. Folding the card, turning it upside down, or throwing it away were all reactions in which the pictures were put out of sight. The card was manipulated and used as a toy or it was completely discarded; the baby's interest and attention were not on the pictures. Reactions of this sort were of frequent occurrence and showed only a slight tendency to decrease toward the end of the period. Pointing to the wrong picture occurred at each age, the frequency of this reaction always varying around 20 per cent.

Pointing to the mother, the correct reaction, increased in frequency fairly regularly up to the 94th week (see Figure 18b). The drop in the curve at the next two ages may be accounted for by the fact referred to above, that many children who were out of town during their second summer returned before the last weeks of testing and were less familiar with the test than those who had been examined all summer. Occasionally a baby did not point but looked fixedly at his mother's picture. This reaction was credited as successful only when the examiner felt sure that the baby's prolonged gaze indicated his recognition.

At the later ages a small percentage of the babies

showed marked interest in the photographs by looking intently and pointing at the other women's pictures after having located the correct picture. When the baby pointed out his own mother promptly and still remained interested in the pictures, the examiner pointed to and named the other women. The baby was then asked to point out these women as the examiner named them. This reaction required only immediate memory of the other names, of course, and it must be emphasized that this variation of the test was tried only on those babies who were alert and interested in the pictures. From 78 weeks on, one or more babies were able to point out another woman on request, and at 94 weeks, the age of greatest proficiency on this test, 25 per cent of them could do so. Individual differences in attention and interest in these pictures were very great. Four babies of the group never showed any interest or recognition of their own mothers' pictures during the entire period. Six accomplished the more difficult task of learning temporarily the names of other women.

Smiling during this test was of relatively rare occurrence. The desire to keep the card longer than the 1-minute interval was manifested by only one baby, at the single age of 74 weeks. Attempting to escape occurred with a frequency of between 25 and 50 per cent at practically every age. The tendency for the escape reaction to decrease with age was by no means definite.

Vocalization. — During the first of this testing period about two-thirds of the babies did no vocalizing, but the number of silent babies decreased toward the end of the period. The curve for lack of vocalization shows a very irregular course, but the general tendency is downward (see Figure 18c).

The babies who did talk frequently uttered both in-

comprehensible and comprehensible words, and therefore they were scored once for each type of reaction. For this reason the total percentage of vocalization was sometimes greater than the difference between 100 per cent and the percentage for lack of vocalization. Incomprehensible vocalization attained its highest frequency in the period between 12 and 18 months; after 82 weeks it reached a low level and thereafter varied around 10 per cent.

Comprehensible but irrelevant vocalization did not occur in the early weeks, but it attained a frequency of about 25 per cent at 82 and 86 weeks and then decreased to the region of 16⅔ per cent, at which level it remained for the rest of the year. Comprehensible and relevant responses included such remarks as "Mamma," "dere" or "dah" (there), or "Mamma dere," accompanying the correct pointing response. A few babies at the later ages proceeded to point to their mothers' clothing and name "toat" or "shoes." One baby, Sibyl, even pointed to the brick wall in the background and volunteered the information, "Dat's our 'ouse," and this same little girl at 98 weeks said, as she watched the examiner lift the folded card from the box, "Mamma on dere," even before she was able to see the pictures or had been told to locate the picture of her mother. It was clear that her memory of this situation had persisted over the 4-week interval since the last examination. Comprehensible and relevant responses gradually rose about 10 per cent between the ages of 62 and 82 weeks; at 86 weeks they leaped to a new high level of between 50 and 65 per cent, and they maintained this level till the end of the year.

Interval in which successful recognition occurred. — It was thought that perhaps the baby who did not appear to comprehend immediately the instruction "Show

TABLE XLVIII

PERCENTAGES OF BABIES REACTING SUCCESSFULLY DURING EACH INTERVAL IN THE MOTHER'S PICTURE TEST

INTERVALS OF RECOGNITION (IN SECONDS)	PERCENTAGE REACTING IN EACH INTERVAL										
	Age in Weeks										
	62	66	70	74	78	82	86	90	94	98	102
0–14	18.2	23.1	5.6	10.5	16.7	7.1	21.4	25.0	25.0	31.8	42.0
15–29	18.2	7.7	22.2	31.5	16.7	42.9	14.3	8.3	66.7	31.8	15.7
30–44	0.0	7.7	22.2	21.0	27.8	21.4	7.1	0.0	25.0	53.9	21.0
45–59	0.0	7.7	16.7	26.3	11.1	7.1	35.7	25.0	16.7	31.8	15.7
60	18.2	15.4	22.2	21.0	27.8	14.3	14.3	8.3	16.7	23.1	26.3
Average point score	2.9	2.5	3.3	4.6	5.6	4.7	8.1	6.8	9.0	7.8	8.3

me Mother's picture" would later discover what was wanted, if it was repeated each succeeding 15 seconds. If the stimulus had had a cumulative effect there would have been more successful reactions in the later intervals of the 1-minute test. The percentages of successful reactions occurring during each interval, as given in Table XLVIII, showed very little variation from one interval to another, although they were somewhat lower during the first 15 seconds. Some babies were willing to point to the mother's picture each time the examiner requested it; such reactions assured the recorder that the first reaction was not merely a lucky chance. Others, however, refused to point more than once, and after doing so successfully they either played with the card as a toy or handed it back to B and went to look for other playthings. The time intervals in which success occurred thus gave little information on the quality of the response.

Point scale for scoring the mother's picture test. — Reactions that clearly indicated a developmental trend in this test were those of pointing to correct picture, pointing to the pictures of other women upon request, and vocalization. Point scores were made out for these reactions as follows, the number of points for each type of vocalization being the same as those allowed for vocalization in the picture test:

Reaction	No. of Points
Correctly point to the mothers' pictures during first 15-second interval	5
Correctly point to the mothers' pictures for the first time in later intervals	4
Each additional success after the first	1
Point to other women upon request once	5

Reaction	No. of Points
Point to other women upon request each additional time	1
Repeated incomprehensible vocalization	1
Incomprehensible vocalization	2
Comprehensible but irrelevant vocalization	3
Comprehensible and relevant vocalization	4

Since this scoring system is rather complex, it will perhaps be well to include one or two examples. Although the number of points for each activity was assigned arbitrarily, the reactions that should be scored were discovered by studying the developmental curves for each reaction. Since fewer successes occurred in the first 15 seconds, those that did occur early in the test deserved more credit. A repeated recognition of the mother's picture during the later intervals made the response an absolute certainty, but it hardly deserved as much credit as the first response. Pointing to other women after having recognized the mother received an additional credit. The values assigned to these reactions were such as to make the usual scores on this 1-minute test about 2/5 of those on the picture test, which had required 2.5 minutes. Since vocalization was scored at 15-second intervals during the picture test, it was considered only fair to give credit for more than one comprehensible response during this test. On the other hand, vocalization was not requested at this test; whatever talking occurred was spontaneous. After considering both these facts, it was decided to give credit for vocalization twice during the 1-minute interval, once in the first 30 seconds, and once in the last 30 seconds. Two sample records and their scores are presented on the following page.

Time in Seconds	Reaction	Vocalization	Score
0	Points to Mother immediately.		5
15	Points to Mother.....	"Mummy"	1+4
30	Points to other women as B names them.....		0
45	Points to Mrs. R. at B's request		5
60	Points to Mrs. T. at B's request		1
			16
0	Pokes at Mrs. V.....		
15	Points to Mrs. R.....		
30	Points to Mrs. V.....		
45	No attention.....		
60	Points to Mother.....	"ha, ha" (here, here?)	4+4
			8

Scores obtained by this method showed an increase with age. The average increased from 2.9 and 2.5 at 62 and 66 weeks, respectively, to a peak of 9.0 at 94 weeks, the age of greatest proficiency in this test. The point scores showed a satisfactory upward trend with age.

Reactions to the Manipulation Tests

The six manipulation tests were devised with the hope of calling forth a wide variety of exploratory reactions from the babies. The correct solution of each little problem required a different type of manipulation, and considerable precision in fine motor skill was necessary for success with the toys. The successful solutions were opening or closing the toy, in the case of the boxes and the bottle, stacking the blocks, rolling or throwing the ball, and putting the circular block into its hole in the form board. Thus two or more successful reactions were possible with each toy. The unsuccessful ways of ex-

ploiting the objects were so numerous and so diverse that it was impossible to make out a single set of categories that could be applied to all the reactions. It was necessary to modify and supplement the usual list of reactions to each toy and to devise a point-score system for each separately.

After the reactions were classified, the total time spent in each type of reaction was computed, and the number of each type of reaction made during the entire 1-minute interval was recorded. All the tables were divided into three parts: the first showed the frequency of a given reaction at each age level in terms of the percentage of babies reacting; the second gave the average time spent in each reaction, based on the number of babies who manifested the reaction; and the third gave the average number of each type of reaction, also based on the number of babies. The extent to which a given reaction was characteristic of the group was indicated in the percentage table; the length of time the babies persisted in a reaction was presented in the time table; and the extent to which the babies tried the same reaction again and again was shown in the table giving the number of reactions.[2] If a reaction had developmental significance, one would expect that the percentage of the babies manifesting the reaction would increase with age, that less time would be spent in random manipulation of the toy, and that fewer unsuccessful attempts would be made as age increased.

As a rule, attention to the demonstration of all the toys was good. In general, the babies were interested in the manipulation tests, and they not only watched the

[2] The tables on which this discussion is based are not included in the text. The percentage of babies reacting during each test is shown in Figures 19 and 20.

examiner closely but frequently took the toys from her hands. Paying attention to the demonstration was not an item of developmental significance. Attention was as good at 54 as at 74 weeks. Inattentiveness was an individual characteristic rather than a characteristic dependent on age or development. Further discussion of this type of attention is reserved for the third monograph, in which such individual characteristics will be taken up in detail.

Wooden box with sliding cover, tape inside.[3] — Attention was classified under the usual headings, attention to the object as a toy, to the examiners, or to the audience, and looking around. While the baby was busy manipulating the box in various ways, it was impossible for the recorder to write down notes on his attention in addition to the descriptions of his reactions. Consequently, unless attention was recorded otherwise, it was assumed that the attention was on the object. Hence the percentage of babies reacting with attention is probably too low at each age level. Attention to the examiners or audience occurred somewhat less frequently at the later ages, and the reaction of looking around occurred infrequently during this test.

Unsuccessful manipulation of the box consisted of no reaction, passive holding, random play, accidental opening of the box, and unsuccessful attempts to open it. "No reaction" to the box was rare; only one baby at 54, 62, and 74 weeks and two at 58 weeks ignored it, and they did so for only a portion of the 1-minute interval. Passive holding of the box was observed at some time during the course of the 1-minute test in the ma-

[3] This box and the round box were used in the tests given at 37, 41, 45, and 49 weeks. For a discussion of the earlier reactions to these boxes see Chapter XI.

jority of the babies. At 70 and 74 weeks this reaction became very much less frequent because the babies had become more proficient at opening the box. On the average, about 25 seconds were spent in this passive reaction. Random play with the box, which included the reactions of shaking, rattling, and patting the box, was exhibited by a large number of babies at every age except 66 weeks. The average time spent in random play decreased from 25 seconds at 54 weeks to 13 seconds at 74 weeks. Not only did the reactions of passive holding and random play become less frequent and consume less time as the babies grew older, but they recurred less often during the 1-minute test. At 54 weeks both these reactions were recorded, on the average, about three times for each baby, while at 74 weeks they were recorded slightly more than once. Development was manifested by a decrease in the number of random and passive reactions to the box.

Random manipulation sometimes led to an accidental opening of the box. If the baby held the box endwise with the unprotected edge of the lid down, the lid dropped off. Sometimes vigorous shaking of the box loosened the lid in its groove and caused it to slide off. This accidental opening of the box occurred at each age in about one-third of the cases. There was practically no tendency for this reaction to increase with age. Accidental opening consumed about 10 seconds of the testing time of those babies who made the reaction and never occurred more than one time during a single test. The babies who were lucky enough to shake the lid off by accident then proceeded to play with the object inside. In a few cases accidental opening was followed by an attempt to repeat the success. The baby shook or turned and twisted the box, seemingly with the hope

that it would fall open. This type of reaction, which was called "apparently purposeful opening by an incorrect method," happened only eight times during the entire period and showed no increase with age.

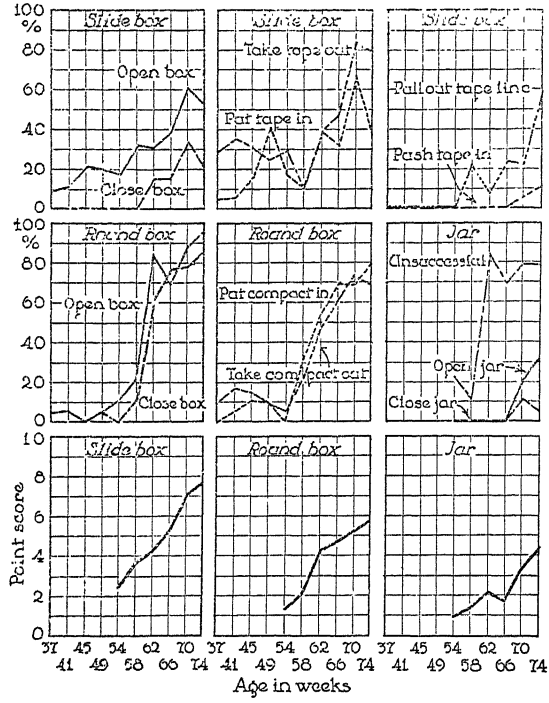
The next category was unsuccessful investigative manipulation, which had two subdivisions, an attempt to open and an attempt to close. Unsuccessful efforts to open or close the box were considerably more exploratory than those of random play. They were at least a step in the right direction. Attempts to open the box included such reactions as prying at the crack between the box and the lid, pushing at the lid but pushing in the wrong direction, and putting a finger in the thumb hole of the lid. Attempts to close the box usually consisted of laying the lid on top of the box, often crosswise or at a slant; sometimes a corner of the lid was jammed down inside the box, and occasionally the baby pressed on the lid after he had laid it across the top in an effort to get it to fit in place. Often this effort to put the lid on took place after the baby had put the tape inside the box. Unsuccessful attempts to open occurred less frequently than attempts to close, the reasons doubtless being that the box was much easier to open than to close and that a large number of babies, either by skill or by chance, were able to open the box. At every age except 54 weeks about one-third of the babies attempted to close the box. These babies spent about fifteen seconds of their time in this attempt.

Successful manipulation of the box included both opening and closing it and playing with the tape that was inside. To successfully open the box it was necessary for the baby to push the lid off by a gentle backward pressure with his palm or fingers, by putting his thumb or finger in the thumb hole and pushing, or by

prying at the crack at the end of the box until it opened far enough for him to insert his finger and thus push the lid off. Successful opening showed a satisfactory de-

FIGURE 19

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON SLIDE BOX, ROUND BOX, AND JAR TESTS



velopmental trend during the 20-week interval between 54 and 74 weeks. The curve for the number of successes is not without its backsets, however (see Figure 19a). The average time required for successful opening was practically the same at every age, about 12 seconds,

and success in this reaction usually occurred only once during the 1-minute test interval. Successful closing of the box was far more difficult than opening. In order to put the lid on, it first of all had to be turned right side up, for the flanges projected from the underside of the lid, and then the flanges had to be inserted into their grooves at the end of the box. When the lid was placed in the correct position for being shoved into place, it did not cover the box but projected out from it. That the babies were interested in getting the box covered was shown by the frequency of unsuccessful attempts to close it. At the ages of 58, 62, and 66 weeks exactly as many babies as opened the box successfully made unsuccessful attempts to close it. Only a few babies ever succeeded in their efforts to close the box. At the two earlier weeks none succeeded, but at 70 weeks one-third of them accomplished this difficult act. The curve for the percentage frequency of this reaction was similar in form to that of opening the box.

Once the box was opened the next reaction was to take out the tape. At every age but 58 weeks this reaction occurred more frequently than the successful opening of the box, which merely meant that taking the tape out occurred when the box was opened accidentally as well as when it was opened successfully (see Figure 19, b and c). The curve of the reaction shows a marked developmental trend. Putting the tape back into the box indicated a less pronounced developmental trend. The curve shows frequent ups and downs, but the most common frequency was around 33 per cent. After the 58th week both the reaction of taking the tape out and of putting it in occurred more than once on the average during the 1-minute test. Placing the tape in the box and putting the lid on was an interesting type of play.

When B demonstrated the box, she not only slid off the cover and took out the tape, but also pulled out the tapeline and snapped it in again. Since the tape had been offered to the babies as a toy from the first examinations, all of them were familiar with it, but not all could make it work. Unsuccessful attempts to pull out the tapeline were recorded for only three babies during the entire period of the test. Successfully pulling out the tapeline somewhat increased in frequency from 58 to 74 weeks. The reaction of pushing the button to make the tapeline run into the case was not discovered until 70 weeks; at this age one baby did it, and at 74 weeks two others mastered the trick.

A wide variety of reactions denoted lack of interest. The reaction of chewing the object was manifested very rarely during this test, and sucking the fingers or thumb did not occur at all. Attempts to escape were made by a few babies at each age level, but this reaction showed a slight tendency to decrease with age. Seeking help was also infrequent; one baby made this reaction at 62 weeks, and three at 74 weeks. Attempting to draw the examiner into the situation by smiles and bids for approval occurred first at 62 weeks, and the frequency increased from zero at 54 weeks to 21 per cent at 74 weeks. The reaction of giving up the task, manifested by throwing aside the box or seeming discouraged over the problem, was shown at only three age levels and by only one baby at each age. Smiling was an occasional accompanying reaction. These latter two reactions were too infrequent to show a developmental trend.

Point scale for scoring the slide box test. — In devising a scoring scheme for the boxes and the bottle, it was decided to give a low score, 1 point, to random play. Although this reaction decreased with development, it was

practically universal at the early ages, and the one point given to it virtually served as a blanket score and prevented a large number of zero scores that would otherwise have resulted. Points were assigned to the various reactions as follows:

Reaction	No. of Points
Random play with the box	1
Accidentally open the box	1
Incorrectly but apparently purposefully open the box	3
Unsuccessfully attempt to open the box	3
Unsuccessfully attempt to close the box	3
Successfully open the box	4
Successfully close the box	5

In order to prevent the baby who, after repeated attempts, finally succeeded in opening the box from scoring 3+4, or 7 points, and thus obtaining a higher score than the baby who opened the box at the first attempt, for which he received only 4 points, only one reaction of this group was scored. The babies were scored on the best reaction made. Hence 5 points was the highest possible score on this group of reactions. There were other reactions to the tape that occurred in addition to successfully opening the box. These reactions were given additional scores as follows:

Reaction	Additional Points
Take the tape out of the box	1
Put the tape into the box	2
Try to draw the examiner into the situation	2
Pull the tapeline out	4
Push the button for the tapeline to snap in	5

The highest possible score on the entire examination

was 19 points. No baby made the maximum score, but two received the score of 16 on a single test, and several made scores above 10 on the later tests. Individual scores ranged from zero to 7 at 54 weeks, and from 1 to 16 at 74 weeks.

The average point scores yielded a curve of high developmental significance. They increased from 2.47 at 54 weeks to 7.63 at 74 weeks (see Figure 19d). Progress in average point scores occurred at each successive test.

Round wooden box with compact inside. — Reactions to the wooden box were classified under the same heads as were those to the slide box. The various reactions of attention again showed no developmental trend. Attention to the object as a toy occurred at each age; attention to the examiners or to the audience occurred with slight frequency at every age except 70 weeks; and looking around was observed at 62 weeks only.

Ignoring the box was very rare; it was observed in only two babies at the earliest age, 54 weeks. Passive holding was a reaction of high frequency every week, but the number of babies reacting in this way decreased somewhat with age. Shaking the box and random play were also reactions of higher frequency in the early weeks than in the later. The time consumed in passive holding and in random play was almost the same at each age and showed a steady decrease from almost 30 seconds at 54 weeks to about 12 seconds at 74 weeks. The average number of times these two reactions were recorded per baby also decreased from 3.0 to 1.5 during the twenty-week period.

Opening the box by shaking or dropping it was low in frequency at every age except at 54 weeks. This accidental opening happened less often with this box than with the slide box, probably because the round box was

so much easier to open corrrectly. Incorrect but apparently purposeful opening by dropping or shaking occurred only twice. Unsuccessful attempts to open the box in the correct way seldom occurred because effort at manipulation was usually rewarded by success. Unsuccessful attempts to put the lid on the box were more frequent, although most of the babies achieved success in this reaction by 74 weeks. The small number of unsuccessful reactions to this box indicate that it was considerably easier to manipulate than the slide box.

The rapid development of skill in handling this toy is shown in the curves for opening and closing the box (see Figure 19, e and f). Although only a few babies were skillful enough to open or close the box at 54 and 58 weeks, far more than half of them achieved success at 62 weeks. The successes shot up rapidly between 58 and 62 weeks and continued to rise gradually until the end of the testing period. The curves are very different in form from those for opening and closing the slide box. The reactions of taking out and putting in the compact case also showed rapidly rising curves that were somewhat similar to those for taking out and putting in the tape in the slide box test. Opening and closing the compact case was too difficult for babies at these ages. Only one baby achieved this reaction, and that at the earliest test at 54 weeks. Since there was no repetition of the success, it is probable that the reaction was accidental. From 62 weeks on, one or more babies tried to open the compact, but all of them failed. Opening the compact was even more difficult than rolling up the tapeline.

Among the reactions denoting lack of interest chewing or licking the box occurred with moderate frequency during the earlier tests but was practically discontinued after 62 weeks. The escape reaction occurred with about

the usual frequency at each age, and a few babies sought help in the later tests. Attempts to draw the examiner into the situation were not made until 66 weeks, and they increased somewhat in frequency at 74 weeks. These social reactions were made with about the same frequency during both the slide and the round box tests. During every box test except that given at 58 weeks one or more babies smiled. The reaction of giving up in apparent discouragement was infrequent in occurrence at all ages. With the exception of the attempt to draw the examiner into the situation none of the reactions discussed in this paragraph showed a developmental trend.

Point scale for scoring the round box test. — Since the round box was easier to manipulate than the slide box, the points given for unsuccessful attempts to open and close the box and for successful opening and closing were lowered by 1 point each. The individual score was based on the best reaction made plus the additional points made on special reactions.

Reaction	No. of Points
Random play with the box	1
Accidentally open the box	1
Purposefully open the box by an incorrect method	2
Unsuccessfully attempt to open the box	2
Unsuccessfully attempt to close the box	2
Successfully open the box	3
Successfully close the box	4

	Additional Points
Take out the compact	1
Put in the compact	1
Try to draw the examiner into the situation	2

The maximum number of points that could be made on reactions to this box was 8, and two babies made this score at 74 weeks. The average number of points scored increased at each age, the most rapid rise occurring at 62 weeks (see Figure 19g). After this age the curve for point scores rose more gradually. In general, the point scores on this box were not so high as those on the slide box. The scoring method, however, was successful in bringing out the developmental trend.

Screw-cap jar with doll inside. — The reactions of attention to this test hardly need be commented upon, because they were of the same type and of about the same frequency as those to the two box tests. Passive reactions of holding the jar occurred with high frequency during the early tests and decreased markedly in the later ones. Random play with the jar was a frequent reaction at each age. The average time spent in these two types of reaction was more than 50 seconds at 54 and 58 weeks, but it decreased to about 40 seconds at 70 and 74 weeks. At all ages, however, the majority of the babies devoted considerably more than half the 1-minute testing interval to passive or random reactions. Accidental opening of the bottle happened only twice in all the tests. In those two cases the cap had been screwed on so lightly that it bounced off when the jar was vigorously shaken.

The percentage of babies making unsuccessful attempts to open the bottle increased greatly with age. The curve for this reaction shows a rapid rise at 62 weeks, very similar to that for successful opening of the round box (see Figure 19h). In general, unsuccessful attempts with the jar seemed to denote as much skill as successful manipulation of the round box. In the later tests an average of about 30 seconds was spent by

the babies in making unsuccessful attempts to open the jar.

Although the cap of the jar was screwed on lightly, at least two twists were necessary to remove it. A single twist of the lid was not so difficult for the babies; sooner or later most of them worked at the problem in this way. But the sequence of giving a twist, releasing the grasp, taking a new hold, and twisting again was one that only two of the babies mastered at 70 weeks. The two babies who were successful at this age did not repeat their success at 74 weeks, although four others succeeded in opening the jar at this age. Successful opening of the screw-cap jar was beginning at 74 weeks, the end of the testing period. Successful closing of the jar by screwing the lid back in place was more difficult than opening it. Two boys accomplished this at 70 weeks, and only one, a girl, did it at 74 weeks.

Failure to open the jar could not be attributed to lack of interest or effort. The high percentage of unsuccessful attempts clearly showed that the babies worked hard at the task. They were much interested in the bottle; indeed it proved such a popular toy that it was kept in the examination series from 78 to 104 weeks as one of the toys in the choice test.

Obviously, only those babies who succeeded in opening the jar could make attempts to take out the doll. The doll was of rubber and represented a policeman; it had the policeman's proverbial big feet, and these appendages were too big to go through the mouth of the bottle without being bent. Four types of manipulation of the doll were tried at 74 weeks. Four babies reached into the bottle with their fingers, grasped the doll by its head, and tried to pull it out. Two turned the jar upside down so that the doll would drop out.

The baby who succeeded in getting the doll out tried both methods and finally gave the toy a hearty yank that bent the stubborn rubber feet, and the doll came out with a jerk. Then he thrust the toy policeman head foremost into the glass prison and spent the remainder of the time trying to cram the feet in and screw the lid.

The chewing reaction was moderately frequent in this test during the early ages. Attempts to escape were made by a very few babies at each age. Discouragement was manifested in a few babies at 70 and 74 weeks. Smiling was recorded a few times. Trying to keep the jar after the time was up occurred at 70 and 74 weeks. Seeking help was recorded only at the ages 62, 70, and 74 weeks, but more babies made the reaction during this test than during the box tests. The baby handed the bottle back to B with a grunt or gesture that was clearly a request that she open it again. A few babies even used the word "op" or "opie." To such requests B usually complied by giving a second demonstration and handing the closed bottle back again. These reactions on the part of the babies gave further evidence of their interest in the jar as a toy.

Point scale for scoring the screw-cap jar test. — Points were assigned to the reactions with the jar as follows: Only the best of the first three reactions listed was scored, but both successful opening and successful closing were scored if both occurred.

Reaction	No. of Points
Random play with the jar	1
Unsuccessful effort to open the jar	2
Unsuccessful effort to close the jar	3
Successfully open the jar	4
Successfully close the jar	5

	Additional Points
Seek help	2
Unsuccessful effort to get the doll out	2
Unsuccessful effort to put the doll in	2
Turn the bottle upside down to get the doll out	3
Get the doll out	4

Although such a large number of reactions were scored that the maximum possible score was 22, the scores in general were low. The highest score made at 74 weeks was 13, and at the early age of 54 weeks a large number of scores were zero. The range in scores on this test was therefore not so great as on the two box tests. The average point scores increased from 1.00 at 54 weeks to 4.47 at 74 weeks (see Figure 19j). The greatest increase in point scores occurred at 70 and 74 weeks. From the standpoint of obtaining a curve of development in the ability to unscrew a jar lid it would have been better to have continued this test for a longer period. The reactions to the jar obtained from the choice test supplemented these results to some extent, but they were not strictly comparable because from 78 to 102 weeks the baby played with the jar only from choice and therefore his time limit was not fixed.

Six 1-inch cubes. — The reactions to the 6 cubes were very different from those to the boxes and the jar. The first reaction of most of the babies at each age was pushing over the tower of blocks that B had built in demonstration. Between 50 and 60 per cent of the babies did this at each age; the reaction showed no tendency to increase or to decrease with age. If the babies sat admiring the tower and did not knock it over, B toppled it over herself, saying as she did so, "Now you build one." Passive holding of the blocks and random play

with them occurred at all ages, but both reactions decreased slightly with age.

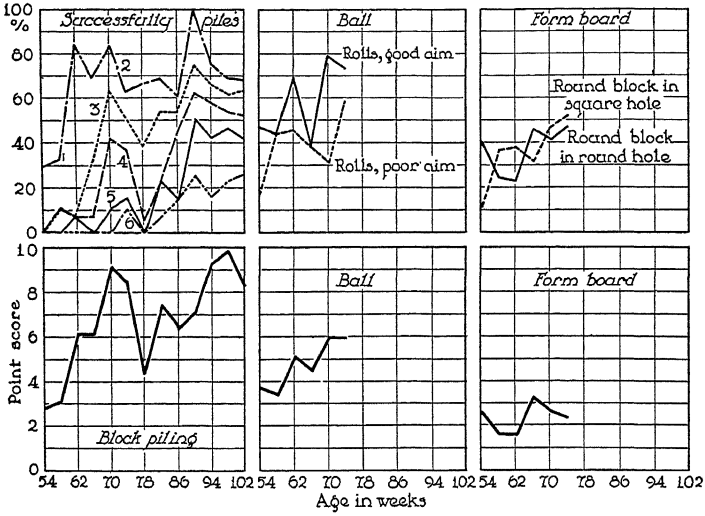
Taking down the tower of blocks one at a time was a reaction requiring considerable skill. At all ages some babies started to tear it down a block at a time, and at 62 weeks and thereafter more than half the babies took at least 1 block off the tower without its falling. About a third of the babies took off a 2nd block, and still fewer took off the 3rd. Only a few babies were able at the later ages to take down the entire tower, block at a time, without its falling. There were many variations of this tearing down of the tower. Now and then a baby picked up the 3rd block from the top, and thus lifted the top 3 off together. Sometimes, after removing 1 or 2 blocks, the baby replaced them and thus built the tower up again. A tower built in this way was a joint product of Examiner B and baby and was usually more stable than a tower built entirely by the baby, since B's foundation blocks were more carefully placed than those of the baby.

Unsuccessful attempts to pile blocks were tabulated according to the number of blocks piled. If 4 blocks were piled successfully and the placing of the 5th precipitated a downfall, 5 was then recorded as the number unsuccessfully piled. Successful piling of blocks was counted according to the highest block that was piled without the tower's falling. At 54 weeks no baby succeeded in piling more than 2 blocks; at 74 weeks two were able to erect a 6-block tower. But even at the later ages the majority of the babies were piling not more than 2 blocks. Figure 20a shows the percentage of babies who succeeded in piling from 1 to 6 blocks at each age tested from 54 to 102 weeks.

The lack of success was partly to be explained by lack

FIGURE 20

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON BLOCK, BALL, AND FORM BOARD TESTS



of interest in the test. The chewing reaction occurred with slight frequency at most ages, and the escape reaction occurred with a frequency of about 25 per cent at each age. Giving up in discouragement and brushing or throwing the blocks aside or putting the blocks into B's hand were more common reactions in the block test than in the test with the boxes.

Point scale for scoring the block test. — Point scores were assigned thus:

REACTION	No. OF POINTS
Take from 1 to 3 blocks from the tower.....	4
Take from 4 to 6 blocks from the tower.....	6
Each block piled.....	2
Try to draw the examiner into the situation.....	2

The use of this scoring method made it possible for the baby to make 20 points, 6 for taking the tower completely down block by block, 12 for rebuilding it, and 2 for trying to attract the examiner's attention. The highest score made at 74 weeks was 18 points, and the lowest, zero points. Average point scores increased from 2.82 at 54 weeks to 9.05 at 70 weeks. Since this test was continued up to 102 weeks, the curve for the average point scores is drawn for the entire second year (see Figure 20b). Little progress in this test was made during the last half of the second year.

Ball. — The scarcity of "no reaction" indicated that the ball was well liked by the babies. Passive holding of the ball steadily decreased in frequency during the testing interval, and the time spent in this reaction also decreased somewhat. Random play with the ball consisted of shaking or patting it; the toy was not treated as a ball. Random play likewise decreased in frequency from 54 to 70 weeks. Rolling or bouncing the ball apparently by accident occurred when the baby dropped the ball. This reaction was made by two or three babies at most of the ages tested.

Two gradations of the successful response to the ball were scored — successfully rolling or throwing the ball with poor aim and successfully rolling or throwing the ball with good aim. In the former the baby attempted to roll or throw the ball to B, but the ball went wide of its mark, and either B or the baby had to chase it. This reaction increased in frequency from 17 per cent at 54 weeks to 58 per cent at 74 weeks. The progress was not continuous, however, and the curve shows a marked dip at 66 and 70 weeks (see Figure 20c). Throwing the ball with good aim was displayed by a larger number of babies at each age than was throwing the ball with poor

aim. A good aim was achieved by 50 per cent of the babies at 54 weeks and by 85 per cent at 74 weeks, but the curve shows a dip at 66 weeks. Walking or creeping after the ball occurred at each age level, but the reaction showed no tendency to increase with age. The babies who rolled the ball spent more than half the 1-minute period in this successful activity.

The social reaction of trying to draw the examiner into the situation appeared at each age. This was rated as one of the successful reactions because the test was planned with a view to obtaining cooperation between the baby and B in playing with the ball. There was no tendency for this social reaction to increase in frequency with age. A desire to keep the ball was manifested once during the tests given at 66, 70, and 74 weeks. All the babies had balls of their own with which they played either alone or with siblings or parents.

The chewing reaction occurred more frequently with the ball than with any other toy in this series of manipulation tests. The reason for this may have been that the ball was painted bright red; a few of the babies seemed to mistake it for an apple. At any rate they nibbled at it industriously with their recently acquired teeth. At every age except at 54 weeks more than one-third of the babies chewed the ball, although the average time spent in this reaction was less than 10 seconds. Attempts to escape were made at each age by approximately the same number of babies. Seeking help and smiling occurred with about the usual frequency.

Point scale for scoring the ball test. — Persistency in playing with the ball was taken into consideration in making out the point scores and for this reason they were based on the time spent in successful manipulation. The scoring points were:

Reaction	No. of Points	
Roll or throw the ball with poor aim	1	for each 15 seconds
Roll or throw the ball with good aim	2	for each 15 seconds
Walk after the ball	2	
Try to draw the examiner into the situation	2	

Thus a baby who threw the ball with poor aim once, walked after it, and then threw it with good aim received a score of 1+2+8, or 11 points, on the entire performance. This was the highest score made on the ball test, and there was a range in score from zero to 10 or 11 at each age. The curve for the average point scores shows a zigzag upward course; like block-piling it did not yield a smooth developmental curve (see Figure 20d). From the reactions obtained in this study it seems that a ball is not well suited to show development during the early part of the second year. Since none of the reactions made to the ball showed a consistent tendency to become more frequent with advancing age, it was impossible to devise a point-score system that showed consistent development.

Form board. — The correct response to the form board was not demonstrated; the board and the circular block were merely put down in front of the baby, and he was left to discover for himself what to do with the materials. The successful placing of the block was elaborately praised by the examiners, however. If, at the later ages, a baby offered B the block in an effort to get her help, she refused, saying, "No you put it in." Passive holding of the block or board occurred with high frequency at 54, 58, and 62 weeks but de-

creased at the three later ages. Patting the block, pounding or rolling it on the floor, and other random play reactions with block or board dropped from 88 per cent at 54 weeks to 37 per cent at 70 weeks. Putting the arm through a hole in the board amused two or three babies at 70 and 74 weeks.

The babies made a step in the right direction when they attempted to put the block into any of the holes. The greatest amount of energy was wasted in trying to get the round block in the square hole. The number of babies who tried this reaction increased from 12 per cent to 52 per cent during the 20-week interval, and the babies who made the attempt worked for about twenty seconds in their efforts to fit the round block into the four corners of the square. Many reverted to this reaction two or three times during the course of a single test. Trying to fit the block into the triangular hole occurred at all tests except the first, but fewer babies made this error. The babies who did, however, spent less than ten seconds in the attempt, and after once deciding that the block would not fit they usually did not try it again during the test period. Unsuccessful attempts were made to put the round block in the round hole, for even though the block had no corners to make it hard to fit, it still required some skill to get it into place. Since the block fitted rather tightly in the hole, it was usually necessary for the baby to give a little pat or shove in order to get the block neatly in place. Occasionally the block was put in the hole on edge and left standing upright. Unsuccessful efforts to put the round block in the round hole were made by about 25 per cent of the babies at each age and usually consumed from fifteen to twenty seconds of the testing time.

Success in putting the round block in the round hole

occurred at all ages, and, strange to say, it increased in frequency very little up to 74 weeks. Up to 78 weeks the number of successes in this reaction varied between 40 and 50 per cent; at 82 weeks a higher level of proficiency was reached, and about 80 per cent of the babies were successful (see Figure 20c). A desire to keep the block was manifested a few times at 66, 70, and 74 weeks.

Chewing the block occurred with a frequency of 25 per cent during the earlier testing. Escaping was a reaction manifested by from 30 to 50 per cent of the babies at each age. Whether it was the difficulty of the task or merely that, after three and a half minutes of picture tests and five minutes of manipulation tests, the babies were somewhat bored it is impossible to say. The reaction of giving up the task occurred at three ages and with a frequency of 31 per cent at 74 weeks. The social reactions of seeking help and trying to draw the examiner into the situation appeared with slight frequency.

Point scale for scoring the form board test. — Since the successful reaction to the form board did not show a clear developmental trend, it was obvious that a point scale based upon it would not indicate development. Nevertheless it was decided to try a scoring system in which the baby's false efforts would count against him. A rather complicated method was worked out as follows:

Reaction	No. of Points
Unsuccessful effort to put the round block in the square hole	1
Unsuccessful effort to put the round block in the round hole	2
Successfully place the round block after three unsuccessful efforts	3

Reaction	No. of Points
Successfully place the round block after two unsuccessful efforts	4
Successfully place the round block after one unsuccessful effort	5
Success with no unsuccessful attempts	6
Immediate success with no other reactions	8
Try to draw the examiner into the situation	2

The highest score made by this method was 8 points. At each age some babies made zero scores. The average point scores showed no consistent developmental trend even when directness of response was taken into account by this elaborate scoring method (see Figure 20f). With these babies the form board test was classed with the ball and the block tests as inadequate for showing development during the age period from 12 to 18 months.

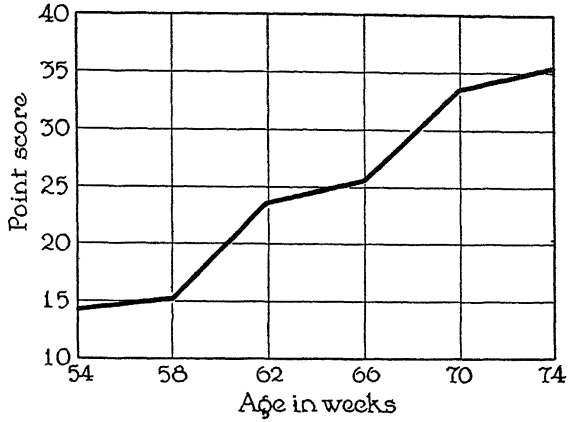
Total Point Scores on the Manipulation Tests

Although some of the toys in the manipulation test failed to give scores that increased with age, the results, when the scores for all six items were summed, indicated a satisfactory developmental trend, as may be seen in the tabulation below (see also Figure 21). The battery of six tests proved useful for detecting increased skill in many types of manipulation.

Age in Weeks	Score
54	14.4
58	15.1
62	23.7
66	25.7
70	33.6
74	35.2

FIGURE 21

AVERAGE POINT SCORES ON THE SIX MANIPULATION TESTS



REACTIONS TO THE IMITATION TESTS

It must be emphasized that the six tests that made up this part of the examination were designated as imitation tests more for the sake of giving them a name than with the idea that they would elicit from the babies only imitative responses. To be sure, the material for the test was chosen with an eye to its familiarity to the babies. The comb, pencil, handkerchief, and book were all objects with which the babies had daily contact. The whistle and the stethoscope were not household friends as were the other toys, but the babies were well acquainted with the latter instrument from their four-weekly physical examinations, and the former had served as a toy in some of the earlier tests.

This series of tests differed from the manipulation tests in that the objects required less complicated maneuvering and the correct manipulation of the object

in most cases involved using it on the child's own body. The comb was to be used on the hair, the handkerchief on the nose, the stethoscope in the ears or around the neck, and the whistle in the mouth. The demonstrations were simpler than those for the manipulation tests. Each test lasted thirty seconds.

Comb. — Attention to the test was classified in the usual way. Passive and random reactions occurred with a frequency of about 50 per cent, and these reactions did not decrease with age as they usually did in the picture book and manipulation tests.

Combing the face or the body was an attempt at the right reaction. A few babies did this at all ages tested except at 74 weeks. Combing the hair was often merely rubbing the hair with the comb flat, entangling its teeth in the locks, or dragging it edgewise as if to part the hair. None of the babies improved their appearance by their efforts, although one or two held the comb in the correct position and raked it through the hair with skill. This reaction did not show a developmental trend. About 45 per cent of the babies combed their own hair at each age. An interesting variation of the combing reaction was combing the examiner's hair. To be sure, B demonstrated the comb by using it on her own hair, and the babies showed a willingness to help her in her primping. Occasionally their interest in combing extended to the mother, and now and then a baby made the complete rounds of the group, using the comb on Mother, B, S, and any other adult or older child who was present. This reaction also showed no developmental trend but was made by from 20 to 40 per cent of the babies at each age. To the babies the comb was quite a social toy; at the later ages a few babies handed comb to the mother or to B.

Pushing the comb away occurred in five cases at the later ages. The escape reaction appeared with about the usual frequency. A new reaction denoting lack of interest was that of dropping or laying aside the comb after it had been used successfully; reactions of abandoning the toy after a successful reaction were not observed in the manipulation tests. Although their occurrence was infrequent, they indicated that the comb was too simple a toy to absorb the baby's interest for more than 30 seconds. The chewing reaction, which usually was more frequent with the toys that indicated less developmental progress, occurred very often during this test.

Point scale for scoring the comb test. — Although none of the reactions to the comb showed a developmental trend, the successful reactions were given points as follows:

Reaction	No. of Points
Comb own hair	4
Comb B's or Mother's hair	5
Give the comb to B or to Mother	2

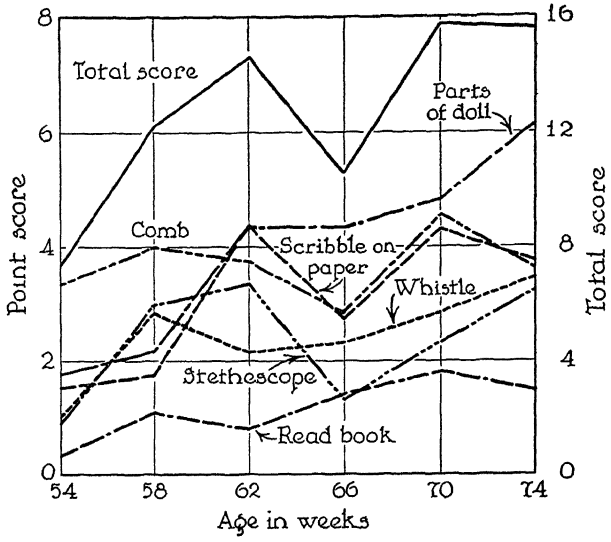
The highest possible score of 11 was made on one test by one baby. Scores of 9 occurred at several ages. The average point scores as given in Figure 22 showed no consistent tendency to increase with age.

Whistle. — Reactions to the whistle were scored according to the same key used in the tests at 42 and 50 weeks. Passive reactions to the whistle and random patting and shaking it occurred at each age. Some babies at each age put the whistle to their mouths but did not blow it; this was the beginning of the correct response. A somewhat better approximation to the correct reaction was blowing the whistle in an incorrect way. This reaction was apparently purposeful, and sometimes the

baby made a noise by humming as he blew at the side or the wrong end of the whistle. This reaction occurred in more than 30 per cent of the cases at most ages, but it did not increase in frequency with age.

FIGURE 22

AVERAGE POINT SCORES ON THE IMITATION TESTS AND ON THE PARTS OF DOLL TEST



Successful blowing of the whistle occurred at all ages except 54 weeks, and the reaction showed a slight tendency to increase in frequency with age. Almost equally successful was the reaction of holding the whistle to B's lips or to the mother's to be blown again. This reaction was made by two or three babies at every age but one. Handing the whistle to an adult also occurred with low frequency at most ages. The social reaction of trying by smiles or bids for praise to bring the examiner or the

mother into the situation had a frequency about as high as that of the other two social reactions. The escape reaction was manifested by some babies at each age.

Point scale for scoring the whistle test. — Since correct blowing of the whistle did increase in frequency somewhat during the period, it was hoped that a point scale would make the progress more evident. Only the best reaction of the first three listed was scored.

Reaction	No. of Points
Blow the whistle incorrectly	4
Blow the whistle correctly	6
Blow the whistle correctly with no other reaction	8
	Additional Points
Seek help by handing whistle to B or putting it to her mouth	2

The highest number scored on any test was 8. Average point scores ranged from 1.0 at 54 weeks to 3.5 at 74 weeks. The rise of point scores with age was gradual but fairly consistent, as is shown by the curve in Figure 22. Progress in this skill was much slower, however, than the examiners had anticipated. This particular whistle was hard to blow; perhaps a tin horn or a mouth organ would have brought more success.

Pencil and paper. — The use of pencil and paper was demonstrated by B's putting a sheet of paper down on the floor and writing the baby's name on it. She first put down a magazine or lapboard in order to make a firm surface on which to write. The reactions of the babies to this test were varied and interesting.

Passive holding of the pencil and random play with it occupied the time of about half of the babies at each test. Manipulation of the paper was a frequent reaction

at most ages. The babies apparently were not satisfied with the paper as B had placed it on the floor; they had to pick it up, turn it over to write on the clean side, and usually they moved it off the hard surface onto the soft rug. Then, after lifting the paper and discovering the magazine underneath they not infrequently marked on it instead of on the paper. At each age some of the babies attempted to mark with the wrong end, the eraser end, of the pencil, but this reaction decreased in frequency during the 20-week interval. Crumpling the paper happened only once during the entire period. The early delight in rustling and tearing the paper, which reached its height in the 5th month (see Chapter VIII), was completely outgrown at this age.

The successful reactions were classified under three headings. Accidental marking on the paper consisted of a single dot or sprawling line made by letting the pencil drop lightly on the paper and pushing it around in a random fashion. The marks thus made were usually very light. This reaction was of about equal frequency during each test. Drawing a line on the paper also occurred with little change in frequency at each age, and here again light lines were drawn more often than heavy lines. In scribbling the baby made several marks without lifting his pencil, sometimes making an arc-like or circular scribble. This reaction occurred most frequently at 62 weeks and became less frequent during the later tests. Light scribbling was more frequent than heavy scribbling.

The papers on which the babies marked were filed away along with their other tests. Not only are great individual differences shown in the skill and form of the marks, but the complete series for each child shows the graphic development much more clearly than a descrip-

tive account can possibly depict it. Through classification and tabulation subtle differences that appear on the papers are lost. The same is perhaps true of block-piling, whistle-blowing, and other acts that failed to show developmental trends. These reactions left no objective records; the examiner's descriptive account is all that remains of them. If it had been possible to preserve these reactions in cinematic or graphic form, some development in the skills might have come to light.

Point scale for scoring the pencil and paper test. — Point scores for this test were given for the reactions as follows:

Reaction	No. of Points
Draw a line, either light or heavy	4
Scribble a line, either light or heavy	6
Try to draw others into the situation	2

Four babies made scores of 10 on the paper test. The average point scores increased from 1.5 at 54 weeks to their highest point of 4.5 at 62 weeks. After this age the scores fluctuated about 4.0. The scoring method failed to show consistent development after 62 weeks (see Figure 22).

Handkerchief. — Of all the tests in the series, that with the handkerchief was the least popular. Blowing the nose was very evidently a duty that the babies preferred to shirk rather than a pleasure in which they indulged. It is worth noting that the reaction of ignoring the handkerchief was made by more than one baby to this test at each age. The reactions of passively holding and dropping appeared with less frequency than in most of the tests, but they did not give way to active and interested manipulation of the handkerchief. Random play was slight.

Three babies found uses for the handkerchief other than wiping the nose. One baby met the examiner half way, as it were, and wiped her hands instead of her nose; another wiped the floor with the cloth; and a third dusted the end of the bed, rubbing the polished footboard with considerable vigor. A few babies at each age wiped or brushed their noses but usually abandoned the handkerchief afterward, dropping it carelessly and going in search of more interesting toys. The large percentage of escape reactions also indicated the babies' lack of interest and their pursuit of other amusements during the test. Two babies retaliated for the nose-wiping task by wiping B's or the mother's nose, and a few dutifully held up their noses to B to be wiped when she offered the handkerchief. Since the handkerchief test was clearly uninteresting to all the babies and since no developmental trend was apparent in any of the reactions, it was not scored by a point scale.

Reading the book. — Just sitting and looking at the book with no sign of interest in the gaily colored pictures made up a part of the passive reactions to the book presented to the babies. Passive reactions and random play occurred with moderate frequency at each age. Turning the pages and opening or closing the book were reactions common at every age. Looking at the pictures was manifested by a few babies at every test except the first. Pointing to the pictures happened most frequently at 66 weeks.

The reaction that was considered successful at this age was holding the book, looking at it intently, and jabbering as if reading. After B demonstrated the book by reading a rhyme from it, she said, as she handed the book to the baby, "Now, you read." From one to three babies made this response at each age tested. Once a

baby returned the book to B to have another story read. Occasionally the babies tried to draw B into the situation by pointing out pictures and showing them to her. The escape reaction occurred very frequently during this test.

Some of the babies assumed the bookworm posture, lying flat on the floor on the stomach with heels waving in the air and the book opened before them. Apparently these babies had observed the reading posture of older brothers or sisters and were imitating them, for the reaction was confined to those babies who had siblings of school age.

Point scale for scoring the book test. — Points were given to the best of the first three reactions in the following list:

Reaction	No. of Points
Point to or rub the pictures	2
Look at the pictures and turn the page purposefully	3
Jabber as if reading	5
	Additional Points
Try to draw the examiner into the situation	2

This scoring method resulted in individual scores that ranged as high as 8 and in average scores that increased slightly with age from .37 at 54 weeks to 1.84 at 70 weeks. Although the curve for point scores is rather flat, its general trend is upward (see Figure 22).

Stethoscope. — In the physical examinations the stethoscope had been an interesting toy, and frequently the babies had tried to put the earpieces in their ears or hang the instrument around their necks. Since it had

already been used imitatively by some babies, it was used as a test object in the imitation series.

Passive and random reactions were of high frequency in this test, perhaps because it was the last in the series. Incorrect but exploratory manipulation, which occurred with moderate frequency at each age, consisted of pulling the earpieces apart and putting the fingers in them. At almost every age a few babies rubbed the stethoscope on their heads as if trying to hang it about their necks; one baby, indeed, draped it about her stomach.

Only a few of the babies at four different ages were successful in putting the earpieces of the stethoscope into their ears or in hanging the instrument around their necks in the approved medical fashion. Giving the stethoscope back to B and putting it in B's ears were the social reactions that appeared in this test. None of the reactions showed a definite developmental trend.

Point scale for scoring the stethoscope test. — These reactions were scored by points, the first four items being scored for the best reaction only.

Reaction	No. of Points
Incorrect but exploratory manipulation	2
Rub on the head or try to put around the neck	3
Successfully put in the ears or around the neck	5
Successfully put in the ears; no other reaction	10
	Additional Points
Give to examiner	2
Put in examiner's ears	3

One baby scored 13 points on a single test. The average point scores rose from 54 to 62 weeks and then fell, to rise again at 70 and 74 weeks. The developmental trend was not clear-cut (see Figure 22).

Total Point Scores on the Imitation Tests

When the points on all the items in the imitation test were summed, the average score showed a tendency to rise with age up to 66 weeks. The average scores on all the imitation tests are given in the tabulation below and are depicted graphically in Figure 22.

Age in Weeks	Score
54	7.3
58	12.2
62	14.6
66	10.7
70	15.8
74	15.7

Evidence with regard to imitation. — From this series of simple acts that had been demonstrated to the baby and were already familiar to him, practically no reactions that were clearly imitative were obtained. If imitation is defined to mean detailed copying or perfect mimicry of the act, then none was observed in the babies in response to these test situations. The babies did make some attempt to use the toy in the adult manner. The comb was used for combing, the whistle for blowing, the stethoscope for hanging around the neck. The most imitative response was that of lying on the stomach to "read" the book. This reaction was not demonstrated by the examiners; the reading posture of older children had not escaped the babies' notice, and it was remembered and enacted at the test. Imitation may have occurred at these early ages, but it seemed to occur spontaneously rather than in response to a demonstration.

Reactions to the Parts of Doll Test

The final test given with the exception of the motor tests, was that of pointing out parts of the body of a doll

as the examiner called for them. By far the most frequent reactions to this test were those of holding the doll and playing with it at random. The doll was held by a leg or an arm and was not given the respect and deference due it. The second type of unsuccessful reactions consisted of rocking, cuddling, and singing to or talking to the doll. Only a few babies at each age treated the doll in this way. Examining the doll and pointing to parts at random were moderately frequent reactions at every age.

Occasionally the baby pointed out the parts on his own body instead of those on the doll. Pointing to the part on the doll occurred at each age, but the reaction did not increase in frequency with age. The average number of parts pointed out by those babies who made the reaction did increase with age; the averages age by age from 54 to 74 weeks were 1.6, 1.2, 2.0, 2.0, 3.8, and 3.0. At the earlier ages a few babies abandoned the doll after making the successful reactions; others cast the doll aside and paid no attention to it. From 62 weeks on, a number of babies took the doll to their mothers for them to admire. In such cases the mother usually talked about the doll, saying, "Isn't she a nice dolly? Love the dolly. No, don't drop her, you'll hurt her. You must be gentle with her." Such remarks gave evidence of the type of training the mothers gave their children with regard to their treatment of toys and particularly of dolls.

Point scale for scoring the doll test. — Points were given the reactions in the doll test as follows:

Reaction	No. of Points	
Rock, cuddle, or talk to the doll....	2	
Point to part on own body or on the mother's.....	2	for each part

Reaction	No. of Points	
Point to part on the doll.....	3	for each part
Give the doll to the mother or to the examiner.....	2	

Scores ranging from zero to 16 were made on this test. The average scores increased from 1.7 to 6.1 (see Figure 22). The curve shows a plateau from 62 to 70 weeks, with sharp rises before and after this point. Responses to this test were more affected by training than were those to any other test in this series. It was very apparent that some mothers had taught their babies the parts of the body, whereas others had not. The names of parts of the body, it seemed, were not facts that the baby under 18 months picked up without help.

Total Point Scores on the Entire Examination

The point scores for all the items that could be scored in each examination were summed and averaged age by age. The scores increased consistently with age throughout the period (see Table XLIX and Figure 23). There is a tendency for the curve of progress to approach a level at 74 weeks, but the general developmental trend

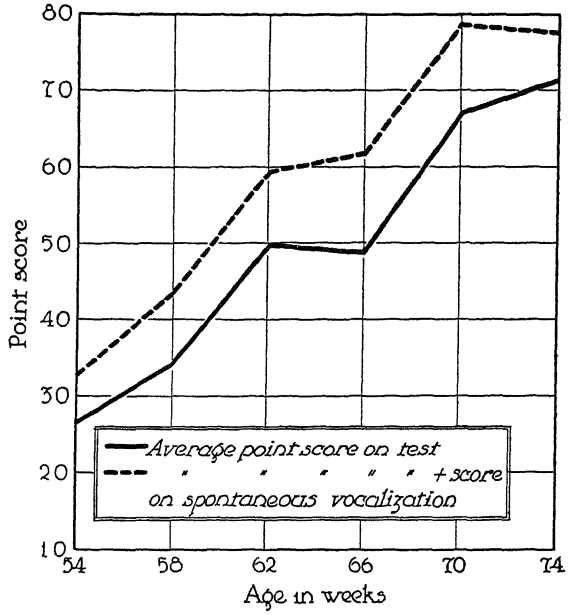
TABLE XLIX

Average Point Scores on Examinations Given from 54 to 74 Weeks

Age in Weeks	Average Point Score on Examination	Average Point Score Plus Score on Spontaneous Vocalization
54	26.5	32.5
58	33.8	43.1
62	49.7	58.9
66	48.6	61.8
70	66.6	78.5
74	79.2	77.1

FIGURE 23

AVERAGE POINT SCORES ON THE ENTIRE EXAMINATION FROM 54 TO 74 WEEKS



is very evident. When spontaneous vocalization, which occurred throughout the examination, was scored according to the point scale devised for vocalization to the pictures and added to the test scores, they were increased, but the rate of progress was not essentially altered.

SUMMARY

1. A battery of tests consisting of naming the picture, recognition of the mother's picture, six difficult manipulation tests, six simpler manipulation or "imitation"

tests, and pointing out the parts of a doll was used between the ages 54 and 74 weeks.

2. Each test was analyzed completely according to the reactions manifested and the time spent in each reaction.

3. Point scores were assigned to the reactions that appeared to have developmental significance.

4. The imitation tests showed least developmental significance; reactions to the manipulation, the mother's picture, and to the parts of doll tests yielded good evidence of development, and elicited speech as obtained from reactions to the picture book had the most sharply rising developmental curve.

5. Point scores on the entire battery of tests consistently increased with age.

CHAPTER XIV

EXAMINATIONS FROM 78 TO 102 WEEKS

By 18 months all the babies had left helpless infancy far behind them; they had advanced to the stage of the runabout child and were beginning to acquire adult speech. It was again necessary to revise the examinations, eliminating those tests in which the babies had become proficient and substituting other items that would show up their increasing ability to comprehend and use language, the nicety of their fine motor coordination, and, if possible, their ability to see through a problem or to grasp an idea. Walking, running, and climbing were accomplished facts, and locomotor development had reached a temporary standstill so far as the development of new types of reaction were concerned. From this point improvement in locomotor functions went on at a much slower pace. Nevertheless, the walking test was retained throughout this period.

Material and Method

Picture book and mother's picture tests. — Since the picture book had proved useful in eliciting speech from the babies from 1 to 18 months, and since this test was far from outgrown at 78 weeks, it was retained intact. The test using the mothers' pictures was also kept throughout the entire second year. Thus the examination for the last six months of the second year was identical with the one preceding in the first two items.

Manipulation tests. — Most of the items in the ma-

nipulation test were changed. The two boxes that had done duty from 9 months on had been exploited to their limit. The tests of block-piling, marking on paper, and the form board were retained. A copy of the record is presented in Appendix 6.

Nested boxes. — The first item in the manipulation series was a test with nested boxes, such as occurs in the Merrill-Palmer tests. The boxes were taken from a nest of nine, the largest of which was a 4½-inch open cube. Boxes 1, 3, 5, and 7 were used in the test; their bases were 1 inch, 2 inches, 2¾ inches, and 3½ inches square, respectively. By thus discarding every other one of the series, differences in the sizes of the boxes were made very noticeable. In the demonstration the boxes were taken apart, nested, taken apart again, and placed in order in a row on the floor for the baby to renest. The time limit was 1 minute, but if the baby completed the test before that time it was discontinued and his time was recorded.

Peg board. — The Wallin Peg Board A, which has the round pegs only, was the second item of the test. The baby was encouraged to help take out the pegs and was told to put them in again. Two minutes were allowed to complete the task, but the test was discontinued when it was completed, and the recorder kept a record of the baby's speed.

Three-block pyramid and 8-block tower. — Blocks were built into a 3-block pyramid for the third test, and the baby was asked to "make one just like that" with 3 other blocks. The time limit was 30 seconds. An 8-block tower was then demonstrated, and the baby was given 1 minute to reproduce it.

Drawing a line. — A straight line was drawn on a sheet of yellow paper, and the baby was told to "make

a nice straight line like that." He was given 30 seconds to mark or scribble, but if he made straight lines the paper was taken away after he made three or four in order to keep him from spoiling his record.

Gesell Form Board. — The last item in this part of the test was the Gesell Form Board. All 3 blocks were given to the baby, and he was allowed 1 minute to fit them in place. No demonstration was given.

Choice tests. — The next two parts of the test were called choice tests. They were devised in the hope that they would call forth characteristic reactions from each baby that might serve as clues to his personality traits. From the previous work it had seemed that the old choice tests, in which several objects had been hung up on a rack, had been the best way of getting at these elusive traits. For that reason it was decided to use similar tests again. Six toys were placed in a row on the floor, and the baby was given 20 seconds to do what he liked with them. Thereafter, at 20-second intervals S gave a signal to B, who picked up a toy, played with it for 5 seconds or so, and put it down again on the floor. She did not call the child's attention to the object except by making a noise with it, and she put it down quietly on the floor in its original place when she had finished her demonstration unless the baby spontaneously reached and took it from her hand. No strict order was adhered to in the demonstration, but S recorded which toy was being demonstrated at each period. B did not take a toy from the child to demonstrate it unless he spontaneously handed it to her. Each toy was demonstrated in this way at 20-second intervals. The object was to see if the child went rapidly from one toy to another, if he was amenable to B's demonstrations, or if he persistently played with the toy of his choice

no matter what other enticing things were presented. Distractibility was rated on a three-point scale, and the baby's favorite toy together with a brief summary of his reaction to the test as a whole was recorded.

Choice group I. — The six toys included in the first choice test were a pink celluloid rattle that had a musical, chime-like ring, the old familiar tape, a small red and green toy tractor of iron, a toy dover egg beater, a toy accordion, and the bottle containing the rubber doll, which had been used before.

Choice group II. — The second set of toys consisted of a toy telephone with a bell, a celluloid doll, a red ball, a tin watch, a small hand bell, and a toy double-boiler with lid.

Compliance to commands. — The next test was one of verbal commands. After the second choice test, B put the little suit case in which the toys were carried on the floor about four feet from where the baby sat playing with the last set of toys. She then said, "Now we have to put all the toys away. I have to go. Please bring me the . . . ," naming the toy with which the baby was playing, "and put it in the box." If the baby failed to comply, she repeated the command twice, and if he did not put it in the suitcase at the third command, she herself took it and said, "Well, I'll have to put it in then." Thus she continued asking for each object until all six were put away. At the end she said, "Now we'll close the lid," and the baby usually helped. If the baby brought a toy other than the one called for, B took it out of the box while the baby's back was turned and asked for it later. At the end of the test S summarized the baby's attention and compliance to the commands.

Walking. — The walking record completed this examination.

Reactions to the Picture Book and Mothers' Pictures

The complete data for these two tests are given in Chapter XIII. Both tests showed developmental trends throughout the entire second year.

Reactions to the Manipulation Tests

Nested boxes. — In cataloguing the reactions to all of the manipulation tests as many as possible of the old classifications used in the tests from 54 to 74 weeks were retained. For convenience in scoring, the boxes were numbered from 1 to 4, beginning with the smallest. Among the unsuccessful reactions to the boxes were passively holding or dropping them and random play, which consisted of the usual patting, scratching, scooting the boxes on the floor, and placing them side by side. These reactions decreased somewhat in frequency with age.

Efforts to put a big box into a smaller one was an interesting type of investigative manipulation that naturally ended in failure. Such reactions were made by more than half the babies at the earlier ages and by a third of them at 2 years. Reactions classified as incorrect nesting of the boxes were those of putting a small box into a larger one that was not the one just following it in the series. There were only three possibilities, those of putting 1 into 3, 1 into 4, and 2 into 4. Failures of this type were made by more than half the babies at each age, and there was no tendency for the reaction to decrease with age. These errors were corrected by the baby's taking out the box that did not fit, a reaction that showed some tendency to increase with age. It is interesting to note that from 78 to 90 weeks a number of

the babies who made the error of putting a small box into one that was too large for it left these errors uncorrected, whereas from 94 to 102 weeks exactly the same percentage of babies made both reactions; this means that every baby corrected his mistake by taking out the wrongly placed box.

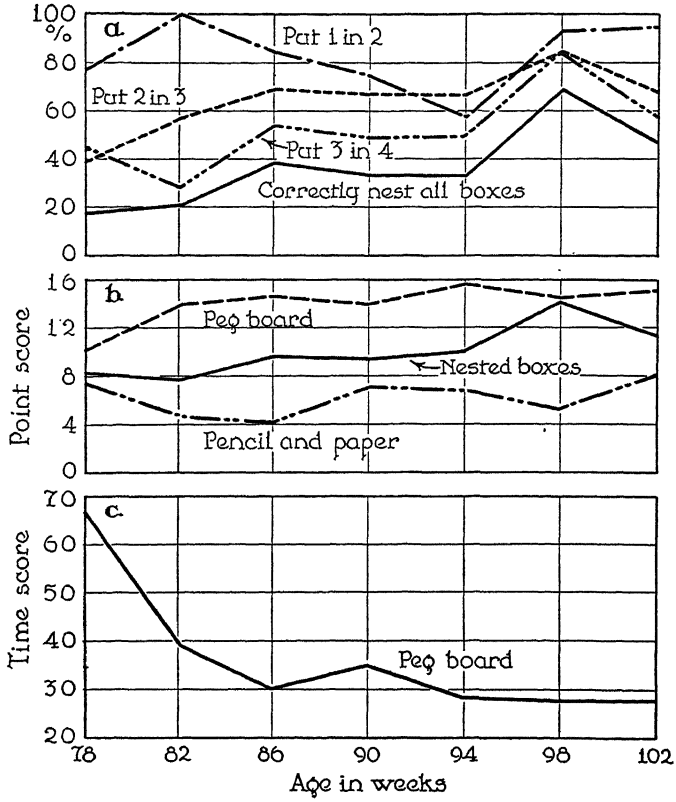
Correct nesting of the boxes showed a developmental trend by increasing with age (see Figure 24). The boxes apparently differed in difficulty, however. At every age box 1 was placed correctly by more babies than were boxes 2 and 3, and box 2 usually surpassed box 3 in number of correct placements. Frequently a box was taken out even after it had been correctly placed. Box 1, which was most often correctly placed, was also most often removed, and box 2 exceeded box 3 in number of removals after having been correctly placed. Interest in the brightly colored pictures on the boxes absorbed the attention of a few babies, and one baby talked about the pictures, pointing out and naming the familiar objects represented.

The reactions denoting lack of interest in the test were classified under the usual heads, escape reactions, seeking help, attempting to draw the examiner into the situation by giving her the boxes, and giving up in discouragement. The escape reaction showed a slight tendency to increase up to 90 weeks; the other reactions occurred only in one or two cases at scattered ages.

The discussion up to this point has been concerned with the percentages of babies reacting. The average number of times each reaction was made during the entire test was also tabulated. It will be noted that the babies who did manifest the reaction attempted more than once to put a big box into a little one; they persisted even more strongly in the incorrect reaction of

FIGURE 24

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON NESTED BOX, PEG BOARD, AND PAPER TESTS



putting a little box into one that was too large. The average number of these reactions per test was well over two at almost every age. Correct responses, on the other hand, were made slightly more than once on the average. Babies who attempted to escape did so about twice during the 1-minute interval.

Number of movements and time required for complete solution. — During the search for a suitable scoring method, the examiners decided that the total number of movements made would give a clue to the baby's skill. It was logical to suppose that the baby who nested the boxes in three movements with no unsuccessful trials and no random play had a clearer understanding of the problem and of its solution than the baby who, after nine or ten false moves and errors, at last got the boxes assembled. Accordingly, the average number of movements made were computed separately for the babies who succeeded at the task and those who failed. At every test except the 98-week test the babies who succeeded averaged fewer movements than those who failed. There were many individual exceptions, however, and it must be borne in mind that the test was discontinued as soon as the baby succeeded. The average time required for a complete solution decreased somewhat between 82 and 94 weeks, but increasing speed of performance was not definitely associated with development.

Point scale for scoring the nested box test. — All of the following correct responses were scored if the problem was not completely solved:

Reaction	No. of Points
Correctly nest 1 in 2	2
Correctly nest 2 in 3	4
Correctly nest 3 in 4	4
Take out the incorrect box	3
Total possible for incomplete solution	13
Complete solution in	
More than three moves	15
Three moves only	20

At each age the point scores on the nested boxes ranged between 2 and 20. Average point scores increased somewhat with age, but the developmental trend was not pronounced (see Figure 24b).

Peg board. — Most of the reactions to the peg board were straightforward and were directed toward the goal. At 78 and 82 weeks there were a few babies who manifested passive or random play reactions with the pegs, but thereafter these reactions practically dropped out. One interesting random reaction was that of putting the fingers into the holes. Trying but failing to put a peg in the hole occurred only once after 78 weeks. Success in putting all six pegs in their holes was achieved by all the babies even at 78 weeks; the few babies who failed at 86 and 90 weeks did so from indifference rather than from lack of skill. Progress, therefore, was not manifested by an increasing number of successful reactions. Taking pegs out after they had been successfully placed occurred with considerable frequency at 78 and 82 weeks. The examiners discouraged this reaction by saying, "Put the other pegs in," and by praising the baby for completing the task. At the later ages this reaction seldom occurred.

Since the number of babies completing the test did not increase between the ages of 18 months and 2 years, the question arose whether the babies became more systematic as they grew older. For convenience in recording the baby's reactions S mentally numbered the pegs from 1 to 6, beginning at the baby's left. She then recorded each peg as it was put in by number. Thus it was possible to tell whether the baby began at one end and worked systematically to the other or whether he inserted the pegs in a haphazard order. Systematic order was counted either from left to right or from right

to left; all that was necessary was that the baby choose a system and stick to it. The hand with which each peg was inserted was also recorded, but this was found to be an individual matter. Some babies were definitely right-handed, some were definitely left-handed, and some used the convenient hand.

Two minutes were allowed for the babies to complete the test. This was much longer than necessary, even at the earliest age. The average time consumed in this test decreased rapidly the first two times it was given. After 86 weeks, however, there was little decrease in the average time spent on the test.

Point scale for scoring the peg board test. — In scoring this test by points, speed was taken into consideration. Points were assigned as follows:

Reaction	No. of Points
Complete in from	
101 to 120 seconds	6
81 to 100 seconds	8
61 to 80 seconds	10
41 to 60 seconds	12
21 to 40 seconds	14
1 to 20 seconds	16
	Additional Points
Insert all pegs in correct order	5
Insert all but one peg in correct order	4

At the early ages, when there were great individual differences in time scores, the point scores ranged from 6 to 19; at the later ages the babies became more uniform in their speed of performance, and most of the scores clustered about 14 and 16 (see Figure 24b). The average point score obtained by this method changed little

after 82 weeks. Like the test of nested blocks the peg board test failed to indicate a developmental trend between 78 and 102 weeks, regardless of the method of scoring.

It is interesting to compare the results of this test with the more complete work of Goodenough (19) with the peg board. She found that board A, the one used in this series, had the highest reliability of the four. Her method of scoring this board was according to the time in seconds required to complete it. The average time score of the babies in the present study at 78 weeks (66.7 seconds) considerably exceeded the median time score of her group of 18.0–23.5-month-old babies (49.3 seconds). By 86 weeks, however, the babies of this group were making as good an average as her group of 24.0–29.5-month-old babies. After 86 weeks they clipped only 2 seconds off their average score for the remainder of the year.

Goodenough's scoring method, which consists of using the total time in seconds required to complete the board, could not be adapted to this study because such weighting would have been too high in comparison with the scores assigned on other tests. The method adopted is essentially the same as hers, however, since weights were assigned on the basis of time only. The curve for time, given in Figure 24c, shows the trend the scores would have taken if they had been computed according to Goodenough's method. She found a correlation of .46 between the time scores and the Kuhlmann-Binet mental age scores at 2 years of age, which shows that peg board A is a very good item to include in an intelligence scale at this age. Her findings, however, do not nullify the statement made above that this test is not a good one for showing progress between 78 and 102 weeks.

Three-block pyramid. — The 3-block pyramid test completely failed with the babies of this group. A pyramid like the model was built only four times throughout the entire period of the examination, twice by one child and once each by two others. It seemed to the observer that the directions "Make one like this" were not understood by the babies. Certainly a lack of manipulative skill would not account for the failures, for it required less nicety of adjustment to put 1 block on a foundation of 2 than to build a tower 3 blocks high. For building a 3-block bridge like a model, Gesell gives an A+ score at 18 months and an A at 2 years.

The reactions that the babies manifested in this 30-second test were exclusively random play with the blocks and building by adding to the model or by starting a new tower. In the four cases in which the model was duplicated, whether by chance or purposefully, the baby was given a score of 10 points. For the rest the reactions were not tabulated or scored.

Eight-block tower. — Since the 8-block tower test was essentially the same as the 6-block tower given between the ages of 54 and 74 weeks, the same types of reactions were elicited from the babies. For a graphic representation of the essential items of the tower-building test the reader is referred to Figure 20, a and b. From the table it will be seen that the reactions of passive holding and random play decreased with age. Taking the tower down a block at a time, a reaction that occurred frequently between the ages of 54 and 74 weeks, was seldom recorded in the last half of the second year. The percentage of babies piling 4 or more blocks successfully increased with age between 78 and 102 weeks. No baby succeeded in constructing a tower of the entire 8-block height until 94 weeks.

Chewing the blocks did not occur at all after 18 months. A new reaction was noted during this period, however; the baby placed the blocks in a row on the floor and sometimes pushed them along as a train. The most amusing example of this reaction occurred in the case of the twins, Fred and Winifred. While Winnie was being tested at 82 weeks, Fred sat quietly in his little chair watching her with interest. He had already gone through the test but had been told he could remain in the room so long as he was a good boy and did not bother Winnie. When the blocks were put down for her, however, he had a bright idea about them and was unable to keep silent. A whispered "choo-choo-choo" escaped from his lips, and at the suggestion Winnie immediately placed her blocks in a row and pushed them across the floor. This is an excellent example of cooperative play and communication of ideas between these twins, who at the time uttered very little speech that was comprehensible to the examiners.

Attempts to escape were common during the block test. The babies became increasingly social in their use of the blocks as they grew older, and more of them tried to draw the examiner into the test. Throwing away the blocks in discouragement occurred with moderate frequency at each age. From the number of reactions denoting lack of interest it is very clear that the babies did not enjoy the block test and that they became somewhat more bored with it as time went on.

Point scale for scoring the block test. — The scoring system used in the block test from 54 to 74 weeks was continued from 78 to 102 weeks; 2 points were given for each block successfully piled. To this score 10 points were added for a successful duplication of the pyramid model, but these additional scores were given in only

four cases. The curve for point scores is presented in Figure 20 (page 314). A rise in the point scores occurred between 54 and 70 weeks; thereafter the scores decreased sharply at 78 weeks and again rose gradually up to 98 weeks. It is hard to explain this decline in score at 78 weeks. Although the test from 78 to 102 weeks differed considerably from the preceding test, the block-building test was identical except for the addition of 2 blocks. Whatever the reason may be, the block test was worth little for obtaining a measure of development during the last half of the second year.

On the subject of the block-building test that is included in the Yale Developmental Schedules at 18 months and 2 years Gesell writes, "The block building tests undoubtedly reveal progressive grades of capacity and motor maturity. . . . Motor coordination and painstaking personality qualities are incidentally revealed by the test."[1] From observations on the babies of this group it almost seems that the "painstaking personality qualities" in some babies offset poor motor skill, and conversely that good motor coordination did not compensate for lack of interest in the test. Suffice it to say that the progressive grades of motor maturity did not show up so clearly in this study as Gesell's statement would lead one to expect.

Pencil and paper test. — Reactions to the pencil and paper were classified according to the scheme that had been used from 54 to 74 weeks. Although the reactions showed little or no developmental trend within any of the half-year age periods, they differed considerably from one half year to the next in developmental significance. The demonstration was different in the two tests: that for the ages of from 54 to 74 weeks was writ-

[1] *The Mental Growth of the Preschool Child*, p. 109.

ing the baby's name, a demonstration that might be supposed to call forth scribbling, whereas that for the tests between 78 and 102 weeks was drawing a line with the added verbal directions, "Now you make a nice straight line like this." Although the changed directions might account for differences in the number of successful responses, there is little reason why they alone should have altered the random and unsuccessful reactions.

Nevertheless, passive holding and random play with the paper, both of which had been manifested by upwards of 30 per cent of the babies before 78 weeks, dropped to about half that frequency during the latter half of the second year. The reactions of turning and manipulating the paper also decreased in frequency, and using the rubber end of the pencil for marking, which occurred often in the early ages, was noted only once after 74 weeks. Lifting the paper and marking on the book or board underneath happened only once in the tests given before 78 weeks but at almost every test thereafter. Accidental marking, which occurred in more than 30 per cent of the cases from 54 to 70 weeks, dropped to about 15 per cent at 74 weeks and remained at that level throughout the rest of the year.

During the last half year more babies drew lines, and heavy lines gradually surpassed light lines in frequency. Heavy lines undoubtedly indicated greater skill at these ages. Random scribbling, both light and heavy, occurred less frequently after 74 weeks. In scribbling in an arc the baby used his forearm as a pivot and swung the pencil back and forth across the paper, making a wide arc-like scribble; each individual arc approximated a straight line, but all of them were drawn without lifting the pencil between arcs and without moving the arm and hand in a straight line. These arcs were more often

heavy than light. Arcs seemed to be slightly less difficult for the babies than lines. The frequency of drawing arcs was highest at 86 weeks, whereas drawing lines continued to increase in frequency up to 102 weeks. The escape reaction was highest in this test between the ages of 70 and 82 weeks.

Point scale for scoring the pencil and paper test. — Since a line rather than a scribble had been demonstrated and verbally called for, it received a higher score. The points assigned were:

Reaction	No. of Points
Draw a line, light or heavy	9
Scribble, light or heavy	6

In case both a line and a scribble appeared on the same paper, the score was given for the line. Although the average point scores showed no consistent tendency to increase from 78 to 102 weeks, they exceeded the scores made between 54 and 74 weeks. Figure 24b (page 342) depicts their course during the last half of the second year.

Form board test. — All 3 blocks were presented to the babies at this test, whereas only the circular block had been given at the earlier age, and the number of possible reactions was consequently greatly increased. Passive holding and random play with the blocks was considerably less frequent during the last half of the second year (see Table L).

There were nine possible failures with the 3 blocks, and since some of these failures were better errors than others, each was tabulated separately. Three of the failures consisted of unsuccessful attempts to get the right block in the right hole. Of these, the reaction of failing

TABLE L

Reactions to the Form Board

Reaction	Percentage Reacting							Average No. of Reactions						
	Age in Weeks							Age in Weeks						
	78	82	86	90	94	98	102	78	82	86	90	94	98	102
Passive holding	27.8	28.6	15.4	16.6	0.0	17.7	0.0	1.20	1.25	1.00	1.00	.00	1.00	.00
Stack blocks or random play	33.3	35.7	31.8	33.3	8.3	46.1	42.0	1.83	1.80	1.50	1.25	1.00	1.33	1.37
Unsuccessfully fit block														
Round in round	11.1	0.0	0.0	0.0	8.3	0.0	0.0	1.00	.00	.00	.00	1.00	.00	.00
Round in square	44.4	42.9	83.6	58.3	25.0	31.8	36.8	1.37	1.33	1.73	1.28	1.00	1.75	1.28
Round in triangle	27.8	21.4	38.4	0.0	8.3	15.4	5.2	1.00	1.30	1.60	.00	1.00	1.00	1.00
Square in square	11.1	14.3	0.0	33.3	25.0	23.1	26.3	1.00	1.00	.00	1.25	1.00	1.66	1.60
Square in round	61.1	42.9	46.1	58.3	33.3	38.4	31.5	1.46	2.00	1.83	1.42	1.50	1.40	1.33
Square in triangle	33.3	42.9	38.4	25.0	33.3	23.1	36.8	1.16	1.16	1.20	2.00	1.00	1.30	1.28
Triangle in triangle	16.7	21.4	23.1	41.5	16.6	31.8	10.5	1.00	1.00	1.66	1.20	1.00	1.00	2.00
Triangle in square	16.7	21.4	23.1	25.0	16.6	31.8	42.0	1.66	1.00	1.00	1.00	1.00	1.00	1.37
Triangle in circle	5.5	42.9	23.1	16.6	0.0	15.4	10.5	1.00	1.16	1.30	1.00	.00	1.00	1.00
Total	89.0	85.7	92.5	83.3	66.6	61.5	84.2	3.25	3.83	4.66	4.10	2.75	4.37	3.25

TABLE L — *Continued*

Successfully fit block														
Round in round	55.5	85.7	69.2	83.3	91.7	77.0	79.0	1.50	1.58	1.55	2.00	1.09	1.00	1.60
Square in square	33.3	28.6	31.8	58.3	75.0	77.0	58.0	1.00	1.25	1.50	1.14	1.11	1.00	1.09
Triangle in square	38.8	35.7	53.9	66.6	75.0	61.5	58.0	1.00	1.00	1.28	1.25	1.22	1.00	1.27
Total	66.6	85.7	92.5	91.5	100.0	84.6	89.5	2.30	2.42	2.42	3.45	2.75	3.09	2.94
Total succeeding with 3 blocks	27.8	14.3	15.4	33.3	58.3	46.1	31.5	...	...	...	...	...	...	...
Take out block successfully fitted														
Round out of round	38.8	57.2	53.9	66.6	16.6	31.8	47.3	1.42	1.37	1.28	1.25	1.00	2.00	1.22
Square out of square	0.0	7.1	15.4	16.6	16.6	23.1	21.0	.00	1.00	1.50	1.50	.00	1.00	1.25
Triangle out of triangle	5.5	0.0	31.8	25.0	0.0	7.7	15.7	1.00	.00	1.25	1.00	.00	1.00	1 00
Total	38.8	57.2	69.2	75.0	33.3	38.4	52.5	1.55	1.50	1.88	1.77	1.00	2.40	1.90
Seek help	0.0	0.0	0.0	8.3	0.0	0.0	5.2	.00	.00	.00	1.00	.00	.00	1.00
Draw examiner into situation	11.1	28.6	15.4	16.6	0.0	23.1	31.5	1.50	1.50	2.00	1.00	.00	1.00	1.00
Give up in discouragement	5.5	7.1	15.4	0.0	0.0	0.0	5.2	1.00	1.00	1.00	.00	.00	.00	1.00
Try to keep blocks or board	0.0	0.0	0.0	8.3	0.0	7.7	0.0	.00	.00	.00	1.00	.00	1.00	.00
Try to escape	22.2	21.4	15.4	0.0	0.0	7.7	10.5	2.50	1.66	1.00	.00	.00	1.00	3.00
Total number of moves	...	...	...	...	...	...	...	6.50	7.64	8.77	8.92	5.00	7.15	7.32
Average point score	6.00	7.07	6.46	9.25	11.07	10.46	9.90	...	...	...	...	...	...	...

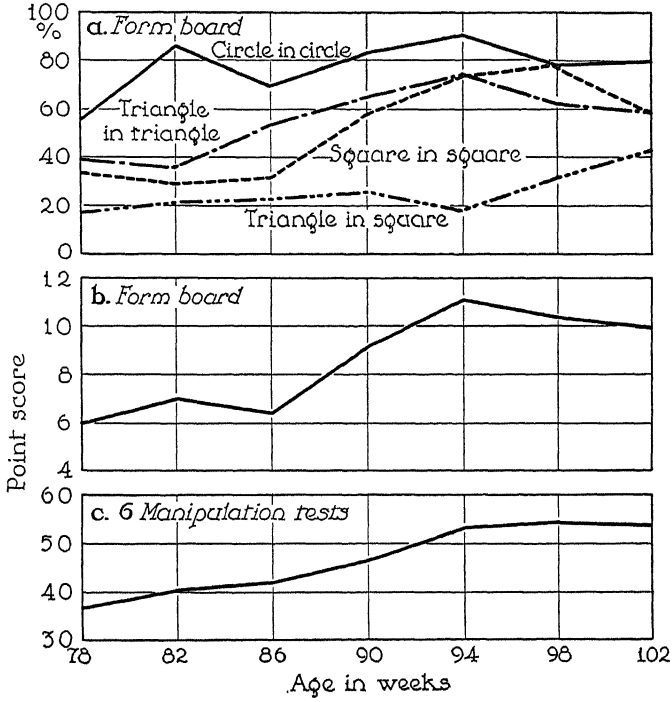
to get the round block in the round hole, which had appeared in 25 per cent of the cases up to 74 weeks, was noted only three times thereafter. Because of the necessity of fitting corner to corner, the square and triangular blocks were much harder to place than the round block. Failure to fit the square block in the square hole increased in frequency up to 90 weeks and then remained on a level. The number of failures to put the triangular block in the triangular hole usually exceeded the failures with the square. Failure with the triangular block also reached its highest frequency at 90 weeks.

Efforts to put the round block in the square hole were frequent at all ages but showed a tendency to decrease toward the end of the second year. Efforts to put the square block in the round hole were of about the same frequency and followed a similar curve. The round block was very often tried in the triangular hole from from 78 to 90 weeks, but thereafter this mistake was seldom made. About 30 per cent of the babies at each age tried the square block in the triangular hole; this reaction did not decrease with age. Attempts to put the triangular block in the circular hole also decreased in frequency after 86 weeks. The only error that showed a tendency to increase with age was that of trying to fit the triangular block into the square hole. The upward trend of this reaction with age makes it a "good" error. The percentage of babies making errors on one or more blocks was high at each age, usually 80 per cent or above, and no developmental trend was indicated.

The greatest number of children achieved success with the round block. More than 50 per cent fitted it

FIGURE 25

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON THE FORM BOARD TEST AND ON ALL MANIPULATION TESTS



correctly at 78 weeks. From age to age the percentages of successes with this block shifted but showed no developmental trend (see Figure 25a). Successful fitting of the square and triangular blocks occurred with about the same frequency at each age, and both reactions showed a developmental trend. Success with 1 or more blocks occurred in from 60 to 100 per cent of the cases

at each age. Success with all 3 blocks increased in frequency up to 94 weeks.

Sometimes a block that had been successfully placed was removed and tried in another hole. The round block was most often removed partly, no doubt, because it was most often successfully placed. This did not seem to be the only reason, however. Usually the babies removed the round block in order to try to fit it into other holes, after having failed to get the triangular and square blocks in place. Judging from their order of manipulation it was as if the babies reasoned thus, "This round block fits easily into this hole, but none of the other blocks seems to work in the other holes. Now I wonder if this would slip as easily into the other holes as it did into the first. I'll try it and see." Since the square and triangular blocks went in only with difficulty, the babies seemed to be more satisfied to leave them in place.

Frequently, after he had fitted the 3 blocks into place, the baby lifted the board to hand it to B, and his surprise that the blocks remained on the floor was amusing. Having just plugged up the holes, he evidently expected them to stay plugged. This reaction gives an interesting side light on the babies' perception and recalls Köhler's (29) observation that his apes reacted to two sticks that were in contact as if they were fastened together. The escape reaction occurred rather infrequently during the form board test. Attempts to draw the examiner into the situation were common at the later ages.

Point scale for scoring the form board test. — In devising a scoring system for the form board the four good errors were given credit as well as the successes. Points were assigned as follows:

Reaction	No. of Points
Unsuccessfully fit	
Round block	2
Square block	2
Triangular block	2
Triangular block in square hole	2
Successfully fit	
Round block	3
Square block	4
Triangular block	4
Complete solution in	
Any number of moves	12
Three moves only	15
	Additional Points
Try to draw the examiner into the situation	2

Scores for the unsuccessful reactions were given when there was no successful achievement with the block in question, and success with individual blocks was counted only when there was no complete solution of the problem. Additional points were given for completing the board in three moves, i.e., with no random play or superfluous gestures or errors. The baby who went straight through the problem with no false moves certainly had a better grasp of the situation than one who fumbled around with the blocks and at last got them arranged. One baby himself voiced this fact. When the blocks and board were set before Martin at 90 weeks he uttered a delighted "Ah know, Ah know," and promptly demonstrated his knowledge by fitting the blocks in three straightforward movements. Incidentally, this verbal statement was the earliest introspective account, if it may be graced with so high-sounding a name, that any baby offered to a test situation.

The curve for the point scores derived by this method maintained a level between 78 and 86 weeks; it rose rapidly at 90 and 94 weeks and probably would have continued to rise slightly or to level off at 98 and 102 weeks had it not been for the return of several babies who had skipped the tests during the summer months. The form board proved to be the best developmental item in the manipulative series at the ages of from 78 to 102 weeks.

Total scores on the manipulative tests. — Individually none of the six items in this battery of manipulation tests gave scores that consistently increased with age. Nevertheless, when the scores of all six tests were summed they rose rather consistently with age. The average point scores for the ages tested are presented in the following tabular summary (see also Figure 25c). The scores tended to approach a level after 90 weeks, a fact that has its explanation in the absences mentioned above.

Age in Weeks	Score
78	36.61
82	40.07
86	41.76
90	46.33
94	53.33
98	54.84
102	53.79

Reactions to the Compliance Test

The choice tests were interposed between the manipulation items and the test called "compliance to commands," in which the baby was asked to put away the toys with which he had been playing. But since the choice tests did not have developmental significance and

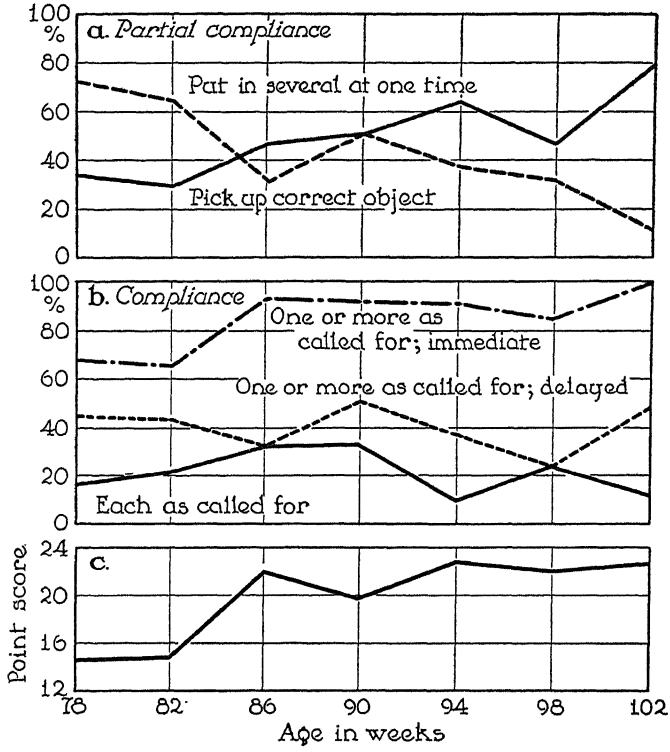
therefore could not be scored by points, it seems best to defer discussion of them until after the compliance tests have been treated.

An unwillingness to comply to the commands was indicated by a few babies at some ages; occasionally they emphasized their refusal by shaking their heads. The few babies who refused to comply happened to be boys. Passive reactions of holding the toys maintained the same frequency at each age, but random play responses decreased as the babies grew older. At every age about 20 per cent of the babies put in a wrong object, i.e., a toy other than the one called for by the examiner. At the early ages many of the babies picked up the object called for but did not put it in the box. This reaction decreased in frequency with age. From this reaction it appears that the babies knew the objects by name even at 78 weeks but that they either did not comprehend or did not wish to comply with the directions. In contrast to this, the reaction of putting in several objects at the command, regardless of the order in which they were called for, quite clearly increased with age. Evidently the babies grasped the idea that the toys were to be put away, and they chose to do it in the fewest possible moves. Figure 26a depicts the opposite trends of these two reactions.

The two successful types of compliance were putting the right toy in the box immediately upon the command of the examiner and putting it in after a delay and a repetition of the directions. More than 60 per cent of the babies complied immediately in returning at least one toy of the six at 78 weeks, and from 86 weeks on such compliance occurred in more than 90 per cent of the cases. Compliance after delay occurred in about 40 per cent of the cases throughout the entire period.

FIGURE 26

FREQUENCY OF THE SEVERAL REACTIONS AND AVERAGE POINT SCORES ON THE COMPLIANCE TESTS



Although most of the babies put in one or more toys upon command, only a few put away all six. Successful compliance with all six toys increased in frequency from 78 to 90 weeks and then followed an ambiguous course the rest of the year. The frequency of these three types of reactions is presented graphically in Figure 26b.

Sometimes a baby desired to keep one or more of the toys. This reaction was rather infrequent, however, and showed no definite tendency to change with age. Efforts to draw the examiner into the situation and attempts to escape occurred with about the usual frequency at each age.

Point scale for scoring the compliance test. — Points were assigned to the various reactions as follows:

Reaction	No. of Points	
Immediate compliance to all six commands	32	
Immediate compliance	5	for each object
Compliance after a delay	3	for each object
Put in several toys regardless of their order	4	
Pick up a correct object but do not put it in	2	

Points were given only for the best reaction made with each of the six objects. The scores thus derived increased from 14.7 at 78 weeks to 22.1 at 86 weeks, and thereafter little change was noted. This test had developmental significance the first few times it was given, but thereafter it failed to show the babies' progress in comprehension and compliance to directions.

Average Point Scores on the Entire Examination

Table LI and Figure 27 give the average point scores on the entire examination from 78 to 102 weeks. The average scores rose steadily with age, in spite of the fact that individual tests of the battery showed little developmental significance. The addition of scores on spontaneous vocalization changed the form of the curve somewhat and made it shoot up rapidly at 94

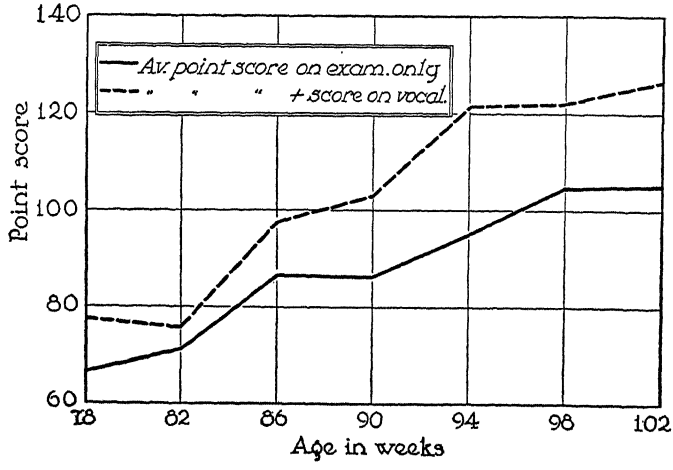
TABLE LI

AVERAGE POINT SCORES ON EXAMINATIONS GIVEN FROM 78 TO 102 WEEKS

AGE IN WEEKS	AVERAGE POINT SCORE ON EXAMINATION	AVERAGE POINT SCORES PLUS SCORE ON SPONTANEOUS VOCALIZATION
78	66.2	77.6
82	71.2	76.0
86	86.9	97.8
90	86.6	102.8
94	95.1	121.4
98	104.2	122.0
102	104.4	126.6

FIGURE 27

DIAGRAM SHOWING THE AVERAGE POINT SCORES ON EXAMINATIONS GIVEN FROM 78 TO 102 WEEKS



weeks. Development during this period showed up most clearly in the picture test, in which vocalization was scored. It was in the field of language rather than of manipulation that the babies made most rapid strides between 18 months and 2 years.

Consistency of the Tests in the Second Year

Intercorrelations between subtests. — A good battery of tests for measuring general ability should not only be consistent with itself and in agreement with outside criteria, but it also should test a wide range of capacities. Subtests, therefore, should not only differ in content but should correlate only slightly with each other.

Intercorrelations between the various subtests in the examinations for the second year are shown in Table LII. It will be noted that the correlations fluctuate greatly from week to week. The majority of them, however, are positive. The relation between scores on the picture book test and those on the mother's picture test are consistently high throughout the entire year although the correct response to the picture book was naming the object and the correct response to the mothers' pictures was one of recognizing and pointing. The correlations between the picture book test and the manipulation, imitation, parts of doll, and compliance tests vary widely from small negative to good-sized positive coefficients. The fact that the correlations at different ages came out so differently indicates that the relationship between these tests was largely due to chance factors. The correlations between the picture book test and the combined scores on the other tests in the battery are all positive and of a moderate size.

The correlations between the mother's picture test and each of the other tests in the battery are positive. The mother's picture test correlates rather highly with the compliance test at the ages of from 78 to 90 weeks, the period during which the compliance test showed the most developmental significance. Most of the correlations between the manipulation test and other tests are

TABLE LII

INTERCORRELATIONS BETWEEN THE SUBTESTS GIVEN FROM 54 TO 102 WEEKS

	AGE IN WEEKS												
	54	58	62	66	70	74	78	82	86	90	94	98	102
Number of cases tested	17	9	13	13	19	19	18	15	14	12	12	13	19
Picture book test correlated with													
Mother's picture test	...*	...*	.73	.72	.64	.54	.55	.58	.74	.61	.84	.48	.69
Manipulation test	−.23	−.27	.01	.65	.35	.22	.13	.12	.34	.14	.09	.64	.23
Imitation test	−.09	−.07	.45	.29	.64	.68	...	...	...	...	...	...	...
Parts of doll test	.03	−.35	.14	−.06	.24	.50	...	...	...	...	...	...	...
Compliance test	...	...	...	...	...	...	.17	.40	.63	.46	−.16	.44	.16
Total of other tests	...	...	.41	.52	.64	.72	.24	.26	.68	.48	.28	.63	.49
Mother's picture test correlated with													
Manipulation test	...*	...*	−.14	.80	.16	.20	.41	.56	.44	.11	.18	.38	.12
Imitation test	...*	...*	.36	.24	.58	.49	...	...	...	...	...	...	...
Parts of doll test	...*	...*	.18	.26	.42	.43	...	...	...	...	...	...	...
Compliance test	...	...	...	...	...	...	.74	.55	.44	.79	−.09	.04	.38
Manipulation test correlated with													
Imitation test	.23	−.25	.10	.18	.32	.36	...	...	...	...	...	...	...
Parts of doll test	.08	.39	.04	−.15	.35	−.01	...	...	...	...	...	...	...
Compliance test	...	...	...	...	...	...	.37	.22	−.07	−.14	.12	.60	.10
Imitation test correlated with parts of doll test	.04	.00	.18	.44	.46	.44	...	...	...	...	...	...	...
Spontaneous vocalization correlated with total point score, excluding picture book test	−.08	.17	.36	.36	.35	.35	.16	−.32	−.08	.07	.17	.21	.09

* No correlation was possible because only one case was tested.

low. Point scores for all tests except the picture book test were summed, and the results were correlated with scores on spontaneous vocalization. All these relationships are low.

Consistency of the scores from age to age. — According to the criterion of the independence of variables, these tests make up a fair battery. The consistency of the point scores from age to age is expressed in the following tabulation:

Weeks Correlated	No. of Cases	r
54 and 58	7	.42
58 and 62	4	...
62 and 66	7	.04
66 and 70	12	.73
70 and 74	17	.82
74 and 78	17	.62
78 and 82	14	.66
82 and 86	12	.78
86 and 90	11	.81
90 and 94	9	.81
94 and 98	11	.62
98 and 102	12	.79
54–74 and 78–102	18	.72

If the correlations from the 54th through the 62nd week, at which ages the number of cases were too few to justify working coefficients, are disregarded, the relationships are all fairly high and fairly consistent as to magnitude. In consideration of the small number of cases, the correlations take on even greater significance. It has been pointed out before that correlations such as these cannot be considered as true reliability coefficients because the factor of development makes for increasing scores at successive age levels. The correct interpretation of the coefficients is that in their development between the ages of 1 and 2 years the babies of this group held their respective positions very consistently.

Relation of Test Scores to Minnesota Preschool Test Scores

Some proof that the tests from 54 to 102 weeks measured general ability rather than specific skills was obtained by correlating the point scores with the scores on the Minnesota Preschool Test (21) that were obtained by the Institute's psychometric examiner. The point scores for all tests from 54 to 74 weeks were averaged and correlated with the Minnesota Preschool Test score at 18 months; similarly the scores from 78 to 102 weeks were combined to correlate with the Minnesota Preschool Test score at 24 months. The correlation for the first period, based on seventeen cases, was .81; that for the second period, based on fifteen cases, was .82. In spite of the fact that the number of cases on which each coefficient was based was small, the coefficients are essentially the same and are fairly high. It seems, therefore, that the tests given to the babies measured somewhat the same general capacity as did the Minnesota Preschool Test.

Reactions to the Choice Tests

The aims of the choice tests were wholly different from those of the test items that made up the rest of the examination. They aimed to stimulate the baby's initiative and to measure his suggestibility to the demonstrations of an adult. Since each baby was allowed to play with the toys exactly as he chose and since there were no arbitrarily right or wrong responses, it could hardly be expected that the reactions would show a developmental trend. Nevertheless, the reactions were classified into categories similar to those used for the manipulation test, and the frequency of each type of reaction was computed.

The average percentages of babies reacting in the specified way to each of the six toys in the choice tests are given in Table LIII. The simplest reaction made to the toys was that of picking them up or taking them from the examiner's hands. From 60 to 80 per cent of the babies took each toy at each age. Passive holding of the toys was observed in more than 20 per cent of the babies at most ages, and random play with the toys appeared in about 20 per cent of the babies at each age. Unsuccessful manipulation of the object occurred more frequently with the toys in choice group I than with those in group II, and conversely, successful manipulation was somewhat more frequent with the toys in group II. The escape reaction was less frequent than the social reaction of seeking help, and attempts to draw the examiner into the situation occurred less often during the choice tests than during the other parts of the examination.

None of these reactions showed a definite developmental trend to increase with age, nor was there any change with age in the number of toys taken after the examiner's demonstration. On the average, three toys were accepted immediately after the demonstration at each age. At times some of the babies, to be sure, took each of the six after the examiner's demonstration; others occasionally were not amenable to any of the demonstrations. But no baby consistently accepted all the demonstrations at all ages, and none consistently refused them all. Acceptance of the demonstration, therefore, had no developmental significance, nor was it particularly characteristic of individual babies. Some babies took the toy immediately after the demonstration but soon dropped it to return to a toy of their own choice. Toward the end of the second year two babies

TABLE LIII

REACTIONS TO THE CHOICE TEST

	AVERAGE PERCENTAGE REACTING													
	CHOICE I							CHOICE II						
	Age in Weeks							Age in Weeks						
	78	82	86	90	94	98	102	78	82	86	90	94	98	102
Passive holding...	26.80	36.90	28.18	22.16	6.91	10.43	12.24	27.76	28.60	21.80	24.91	12.13	16.85	21.00
Take object.	79.60	73.80	73.10	76.35	50.60	51.85	57.80	65.73	48.83	60.45	63.80	68.25	50.00	56.06
Random play.....	17.60	21.43	12.83	18.00	19.41	15.40	9.60	25.90	21.43	24.70	20.80	13.60	14.10	13.10
Unsuccessful manipulation.....	14.60	15.48	17.93	15.26	12.48	7.86	13.12	6.46	4.75	7.86	4.15	10.61	15.95	7.86
Successful manipulation.....	31.43	29.76	44.85	40.21	31.90	37.16	50.86	44.43	88.10	42.30	38.81	50.05	45.98	43.81
Chew object	.00	1.19	.00	.00	.00	.00	1.75	2.75	1.19	1.28	1.40	.00	1.28	1.75

TABLE LIII — *Continued*

Try to escape	2.75	7.13	2.56	.00	.00	2.56	3.50	2.75	1.19	3.85	4.15	.00	1.28	2.62
Seek help...	9.13	3.57	6.41	2.75	5.53	1.28	1.75	.00	1.19	1.28	.00	1.50	.00	.87
Draw examiner into situation.	8.20	10.71	5.13	6.91	2.75	3.85	8.75	8.31	8.30	3.85	11.10	10.61	1.28	13.10
Reaction to jar														
Try to take doll out	11.10	14.30	.00	.00	8.30	15.40	5.20							
Take doll out or put it in	5.60	.00	.00	.00	33.30	23.10	31.50							
Play with doll....	.00	.00	.00	.00	.00	7.70	15.70							
Average number of toys taken after B's demonstration..	3.50	3.40	3.50	3.00	2.60	2.80	3.20	3.30	2.50	2.80	3.20	2.80	3.00	2.90

apparently got the impression that they were expected to take each toy after it was demonstrated. To them this was the rule of the game. They, therefore, took each toy after it was demonstrated, played with it momentarily, and then dropped it and returned to a spontaneous choice.

Reactions and Choices of Individual Toys

Correct manipulation differed with each toy; with some toys it was a reaction demanding a great deal of skill, and with others it required very little. Correct manipulation showed a developmental trend in some toys, and in others it did not. Some of the toys were much more interesting to the babies than others. Time was taken as the criterion of the baby's choice or preference among the toys; the number of seconds spent on each toy was computed for each baby and averaged for the entire group, and the toy that was played with for the longest time was designated as first choice. The complete data for correct manipulation, the average amount of time spent on each toy, and the percentage of first choices received by each toy are given in Table LIV. Figure 28 depicts the average amount of time spent on each toy in the two choice groups.

Screw-cap jar. — Correct manipulation of the screw-cap jar consisted of unscrewing the lid. This reaction, which had been made by a few babies prior to 78 weeks, increased in frequency throughout the remainder of the year. Once the jar was opened, it presented other possibilities, chiefly that of taking out the rubber policeman. Most of the babies reached into the bottle and tried to pull the doll out; occasionally they turned the bottle upside down in an effort to pour out the toy. After the toy was extracted, they played with it in various ways and

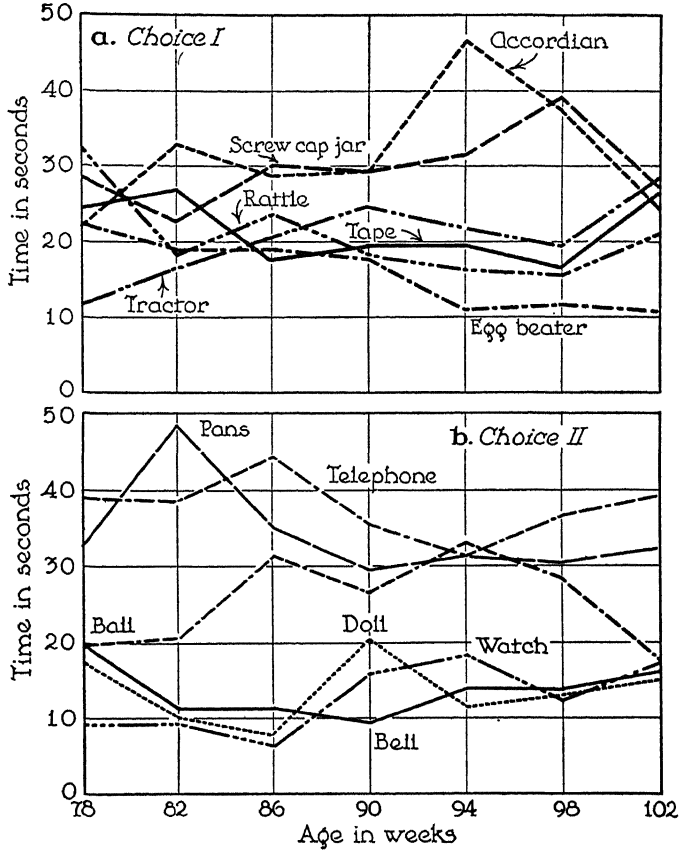
TABLE LIV

Percentages of Correct Manipulation and of Choices Made at Each Age Tested

	Percentage of Correct Manipulation							Percentage of First Choices, Based on Time Spent in Playing							Percentage of Choices for All Seven Ages		
	Age in Weeks							Age in Weeks							First Choice	Second Choice	Third Choice
	78	82	86	90	94	98	102	78	82	86	90	94	98	102			
Choice test I																	
Jar	11.1	7.1	15.4	25.0	41.5	53.9	42.0	27.8	21.3	38.4	25.0	25.0	38.5	26.5	29	21	19
Accordion	33.3	57.2	69.2	58.3	66.7	69.2	68.5	11.1	35.5	7.7	25.0	33.3	38.5	15.9	23	21	21
Tractor	50.0	42.9	61.5	50.0	33.3	53.9	89.5	0.0	14.3	15.4	16.7	8.3	0.0	31.8	13	15	16
Egg beater	22.2	21.4	46.1	41.5	16.7	7.7	26.3	16.8	7.1	15.4	16.7	16.7	0.0	0.0	9	11	19
Rattle	83.3	50.0	69.2	41.5	41.5	53.9	79.0	27.8	7.1	23.1	8.3	16.7	15.4	5.3	15	18	17
Tape	16.7	14.3	23.1	25.0	25.0	7.7	21.0	16.8	21.3	7.7	8.3	8.3	7.7	31.8	16	16	21
Choice test II																	
Ball	61.1	64.3	61.5	58.3	63.7	53.9	58.0	11.1	7.1	15.4	25.0	45.5	30.8	5.3	18	15	24
Doll	16.7	0.0	7.7	8.3	18.2	15.4	15.7	5.6	7.1	0.0	16.2	0.0	0.0	0.0	12	13	32
Pans	77.8	71.4	77.0	66.7	72.8	61.5	63.1	33.3	42.9	30.8	16.7	27.3	30.8	42.4	33	27	14
Bell	72.3	28.6	53.9	50.0	72.8	61.5	73.6	5.6	0.0	0.0	8.3	0.0	0.0	0.0	2	12	22
Telephone	50.0	57.2	61.5	75.0	72.8	69.2	58.0	44.8	42.6	53.9	25.0	27.3	38.5	42.4	40	27	14
Watch	5.6	7.1	7.7	8.3	18.2	15.4	10.5	0.0	0.0	0.0	8.3	18.2	0.0	10.6	5	6	16

FIGURE 28

AVERAGE TIME SPENT ON EACH TOY DURING THE CHOICE TESTS



usually tried to put it back again. The babies worked hard at this task; at 98 weeks Sibyl ejaculated, "Come out," as she tugged at the doll. At the same age Walley, having learned that rubber dolls usually squeak, squeezed the doll but got no response from the long-

suffering "cop." At the final test this same child commented "Broken," as he pulled out the doll, whose head by this time was all but severed from its body. He remarked, as he crammed the doll back into its jar, "Go beddy."

The jar was very well liked; the accordion was its only rival in popularity among the toys of this group. At each age the babies spent thirty seconds or more playing with this toy, and for more than 25 per cent of them it was always first choice. Perhaps the fact that the jar presented a problem in difficult manipulation was the secret of its hold on the babies' interest.

Accordion. — Correct manipulation of the accordion consisted of pulling and pushing it to make music. This reaction was rather simple, and after 78 weeks 60 per cent or more of the babies did it at each age. Babies who had difficulty in wheezing out sounds on the accordion usually handed it back to B with a grunt of request for her to play it again; hence it was a very social toy. The curve showing the average time spent on the accordion was high and reached its peak at 82 weeks. Throughout the entire year more than 20 per cent of the babies made it their first choice.

Tractor. — Pushing the tractor across the floor was considered the correct manipulation of this toy. Although this simple act was well within the repertoire of all of the babies, only about half of them at each age tested saw fit to play with it in this way. This toy was not very well liked at 78 weeks, but it gained in popularity as the children approached 2 years, as was shown both by the upward trend of the time curve and by the percentage of first choices.

Egg beater. — Correct manipulation of the egg beater was a difficult reaction for babies of these ages, for the

crank could not be successfully turned unless the beater was held upright so that the whirling knives did not hit against the carpet and come to a stop. The relatively small amount of correct manipulation is also partly accounted for by the fact that the beater was not a high favorite. The average amount of time spent on this toy steadily decreased with age from 22 seconds at 78 weeks to 11 seconds at 102 weeks. At the earlier ages only 16 per cent of the babies preferred it to any other toy, and at the last two ages no baby made it his first choice.

Rattle. — The rattle had only to be shaken to give forth pleasing musical notes. This reaction was an easy one for all the babies. The fact that it did not occur with 100 per cent frequency at each age indicated the babies' lack of interest in so simple a toy. This object also steadily decreased in popularity with age, as marked by time scores, and although it usually received more first choices than the tractor or the egg beater, it was never a high favorite.

Tape. — Pushing the tape button to make the line roll up was the only reaction that was considered correct manipulation in this test. The act in itself was not difficult, but only a few babies discovered the significance of the button. The tape also lost rather than gained in interest as the babies grew older.

Of the six toys in this group the screw-cap jar and the accordion were high favorites; the tractor increased in interest value with age; and the tape, rattle, and egg beater all decreased in popularity with age.

Ball. — Correct manipulation of the ball consisted of throwing, rolling, or bouncing it. At each age about 60 per cent of the babies made these reactions. The curve for the average amount of time spent on the ball followed a peculiar course; at 78 weeks and at 102 weeks

the ball was only a little more popular than the bell, the doll, and the watch, whereas between 86 and 94 weeks it rose in popularity till it rivaled the pans and the telephone. At 94 weeks almost half the babies played with the ball more than with any other toy in the series. Whether children in general develop their greatest fondness for balls between 18 months and 2 years or whether the waxing and waning of interest observed in this group is purely a chance matter of the conditions of the test, it is impossible to say.

Doll. — Hugging, cuddling, rocking, or swinging and talking to the doll were considered correct manipulations, but these reactions were extremely rare. These babies paid little attention to the doll and spent little time on it. It was chosen as a favorite toy by only one or two babies at the earlier ages, and after 90 weeks it was never a first choice.

Pans. — The toy double-boiler was correctly manipulated by nesting the pans together and putting on or taking off the lid. About two-thirds of the babies made reactions of this sort at each age. Another interesting reaction was that of putting the ball in the pans. Since the ball was a neat fit for the pan, the babies seemed highly pleased with this reaction, particularly if they then succeeded in putting the lid on the pan. "Bye-bye, ball," said Winifred at 98 weeks as she dropped the ball in the pan and placed the cover over it. On the average, more than thirty seconds were consumed in play with the pans at each week, and these toys always received a high percentage of first choices.

Bell. — Ringing the little hand bell, a reaction established long before 9 months, varied in frequency from age to age. All the babies were competent in this simple act, but for many of them the bell had lost its charm.

Only a small amount of time was spent on this toy, and only twice during the entire period of the test did a baby mark it as his favorite.

Telephone. — Correct manipulation of the telephone consisted in taking down or hanging up the receiver on the hook, ringing the telephone bell, holding the receiver to the ear, calling "hello," or pretending to talk. From 50 to 75 per cent of the babies made these reactions at each age. The telephone was the most delightful toy of this series, if the amount of time spent is considered. It also received the highest number of first choices.

Watch. — There was little the baby could do with the watch in the way of manipulation except twist the stem and make the hands turn or hold the watch to his ear as if to hear it tick. Both types of manipulation were very rare, perhaps because the watch was so unpopular. Very little time was spent on this toy, and it was the first choice of only a very few babies at the later ages. The toys of choice group II definitely fell into three classifications: The telephone and pans were very much liked; the bell, doll, and watch were of little interest; and the ball occupied an intermediate position.

As developmental items the choice tests had very little significance. True, some toys became more popular and others less popular as the babies grew older, but it was inadvisable to score the choice tests on a point scale because each toy was played with only so long as the baby chose, and hence the time element was not uniform from baby to baby. Acceptance of the demonstration also proved to have no developmental significance. In their choices and in their types of play with the toys the babies differed widely. The significance of their choices and of their reactions as indices to personality traits will be taken up in a later work.

Summary

1. During the period from 78 to 102 weeks the babies showed marked progress in naming pictures in the book and in recognizing their mothers' pictures.

2. Manipulation tests given at these ages were nested boxes, the Wallin Peg Board A, the 8-block tower, drawing a straight line on paper, and Gesell's form board. The form board was the only item in this series indicating a developmental trend.

3. Nevertheless, the composite scores on the six manipulation items increased consistently with age.

4. The compliance to commands test also failed to reveal much developmental significance.

5. Average point scores on the entire battery of tests increased rapidly with age from 78 to 90 weeks and more slowly from 94 to 102 weeks.

6. Intercorrelations between most of the subtests from 54 to 102 weeks were slightly positive. The picture book and mother's picture tests showed the highest interrelationship. Correlations between manipulation tests and other tests were generally low but positive.

7. Correlations between scores at successive ages from 66 to 102 weeks were high and positive.

8. Average test scores from 54 to 74 weeks correlated .81 with the Minnesota Preschool Test given at 18 months, and the correlation between the group tested from 78 to 102 weeks and the preschool test given at 24 months was .82.

9. Choice tests did not yield developmental scores, but the babies showed considerable preference for certain toys. A screw-cap jar and a toy accordion were the favorites in the first group of toys; a telephone and a double-boiler set were best liked in the second group.

CHAPTER XV

DEVELOPMENTAL TRENDS IN CERTAIN TRAITS OBSERVED THROUGHOUT TWO YEARS

The foregoing detailed analysis of the psychological examinations are of interest for two reasons: first, because they give all the data on the tests and devices used in this study and therefore may be of help to students desiring to do work along similar lines; secondly, and more important, because they are the source from which are drawn together the data on sequence, which are presented in Part I, and the data on rates of development, which will be discussed in Part III. But from these long, drawn-out accounts it is impossible to get an adequate picture of the onrush of development. This chapter will present developmental trends in those reactions that were consistently observed and recorded at successive examinations from birth to 2 years.

Methods of Computing Data on Each Reaction

In most cases the reactions known as correct response or successful manipulation varied from one type of examination to another and from test to test within the same examination, but there were several reactions, among them looking around, watching the examiners or the audience, chewing objects, smiling, and random play with the toys, that were recorded for each test item on all examinations. Since a given examination was made up of a number of test items, all of the same

length, the relative frequency of each type of reaction was obtained by dividing the total percentage frequency by the number of test items in which the reaction occurred. Thus in the tests of development there were 13 items, all of which were averaged in order to obtain the percentage of babies who watched persons and those who looked around. In only 7 of these items was the baby offered an object; therefore the frequency for the reaction of chewing an object was averaged by 7. In most of the examinations all items were one minute long. Three items in the early choice tests, however, were five minutes long, and 4 items in the later tests were three minutes long. The average frequencies of reactions at these examinations were in general much higher than they were at other examinations because of the undue length of the items. There was no way of correcting this discrepancy, however, and it seemed inadvisable to do so because there was some evidence that the frequency of occurrence of many of the reactions was really higher during this period and was not wholly due to the tests used. The data for the average frequencies of each reaction are given in Table LV and are represented graphically in Figures 29, 30, 31, and 32.

Resulting Developmental Trends

Eye reactions and attention. — Eye coordination and watching were recorded at every examination from birth to 2 years. These data are therefore unusually complete and enable one to trace the waxing and waning of the attentive reactions with considerable exactness.

The reaction of watching persons put in an appearance before 3 weeks (see Figure 29). From this time on it increased in frequency at a very rapid rate until at 10 weeks 60 per cent of the babies were watching the ex-

TABLE LV

DEVELOPMENTAL TRENDS IN TRAITS CONSISTENTLY OBSERVED THROUGHOUT THE TWO YEARS OF EXAMINATION
(Average Percentages of Babies Reacting to Each Test Item)

AGE IN WEEKS	ATTENTION TO AUDIENCE	LOOK AROUND	RANDOM PLAY WITH TOY	PASSIVE HOLDING	CHEW OBJECT	SMILE	TRY TO ESCAPE	SEEK HELP	DRAW EXAMINER INTO SITUATION	GIVE UP, DISCOURAGED	TRY TO KEEP TOY	SCREAM OR FUSS
3	10.30	15.30				.00						32.50
5	31.70	11.70				3.30						44.60
7	39.20	7.20				.00						35.50
9	57.50	1.50				4.50						27.00
10	61.70	5.10				7.10						25.70
11	39.30	3.00				10.60						22.10
13	11.20	18.30			14.00							6.50
14	9.40	30.20			6.90							5.30
15	17.90	19.20			17.70							9.60
18	9.70	14.20			24.90							11.40
19	11.90	10.10			18.10							2.10
21	17.70	4.60			31.60							1.15
22	8.20	2.70			41.20							7.60
23	19.60	3.70			40.60							6.20
25	75.70	28.80	87.20	88.80	72.60							14.30
27	87.90	52.90	76.30	95.00	81.10							13.70
29	89.40	70.60	75.30	100.00	86.80							9.10
30	79.50	63.30	60.10	100.00	81.60							6.90
31	81.40	69.90	68.50	97.20	80.00							10.50

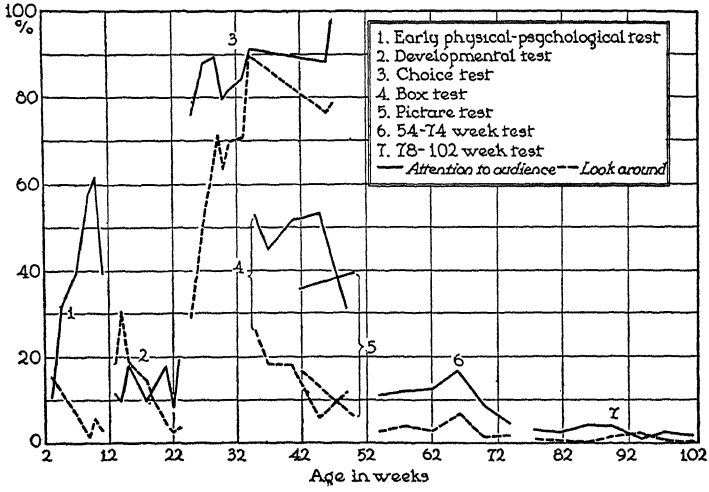
TABLE LV — *Continued*

33	84.60	70.80	62.40	98.60	83.30							4.90
34	91.20	89.90	63.30	98.70	86.10							7.90
35	52.60	26.10	58.80	86.50	51.60	15.10	23.00		4.70			6.40
37	44.90	18.30	93.90	87.90	74.20	15.60	14.80	.00	4.60	1.40	.00	8.60
41	51.50	18.00	98.70	92.90	72.20	13.80	13.10	.00	10.90	2.60	.00	8.50
42	35.30	16.60	53.50	71.10	27.50	5.10	31.70		1.60			8.40
45	53.30	5.98	94.80	88.80	70.60	17.40	32.30	1.50	8.20	4.50	.00	2.50
46	88.10	76.30	73.60	94.70	78.90							6.90
47	97.30	77.60	65.70	90.70	85.50							9.20
49	33.10	11.40	92.10	81.20	58.20	10.70	39.90	1.40	9.40	11.00	5.00	5.50
50	39.90	6.20	55.70	57.10	17.50	3.20	39.50		5.40			13.30
54	10.90	2.18	48.50	67.16	23.70	5.27	23.11	3.60	2.70	2.70	.00	
58	11.80	3.98	42.70	62.98	21.56	9.00	24.65	2.55	5.97	1.70	.00	
62	12.53	2.77	46.20	56.90	12.50	6.00	25.30	6.00	10.20	6.00	.00	
66	16.67	6.55	33.47	53.90	8.80	10.50	24.30	1.80	16.56	1.20	1.65	
70	8.85	1.27	39.00	48.30	7.69	7.54	30.40	5.24	16.16	3.24	2.61	
74	4.73	1.40	41.73	43.40	6.49	8.50	28.15	9.35	19.83	6.85	2.61	
78	2.97	.95	29.75	25.56	1.19	3.83	22.54	2.92	15.92	9.70	2.78	
82	2.11	.44	36.12	23.57	2.37	8.30	19.17	2.37	17.56	5.50	.00	
86	4.21	.43	22.25	17.80	.18	7.11	10.95	3.08	10.73	11.80	1.30	
90	3.81	1.43	31.90	14.23	1.40	1.66	19.31	2.21	14.74	12.87	6.93	
94	.85	2.06	17.15	9.94	.00	3.42	10.89	3.06	10.08	10.40	1.40	
98	2.17	.53	22.90	14.12	.18	.25	11.50	1.79	11.35	7.70	1.30	
102	1.65	.19	19.25	11.37	.50	20.38	11.48	2.60	15.18	6.55	.87	

aminers at each test. Since few toys were presented to the babies at these ages, they had little opportunity to watch objects, a fact that may partially account for their great interest in the examiners. During the tests of development from 13 to 23 weeks the babies were

FIGURE 29

DEVELOPMENTAL TRENDS IN ATTENTION TO AUDIENCE AND LOOKING AROUND, EXPRESSED IN PERCENTAGES



given a series of toys, and their attention to faces consequently decreased greatly. In the choice tests, partly because they lacked variety no doubt, very high frequencies of attention to the examiners were elicited. At the tests with boxes and the early picture tests, which were given between 35 and 50 weeks, about 50 per cent of the babies spent some time in watching persons. A plausible explanation of the high frequencies of this reaction at these particular examinations is that the ma-

terial was a bit too difficult and complicated for successful manipulation by the babies.

During the second year, however, the frequency of this reaction maintained a fairly consistent downward trend. In general, the babies became more and more absorbed in playing with the toys that were offered and grew less interested in adults, probably because, as their skill increased, they had less need for the examiners' assistance or approval. The very slight rises in the curve that occur at 66 and 86 weeks are interesting because they come at ages when proficiency in these examinations increased most rapidly. When the babies first "got the hang of the thing" and made their first successful reaction to the tests, they frequently turned to the adults, apparently for a smile of approval at their achievement. Certainly there were individual instances of such reactions, and they show up in the slight changes in the curve for the group.

If the course of development of this trait is viewed as a whole, it will be seen that attention to and interest in persons develops most rapidly in the early weeks. By 3 months, however, interest in objects begins to supplant interest in persons to some extent. Thereafter, whether the babies give their major undivided attention to the toys and the test situation or whether they devote a large part of their time to watching the examiners or other persons in the room is determined largely by the variety of the test material and by the babies' skill in handling it. The ability to watch people is established before 12 weeks; after that the baby can direct his gaze where he chooses, and the frequency of the watching reaction is more or less an index to the baby's lack of interest in the situation.

Looking around. — At 3 weeks the reaction of letting

the gaze rove more or less at random around the room was slightly more frequent than that of watching persons; but whereas the latter rose rapidly in frequency during the early period, the former declined slightly. When the tests of development were begun at 13 weeks, there was a marked revival of interest in exploratory looking around, but it declined as the babies grew accustomed to sitting on adults' laps and became proficient in the tests, a fact that has been discussed at length in Chapter VIII. During the course of the choice tests the reaction became increasingly frequent, and here again the explanation probably is that the babies became more bored as the tests continued. During the box and picture tests looking around declined in frequency with age. After 54 weeks it sank to insignificance and remained a negligible distraction throughout the remainder of the second year.

In general, it appears that up to about the 5th month the baby is absorbed in exploring his visual environment, particularly when it presents new features, as it does when he changes from a lying to a sitting posture. Since the change in the visual environment with the change from a lying to a sitting posture is indeed a radical one, it is not to be wondered that looking around is somewhat of a distraction for the baby between 3 and 6 months of age. After the 5th month persons more frequently divert the baby's attention from his toys than do the ordinary sights in the room.

Manipulation. — The only categories of manipulative reactions that were consistent from one examination to another were passive holding of the toy and random play, which included patting, scratching, and shaking the toy, pounding or scooting it on the floor, and other inadequate and inappropriate ways of ma-

nipulating it. The frequency of these reactions were not computed earlier than 25 weeks because prior to this age, during the establishment of the reaching response, manipulation had consisted of little more than holding the object, an act that represented a good response at that stage of development. The choice tests presented little opportunity for any reactions other than random swinging, banging, or fingering of the objects. Beginning with the box tests at 37 weeks, however, there was ample opportunity for the babies to exhaust their ingenuity in exploratory rather than in random manipulation.

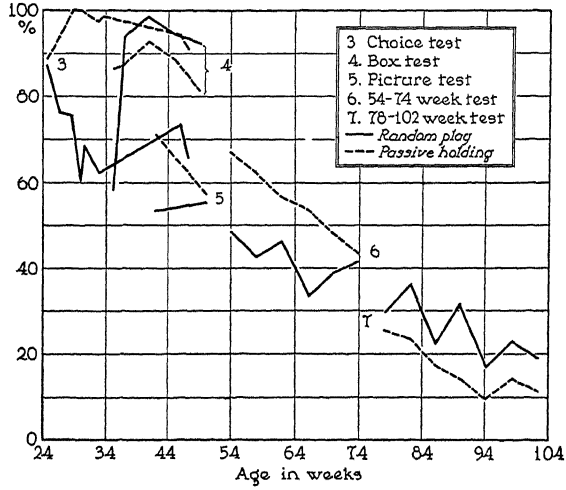
Both these reactions had a high frequency during the choice test and the box tests, and the curves of both maintained a conspicuous downward trend throughout the second year (see Figure 30). The decline of the reaction of holding was more rapid than that of random play, but the two gave way almost completely to more adequate investigative manipulation during the second year.

Chewing objects. — Putting the toys in the mouth to suck and chew was a reaction that followed a very well-defined course (see Figure 31). It did not occur before the 13th week for the very obvious reason that up to this age the babies were unable to get their hands on objects. As soon as reaching and grasping began, the hand-to-mouth reaction appeared, and the two functions grew in frequency at about the same rate up to 23 weeks. In both the choice tests and the box tests the frequency of the chewing reaction was very high. The pictures that were offered at 42 and 50 weeks, however, were less delectable than the wooden blocks and boxes of the previous examinations. The peak of the frequency curve for the chewing reaction seems to have

been reached somewhere between the ages of 30 and 40 weeks. By the beginning of the second year the reaction had been eliminated by three-fourths of the babies, and at 18 months (76 weeks) it had practically disappeared.

FIGURE 30

DEVELOPMENTAL TRENDS IN RANDOM PLAY AND PASSIVE HOLDING OF OBJECTS, EXPRESSED IN PERCENTAGES

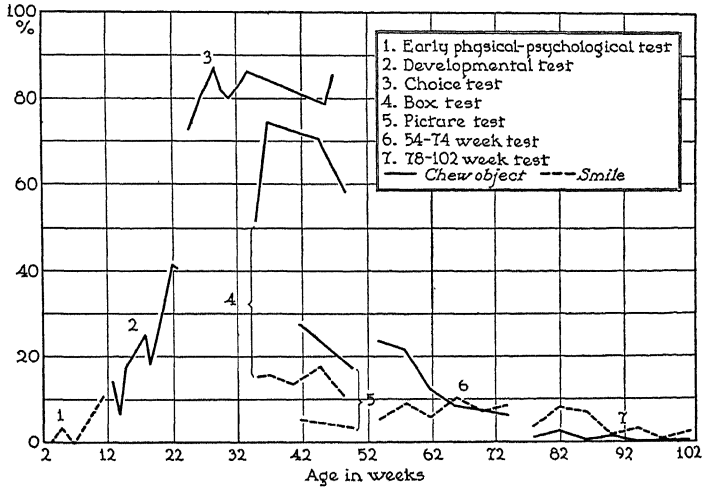


Within the duration of a given type of examination the chewing reaction showed little developmental trend, and the statement has therefore been made in previous chapters that the amount of chewing apparently depended on the baby's whim or mood at a given examination. The reaction did, however, show a developmental trend throughout the entire first 18 months. Since the trend is somewhat similar to that for random play, it seems best to regard chewing as a manipulative reaction

rather than as one having emotional significance. When the babies were not yet skillful enough to exploit the toys in more successful ways, they spent their time in patting, scratching, and chewing them, but once skill

FIGURE 31

DEVELOPMENTAL TRENDS IN CHEWING OF OBJECTS AND SMILING, EXPRESSED IN PERCENTAGES



was acquired these infantile reactions were given up. Like the reactions of looking around and watching persons these unsuccessful manipulative reactions were an indirect index to the babies' skill in handling the toys.

Smiling. — The frequency of the smiling reaction is also shown in Figure 31. Although the occurrence of this response was not computed for the tests of development and choice tests, the remainder of the data indicates that smiling showed no developmental trend after the 3rd month. From 35 to 74 weeks the frequency of

smiling was practically the same at each age, and the decrease was only slight in the latter half of the second year. From early babyhood on, smiling, it seems, is either an emotionally toned reaction that varies with the baby's mood or a characteristic reaction of a few babies. According to either hypothesis the data would plot into a flat curve such as is seen in Figure 31. At any rate it is clear that smiling was not a reaction of developmental significance.

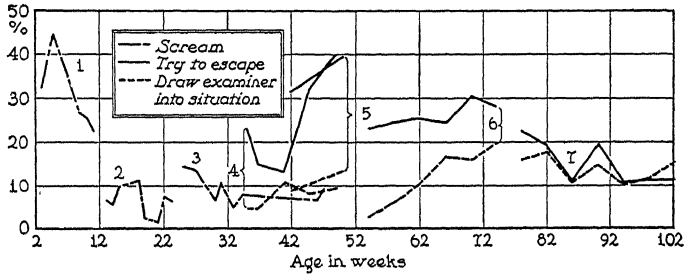
Screaming and fussing. — Irritability, as expressed by the percentage of babies who screamed or fussed at each test item, was highest in the weeks just after birth and decreased rapidly from 5 to 11 weeks (see Figure 32). Thereafter it remained on a level around 10 per cent throughout the rest of the year. By the beginning of the second year fussing had become an individual characteristic. Three babies threw temper tantrums at intervals, and two others occasionally expressed timidity by crying. But irritability was by no means a reaction common to the group, and consequently average scores were not computed.

Escape reactions. — Attempts to escape from the test situation were not recorded systematically until 35 weeks (Figure 32). The chief reason for this was that prior to this age escape from the test situation was impossible for the infants. Their only methods of combating the examination were by kicking and squirming, by paying little attention to the proffered toys, or by screaming and fussing. A few babies, to be sure, used these latter weapons with good effect, as indicated in foregoing paragraphs, but most of the babies were docile and interested in the examinations during the early months. About the time they began to creep the babies

developed the escape reaction. Sitting still to play with toys failed to give them the exercise and excitement they craved; consequently they varied the procedure of sitting by climbing on the examiner's lap, creeping away to investigate the instrument case, or climbing to a standing position by means of furniture. These reactions have been described in Volume I, pages 128–165. The escape reaction was at its height at the end of the

FIGURE 32

DEVELOPMENTAL TRENDS IN SCREAMING, TRYING TO ESCAPE, AND DRAWING THE EXAMINER INTO THE SITUATION, EXPRESSED IN PERCENTAGES



1. Early physical-psychological test
2. Developmental test
3. Choice test
4. Box test
5. Picture test
6. 54-74 week test
7. 78-102 week test

first year. During the first half of the second year it maintained a frequency of from 20 to 30 per cent, but after 18 months it became somewhat less common. The course of this trait proceeds parallel to the development of locomotion. While creeping and walking are developing, escape reactions reach their highest frequency. After walking is established, the great urge to be "up and doing" partially subsides, and the child is more content to amuse himself with quiet play.

Seeking help. — Two social reactions were noted, beginning at the 35th week and continuing throughout the remainder of the two years. They were reactions of attempting to draw the examiner into the situation and seeking help in the manipulation of toys. The former was much more frequent than the latter, but both followed the same general course. Both rarely occurred until 54 weeks, after which age they rose in frequency, reaching their apex at 74 weeks. From then on they declined slightly and maintained a level during the rest of the year.

The emotional reaction of giving up the task in apparent disgust or discouragement made its début at 45 weeks and was noted at each age thereafter. It increased in frequency up to 90 weeks. Although the observations on this point are too few to make the findings valid, they suggest that as the child grows older he becomes more critical of his own performance and is more likely to recognize his own inadequacy and to admit failure. It would probably be worth while to pursue the study of this trait into the third year.

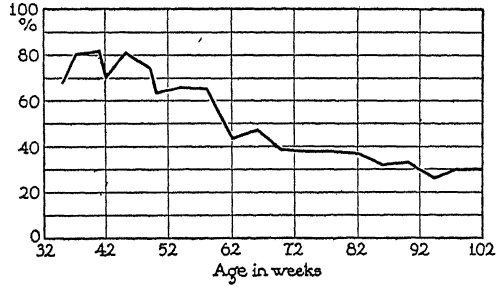
A desire to keep the toy was observed at intervals from 49 to 102 weeks. This reaction never attained a high frequency. For the most part, it was found in only two or three babies. Maurice rather consistently disliked having to give back anything that had once been given him, and now and then he went to the length of carrying the toys into another room and hiding them. Indeed, he was so distressed at giving back the watch at 94 weeks that his mother quelled his riot by buying the toy. A few babies, including David, Quentin, and Virginia Ruth, tried to keep the ball; perhaps their reason for selecting this toy was that most of them had a similar ball among their own playthings.

Reactions to Tests Compared with All Other Reactions

The general downward trend of all the extraneous reactions considered in this chapter was further shown by computing all these constantly recurring reactions as a percentage of all the reactions made during the examination. These computations were made for each child separately, and medians were obtained by ages. The results are shown in Figure 33.

FIGURE 33

Median Percentages of All Reactions Not Directed toward the Test Situation*



* These represent the irrelevant reactions that occurred consistently. The figures were obtained by converting the sum of the irrelevant responses (i.e., random play plus passive holding plus chewing objects plus trying to escape plus drawing the examiner into the situation, etc.) into a percentage of the total number of responses for each child. Medians were then determined.

The percentage of all extraneous and useless reactions from the standpoint of adequate solution to the tests — that is the reactions of random and passive play, chewing objects, trying to escape, seeking help, and giving up in discouragement — clearly decreased with age, and the percentage of reactions directed toward the correct solution of the test constantly in-

creased. These results add to the large body of evidence that the infant's development proceeds by an elimination of nonspecific or generalized responses and an increase in specific responses.

Summary

A study of the frequency of occurrence of certain reactions that were consistently observed throughout the two years revealed the following generalizations:

1. There was an upward developmental trend in the reaction of watching persons during the first 3 months, an upward trend in the reaction of looking around to explore the visual environment from 3 to 5 months, a high frequency of these reactions when the examinations were boring or difficult, and a falling off of the reactions in the second year.

2. The frequencies for random play with and the passive holding of objects were high during the first year, followed by a marked decline in these reactions during the second year.

3. There was an increasing frequency of chewing the object up to 9 months, a partial elimination of the habit between 9 and 12 months, and a complete elimination by 18 months.

4. No tendency for the smiling reaction to fluctuate with age was observed.

5. There was a rapid decrease in screaming and fussing before 3 months and almost a complete elimination of it during the psychological examinations after one year.

6. The escape reaction developed along with creeping and early walking and declined in the last half of the second year.

7. Social reactions of seeking help and drawing the

examiner into the situation followed an upward course of development during the first eight months of the second year and after that period remained on a level.

8. Giving up the task in apparent discouragement appeared late in the first year and increased slightly in frequency throughout the second year.

9. In general nonspecific reactions tended to decrease and specific and successful reactions to increase with age.

PART III

CONSISTENCY IN RATE OF DEVELOPMENT

CHAPTER XVI

DEVELOPMENTAL SCORES

Theoretical Considerations

A quantitative statement of the amount of development that takes place within a given time and the rate or speed at which it proceeds is just as important to the study of development as a qualitative description of its nature and the orderly sequence of its items. Heretofore rate of development has been studied chiefly in two ways, by developmental or mental tests given to children at widely spaced age intervals and by learning curves derived from the continuous study of a given trait over a fairly short period of time. By the former method it is possible to obtain only the child's levels of ability at such times as he is tested; nothing can be ascertained as to his rate of development between tests except that it has been such as to enable him to depart from the old level and reach a new level on the subsequent test. Learning curves, on the other hand, do show the rate of acquisition in that they toil upward at a more or less gradual rate; but one cannot generalize from the slope of learning curves to the rate of development as a whole, for the learning curves have been drawn up on only a few isolated and rather specialized skills, and curves of two or more skills drawn on the same child do not always show the same rates of progress.

Nevertheless, the acceptance of cues from learning curves and arguments by analogy with physical growth

have led to two important generalizations about development, one as to its continuity and the other as to the regularity of its rate. These generalizations have been ably stated by Hollingworth as follows:[1] (1) "Development is continuous rather than saltatory and spasmodic"; and (2) "Development commonly proceeds at the pace at which it starts." Before bringing forth the evidence from this study that relates to these laws, let us question the methods whereby they were derived.

Inadequacy of data for proving developmental continuities. — In the first place, continuity of development cannot be established by discontinuous observation. We may postulate continuity and may represent our data obtained from infrequent tests as continuous by drawing smooth curves from point to point of the obtained values. But postulation and representation do not constitute proof. Whereas saltatory test periods have led us to conclude that development is continuous, continuous observation may give us the impression that development is saltatory.

Furthermore, regularity in growth rate can be established only by repeated observations on the same child. Growth curves drawn up from averages of groups are useful in predicting general developmental trends, but they mask possible spurts of the individual child. Finally, in normative tests developmental criteria are set up for each item at each age level, and the tests are simply marked as passed or failed. The examiner has no way of knowing whether an item the child passes is an accomplishment of long standing or whether it has only at that moment developed, nor does he know that the failure of another child is of an "all-or-none" character rather than of a "more-or-less" character. Con-

[1] *Mental Growth and Decline*, pp. 18, 23.

tinuity of development and regularity of rate can be affirmed with certainty only when a large number of children are observed continuously over a long period of time and when the behavior traits observed are analyzed as far as possible into their component items, the exact age of the first appearance of these items noted, and the regularity of their spacing charted.

Emergence vs. improvement. — In reasoning about development by its analogy with physical growth and with learning curves, there is danger of overlooking the distinction between ability and proficiency mentioned in Chapter III. In physical growth increments are imperceptibly added to an already completely formed whole, and in the learning curves the improvement wrought by practice in already partially organized skills is plotted. In neither case is progress achieved by the sudden appearance of totally new elements. Development in its entirety, however, consists of two phases, growth by addition of parts and growth by increase in size of parts, or, technically speaking, by hyperplasia and by hypertrophy. In physical growth hyperplasia is most apparent during the embryonic period, but new physical traits do emerge after birth, particularly during babyhood and during adolescence, periods at which development is proceeding at its most rapid rate.

If we must make analogies between physical growth and behavior development, we are just as justified in calling attention to the analogy between differentiation of structure and emergence of function as to that between increase in size of structure and improvement in function. Emergence of new items of behavior is just as truly a phase of development as is improvement in these items after they have appeared. When we compare the small number of abilities of the newborn child

with his large repertoire of arts at two years, we realize what a vast number of new behavior items have emerged in the interval. It is hardly possible that this great development has been solely the improvement in and reorganization of behavior items already possessed. It is possible that development by the emergence of new behavior items proceeds with less continuity and at a less regular rate than does development by improvement in old behavior items.

There is a question, of course, as to what should be the criteria of continuity and the regularity of growth rate in the emergent items. It is frequently difficult to analyze behavior items into their component elements and to decide whether the new item is made up of several old elements with the addition of a crucial new one or whether it is merely an integration of many old elements into a new pattern. The present study does not claim to have made adequate analyses of these items; it only claims to have made a very crude start, analyzing the larger and more complex behavior patterns into items on the basis of observed differences in the acts. A more refined analysis is certainly needed if the problem of the continuity of emergent items is to be adequately solved. Even if it were proved conclusively that behavior items had been analyzed into their irreducible units, that each emerged as an isolated whole, that there were noticeable gaps in emergence from item to item, and therefore that development in its emergent phase was not continuous, the developmental rate might still be regular. To establish a criterion for regularity of rate in emergent items one would have to be certain that the items were of equal value and emerged at equal intervals, or, if unequal, that they emerged at intervals appropriate to their developmental value. It will be a

long time before such evaluation of items can be made, for it would entail the determining of an absolute behavior unit as invariable and unambiguous as is the inch in linear measurement. It appears likely, however, that when inroads are made into the problem of continuity and growth rate they will be made by methods akin to those of this study. The same children will be observed continuously over a long period, their new responses will be enumerated and described as they emerge, and their old responses will be measured for improvement. Then the assumption that development is continuous and that its rate is gradual and consistent will not have to rest upon a foundation of analogy.

Methods of Computing Developmental Scores

In coping with the problem of developmental scores it was necessary to decide which items were to be scored, how they were to be evaluated, and what numerical values were to be attached to each. Since it was impossible to tell which items were significant and which were not, it seemed best to include them all in the scoring. Numerical values could not be attached to the items without first making some assumptions.

Underlying assumptions. — It has been repeatedly stated that the only available measure in most of these items was chronological age. In the first place, it was assumed that the later a reaction emerged, the more difficult it was and the higher a developmental level it represented. This simple assumption is not unique; it is based on common-sense observation and is fundamental to all testing programs. It was also necessary to decide arbitrarily upon a relationship of development to age. Many authors consider development a direct function of age; in other words, $D = A$, a function that is

represented graphically by a straight line. Binet made this assumption and thus formulated his important concept of mental age. Gesell[2] prefers to think of development as a curvilinear function of age and plots his developmental curves according to the equation $Y = \log X$, in which Y is development and X is age.

The assumption that development is a direct function of age was chosen as a basis for the derivation of scores in this study because its use has been established by long precedent and because it is the simpler of the two theories both in implications and in application. Another assumption underlying the computation of the scores in this study was that the group as a whole was best represented by its median score.

The scores. — In accordance with these assumptions values were attached to each reaction so that the cumulative developmental score was always equal to the median age at which the reaction in question emerged. Thus, chin up, the first item of the locomotor sequence to appear, emerged at a median age of 3 weeks and was therefore given a score of 3 points; chest up, a reaction that emerged at 9 weeks, was given a score of $9 - 3$, or 6 points; the cumulative score then was 9. The numerical value attached to each item was always the difference between the age of appearance of a given item and the age of appearance of the item just preceding it. When two or more items emerged at the same age, each was given the same value; the total number of weeks elapsing since the development of the last item was divided by the number of items simultaneously developed. Thus, sitting alone and knee push of the locomotor sequence both developed at 25 weeks, seven

[2] *Infancy and Human Growth*, pp. 136–162.

weeks later than sitting on lap; each of these items was therefore given 3.5 points.

After items were thus weighted, the record of each baby was scored. In order to do this the baby's reactions were arranged in chronological order, and his cumulative score for each age was worked out according to the scoring key. An example of the scoring is given in Table LVI.

For the sake of comparing rates of development in different types of items, developmental scores were computed separately for eye coordination, locomotion, fine motor control or manipulation, and vocalization. Scores were also computed for all the items together. The number of items scored and the age range of the median are as follows:

	No. of Items	Age Range
Eye coordination	10	4 days– 10 weeks
Vocalization	14	6 days–101 weeks
Locomotion	17	3 weeks– 66 weeks
Manipulation	37	14 weeks– 94 weeks
All development	84	4 days –102 weeks

The items in the entire developmental scoring system together with the values assigned to them are given in Appendix 7.

From the example given in Table LVI we see that Baby W had only two items of eye coordination that failed to follow the sequence of the median; these were smiling at a person and watching a person three or more times. At 3 weeks her developmental score in eye coordination was 4 points, and at 4 weeks it was 6 points. After 4 weeks, however, her rate became slower than the median, and her score was only 8 points at 9 weeks and 10 points at 13 weeks. This case is not cited

TABLE LVI

An Example of Developmental Scoring in Eye Coordination (Baby W)

Reaction	Median Age in Weeks	Developmental Weight	Reaction	Age of First Appearance in Baby	Points Added	Developmental Score
Follow light	4 da.	.57	Follow light	11 da.	.57	.57
Reflex smile	6 da.	.28	Reflex smile	2	.28	...
Watch person 1 or 2 times	2	1.15	Watch person 1 or 2 times	2	1.15	2.0
Watch object 1 or 2 times	3	1.00	Smile at person	3	1.0	4.0
Follow tape horizontally	5	1.00	Watch object 1 or 2 times	4	1.0	...
Watch person 3 or more times	5	1.00	Watch person 3 or more times	4	1.0	6.0
Watch object 3 or more times	6	1.00	Follow tape horizontally	7	1.0	7.0
Smile at person	8	2.00	Follow tape vertically	9	1.0	8.0
Follow tape vertically	9	1.00	Follow tape circularly	13	1.0	...
Follow tape circularly	10	1.00	Watch object 3 or more times	13	1.0	10.0

as a typical one but is used merely to illustrate the scoring method.

When all the babies had been scored in this way, a master sheet was made out on which the babies' names ran down the page and the chronological ages ran across the top as headings for the columns. Then the developmental scores of each baby at each age were entered in the columns. The completed master sheet showed several gaps that were occasioned in two ways: first, by a baby's showing no new developmental item at a given age and hence having no increase in score at that time; and secondly, by examinations having been missed at intervals. In order that developmental scores might be available on every baby at every week these gaps were filled in. Gaps occasioned by the failure of new items to appear were filled by simply giving the baby the score he had made at the previous age. These gaps wherein no new items appeared ranged in length from one to eight weeks. There can be no question as to this method of filling in the gaps, for if the baby showed no new developmental item, his latent progress, granting that he had made some during the interval, could not be estimated. Gaps occasioned by missing the test were a different matter. If an examination was missed and the baby exhibited one or more new developmental items at the next examination, it was assumed that he would have shown progress had he been tested in the missing week. Therefore he was scored for all the items developed in the week tested, and a score was interpolated for the missing week; if two weeks were missed in succession two scores were interpolated. It sometimes happened, however, that the baby who missed an examination still did not show a new developmental item at the next test. In this case his score for both the skipped

week and the week following became the same as that made at the last test in which he had shown progress. Some may question the procedure of interpolating scores. The total number of interpolated scores was not large. In all, 1,529 developmental scores were computed, and only 124, or 8.1 per cent, of them were interpolated.

After all the scores were computed in this way, each baby's scores were plotted on millimeter cross-section paper. The straight line bisecting the right angle between the *X* and *Y* axes was drawn on each curve; this represented the line of the median and served as a reference point for the baby's own scores. This method of plotting allows one not only to compare each baby with the median but also to compare the developmental rates of different babies.

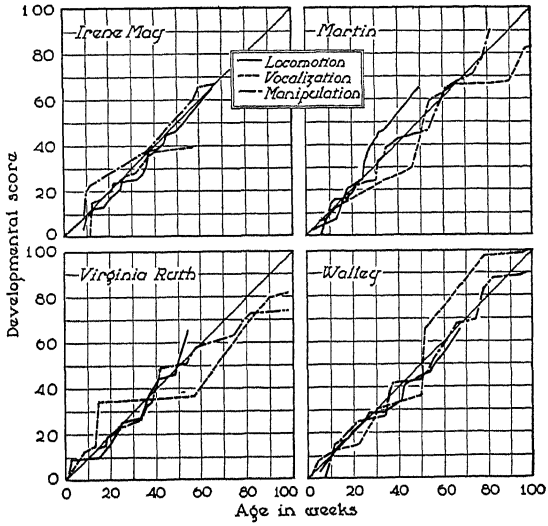
Interrelations in developmental scores in different types of behavior. — The relationship of the scores on locomotion, vocalization, and manipulation to each other is best shown by the individual developmental curves, but it is impossible to publish all twenty-three charts. A few examples are given in Figure 34.

Inspection of all charts reveals no consistent tendency for all four curves to rise together. Frequently the vocalization or reaching of one baby is accelerated above that of the median, and at the same time locomotion is retarded. Sometimes one curve spurts ahead, leaving the other two behind; a few weeks later it may lag while another curve forges ahead. Some of the curves tend to fan out at the later ages; this indicates that the rates of development are not the same for the different types of items. In short, the lack of consistency among them is very marked, and according to the curves the inconsistency seems to increase with age. This situation, however, is largely due to the way in which the

curves are drawn. Deviations from the median and fluctuations of the curves with respect to each other are numerically smaller at the younger ages, but since the medians are also smaller the small deviations are of considerable importance. The size and nature of the

FIGURE 34

DEVELOPMENTAL SCORES OF FOUR BABIES ON THE LOCOMOTOR, VOCALIZATION, AND MANIPULATION TESTS



fluctuations differ from baby to baby; hence they will be further treated in the discussion on individual characteristics.

The inconsistency shown by the curves is corroborated by the rank-order coefficients of correlation at different age levels. The age levels at which correlations were worked began at 15 weeks and were computed at

10-week intervals up to 45 weeks. Ages 50 and 54 weeks were both included, since they were the ages of the psychological examinations nearest the first birthday. Thereafter, ages 66, 74, and 82 weeks were chosen as being appropriate levels for the correlations, because intervals of ten weeks would have brought psychological examinations into comparison with anthropometric measurements. These correlations are presented in Table LVII. Since the babies who were most advanced in

TABLE LVII

CORRELATIONS BETWEEN DIFFERENT TYPES OF DEVELOPMENTAL SCORES

AGE IN WEEKS	NO. OF CASES	ITEMS CORRELATED		
		Locomotion with Manipulation	Locomotion with Vocalization	Vocalization with Manipulation
15	22	.38	.04	−.03
25	22	−.08	−.32	.16
35	22	.20	.16	.08
45	21	−.25	−.32	.36
50	21	−.08	−.12	.60
54	21	...	...	.44
66	19	...	...	.30
74	19	...	...	.38
82	15	...	...	.48

locomotion had achieved their highest possible scores at 50 weeks, no correlations could be worked with this variable beyond this age.

The number of cases are few, and practically all the correlations in which locomotion is a variable are so low that they are within the range of their probable error. The inconsistency of the signs of the correlations also leads one to suspect that they represent merely chance relationships. Developmental scores on vocalization correlate with those on manipulation very little up to 45 weeks; then and thereafter the correlations are fairly

consistent in size, and all of them are positive. It is hard to say why these correlations are higher than those between locomotion and manipulation; a priori, one would expect the two types of motor behavior to be more related to each other than either of them to vocalization. This finding substantiates previous statements that postural control and locomotion are apparently quite different from the fine motor coordination that, for example, is involved in acts of reaching and manipulation.

Why manipulation and vocalization show as high a relationship as they do in the second year is difficult to explain. It may be that, as the child grows older and as the repertoire of his acts along various lines becomes larger, the various types of behavior are knit more closely together and the child behaves more as a unit. The low figures of these correlations, however, hardly warrant speculation. The significant fact is that in infancy there is apparently little or no relation between the rates of development in these three different types of functions, if developmental scores such as these are to be trusted as measuring instruments.

Consistency of All Developmental Scores

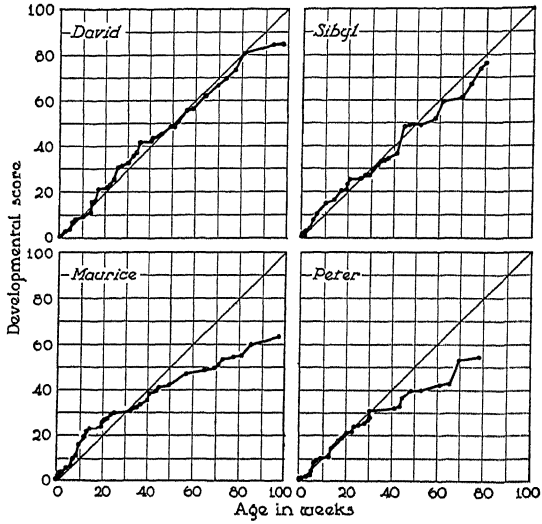
Here again the individual charts of the cumulative developmental scores on all items depict the nature of each baby's progress much more adequately than it can be described. Naturally the curves for all items show less irregularity than those for the three types of functions simply because the items were more numerous and consequently were more closely spaced. However, no two of the individual curves have the same contours, and all of them show some alteration in speed of development. The upward trend of the curves is far from

smooth and regular. Most of them approach, cross, advance beyond, and then recede below the median line in the course of their rise; a few of them cross the median line as many as nine times.

Although all the curves are different, they may be divided roughly into three types (see Figure 35). In one

FIGURE 35

TOTAL DEVELOPMENTAL SCORES OF FOUR BABIES



type the curves cling closely to the median and mount upward at a gradual rate. These curves indicate that the babies whose scores they represent showed a new developmental item almost every week. Seven babies have curves of this type. A second type of curve is one that climbs upward by little steps. These steps indicate that two or three weeks often elapsed without a new item being noticed and then two or three new items ap-

peared at the same week. These short-step, stair-like curves are shown by eight babies. The third type of curve has long, wide steps; this means that the intervals during which no new item appeared were several weeks long and that several new items then appeared simultaneously. Six babies have curves of this sort. These step-like rises in the curve cannot be accounted for on the basis of absence from examinations, for interpolated scores were plotted for the intervening weeks.

Correlation coefficients were computed on these scores at adjacent 4-week intervals from 3 to 49 weeks and from 50 to 94 weeks. Intercorrelations were also worked for the weeks that marked the beginning and the end of a given type of psychological examination. With one exception these coefficients for adjacent 4-week intervals, as shown in Table LVIII, are positive and high. They range from .16 to .96, and of the twenty-three coefficients, only two are below .50. But the very nature of cumulative scores would lead one to expect correlations of this magnitude or greater; from week to week the scores fluctuate in only one direction and that is upward. The coefficients computed between more widely separated ages present a different picture. Up to 49 weeks the intercorrelations hover around zero, and many of them have negative signs. In the second year, however, the correlations are all positive, and all but one are above .60. A tendency toward a greater consistency of the curves for the second year is also evident in the charts.

Consistency of the Rate of Development

Another method of getting a rough measure of the consistency in the rate of development is by correlating the interval that elapses between the development of

TABLE LVIII

Correlations on Cumulative Developmental Scores

Weeks Correlated	r	Weeks Correlated	r
3 and 7	.64	50 and 54	.94
7 and 11	.52	54 and 58	.91
11 and 15	.58	58 and 62	.88
15 and 19	.68	62 and 66	.83
19 and 23	.76	66 and 70	.62
23 and 27	.16	70 and 74	.92
27 and 31	.44	74 and 78	.86
31 and 35	.62	78 and 82	.84
35 and 37	.60	82 and 86	.88
37 and 41	.70	86 and 90	.96
41 and 45	.60	90 and 94	.92
45 and 49	.78		

Intercorrelations on Weeks Marking the Beginning of Each Type of Psychological Examination

Age in Weeks	Age in Weeks					
	13	25	37	42	54	78
3	.36	−.24	.24	.13	.10	−.04
13		−.01	.14	−.14	−.40	−.26
25			−.10	.02	.00	−.18
37				.66	.20	.22
42					.38	.28
54						.46

Intercorrelations on Weeks Marking the End of Each Type of Psychological Examination

Age in Weeks	Age in Weeks					
	23	34	49	50	74	94
11	.66	−.02	−.30	−.25	−.36	−.32
23		−.06	−.08	−.06	−.18	−.12
34			−.13	−.13	.10	.30
49				.98	.67	.70
50					.60	.70
74						.88

two behavior items that appear early with the interval that elapses between the development of two items that appear later. If developmental rate is constant, the correlation between the two intervals would be 1.00; if rate fluctuates, the correlation would approach zero. In other words, if rate is constant the intervals between the developmental items of a baby who is developing rapidly would be shorter than those of a baby who is developing slowly.

In following out this theory certain developmental items were chosen that had been tested consistently and were considered least subject to experimental error, and the intervals between these items were computed for each baby. The items were also selected with a view to having some of them representative of locomotor control and others of fine motor coordination. Below are samples of the correlations computed between 56 sets of intervals. These correlations vary from $-.70$ to .55, the majority ranging between $\pm.20$; the average is $-.006$. There is no consistent tendency for long intervals to show higher correlations than short intervals, nor for locomotor intervals to correlate more highly with other locomotor intervals than with intervals between two items of fine motor coordination. In short, the correlations tend to confirm the general conclusion that developmental rate is far from constant during the first year.

The following correlations are based on twenty-one cases and show consistency of the developmental rate:

Correlation of Interval between	r
Watch person and follow tape horizontally and interval between	
Chest up and sit on lap	.28
Chest up and grasp object	.27
Follow tape in a circle and grasp object	$-.01$

Correlation of Interval between	r
Retain stationary object and retain dangling object	−.25
Sit on lap and swimming movements, prone	.10
Sit on lap and sit alone	.08
Sit alone and creep	.15
Creep and walk alone	−.08
Watch person and smile at person and interval between	
Chest up and sit on lap	.38
Chest up and grasp object	.25
Follow tape in a circle and grasp object	−.07
Retain stationary object and retain dangling object	−.43
Sit on lap and swimming movements, prone	−.61
Sit on lap and sit alone	.06
Sit alone and creep	.15
Creep and walk alone	−.01
Chin up and chest up and interval between	
Chest up and sit on lap	−.70
Chest up and grasp object	−.61
Follow tape in a circle and grasp object	.02
Retain stationary object and retain dangling object	.50
Sit on lap and swimming movements, prone	−.06
Sit on lap and sit alone	.08
Sit alone and creep	−.24
Creep and walk alone	−.19
Follow tape horizontally and follow tape in a circle and interval between	
Chest up and sit on lap	.04
Chest up and grasp object	.08
Follow tape in a circle and grasp object	−.74
Retain stationary object and retain dangling object	.16
Sit on lap and swimming movements, prone	.25
Sit on lap and sit alone	.45
Sit alone and creep	−.18
Creep and walk alone	−.44

Consistency of Developmental Scores with Other Measures of Achievement

Since developmental scores at widely separated ages during the first year were so inconsistent, it is of interest to ascertain whether the inconsistency is attributable to the method of scoring or to inconsistencies in the babies' performances from time to time. To do this it is necessary to have some other measures of development. Two measures aside from the regular tests were used on all the babies, the Yale Psycho-Clinic Developmental Schedules and the Minnesota Preschool Test. The former were given at appropriate ages during the first year, and the latter were used at 18 months and 2 years.

Yale Developmental Schedules. — The regulation materials prescribed by the Yale Clinic were used in making the tests, and the method recommended by Gesell (16) was followed in so far as it was possible to do so from merely reading and studying his descriptions. On a few of the developmental items, however, the examiner was in considerable doubt as to the procedure and technique of testing the baby and as to the criteria for scoring the test. Nevertheless, the letter ratings were assigned with as much exactness as possible.

For the purpose of comparing these scores with those on other tests it was necessary to have a numerical total on each examination. Gesell publishes only letter ratings and does not describe his method of weighting the individual items to obtain developmental levels or developmental quotients, although he talks about them and plots curves to depict them. It is very likely that the numerical scoring method herein devised would not have Gesell's sanction. The method consisted of assigning to each alphabetical rating a given number of

points so that A+ ratings received the highest number of points and C ratings, the lowest. The values assigned were as follows: A+, 5 points; A, 4 points; B+, 3 points; B, 2 points; and C, 1 point.

The Yale schedules contain, in addition to the items tested for, several items that are obtained verbally from the mothers, such as "kicks feet in bath," "adaption to nursing," "takes bottle in and out of mouth," "dances to music," and "bowel control." In the present study these reactions were printed on a separate page, and the two parts of the examination were scored separately. Intercorrelations on the total and partial test scores are given in Table LIX.

TABLE LIX

INTERCORRELATIONS OF POINT SCORES ON THE YALE DEVELOPMENTAL SCHEDULES

Age in Months	Total Scores			Items Tested for			Items Reported by Mothers		
	6	9	12	6	9	12	6	9	12
4	.18	.16	.40	.20	−.10	.20	.30	.25	.34
6		.43	.32		.30	−.06		.38	.38
9			.60			.64			.26

The coefficients are positive for the most part, but they are very low during the early months. At 9 and 12 months the scores seem to be somewhat more stable and consistent. These correlations are in accordance with the previous finding that, in the early period of development, there is considerable shifting of ranks; as they approach their second year, the babies seem to strike their strides and from then on they hold their places more consistently among their contemporaries.

Correlations were also computed between the scores on the Yale tests and the developmental scores. The

highest coefficient was .51 at 12 months and the lowest, .16 at 6 months; the coefficients for the 4th and 9th months were .43 and .18, respectively. The probable errors are high because there were only twenty cases at 4 months, nineteen at 6 months, and eighteen at 9 and 12 months. The low figures of the correlations indicate that in this group there was little relationship between development as measured by the Yale tests, scored in this crude fashion, and the developmental scores of the present study. The two were slightly more consistent at 12 months than at any other age. Unfortunately, Gesell's test was not given at 18 months, so that no comparison is possible at this age. The Minnesota Preschool Test (21), however, shows considerably higher relationship, .73, with the developmental scores than did the Gesell tests at the earlier ages. All these coefficients tend to confirm the point previously made that, although development proceeds at breakneck speed during the first year, its pace is not steady. After the early milestones are passed, the gait gradually becomes fairly regular.

Summary

Perhaps it is going too far to generalize concerning the continuity and rate of development from these rather crudely computed developmental curves on this small group of babies. The value of these developmental scores lies in the fact that they represent a departure from the normative summary method of studying the rate of development. The trend of these curves and the nature of the correlation coefficients clearly indicate that development, in so far as it was measured by these cumulative scores, did not proceed at a uniform rate during the brief period from birth to 18 months. Fur-

thermore, the different aspects of development that went on simultaneously did not proceed at the same rates. There is some evidence that during the first year and a half fundamental behavior items emerge and patterns of reaction are laid down which serve as a foundation for future development, and that once these are established the developmental rate becomes more regular.

These results are merely suggestive, but they do strengthen the arguments that continuity of development and regularity of its rate can be determined only by continuous examinations; that emergence of new items of behavior represents a different type of development than improvement in old items; and that the two types possibly do not follow the same developmental laws. Logically we would expect the emergent phase to be more dependent on maturation and the improvement phase to be more dependent on practice.

CHAPTER XVII

POINT SCORES

The point scores worked out on each examination offered another method of dealing with the problem of consistency in development. The data presented in Figures 6, 14, 16, 23, 27, Tables XXIV and XXVIII, and in the tabular material on page 365 show that, in general, the point scores increased from week to week, that scores for adjacent weeks were usually fairly consistent as measured by rank-order correlation coefficients, and that consistency was greater toward the end of the age period in which a specific examination was given than at the beginning.

Valuable as they are for measuring the consistency of the group, correlation coefficients give no clue as to the consistency of the individual child. In a study such as this the developmental trend of several individuals rather than the trend of a group is the primary object of study. Therefore it is essential to devise a method of handling the successive scores of each baby so that his development may be studied for changes in level and spurts in rate. Since the total possible points differed in each type of examination, however, the raw point scores could not be used as measures of developmental rate.

Method of Equating Point Scores

Three methods were used to make the point scores comparable from one examination to another: the per-

centile rank scores, the percentage of average scores, and the percentage of highest scores. The scores made by every baby at every test were recomputed on these three bases. It is perhaps worth while to justify the choice of these three methods and to state at the outset that the conventional method of equating scores by converting them into standard deviation scores was not employed because the cases were too few to warrant the use of this statistical measure. These three methods are admittedly crude, but they offer a point of attack on the problem.

Percentile rank scores. — Percentile rank scores were computed by ranking the babies each week and converting the ranks into the percentage of the total number of cases. This was necessary because the number of babies examined was not constant from week to week; one or more babies usually were skipped each week because of illness or for other necessary reasons. The percentile ranks for each baby throughout the entire two years were then plotted for study.

These scores are the same as those used in the computation of the correlations, and the ups and downs of a baby's curve show graphically his variations in rank from week to week. The curve for the median score is, of course, a straight line parallel to the base line and located at the 50 per cent point on the ordinate axis. If a baby consistently held the same rank within the group, his curve would be a straight line parallel to the base and located at the height corresponding to his rank. Inconsistency in rate of development would be shown by departures from the straight line, and the greater the inconsistency, the greater would be the zigzags back and forth across this imaginary straight line. These curves would also show whether a given baby tended gradually to rise above his fellows or to sink

below them. Let us assume that a prematurely born baby ranked lowest in development at birth, but that at one year he had caught up to the rest of the group to the extent that he was the median baby, and that at two years he held the highest rank in the group. Such progress would be represented by a straight line running diagonally from the lowest rank to the highest. Another baby might gradually fall from the highest rank to the lowest; his curve would be a straight line leading diagonally downward. To be sure, such hypothetical cases would rarely be found even in a much larger group than this one. They are postulated merely to show the possibilities of this method of presentation.

The objection to percentile scoring is that it makes the step intervals between children equal. Ranks do not represent true variations in score; large differences in rank of scores close to the median may represent only a few points of difference in score.

Percentage of average scores. — The magnitude of the scores was taken into account by converting each baby's score into a percentage of the average point score for that week. In addition to leaving the relative sizes of the scores unchanged, this method has the advantage over the percentile rank method of increasing the range of scores. Whereas percentile scores varied only between 4 and 100, the percentages of average scores varied from about 15 to 200 per cent. The curve for the average score in this case is a straight line parallel to the base and located at 100 on the ordinate axis. Presumably, if the rate of development were the same for all babies, the curve for each would be a straight line parallel to the base line. If the rate of development of one baby were faster than that of the group, his curve would rise above the 100 per cent line, and if it were slower, his curve would fall.

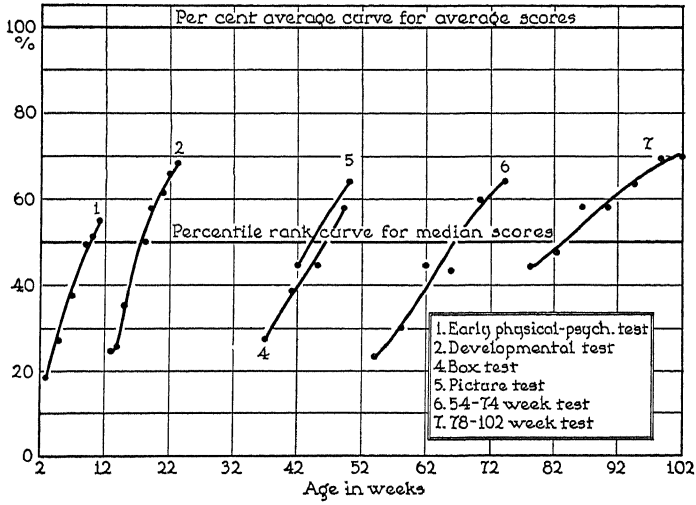
The linearity of individual curves for both the percentile rank and the percentage of average scores is contingent upon the fact that the different types of examinations are measuring the same thing. This, however, is not the case. The early tests of development measured little besides the ability to reach and grasp objects, and the test with boxes was a test of manipulation. During the latter part of the first year the examinations were arranged so that different types of development would be studied at different weeks; the attempt was to make a detailed study of each type rather than a comprehensive survey of the whole at each test. The examinations of the second year were somewhat wider in scope and came nearer to tapping all the babies' varied skills and capacities. Hence we should expect linearity of the individual records to hold only in separate types of examinations and not to hold from one type of examination to another.

Percentage of highest score made on each type of test. — Since the average or median scores for both the above types of curves yield straight lines, they are more useful in studying the consistency of the level of development than the regularity of its rate. To study developmental rate it is necessary to take into account the relative magnitudes of the actual scores on successive examinations. The curves for average scores on each type of examination must rise with age. In order to obtain these scores, one must choose an arbitrary point of reference. Any score may be chosen as this point, the lowest score made by any child on any examination, the highest possible score, or any other score. The point used in these computations was the highest score made by any baby on the examination in question. This score was usually made at the latest age the examination

was given. The highest score achieved was used instead of the highest possible score because it represented the actual accomplishment of one baby. The highest possible score was seldom achieved, and to have taken it as a point of reference would have diminished the range. The possible range in these scores was from 0 to 100;

FIGURE 36

AVERAGE POINT SCORES EXPRESSED AS PERCENTAGES OF THE HIGHEST SCORE



the average scores for the most part rose from about 25 per cent to 60 or 70 per cent.

The only drawback to this method of scoring was that the examinations changed from time to time. At each change in examination the babies had to start over again at a low score and gradually climb to a high one. Hence the curve for the average is not a single straight or curved line gradually ascending but a series of such

ascending lines (see Figure 36). The curve for a baby who progresses at a rate greater than that of the average rises more steeply than the average curve, and the curve for a baby who progresses more slowly will ascend more gradually than the average. It is quite possible for the baby to progress at the same rate as the average and yet remain consistently above or below it. The curves in such a case would have the same slope as the average, and the average and individual curves would be equidistant from each other at every point.

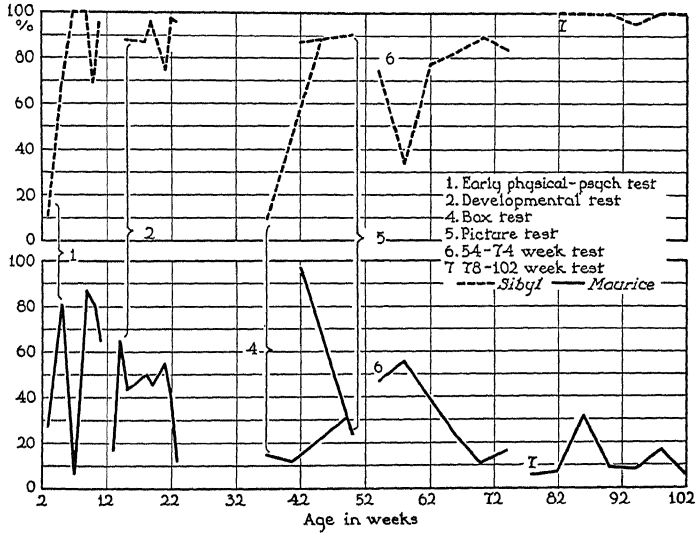
Meaning of the three types of scores. — The extent to which the individual curves depart from the straight line curve of the average gives some indication of the consistency with which each baby kept to his particular level of development and progressed along the level at a regular rate. The slope of the average curves for the percentages of the highest scores on successive examinations yields some information as to whether development proceeds at a constant rate or whether it slows up with advancing age. The curves for individual babies may be compared for differences in both level and rate of development.

Individual curves give the best picture of the marked degree of fluctuation in developmental levels. Careful inspection of the individual curves of percentile rank and percentage of average scores reveals that in the early weeks there was little tendency toward maintaining a constant level. (See the sample curves in Figures 37 and 38.) The curves for all babies show many shifts in percentile ranks and percentages of average scores from week to week up to the age of 6 months. Some of the curves have an upward trend, indicating that those babies were progressing at a more rapid rate than the group as a whole; others tend to decline, showing that

the babies represented were developing at a slower rate than the group. All the curves, however, fluctuate widely, and very few of them could be said to approximate a straight line.

FIGURE 37

INDIVIDUAL POINT SCORES EXPRESSED IN PERCENTILE RANKS

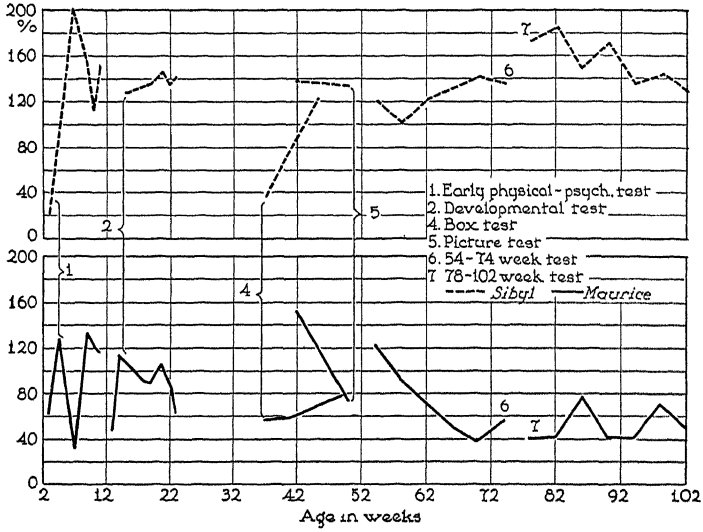


The greatest amount of fluctuation occurred in the early physical-psychological examinations given between the ages of 3 and 11 weeks. The inconsistency of the examinations was likewise shown by very low intercorrelations (see Table XXIV, page 133). Toward the end of the series of developmental tests, which were given from 13 to 23 weeks, the curves fluctuated less, and it appeared that the babies were about to reach their appropriate levels in the group. It will be remembered that fairly high intercorrelations were obtained

at these weeks (Table XXVIII, page 176). During the latter half of the first year the box tests, the picture and perfume examination, and the Gesell developmental schedules were evidently measuring very different as-

FIGURE 38

INDIVIDUAL POINT SCORES EXPRESSED AS PERCENTAGES OF THE AVERAGE SCORE



pects of development, for their respective curves cross and recross and in no case do they approximate one continuous line.

The curves for the second year fluctuate much less than those of the first. Although few of them approximate a straight line, they show fairly consistent trends. High intercorrelations between the ages of 64 and 102 weeks are another indication that by the second year

the babies had arrived at a developmental level they were able to maintain.

Medians of the percentages of average scores for each type of examination were worked out for each baby. These medians are presented in Appendix 8. The inconsistency of these averages is readily apparent from the table. That the scores were somewhat more consistent during the second year than they were during the first is shown by a correlation of .33 between the composite point scores for the entire first and second years as compared to a correlation of .72 between the composite point scores for the first and second halves of the second year.

The general tendency for point scores to be erratic during the first year and to approach a stable level in the second bears out the findings of the previous chapter with regard to developmental scores. Fluctuation and instability seem to be characteristic of the babies' early development no matter how it is measured, and stability and consistency come with advancing age. This fluctuation and inconsistency cannot be explained on the basis of a narrow range in the babies' abilities, for at 2 and 3½ years the *IQ*'s ranged from 78 to 140 points.

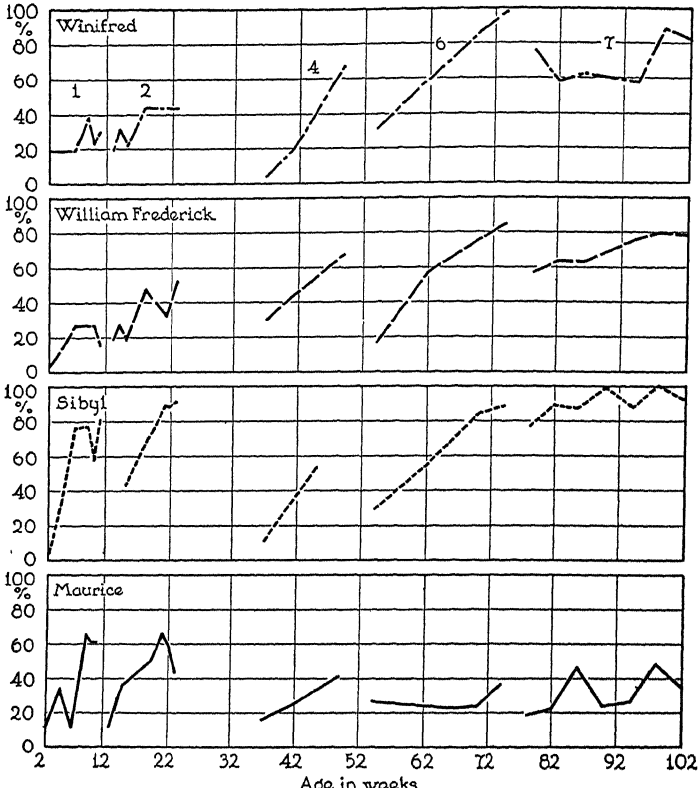
Consistency of the Rate of Development

The curves for the percentage of the highest scores serve as a crude index to developmental rate. These curves also fluctuate greatly, especially in the first half year. Few generalizations can be drawn from the curves, for each differs markedly from the others. Those for Winifred and Fred, premature twins, are somewhat similar; up to about 9 months the curves for these babies rise somewhat more slowly than those for

the average (see Figure 39, a and b). From this point there is suddenly a marked upward spurt, and from then till 18 months the curves rise more rapidly than the

FIGURE 39

INDIVIDUAL POINT SCORES EXPRESSED AS PERCENTAGES OF THE HIGHEST SCORE*



1. Early physical-psychological test
2. Developmental test
4. Box test
6. 54-74 week test
7. 78-102 week test

* Compare with Figure 36, page 423.

average curves; after 18 months the slope is very slightly, if any, steeper than the average, but the curves are on a higher level. If we were to interpret these curves in terms of developmental rate, we would say that these twins, being premature, were a trifle retarded in development at the outset but that by 9 months they had caught up with and surpassed the group; after this spurt their development proceeded at a rate sufficient for them to maintain their lead. Sibyl's and Judy's curves rise more steeply than the average from birth until 18 months and from then on they become somewhat flatter and more nearly approximate those of the average, although they are higher in level (see Figure 39c). The curves for some of the other babies are close to average up to 6 or 9 months and thereafter fall away from the average; in other words, the developmental rate of these babies slackened as they grew older.

Three features of the curves seem to be fairly consistent: first, the irregularity in rate of development from birth to the end of the first year, secondly, the settling down to a fairly consistent rate during the second year, and thirdly, the slacking of the rate with age. The curves for the average indicate that development proceeds at its most rapid pace in the early months; by the end of the first year it has slackened considerably, and it becomes progressively slower in the second year. From these data alone one would not be justified in pressing these conclusions if they were not in harmony with the findings of other experimenters. The slowing of developmental rate with age was postulated by Gesell in drawing up his mental growth graphs, and it is a well-established fact that physical growth is most rapid in the early weeks of infancy and gradually slows down in late babyhood and early childhood. Fluctuations in de-

velopmental rate during the first year are perhaps explainable also on the basis of the great speed of development. It is natural that variations in rate are greater when development is going at top speed than when it is proceeding at a moderate rate.

Consistency of Point Scores with Other Measures of Development

Correlations computed between point scores and other measures of development at various ages are as follows:

Point Score	Yale Development Score	r
18 weeks	4 months	.34
23 weeks	6 months	.61
41 weeks	9 months	.50
50 weeks	12 months	.34

Point Score Average	Developmental Score	r
0–12 months	1 year	.04
12–18 months	18 months	.75
12–24 months	2 years	.65

Point Score Average	Minnesota Preschool Score	r
0–12 months	18 months	.30
0–12 months	24 months	.18
12–18 months	18 months	.77
18–24 months	2 years	.90
12–24 months	2 years	.93

The scores made on the Yale developmental test were correlated with the point scores made on the nearest psychological examination. These correlations are all positive and of moderate size, although their probable errors are large because the number of cases is few. Since the Yale examination is presumably a comprehensive test of general ability, and since the psycho-

logical examinations of this series do not claim to be so, the correlations are as high as one might reasonably expect. There is an indication, however, that these varied types of examinations measure somewhat the same skills and abilities as those measured by the Yale examinations.

Developmental scores were cumulative and therefore were not comparable to the point scores on a single examination. Consequently the median of the percentages of average scores for the first-year period, the 12- to 18-months period, and the entire second year were used as composite point scores. The correlation between developmental and point scores for the first year was practically zero, a fact that further corroborates the statement that development was erratic during the first year. This zero relationship, if it be a true one, cannot be explained in terms of disparity between the items comprising the developmental scores and those entering into the point scores, for many of them were the same. The difference between the two scores is due to the fact that the developmental scores were given at the first appearance of a new act. Point scores, on the other hand, were given for going through a large repertoire of acts, some of them new but most of them old. Frequently, the baby who had exhibited his ability to do an act at an early age did not perform in the desired way at subsequent examinations. In the second year, however, the discrepancy between ability and performance was not so great. Correlations between point scores and developmental scores were positive and fairly high.

The correlations between the Minnesota Preschool Test scores and the average point scores were positive and high at both 18 months and 2 years. The consist-

ency of the two correlations makes it safe to say that the repeated psychological examinations were a fairly adequate measure of the mental traits measured by the preschool test. The correlations between the point scores and the Minnesota Preschool Test scores, .90 and .93, are higher than that between developmental scores and Minnesota Preschool Test scores, which is .73. This suggests that obtaining a developmental level by noting each new act as it appears and weighting it according to its difficulty is somewhat different from obtaining a developmental level by sampling behavior at given intervals. But no conclusion as to which is the better method can be drawn from this study. Only through painstaking application of both methods to the same group can the question of their relative merits be solved. Even if the method of noting the exact age of the first appearance of all significant behavior traits should prove better than the method of sampling behavior at stated ages, the latter method would always be easier of application and therefore more practicable.

Results of Other Investigations of Mental Development in Infancy

Gesell is greatly interested in the period of infancy and has studied it carefully and written much about it. His discussions and his graphs on mental growth lead one to infer that he believes mental development to be as consistent throughout the first year as it is in later years; but he does not give any figures as to the consistency of the examinations from age to age. Indeed, he makes a point of the fact that

> . . . individual tests were not scored in an arbitrary manner, nor were they arithmetically compounded. . . . It was our purpose to build up a cumulative familiarity with the child.

In each instance, therefore, the last examination was brought into comparison with the results of the preceding examination. A new series of ratings was made and the data on the previous examination were used critically in the weighting of the succeeding examination. The antecedent ratings were not changed. They were simply reviewed. In summary terms the problem each time was to decide whether, in the light of the data, the antecedent estimate could be confirmed, or whether it needed to be reduced or advanced in the new rating.[1]

This policy of reviewing previous ratings in evaluating succeeding examinations probably endows the baby's development with a false consistency. With the previous ratings on the infant clearly in mind, the examiner could hardly help seeing more similarity than dissimilarity in the baby's performance on successive examinations.

Gesell does not reveal the method whereby logarithmic graphs of mental growth are drawn up from non-arithmetically compounded scores. He publishes many of these growth curves, most of which are very smooth and regular. A half dozen "atypical and pseudo-atypical" curves he explains on the basis of dystrophy, early neglect, mongolianism, motor retardation, temporary developmental arrest, personality complications, and physical handicaps. The developmental curves for the babies of this study were not drawn up according to the refined methods used by Gesell, but irregularities in development during the first year were so great that even if such fine methods had been used, the majority of curves would have fallen into Gesell's class of "atypical and pseudo-atypical growth complexes."

Other workers also find inconsistency in early devel-

[1] *Infancy and Human Growth*, p. 141.

opmental ratings. Follow-up studies[2] of the babies on whom the Linfert-Hierholzer (36) Scale was standardized have failed to confirm the investigators' hopes that here at last was a scale that would enable them to forecast mental ability from tests given in infancy. The correlation between the ratings on the infant test and the Stanford-Binet mental examinations at the age of 4 years is practically zero.

Conger (9), using the Linfert-Hierholzer Scale, obtained only slight consistency in her tests during the first three months of life. She applied the scale to twenty-five babies successively, and her test-retest reliabilities, the retest being given two days after the original test, were −.24, .44, and .69 for the first, second, and third months, respectively. With the addition of the Gesell items the test gave reliabilities of .30, .56, and .37 for the same ages. Scores made the first month gave zero correlations with those given the second and third months; the second and third month scores, however, correlated .58. There was no correlation between the babies' scores and the mothers' scores on either the Stanford-Binet or the Arthur Performance Scale, although the usual parent-child correlation, .30, was obtained between mothers and babies on the physical trait of height. Conger attributes the inconsistency of babies from month to month and the lack of relationship in ability between mother and baby largely to the unreliability of the Linfert scale, but she intimates that this fact does not wholly account for the lack of agreement. She raises the question as to whether it is possible to devise a reliable test for the infant under three months.

[2] P. H. Furfey and J. Muehlenbein. "The validity of infant intelligence tests." *J. Genet. Psychol.*, 40: 219–223. 1932.

Bayley (3), working with tests adapted from Gesell, likewise found low reliabilities for the first three months, when she used the split scale method for computing reliability. She also obtained low correlations between adjacent months during the first half year. She writes,

> These studies indicate that the score at any given month may be affected by the child's health, or his emotional reactions, but these do not affect the general trends. . . . There is also some indication that the tests measure, at different levels, different functions whose rates of growth are independent of each other.

Possible Explanations of Inconsistency in Early Development

Fluidity, inconsistency, and lack of fixity in response are, it seems from these investigations, just as characteristic features of early development as consistency, regularity, and fixity are of later development. How can they be accounted for? For the most part the data are not yet complete enough to allow for general statements on this point.

Discrepancy in the physical condition of the baby from test to test readily comes to mind as a possible explanation of inconsistency in scores. Bayley advances it as a partial solution, but it by no means accounts for all the irregularities. Conger correlated the babies' scores with hunger, as measured by the length of time from the last feeding hour, fussiness, and sleepiness, but the detrimental effect of these unfavorable factors on the scores was very slight. To be sure, the onset of hunger, fatigue, and incipient illness are perhaps more subtle and less easily recognized in infants than they are in children who are old enough to make their wants known. Hence there is a greater possibility of the baby's

being submitted to an examination when he is not in the pink of condition. Although our experience with older children and adults has minimized the importance of these factors in test results at later ages, no doubt they play considerable part in the testing of infants. It is also important to look for other factors in the lives of infants that may have a marked influence on their responses to test situations. A number of such factors suggest themselves — the speed of early development, the influence of prematurity and postmaturity, the lack of incentives, the poorer ways of dealing with personality traits in infancy, the inattentiveness of babies, their lack of comprehension of the social situation, and finally the relatively greater importance of emergences of new behavior items in early development.

Speed of development. — As has been stated above, the great speed of development during the first half year is partly responsible for the inconsistency in development. The greater the weekly or monthly increment in development, the greater the possible deviation from that speed. The slowing down of developmental rate decreases the possible amount of deviation. It is natural, therefore, that 2-year-olds hold their ranks more consistently than infants under 6 months.

Prematurity and postmaturity. — If the effect of prematurity on development is to retard it a uniform amount of four, six, or eight weeks, according to the amount of prematurity, and leave the developmental rate unchanged, then a premature baby would always be a few weeks behind a child of the same ability who was born at term. Gesell thinks this is the case and implies that the effect of 8 weeks' prematurity may be of significance in retarding the child up to the age of 5 years, but that thereafter the discrepancy in age would

be too slight to be of much importance. He suggests that it is fairer to premature infants if age is reckoned from conception rather than from birth. The facts of physical growth, however, are not in harmony with the concept of permanent retardation. Scammon (50) has shown that the premature baby continues to grow at a rate more nearly approximating that of the fetus than that of the newborn. Hence the discrepancy in size of premature and term babies has practically vanished by the end of the first year. Since the premature baby grows rapidly enough to catch up with babies of his age by his first birthday, is it not likely that his nervous system likewise matures more rapidly and that he also catches up with his fellows in behavior development? Similarly, the postmature infant does not maintain his lead in physical development; instead his growth rate slows down somewhat earlier than does that of the term baby, and hence at 1 year the latter is his physical equal.

The cases of Fred and Winnie, premature twins, and Walley, postmature by about three weeks, seem to bear out the assumption that in mental as well as in physical development the premature baby is not permanently retarded nor the postmature baby permanently accelerated. The retardation of Fred and Winnie in the first half year and their spurts ahead in the last half have already been discussed. Walley, on the other hand, led the group for the first three months, and throughout the remainder of the year he held third place, whereas Fred and Winnie ranked low in the group. Early in the second year, however, they caught up with him, and the three vied for the high ranks in the group; Winnie usually outranked the two boys.

These cases are not numerous enough to warrant conclusions as to the acceleration of the developmental

curves of premature infants. They merely make it seem probable that mental development is similar to physical growth in this regard. If this is the case, the problem of inconsistency of development during the first year is largely solved. If postmature, term, and premature babies start out unequal in development and emerge from the first year equal or redistributed more nearly in accordance with their hereditary capacities, there must have been great differences in developmental rates and large shifting of ranks among them during the interval.

Lack of incentive. — One of the great difficulties in infant-testing is that of motivating the baby. There is no way of gaining and holding the baby's attention except by the intrinsic interest of the test; there is no way of urging him to do his best and no definite and objective way of knowing whether he has put forth real effort or whether he has malingered. One only knows that sometimes the baby does the test well and sometimes he does not. If the baby's attention or interest happens to be fixed upon some newly discovered accomplishment, such as blowing bubbles, playing with his hands, or climbing, there is little chance of getting his wholehearted attention to dangling toys, picture books, or block-building. Fluctuations in scores from week to week may thus be partly due to differences in the degree of the baby's attention to and absorption in the test.

Personality factors likewise are less easily dealt with in babies. The docile, even-tempered baby may outstrip the determined infant who has a "mind of his own," even though the latter has greater potentialities. The progress of Quentin and Virginia Ruth constitutes

a case in point. Quentin was a willing, eager, and interested baby, and throughout the first year frequently led the group. On subsequent mental tests his *IQ* proved to be very little above average. Virginia Ruth, on the other hand, a most irritable baby in the early months, ranked very low throughout the first year, but after she became able to get about alone and satisfy some of her own wants in her independent fashion, she became a most amiable child, cooperated willingly in mental examinations, and earned very high scores. Personality traits no doubt have some influence on test scores even at later ages, but in the older child their influence is reduced considerably by proper motivation.

Inability to understand directions or to comprehend the social situation enough to realize that the examiner expects something of them is another possible explanation of the inconsistency of the babies' scores during the first year. The beginning of language comprehension in the last quarter of the first year and the recognition and use of social interplay no doubt are factors that make for stabilization in the developmental rate early in the second year.

Emergence of new traits. — Finally, the possibility suggests itself that fluctuation is a characteristic of emergent development, whereas consistency is a characteristic of improvement in skills that have already emerged. The emergence of new behavior items proceeds most rapidly in the first half year. It has repeatedly been pointed out that although the items emerge in a definite sequence there is great variation in age of emergence. In one baby the period between the emergence of two items is expanded; in another it is

contracted. If an item that figured in a developmental scale were held in check awaiting the development of an item in the sequence that was not an item of the test, the baby would fail the test; if the interval between the emergence of subsequent items were condensed, the baby would catch up at the next examination.

In the early months of life the emergent phase of development would seem to be more important than the improvement phase. Until a modicum of behavior traits have emerged, the baby has no foundation upon which to erect his structure of mental life. Some acts of motor control, a few manipulatory skills, a bit of babbling ability, a few social accomplishments — these emerge with growth from the mass activity and reflexes of the newborn. It seems reasonable that until they have emerged the baby cannot settle down to a consistent rate of development, but that after their emergence he may improve them and may organize and integrate them into new patterns at a rate consistent with his potentialities.

Summary

Point scores were handled in three ways to show the consistency of the babies in level and in rate of development, and individual babies were found to be very erratic in both level and rate of development during the first year. In the second year each settled down to a regular pace and maintained his place in the group fairly consistently. With the exception of Gesell, other investigators agree with this finding. Inconsistencies in first-year development may be attributed to the great speed of development, to the catching up of premature babies and the slowing down of postmature babies in

developmental rate, and to the difficulties of motivating babies and of reducing unfavorable personality traits to a minimum. Finally, it is suggested that it is impossible for the baby to settle down to a consistent rate of development until a sufficient number of traits have emerged to serve as a foundation for future skills. Fixity and consistency in behavior apparently are end points rather than starting points in behavior development.

CHAPTER XVIII

SUGGESTED PRINCIPLES OF BEHAVIOR DEVELOPMENT

The foregoing chapters have traced the course of development in several behavior traits as it was observed in this group of babies. The account has necessarily been piecemeal, for it is impossible to survey the broad general trends of development without first following through each trait step by step. After studying the developmental progress in detail, however, it behooves us to seek the underlying principles of behavior development. The data of this study alone are far too inadequate for the formulation of definite laws of behavior. Only in so far as they are confirmed by the results of others will the general principles suggested by this study have worth.

Scientists have long since adopted the law of parsimony as a criterion of the soundness of their explanatory principles. For students of behavior the application of this principle amounts, for the most part, to explaining behavior phenomena on the basis of biological laws. Although psychologists do not limit their investigations to a study of behavior for which physiological explanations have already been worked out, they rightly look with suspicion on any explanation of behavior that goes counter to known biological laws. The general principle that the human infant presents no important exceptions to the fundamental laws of growth and development that hold throughout the animal scale

is implicitly accepted by all students of infant behavior. It will not be amiss, however, to point out some specific instances of the operation of these biological laws in the behavior development of infants.

CONFORMITY TO BIOLOGICAL LAWS

The first law of behavior development may then be stated as follows: In babyhood behavior develops in harmony with or in conformity to biological laws of development. This law finds its chief support in two outstanding features of infant behavior: first, the orderly sequence or pattern of development that holds from baby to baby, and secondly, the conformity of the motor sequence to the anatomical law of developmental direction, namely development from the head downward. These features, which stand out so clearly in the data of this study, are amply confirmed by the literature.

Principle of the Sequence

That development follows an orderly sequence is by no means a new idea in the field of child behavior. It has been propounded by other authors, notably by Gesell (16), who writes,

> The behavior of the infant, by nature, is obedient to pattern. Never does the picture of normal behavior become as diffuse and formless as a drifting cloud. Even the random movements of the month-old child are not utterly fortuitous. The closer one studies them the more configuration they assume. There is no such thing as utter randomness in infant behavior.

Citing the work of Minkowski on the fetus, Gesell continues:

> These patterns of behavior follow an orderly genetic sequence in their emergence. Genetic sequence is itself an expression of elaborate pattern.

Goodenough and Anderson (20) thus state the law of serial order in development: "Although children vary greatly in rate of development, the order of development as marked by the successive appearance of various developmental events varies but little from one child to another."

Consistency of the sequence. — The sequence of development as worked out from the median ages of the appearance of individual behavior items in this small group of babies takes on significance because of the consistency with which each baby adheres to it. It was pointed out in Chapter III that the percentage of reversals in the motor sequence was small. Consistent sequences were also observed in the development of speech and social reactions. Finally, it appears that the developmental items for all these different forms of behavior fall into one consistent order that may be called the sequence of behavior development in babyhood. That this sequence is not merely a by-product of the specific tests used on these babies is apparent from their spontaneous play and incidental behavior. In Volume I, pages 135–164, the motor activities of each stage or order of locomotor development were enumerated and described, and in Chapter II of this volume the play reactions accompanying the different stages of fine motor control were described in detail. To recapitulate briefly, looking around was the play activity that immediately followed the development of eye coordination and postural control of the head and upper trunk. Simultaneously with reaching came scratching. Successful grasping of moving objects and efforts to sit alone were accompanied by playing with the toes. Along with sitting came rocking, head-shaking, and jiggling; exploratory acts of pointing and poking into

holes accompanied the control of the index finger. In short, these babies always played at their developmental level and neither above nor below it. The data on play is important internal evidence as to the validity of the developmental sequence; nevertheless, the sequence would have small significance if it could not be confirmed by results from outside sources.

The sequence according to students of infant behavior. — Other experimenters employing very different methods of observation from those used in this study have discovered strikingly similar developmental sequences. A tabular comparison of locomotor development as described in the biographical records of Shinn, Myers, and Fenton reveals a sequence identical with that of this study. (See Volume I, pages 184–185.) From Preyer to Fenton the biographers agree as to the order of development, and their findings are consistent with those of the present study. In the three hundred and sixty-nine letters from parents published by Hrdlička (25) in his study on quadruped locomotion in babies there are many fragmentary accounts of motor development that confirm the sequence set forth herein. Further evidence confirming the sequence is contained in the study of Jones (27), whose percentile curves for smiling, horizontal, vertical, and circular eye following, reaching, and sitting alone follow consecutively and show no crossing.

In Appendix 9 are listed the various items of development in the order of their first appearance according to the observations of Shinn (52) and Bühler (7). These two accounts are particularly interesting for comparison with the present study because they differ most widely from it in methods and point of attack. Shinn's work represents perhaps the most complete biographical ac-

count of infant development that has yet been published. Bühler's study is an application of the method of continuous observation without artificial stimulation for a period of twenty-four consecutive hours at monthly age intervals. Miss Shinn's niece was a child of the nineties whose babyhood was wholly without benefit of modern ideas on infant nutrition, dress, and routine care. If her vitamin intake and her daily exposure to actinic rays were what they should have been according to present standards, they were so by accident or by common-sense good care rather than by the dictates of scientific knowledge. The infants studied by Bühler were modern babies of Vienna born about the middle of the last decade. Most of them were observed during residence at a reception home where they were temporarily placed before being sent to a foster home or to another institution. Bühler classifies 60 per cent of these babies as institution children and 40 per cent as children from private homes. The babies of the present study had in their favor not only the advantage of home surroundings during the observation, but also the best of diet and care that the pediatricians of 1927 were able to recommend and conscientious mothers to carry out.

In spite of great dissimilarity in point of time, geographical location, and environmental surroundings of the babies of these three studies and in spite of the disparity of observational methods used in studying them, the three sequences of development are strikingly similar. Like the babies of this study, Baby Shinn's first eye reactions were those of fixating a light and watching moving objects. (Compare Appendix 7 with Appendix 9, Shinn.) Head control likewise appeared in the early weeks. The downward progress of motor control in Baby Shinn was manifested by the development of the

touching and grasping reactions at 12 weeks and of sitting with support at 16 weeks, and by the orderly progress through turning, rolling, approximate creeping without intention (compare knee push or swimming movements), sitting alone, drawing forward on the stomach, pulling to the feet, creeping backward, walking with support, standing, and walking alone. The sequence as given by Shinn differs slightly in descriptive terms from that obtained from the present study, but it shows no reversals in the order of developmental events.

Similarly, the motor items that Bühler lists closely follow the motor sequence of this study. (See Appendix 9, Bühler.) Head control was the first motor act to be achieved by the Viennese babies; postural control then moved down the trunk, as was shown by the reactions of head- and shoulder-lifting in the dorsal position, propping on the hands when prone, sitting with support, turning from side to side or from front to back, sitting without support, kneeling, rising to standing posture, walking with help, and walking alone. Social responses as noted by Bühler also appeared in much the same order as they were observed in this study. Smiling in response to an adult's smile appeared in the third month in Bühler's tests and in the 8th week in this study. Viennese babies "lalled" (a German descriptive word for the cooing or babbling done by a tiny infant) in the 3rd month; young Minneapolitans cooed and gurgled at 8 weeks. The former were disturbed by the sight of people in their 4th month; the latter recognized strangers by showing signs of timidity or fear at 14 weeks, according to the records kept by the mothers. Striving for attention by "lalling" or by movements occurred in the 8th and 9th months in Bühler's study; drawing the

examiner into the situation appeared at a median age of 45 weeks in the babies of this study.

A recent note by Hazzard (23) gives the order of development of reaching and grasping as identical with the one obtained in the present group. Her baby was consistent with the babies of this group in playing with his toes during the interval between sitting propped and sitting alone. Transferring his rattle from one hand to another was noted at 20 weeks, as compared to the median of 21 weeks obtained in this study. Many other instances could be cited wherein the sequence is confirmed by continuous records of the development of individual children.

We may then formulate the law of the sequence as follows: Behavior development in human infants unfolds in an orderly sequence that is independent of the rate of development and of the environmental conditions under which the babies live. As a corollary to the law of the sequence, the law of spontaneous play may be stated thus: Human infants play in accordance with the level of the sequence they have reached. Old play activities are dropped, and new ones are acquired as the baby progresses from stage to stage in the sequence.

The sequence according to students of animal behavior. — Confirmatory data on developmental sequence become even more impressive when studies on animal development are considered. Widespread interest in the functional development of the nervous system has led many investigators to follow the lead of Coghill (8) in correlating the behavior of young animals with their neural growth. Thus, the sequence of behavior items in kittens, opossums, rabbits, rats, guinea pigs, and amblystoma have been rather thoroughly worked out. These sequences, together with some observations on

the monkey and the ape, are presented in Appendix 9 for comparison with the human sequence given in Appendix 7.

The fact that no captive-born chimpanzee has yet been raised to maturity has hampered the genetic studies of primates, whose development presumably would closely approximate that of the human infant. It is expected, however, that such a study will shortly be forthcoming, for Jacobsen, Yoshioka, and Jacobsen,[1] working at the Anthropoid Experiment Station of Yale University in Florida, have brought an orphan chimpanzee successfully through the first year and have kept systematic records of its development. A brief account of the first six months of a chimpanzee's life has been given by White (66). (See Appendix 9, White.) At 1 month the baby chimpanzee looked at persons and followed them with his eyes if they moved about the room, reactions that were noted in the babies of the present study at a median age of 2 and 5 weeks. Smiling, recognition of the caretakers, and soft, cooing vocalizations appeared in the chimpanzee in the same order and at almost the same median ages as they appeared in the human infants. Likewise, the baby ape recognized strangers and disliked them, as did the babies. Scratching and toe play, two of the play responses so characteristic of babies at the reaching stage, also appeared at the corresponding stage in the ape. The little fellow began scratching his basket and the persons who waited on him at 3½ months. Concerning toe play White

[1] C. F. Jacobsen, M. M. Jacobsen, and J. G. Yoshioka. "The development of an infant chimpanzee during her first year." *Comp. Psychol. Monog.*, 9: 1–94. 1932. The motor sequence of development in the baby chimpanzee closely approximates that in the human infant, although locomotor items appeared at an earlier age in the chimpanzee.

writes, "No human baby ever enjoyed the exquisite flavor of his toes any more than did this tiny ape. When I approached immediately the foot was withdrawn from his mouth and I was greeted with a face-wide smile, usually the foot being offered to me for a taste."

The order of development in the macacus rhesus monkey, as given by Lashley and Watson (35), likewise has much in common with the sequence in human babies. (See Appendix 9, Lashley and Watson.) Eye following and head-holding were among the earliest reactions to be developed; thumb opposition, picking up objects, crumpling paper, and adult vocalization were among the latest. Crawling, walking, and running, however, were perfected in the monkey before the reaction of picking up objects, whereas in the human infant the reaching and grasping activities preceded the development of locomotion.

The order of developmental items in kittens has been carefully observed by Tilney and Casamajor (61) and Windle (67). In the essential features of the sequence the authors agree. (See Appendix 9, Tilney and Casamajor, Windle.) Windle analyzes the righting response or postural reaction, which Tilney and Casamajor consider as established two minutes after birth, into the simpler responses of head rotation, rotation of shoulders, followed by rotation of trunk and pelvis; he thinks that these responses gradually developed during prenatal life. The reactions of turning the head and eyes and the visual pursuit of objects developed in the late 2nd and early 3rd week in kittens, about one week after their eyes open. Backward crawling, sitting, walking, scratching, righting the body in the air, running, climbing, and playful pawing developed in turn. Windle repeatedly mentions that the front legs have comparatively greater strength and skill than the hind legs.

Repeated observations on pouch-young opossums have enabled Langworthy (31, 33) to draw up a developmental schema for this animal. (See Appendix 9, Langworthy.) The chief similarities between the opossum sequence and the human sequence are the early mass contractions, the superiority of fore paws over hind paws, and the appearance of the reactions of crawling, walking, running, and climbing late in the sequence. In both kittens and opossums there are some items of the sequence, notably the righting reaction in mid-air, the climbing on a rope or screen, and the prehensile use of the tail, that have no counterpart in the human sequence.

With regard to Langworthy's work Stone[2] says,

> That development in the pouch young opossum is not proceeding in a hit or miss manner may be demonstrated by arranging together those items that have a functional relationship. With such an arrangement it is apparent that there is a remarkable degree of correlation between developmental trends and successive life functions of the individual while in the pouch, as it emerges from the pouch, and as it finally becomes self-maintaining. In this correlation one finds the primary evidence for a prevalent assumption that there is in animal development a timing factor by which organic development and the necessities of functional maturity are coordinated.

According to Avery (2), the sequence in guinea pigs differs from that in human and other animal infants in that development up to the walking stage takes place during the fetal period. (See Appendix 9, Avery.) The order is nevertheless consistent with that of other ani-

[2] Calvin P. Stone in a lecture on animal behavior included in a series of Lectures in Educational Thinking delivered at the University of Minnesota during the summer of 1931. These lectures are soon to be published by the University of Minnesota Press.

mals in that eye-opening and lid and pupillary reflexes precede holding up the head, and crawling precedes standing and walking.

Swenson (59) states that active movement in fetal rats appears when the fetus starts the period of rapid growth and that

> each simple movement makes its appearance in a definite order with other simple movements. Once a simple movement has appeared it persists in kind, but its qualities change with the development of the animal. It may occur in any combination of sequences with other simple movements.

Angulo y Gonzáles (1) emphasizes the fact that the postural reaction in the rat fetus begins with the lateral flexion of the neck and spreads cephalo-caudad through lateral flexion of the trunk with which fore limb movements are soon coordinated, head extension, rump extension, and rotation on the axis.

Finally, amblystoma punctatum, the animal so intensively studied by Coghill, has some features in its embryonic sequence of development that correspond to the sequence in the human infant, who is so far above it in the animal scale. The general sequence in amblystoma is first, head flexion, second, coil movements, and third, serpentine movements as used in swimming. Functional control of the body in both amblystoma and humans begins headward and travels tailward.

We may then expand the law of sequence stated above and say that: The behavior development of human babies is consistent with that of animal infants in that new items of behavior appear in a sequential order that is consistent from one infant to another of the same species and similar in different species. Furthermore, the higher one goes in the animal scale the more

closely the sequence of the animal infant approximates that of the human infant.

CONFORMITY TO ANATOMICAL LAWS

Comparative neurologists have sought an explanation of behavior development in terms of neural growth and organization. The work of Coghill clearly points to a correlation between function and structure in the nervous development of amblystoma. From their experiments with kittens Tilney and Casamajor believe that the development of function is contingent upon the myelinization of the nerve tracts involved. In rats, however, a certain amount of activity takes place before myelinization is complete, according to Angulo y Gonzáles. Langworthy in 1927 (34) discovered that movements of the front legs of a kitten could be elicited by stimulation of the motor cortex at birth, whereas hind leg movements could not be elicited until the kitten was 16 days old. Since myelinization of the motor traits does not occur until 9 or 10 days, he believes that the growth of the protective sheath is not correlated with the development of the electrical response in the cortex. In a later paper published in 1929 (32), however, he states that myelinization occurs first in the cervical portion of the cord and proceeds in the caudad direction. Hind leg movements become better coordinated when myelinization becomes marked in the lumbar portion of the cord.

Windle correlates the development of the spinal cord with motor control in his study of kittens. He finds an early lack of longitudinal fibers, and that instead fibers are arranged in transverse and oblique planes, a fact that may, in his opinion, account for the spread of the nervous impulse that leads to a diffuse response. The

greater control of head and fore legs occurs concomitantly with the appearance of a greater number of longitudinal fibers in the spinal accessory nucleus and anterior motor cells of the lower cervical segments of the cord. He writes,

> In the third week when forelegs come under fair degree of control there occurs marked proliferation of fine fiber meshwork in the cervical cord; improved control over hind legs is noticeable in the fourth and fifth weeks when similar histological changes are observed in the lumbar cord.

It is clearly beyond the province of this study to enter into the controversy as to whether functional development is most closely related to growth in the cerebral or the cerebellar region, to proliferation of fibers in the cord, or to myelinization of the tracts. The evidence suggests that all three play important rôles in functional development, but it does not preclude the possibility that growth of the body framework and muscles also have something to do with functional control. The main points wherein all agree are that development occurs in an orderly manner and that it proceeds in the cephalo-caudad direction. Hence a fourth law may be stated: In the development of motor behavior both human and animal infants adhere to the anatomical law of developmental direction in that postural and locomotor control begin headward and sweep over the body in the tailward direction. The principle of a developmental gradient apparently holds for behavior development as well as for anatomical growth.

Another minor point that serves as further evidence of the close agreement between behavior and anatomical and physiological development is the fact that the low tide of the newborn infant's reaction to external

stimuli, according to the numerous tables of Pratt, Nelson, and Sun (48), comes on the 5th day, which, on the average, marks the end of the period of neonatal weight loss. It seems, therefore, that the turning point in anatomical growth is likewise a turning point in behavior. The consistency of behavior development between human and animal infants and the conformity of the sequence to biological laws suggests that maturation is relatively more important than training or practice in early infant development.

Principle of Development from Mass Activity to Specific Responses

Another important principle of infant behavior is that development proceeds from generalized mass activity to specific responses. This law has been amply demonstrated by Coghill in his work on amblystoma. Irwin (26) produces good evidence that it is also an important law of human growth. He found that mass activity greatly predominated at birth, but that specific responses gradually increased during the ten-day period of his observations. In the present study no attempt was made to reach a quantitative estimate of the amount of squirming and wiggling indulged in by the babies apart from their specific responses. The same spread of activity is to be seen in the babies' early defense reactions to the knee-pinching stimulus. Furthermore, their early reaching and grasping activities were accompanied by much kicking and struggling with their legs and rubbing together of their toes. An interesting account of the decrease in accessory activity that accompanies progress in reaching and grasping is given by Curti (10). Her baby's kicks in reaching for a rattle diminished from

day to day, and the record yielded a curve similar to the usual error curve for maze learning.

Principle of the Emergence of Behavior Items

The two types of physical growth, differentiation of structure and growth in size, have their analogies in two types of behavior development — development of new functions and improvement of old functions. While we must guard against carrying analogies too far, we will do well to examine some of the facts of physical growth for the light they may throw on behavior development. In the first place, differentiation of structure takes place early in the life cycle. After a two-week period in which little takes place except multiplication of the cells, the fertilized egg enters upon the period of embryonic development. During this period differentiation goes on at a rapid pace until, at the end of the second prenatal month, all organ systems are established. The period of the fetus is characterized by rapid growth in size. In anatomical development, therefore, differentiation of structure precedes growth in size, and in point of time consumed the process of differentiation lasts but a few weeks, whereas growth in size continues for twenty years.

Reasoning by analogy, one might expect the period of early infancy to be characterized by a rapid differentiation of behavior and the formation or emergence of new units of response. Increased proficiency in these behavior units would come later and would extend over a longer period of time if the analogy held. One also might expect that at the time of their emergence the behavior traits would be relatively independent of one another but that, during the long period of improvement that follows, these units would become organized

into an integrated whole. That something of this sort actually does take place in human infancy has been demonstrated by the work of Irwin on the differentiation of specific reactions out of mass activity.

In Chapter XVI the data of this study have been analyzed to show that large numbers of new behavior items — we cannot go so far as to call them behavior units — do put in an appearance in the first two years. It is also true that new items emerge at more closely spaced intervals during the early weeks and that from six months on the gaps between the emergence of new items become longer. Finally, the three types of behavior, locomotion, manipulation, and vocalization, show practically no interrelationships throughout the first year but some correlation in the second. These results substantiate the reasoning as to the speed of emergence of new behavior items and their early lack of organization.

There remains the question as to whether traits emerge gradually by imperceptible increments, or whether they suddenly appear full-fledged. The author's observations have led her to believe that many new behavior items spring forth suddenly, but it may be that the gradual piling up of increments was not noticeable until a certain minimum state of organization had been reached. In other words, the psychophysical law of the "threshold of sensitivity" and "just noticeable differences" may be the cause for the observer's belief that new behavior items were added intact.

The notion that mental growth proceeds by imperceptible increments probably arises from its analogy with physical growth, in which the curve moves upward in a graceful sweep rather than by steps. But this analogy may be false, for the curve of physical growth,

just as that of mental growth, acquires much of its smoothness from the time units in which it is plotted. If growth in stature is plotted in long intervals of six months or a year, the curve shows a steady upward rise, but if it is plotted in time units of less than a day, it pursues a saw-toothed upward course. From the time when Montbeillard, in the late eighteenth century, observed that his adolescent son had shrunk in height after dancing all night, the daily fluctuations in height have been known. In a recent able review of the literature on periodic variations in growth, Nylin (45) describes the careful daily measurements of stature made by Malling-Hansen at the Danish Royal Deaf and Dumb Institute in 1886. He found that the boys lost about 1 centimeter from the time they arose in the morning until they went to bed at night. Weight decreased from 290 to 280 grams during the night. Recently a study of daily fluctuation in height has been made by Palmer,[3] who finds that, on the average, 7.0 millimeters are lost in the first hour after rising, 3.5 in the second, and 2.5 in the third; at the end of the fourth hour the body is 15.0 millimeters shorter than it was at rising, and at the end of sixteen waking hours a total of 25.0 millimeters have been lost. These daily fluctuations are attributed to the stretching and settling of the vertebral column rather than to growth itself.

Part of the saw-toothed effect of growth curves plotted in daily units is also attributable to experimental error in measurement. Boyd (6) has shown that an error of about .5 of a centimeter is to be expected in measuring the height of a growing child. Yet even when errors are allowed for, Nylin's curve for the growth of a

[3] Carroll Palmer. "Diurnal Variations of Height and Weight in the Human Body during Growth," *Anat. Rec.*, 45: 234–235. 1930.

five-year-old child shows some definite upward steps that are not counteracted by subsequent drops. Seasonal fluctuations in growth of children were also noted by Malling-Hansen, who found three growth periods in the year, a period of minimum growth from August to November, an intermediate period from November to March, and a period of maximum growth from March to August. Although improvement in diet in recent years has done much to lessen the retarding effect of winter on children's growth, Nylin still finds evidence of periodic fluctuation. The metabolism and oxygen capacity of the blood are also lower during the dark winter months than they are in the summer.

It seems likely, therefore, that physical growth proceeds by spurts rather than by imperceptible increments. If this is true, we may question the statement of Hollingworth, "Growth is continuous rather than saltatory and spasmodic."[4] Furthermore, if this be true, then the fact that new behavior items emerge at irregularly spaced intervals has a counterpart in the facts of physical growth.

Sudden emergence of new behavior items is what we might expect if maturation plays an important rôle in developing behavior. This view has been set forth in Volume I, pages 169–175. That maturation does influence behavior seems amply demonstrated by the works of Coghill, Avery, and others referred to above, and by the studies of Gesell and Thompson (17) and Strayer (57) on infants. It has been pointed out elsewhere (53) that the existence of a sequence in behavior is good evidence that development unfolds largely in response to progressive changes in physical growth.

[4] *Mental Growth and Decline*, p. 18.

For example, if standing erect is dependent upon proliferation of nerve fibers and myelinization of the tracts in the lower cord, upon the increasing length of leg in comparison to that of trunk, and upon the decreasing ratio of weight to height, then, when all these functions have reached a minimum point of development, the act of standing may put in its appearance.

The laws of emergence in infant behavior, then, seem to be four: (1) In infancy a large number of new items of behavior emerge from undifferentiated mass activity. (2) More new items emerge during the first year than during the second; the gaps between the emergence of new items become longer as the babies grow older. (3) At their emergence little relationship exists among items of locomotion, vocalization, and manipulation. (4) Many behavior items appear to emerge suddenly in a fairly well-organized and full-fledged form. Gradual improvement in these items, however, takes place with practice.

Principle of Inconsistency in Developmental Rate during Babyhood

The third law given above has been stated by Hollingworth as follows: "Various features develop at different rates and approximate their maximum at different times." He adds another law, "Development commonly proceeds at the pace at which it starts."[5] Gesell (14) finds evidence to support this law from repeated measurements of individual children; the developmental curves for a given child remain consistently above, below, or at an average from age to age.

The correlations reported in Chapter XVI do not support this hypothesis of consistency in developmental

[5] *Mental Growth and Decline*, pp. 22, 23.

rate during the first year. The work of Bayley (3) was cited as supporting the findings of this study. Further support is given by the results obtained by Muhlenbein (44) through follow-up studies on the children tested by the Hierholzer scale. She obtained the following correlations between the Linfert-Hierholzer quotients and the Stanford Binet *IQ*'s at 4 years:

Age in Months	No. of Cases	r
6	27	$.11 \pm .13$
9	26	$.34 \pm .11$
12	28	$-.20 \pm .12$
All ages	81	$-.004 \pm .07$

In commenting on these results, Furfey[6] writes,

I can think of several possible explanations: 1. The infant tests may be unreliable, invalid, or both. 2. The Binet test at age four is probably unreliable. 3. Tests like the Linfert-Hierholzer and Gesell scales may measure motor ability and the Binet may measure a linguistic type of intelligence. 4. It may be that the IQ is not really constant and this might be due to various things. It may be due to the maturation of the subjects. Environment may affect intelligence.

Evidence on the latter point was obtained by Muhlenbein, who found positive correlations around .30 between net change from Linfert-Hierholzer quotients to *IQ*'s at 4 years and Chapman-Sims' ratings of the homes.

In Chapter XVII three other possibilities of explaining the inconsistency of test scores during the first year were suggested: first, the possibility of telescoping and expanding the intervals between the emergence of new items; secondly, the possible influences of prematurity

[6] In correspondence with the author.

and postmaturity; and thirdly, the impossibility of equalizing the incentives from time to time and from baby to baby. The first of these unquestionably does take place. For one baby the period between sitting alone and creeping may be very short, and that between creeping and walking may be very long; for another the time between the first two may be long, and between the last two, short. Let us suppose that two babies sit alone at the age of 7 months and walk at the age of 1 year. They are equal in motor development at the ages of 7 and 12 months as judged by the ability to sit and the ability to walk. At the age of 9 months, however, when they are tested for proficiency in creeping, the first baby is found to be considerably superior to the second. This hypothetical example is not at all incongruous with the facts. Indeed, such discrepancies in the rate of emergence of different behavior items occur often. In one baby locomotor development proceeds rapidly at the expense of language and manipulatory development; in another the situation is reversed. Perhaps at 2 years, after the basic items of behavior have emerged, the children are on a par in all three types of behavior. If the tests given at the period of emergence had contained more locomotor items than language items, however, the first baby would have seemed accelerated and the second, retarded.

The influence of prematurity and postmaturity on physical growth is well known. Weights reported by Hahn (22) show that the premature baby, after the first month of slow increase in growth, begins to gain rapidly, and that by the end of the first year he has about caught up with babies born at term. Scammon (50) has also shown that premature infants, after the

first month, revert to the rapid fetal rate of growth and thus eventually overtake full-term children. In fact he believes there is evidence that premature babies eventually outstrip term children in growth. The reason is that they are less viable than term babies, and hence the potential weaklings in their number die off, leaving only those of superior physical stock.[7] Postmature infants, on the other hand, suffer a greater neonatal weight loss than term babies, and grow somewhat less rapidly in the early weeks. Thus, by analogy with physical growth, we are better warranted in assuming that discrepancies caused by variations in age at birth are equalized rather early in postnatal life than that these inequalities are carried on into childhood.

Since developing behavior is closely allied to physical growth and maturation, we would expect the "catching-up" effect to appear in that quarter also. Examples of this were cited in the previous chapter. If such speeding up of development in premature and slowing down in postmature babies does hold for behavior traits, some of the inconsistencies in test scores from time to time are accounted for.

With regard to unequal motivation little need be said, except that behavior at the early ages is determined much more by the internal factors of physical condition — hunger and sleepiness — than it is in the older child or adult. With the increase of growth and age external stimuli gradually gain ascendency over temporary physical conditions.

We may state as a tentative law of development: Behavior development in infancy shows fluctuations in

[7] Obtained in conference with Dr. Richard E. Scammon, professor of anatomy, University of Minnesota.

rate and inconsistencies in the ranks of individual babies from age to age. After 1 year or 18 months the babies settle down to greater regularity in development and hold their places more consistently in the group.

CONCLUSIONS

In consideration of the results of this study and of the literature on human and animal development, the following laws or principles of behavior development in infancy are suggested.

1. Behavior development in infancy always proceeds in harmony with or in conformity to biological laws of development in that: (a) development of behavior follows an orderly sequence that is consistent from baby to baby; (b) there is continuity between human and animal infants in the development of behavior, as is shown by a marked similarity in their developmental sequences; and (c) both human and animal infants adhere to the anatomical laws of developmental direction in that postural and motor control begin headward and travel tailward.

2. The conformity to biological laws and the consistency of development in human and animal infants suggest the importance of maturation in the development of behavior in infancy.

3. Development in babyhood proceeds by the differentiation of specific acts out of mass activity and by the emergence of new items of behavior as well as by improvement in behavior after it appears.

4. New items of behavior emerge more rapidly during the first year than during the second.

5. At the time of their emergence the different types of behavior — locomotion, vocalization, and manipula-

tion — are little related; integration begins in the second year.

6. There is some evidence that traits emerge suddenly, a fact that lends support to the maturation hypothesis.

7. Fluctuations in level of ability seem to characterize the behavior of babies during the first year. At about 18 months the babies begin to hold their places in the group with considerable consistency.

APPENDIXES

APPENDIX I

Complete List of Words Used at Test Situations by Eighteen Babies under Two Years

WORDS TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

auto.....5	bow-wow.....12	doll.....12	house.....5
baby.....14	car.....7	girl.....5	kitty.....9
ball.....13	cup.....2	hello.....10	man.....9
bird.....9	dog.....5	horse.....6	

NOUNS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

A (letter).....4	doctor.....2	Marjorie.....2	shoe.....6
alcohol.....2	door.....1	Mary.....1	slippers.....2
Ardella.....1	dress.....1	milk.....3	star.....1
arm.....2	duck.....1	milkman.....1	stick.....1
B (letter).....3	ears.....2	Miss.....1	stocking.....4
balloon.....1	elephant.....1	monkey.....1	tail.....2
Barbara.....2	elevator.....1	mother.....3	tape.....1
bathing suit....1	eye.....6	Mrs.....1	Teddy.....1
beads.....1	feet.....2	music.....3	telephone.....1
bed.....1	flower.....1	mouth.....2	things.....1
bib.....1	garter.....1	nose.....1	Thommen.....1
bill.....1	grandpa.....1	oil.....1	tigers.....1
Billy.....1	gum.....1	orange.....1	toes.....2
block.....2	hair.....2	pa.....1	tower.....3
board.....1	hand.....4	page.....1	truck.....1
Bobby.....2	hanky.....1	pan.....1	valise.....1
book.....2	hat.....1	papa.....1	Voight.....1
bottle.....8	hippopotamus..1	Patsie.....1	watch.....1
box.....1	holes.....1	pencil.....1	water.....1
boy.....6	home.....1	person.....1	wheel.....2
Boyd.....4	Irene.....1	piano.....1	windows.....1
bumblebee.....1	ischium.....1	picture.....3	Z (letter).....1
bus.....1	Jack.....1	pig.....2	"1".....4
button.....1	jar.....1	pillow.....1	"2".....1
camel.....1	kid.....1	pin.....1	"3".....2
candy.....1	knee.....1	puss.....1	"4".....1
chimney.....2	leg.....3	R (letter).....1	"8".....1
clock.....5	lid.....1	ring.....1	"9".....4
coat.....2	light.....1	Rockwell.....1	"10".....1
daddy.....2	line.....1	Rowena.....1	"11".....1
Dick.....1	lions.....1	school.....1	
dish.....2	mama.....15	Shirley.....2	

PRONOUNS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

I.....8 me.....4 my.....5 us.....1 who.....2
it.....8 mine.....5 them.....1 what.....4 you.....1

VERBS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

are.....1	doing.....1	jump.....1	shut.....1
bite.....1	done.....5	know.....2	sing.....1
bounce.....1	fall.....2	let.....1	sleep.....1
broke.....2	fix.....1	look.....1	stand.....1
broken.....2	get.....1	make.....1	swim.....1
build.....2	go.....2	measure.....1	talk.....1
bump.....2	goes.....1	need.....1	turn.....3
close.....1	gone.....4	open.....4	twinkle.....1
come.....2	got.....1	play.....1	want.....3
copy.....1	grease.....1	put.....3	went.....1
dance.....1	hurt.....2	ride.....2	will.....2
do.....2	is.....6	run.....1	works.....1
does.....1	isn't.....1	see.....8	

ADVERBS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

all right.....11	not.....2	'round.....1	up.....4
down.....7	now.....4	so.....1	'way.....1
fast.....1	out.....3	sure.....1	well.....2
here.....5	over.....2	then.....2	where.....1
no.....11	please.....3	there.....12	yes.....2

ADJECTIVES NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

a.....1	dirty.....2	new.....1	the.....3
afraid.....1	fine.....1	nice.....3	these.....1
all.....6	good.....1	pretty.....5	this.....2
bad.....1	green.....1	right.....1	top.....1
big.....2	high.....1	some.....3	
blue.....1	hot.....1	straight.....1	
dear.....2	more.....4	that.....7	

PREPOSITIONS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

above.....1	of.....1	through.....1
in.....1	on.....1	to.....1

CONJUNCTIONS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

and.....2	'cause.....1

INTERJECTIONS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

aah.....1	boom.....2	heck.....1	whee.....1
ah.....4	good-bye.....1	howdo.....2	whoopee.....1
aw.....1	gosh.....1	oh.....7	

CHILDISH WORDS NOT TESTED FOR AND THE FREQUENCY OF OCCURRENCE OF EACH

bye-bye.....11	ding-dong.....1	peep.....3	un hunh.....2
choo-choo.....3	hunh.....13	tick-tock.....7	

SUMMARY OF WORDS NOT TESTED FOR*

Nouns	127
Pronouns	10
Verbs	51
Adverbs	20
Adjectives	25
Prepositions	6
Conjunctions	2
Interjections	11
Childish words	7
Total not tested for	259
Total tested for	15
Total vocabulary	274

* In order to make a small vocabulary go a long way, the young child often uses a single word as a complete sentence. In such cases the word really serves as subject, verb, and predicate. "Fwaid" means "I am afraid of those people." "Broken; me fix" in adult speech is "This toy is broken, but I can fix it." Hence the classification as to parts of speech is only approximate. The words have been spelled correctly rather than in imitation of the child's pronunciation.

Items on Weekly Physical Examination

- Name
- Date
- Hour
- Birth date
- Posture in crib
- Clothing
- In crib 1st min.
- In crib 2nd min. (talking)
- Respiration { 30 sec. 1 min. / R. R.I. I.II. D. S. }
- Uncover baby
- Lift from crib
- Adjust for lifting
- Skin { Color / Cyanosis / Jaundice / Red areas / Miliaria / Sudamena }
- Breasts: Swollen Milk
- Hour
- Mouth breathing
- Stridor
- Notes
- Lying on back 1 min.
- Knee pinched { R.1 2 / L.1 2 }
- Lying on stomach
- Eyes { Pupils to light / Pupils to accomodation / Follow light / Hemm. Nys. / Color }
- Heart rate { 30 sec. 1 min. / R. R.I. I.II. A.C. }
- Apex beat
- Cardiac dullness to left
- Mediastinal dullness { To right / To left }

Hour	
Room humidity	
Room temperature	
Outside temperature	
Barometer	
Muscle tone	
Turgor	
Subcu. fat	
Subcu. fat cal.	mm.
Liver margin	Nipple line
	Axillary line
Spleen	
Costal angle	
Rectal fissures	
Vaginal discharge	
Umbilicus	
Air current	Head
	Abdomen
	Legs
Head	Seborrhea
	Scalp veins
	Parietal eminence
	Frontal eminence
	Hair color
	Hair amount
Fontanelle tracing	

Hour		
Behavior summary		
X-ray		
Lymph nodes	occ	pcc
	pc	m
	pa	j
	sm	sme
	acc	sc
	ax	ep
	ing	pal
Thyroid	visible	
	palpable	
Ears	R.	
	L.	
Mouth	Epithelial pearls	
	Malocclusion	
	Pharynx	
	Tonsils	
Sounds		
Tastes	Salt	
	Bitter	
	Sweet	
	Sour	

Name			
Date		Hour	
Birth date		Age in weeks	
Occupation at doctors' arrival			
Clothing			
Original position 1 min., doctors talking	Smile		
	Roll ½ to ¼		
	Push up		
Bow calipers held 2 min. after attention is obtained	Attention in		sec.
	Reach r.		sec.
	l.	sec. b.	sec.
	Touch with r.		sec.
	l.	sec. b.	sec.
	Grasp with r.		retain
	Grasp with l.		retain
	Grasp with b.		retain
Pull to mouth			
Thumb opposition: none; partial; complete			
Swings tape 30 sec. each position	Horizontal	Head	Eyes
		Reach	Obtain
	Vertical	Head	Eyes
		Reach	Obtain
	Circular	Head	Eyes
		Reach	Obtain

Name			
Date		Hour	
Birth date		Age in weeks	
Occupation at doctors' arrival			
Clothing			
Hand threat at eyes			
Pencil threat at eyes			
Doctor rustles paper			
Offers sheet of yellow paper: Reach for			sec.
Grasp	sec. Crumple		sec.
Doctor holds out arms 3 times, 5 sec. each time	1.		
	2.		
	3.		
Seated on doctor's lap 1 min.	Support		
	Head steady		
Bow calipers 2 min. after attention is obtained	Attention in		sec.
	Reach r.		sec.
	l.	sec. b.	sec.
	Touch r.		sec.
	l.	sec. b.	sec.
	Grasp with r.		retain
	Grasp with l.		retain
	Grasp with b.		retain
Pull to mouth			
Thumb opposition: none; partial; complete			

Name			
Date		Hour	
Birth date		Age in weeks	
Occupation at doctors' arrival			
Clothing			
Swings tape 30 sec. each position	Horizontal	Head	Eyes
		Reach	Obtain
	Vertical	Head	Eyes
		Reach	Obtain
	Circular	Head	Eyes
		Reach	Obtain
Offers sheet of paper: Reach			sec.
Grasp		sec. Crumple	sec.
Offers bell held high: Reach			sec.
Offers bell held within range	Reach		sec.
	Grasp		sec.
	Ring		sec.
Seated at table, tape in front 1 min.	Regard		sec.
	Reach		sec.
	Grasp		sec.
Bell in front 1 min.	Regard		sec.
	Reach		sec.
	Grasp		sec.
	Ring		sec.
Held erect on table 2 min.	Plant feet correctly		
	Stiffen knees		
	Lift and pat foot		times

BEHAVIOR SUMMARY

Name		
Date	Hour	
Birth date	Age in weeks	
Occupation at doctors' arrival		
Clothing		
Held erect	Pat both feet alternately	times
	Step forward	times
On stomach 1 min., bell in front	Push with toes	
	Progress forward	
	Reach object	
	Obtain object	
Wave good-bye		

APPENDIX 4

Sample Records of Choice Test I Showing Consistency of Recorders

Carol, 25 Weeks; April 26, 1928

Time	Recorder S	Recorder B
	rubber doll (right) cup (left)	
0s	Rt. reach for doll.	Reach for doll both hands.
15s	Both hold doll.	Fingering doll both hands.
30s	Rt. hold doll. Lt. reach for cup.	Holding doll rt. hand. Fingering cup lt.
45s	Both hold cup. Look at Mother.	Holding doll lt. hand. Fingering cup rt.
1m 00s	Both hold cup to face.	Holding doll both hands to mouth.
1m 15s	Rt. hold chair tray. Lt. hold cup.	Holding cup in lt. hand to mouth.
1m 30s	Rt. hold chair tray. Lt. hold cup.	Holding cup in lt. hand.
1m 45s	Rt. hold doll, put to mouth. Lt. touch cup.	Holding cup in lt. hand. Doll in rt.
2m 00s	Rt. hold doll, put to mouth. Lt. touch cup.	Pulling doll in rt. to mouth, head forward.
2m 15s	Rt. hold cup by handle, jerk it.	Cup in rt. hand by handle.
2m 30s	Rt. reach for doll. Lt. hold cup.	Cup in lt. hand. Reach doll rt.
2m 45s	Rt. reach for doll. Lt. hold cup.	Cup in lt. hand. Holds doll rt.
3m 00s	Both bat and jerk at both toys.	Banging at cup and doll both hands.
3m 15s	Rt. hold doll. Lt. hold cup by handle to mouth.	Cup to mouth; drinking lt. hand.
3m 30s	Rt. hold doll. Lt. hold cup by handle to mouth.	Doll to mouth rt. hand. Cup aside in lt.
3m 45s	Rt. hold doll and jerk. Lt. hold cup.	Doll to mouth rt. hand.
4m 00s	Rt. hold doll and chew feet. Lt. hold cup.	Doll to mouth rt. hand.
4m 15s	Rt. reach for doll. Lt. drop cup.	Reach doll with rt. hand. Cup in lt.
4m 30s	Both hold cup to mouth and chew.	Cup to mouth both hands.
4m 45s	Rt. hold doll and drop. Lt. hold cup and drop. "Aah."	Cup to mouth lt. hand. Doll in rt. "A-a-a."
5m 00s	Rt. touch doll. Lt. hold cup to mouth.	Cup to mouth lt. hand. Finger doll with rt.
	Activity: Directed.	Activity: Purposeful.
	Attention: Absorbed.	Attention: Absorbed.
	Manipulation: Banging and chewing.	Manipulation: Exploratory.
	Distraction: None.	Distraction: Once or twice.

APPENDIX 5

Items on Infant Study Record Sheet Used between 54 and 78 Weeks

Name _____ Date _____ Hour _____
Birth date _____ Age in weeks _____
Occupation at examiners' arrival _____
Clothing _____
Place of test _____
Position of examiners _____

A. Recognition of Pictures

Baby seated on B's lap or standing at her side. Each picture shown 15 seconds. B says, "What's that?"

Picture	Time	Performance	Vocalization
1. Ball	0s		
	15s		
2. Cup	0s		
	15s		
3. Dog	0s		
	15s		
4. Horse	0s		
	15s		
5. Cat	0s		
	15s		
6. Bird	0s		
	15s		
7. Auto	0s		
	15s		

8. House	0s	
	15s	
9. Baby	0s	
	15s	
10. Man	0s	
	15s	

B. Picture of Five Mothers

Baby instructed to pick out his mother's picture. Time, 1 minute.

0s
15s
30s
45s
1m 0s

C. Manipulation of Objects

B demonstrates each. Time, 1 minute each. Baby sitting on floor if possible.

Object	Time	Performance	Vocalization
1. Wooden slide box; tape inside		Attention to demonstration: none; some; complete	
	0s		
	15s		
	30s		
	45s		
	1m 0s		

2. Round box; compact inside	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	
3. Six 1-inch cubes	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	
4. Screw-cap jar; doll inside	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	

5. Ball rolled and bounced	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	
6. Round form blocks	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	

D. Imitation Tests

B demonstrates. Time, 30 seconds.

Object	Time Performance	Vocalization
1. Comb	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	

2. Whistle	Attention to demonstration: none; some; complete	
	0[s]	
	15[s]	
	30[s]	
3. Pencil and paper	Attention to demonstration: none; some; complete	
	0[s]	
	15[s]	
	30[s]	
4. Handkerchief	Attention to demonstration: none; some; complete	
	0[s]	
	15[s]	
	30[s]	
5. Read paper	Attention to demonstration: none; some; complete	
	0[s]	
	15[s]	
	30[s]	
6. Stethoscope	Attention to demonstration: none; some; complete	
	0[s]	
	15[s]	
	30[s]	

E. Parts of Doll

B holds baby on lap. Time, 15 seconds to name each part. B repeats question three times if necessary.

DIRECTION	PERFORMANCE	VOCALIZATION
1. Where is doll's eye?		
2. Where is doll's nose?		
3. Where is doll's ear?		
4. Where is doll's hand?		
5. Where is doll's foot?		

F. Motor Tests

ITEM	TRIAL	PERFORMANCE
Aiming test (1 minute, or 3 trials)	1st	
	2nd	
	3rd	
Standing alone (1 minute, or 3 trials)	1st	
	2nd	
	3rd	
Climb stairs (1 minute)		

Walking on paper (30 seconds)

Behavior summary

Audience and interference

APPENDIX 6

ITEMS ON INFANT STUDY RECORD SHEET USED BETWEEN 78 WEEKS AND 2 YEARS

C. Manipulation of Objects*

B demonstrates each. Time, 1 minute, unless otherwise stated. Examiner and baby seated on floor.

OBJECT	TIME	PERFORMANCE	VOCALIZATION
1. Nested blocks (Discontinue when finished.)		Attention to demonstration: none; some; complete	
	0s		
	15s		
	30s		
	45s		
	1m 0s		
2. Wallin Peg Board A (Discontinue when finished.)		Attention to demonstration: none; some; complete	
	0s		
	15s		
	30s		
	45s		
	1m 0s		
	1m 15s		
	1m 30s		
	1m 45s		
	2m 0s		

* The preliminary data and the data given under A and B are identical with those in Appendix 5. See pages 477 and 478.

3. Three-block pyramid (30 seconds)	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
4. Eight-block tower (1 minute)	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
	45s	
	1m 0s	
5. Copy line on paper (30 seconds)	Attention to demonstration: none; some; complete	
	0s	
	15s	
	30s	
6. Gesell form board (1 minute) (Discontinue when finished.)	No demonstration	
	0s	
	15s	
	30s	
	45s	
	1m 0s	

Summary (interest in manipulation tests)

D. Choice Tests

Time, 2 minutes each. B takes objects out of satchel and places them on floor between her and baby. She does not demonstrate or call attention to any of them. Baby is allowed to take whichever he chooses and play with it as he likes. Thereafter, at regular intervals, S signals to B and B picks up a toy and plays with it, making a distracting noise with it (i.e., ringing bell, clattering pan, singing to doll, bouncing ball), but she does not speak to child or attract his attention to the object. If baby drops his toy and reaches for hers, she gives it to him. This is continued until B has played with each object, regardless of how many the child has played with.

Object Demonstrated	Time	Performance	Vocalization
Choice I: Rattle, tape, truck, egg beater, bottle, accordion			
	0s		
	20s		
	40s		
	60s		
	1m 20s		
	1m 40s		
	1m 60s		

Summary: ___ persistent; ___ somewhat distractible; ___ very distractible
Favorite toy _____

Choice II: Telephone, doll, ball, watch, bell, pans

	0s	
	20s	
	40s	
	60s	
	1m 20s	
	1m 40s	
	1m 60s	

Summary: ___ persistent; ___ somewhat distractible; ___ very distractible
Favorite toy_____

E. Verbal Commands

B says, "Now I have to put all the toys away. Please give me the . . . ," naming whatever the baby has at the moment. This command is given three times with intervals of 5 seconds for baby to comply. If the baby complies before three trials, B goes on, "Now please bring me the . . . ," naming another object of the six. If baby does not want to give up what he has, B lets him keep it but asks for another. After she asks three times, she herself gets the object and puts it away. This is continued till all objects are put away.

Object Called For	Command	Performance	Vocalization
(1)	1st		
	2nd		
	3rd		
(2)	1st		
	2nd		
	3rd		
(3)	1st		
	2nd		
	3rd		
(4)	1st		
	2nd		
	3rd		

(5)	1st	
	2nd	
	3rd	
(6)	1st	
	2nd	
	3rd	

Reaction to commands: __ Negativism; __ ignoring; __ unwilling compliance; __ compliance; __ eager compliance

F. Walking on Paper

Behavior summary

Audience and interference

APPENDIX 7

Developmental Sequence with Scores for Items

	Reaction	Age in Weeks*		Score
		Interquartile Range	Median	
23 Cases	Follow light	2 da.–8 da.	4 da.	.57
	Smile reflex	3 da.–5	6 da.	.28
	Watch person one or two times	6 da.–4	2	1.15
	Watch object one or two times	1–4	3	.50
	Chin up	2–7	3	.50
	Follow tape horizontally	3–7	5	1.00
	Watch person three or more times	3–7	5	1.00
	Watch object three or more times	2–9	6	1.00
	Utter one syllable	6–10	8	1.00
	Smile at person	7–9	8	1.00
	Follow tape vertically	7–10	9	.50
	Chest up	5–10	9	.50
	Follow tape in a circle	7–13	10	1.00
	Step	11–15	13	1.50
	Tentative reach (lying posture)	10–15	13	1.50
	Touch (lying posture)	13–15	14	.50
	Adjust for being lifted	14–18	14	.50
	Grasp (lying posture)	13–17	15	.50
	Play with hands	13–18	15	.50
	Retain (lying posture)	15–18	18	.50
	Grasp (sitting posture)	14–18	18	.50
	Retain (sitting posture)	15–19	18	.50
	Thumb opposition	15–21	18	.50
	Scratch	15–21	18	.50
	Sit on lap	15–20	18	.50
22 Cases	Reach for dangling object	16.5–21.0	19.0	1.00
	Grasp dangling object	19.0–22.5	21.0	1.00
	Chew object	18.0–22.0	21.0	1.00
	Retain dangling object	21.5–25.0	23.0	1.00
	Ring bell	21.5–26.5	23.0	1.00
	Play with toes	21.0–29.0	24.0	1.00
	Transfer object from hand to hand	21.0–29.0	25.0	.25
	Sit alone momentarily	20.5–25.0	25.0	.25
	Knee push or swim	22.0–27.0	25.0	.25
	Talk to person	13.0–31.5	25.0	.25

* Reactions that appeared earlier than x week are given in days.

APPENDIX 7 — *Continued*

	Reaction	Age in Weeks*		Score
		Interquartile Range	Median	
22 Cases	Roll	25.0–30.0	28.5	3.00
	Pat object	19.5–34.0	29.0	1.00
	Stand when held	29.0–33.5	30.5	1.50
	Sit alone 1 minute	28.0–33.5	31.5	1.00
	Utter single consonant sounds (f, s, t, etc.)	25.5–43.0	35.0	3.50
	Drink from bell	32.0–39.5	37.0	1.00
	Expressive vocalization	29.5–46.5	37.5	1.00
	Some progress in prone posture	34.5–41.0	38.0	1.00
	Scoot backward	34.0–42.5	41.0	1.00
	Take out inside object (slide box)	37.0–49.0	41.0	1.00
	Point index finger	35.5–45.5	42.0	1.00
21 Cases	Stand holding to furniture	41–42	42	1.00
	Draw examiner into situation	35–58	45	1.00
	Creep	41–45	45	1.00
	Walk when led	37–45	45	1.00
	Pull to stand	42–50	47	2.00
20 Cases	Open slide box	45–70	56	9.00
	Put back inside object (slide box)	49–70	58	2.00
	Seek help	54–70	60	.66
	Utter comprehensible word	47–66	60	.67
	Mark with pencil	54–70	60	.67
	Open round box	62–66	62	.50
	Take out inside object (round box)	49–70	62	.50
	Put back inside object (round box)	58–66	62	.50
	Stand alone	54–66	62	.50
19 Cases	Point out hand of doll	58–74	66	.80
	Put lid on round box	62–66	66	.80
	Put round block in form board	54–74	66	.80
	Walk alone	60–70	66	.80
	Say childish word (choo-choo, bow-wow)	54–82	66	.80
	Pull out tapeline	56–79	70	1.30
	Point out foot of doll	62–†	70	1.30
	Point out mother's picture	66–†	70	1.40
	Point out nose of doll	66–†	74	1.30
	Point out eye of doll	62–†	74	1.30

† Less than 75 per cent of the babies had made this reaction prior to 104 weeks, when the examinations were discontinued.

APPENDIX 7 — *Concluded*

	Reaction	Age in Weeks*		Score
		Interquartile Range	Median	
18 Cases	Put lid on slide box	70–†	74	1.40
	Complete peg board in less than 1 minute	78–82	78	4.00
	Put triangle block in form board	78–86	82	4.00
	Open screw-cap jar	72–†	84	.40
16 Cases	Put 3 objects away	78–94	84	.40
	Pile 5 or 6 blocks	74–94	84	.40
	Put square block in form board	78–90	84	.40
	Name dog from picture	74–†	84	.40
	Nested blocks	78–104	94	10.00
	Name baby from picture	82–102	98	4.00
	Pronoun	90–†	99	1.00
	Phrase	80–104	101	1.00
	Sentence	86–†	101	1.00
	Repeat words	96–†	102	1.00

* Reactions that appeared earlier than 1 week are given in days.
† Less than 75 per cent of the babies had made this reaction prior to 104 weeks, when the examinations were discontinued.

APPENDIX 8

MEDIANS OF PERCENTAGE OF AVERAGE POINT SCORES

	PHYSICAL AND PSYCHO-LOGICAL	TESTS OF DEVELOP-MENT	BOX TEST	PICTURE AND PERFUME TEST	YALE PSYCHO-CLINIC TEST	EXAMI-NATION, 54–74 WEEKS	EXAMI-NATION, 78–102 WEEKS	COMBINED SCORES FOR ENTIRE FIRST YEAR	COMBINED SCORES FOR ENTIRE SECOND YEAR	COMBINED SCORES FOR ENTIRE TWO YEARS
Winifred	64.3	74.3	50.1	108.5	92.9	139.2	119.3	70.4	127.5	90.4
Fred	53.7	74.0	114.2	94.5	101.8	127.2	115.5	72.2	122.3	95.3
Carol	55.3	89.5	160.1	155.7	114.1	126.0	98.3	89.5	111.8	110.0
Doris	105.4	117.2	100.3	102.3	144.5	....	....	113.2	....	113.2
David	102.0	127.8	107.6	141.4	113.4	103.4	111.5	112.8	108.0	111.5
Donovan	90.3	113.7	103.5	58.4	96.4	99.7	71.3	98.6	81.4	92.4
Harvey	107.5	107.9	81.3	69.8	107.7	120.7	83.5	95.6	112.9	99.7
James	141.1	102.5	84.5	92.0	67.2	53.4	91.6	114.4	85.4	92.0
Irene May	76.9	65.3	74.8	76.2	91.4	37.5	....	75.8	37.5	70.6
Larry	124.3	123.4	98.4	105.1	97.9	111.1	125.5	114.7	114.2	114.7
Martin	107.5	68.3	118.5	111.2	86.9	98.8	68.0	97.7	78.3	80.8
Quentin	82.1	136.9	127.2	140.2	106.6	98.0	85.2	127.2	92.8	112.6
Virginia Ruth	101.9	69.9	114.2	62.7	97.9	79.6	79.4	97.9	79.5	93.7
Sibyl	132.7	134.6	80.2	136.1	121.7	122.7	149.6	134.3	138.9	135.3
Maurice	108.3	90.9	59.2	113.7	84.9	57.4	42.7	89.4	51.6	78.2
Torey	64.4	87.2	90.8	80.1	99.0	97.1	77.3	86.7	92.4	87.7
Judy	76.7	116.5	102.6	91.3	103.2	154.6	127.4	108.5	134.4	116.3
Peter	102.4	74.1	94.8	98.8	83.4	20.4	63.2	84.5	34.7	79.5
Patricia	87.1	78.1	71.1	94.3	73.1	102.6	103.5	83.3	102.6	87.9
Walley	128.3	128.2	72.0	81.5	107.9	117.0	119.9	127.8	118.4	119.9
Edith Ann	125.4	96.2	118.1	....	107.7	....	....	107.3	....	107.3
Max	108.5	90.9	102.7	110.8	102.6	....	....	102.7	....	102.7

APPENDIX 9

Developmental Sequence in Human and Animal Infants: Human Infants

After Shinn, 1899

Reaction	Age in Weeks
Showing sensibility to light by reflex eye and neck movements	1
Reflex clasping	1–3
Fixed gazing	2
First efforts to hold head	3
Follow bright moving object	5
Head first balanced erect	6
Wink at hand threat	8
Longer reflex clasping, thumb reversed	9
Touch	12
Grasp	12
Effort to raise self	12
Habitual sitting with support	16
First attempt to grasp by visual guidance	17
Turn from back to side	19
Playing with toes	20
Mouth put to object after clutching with hands	21
Simple manipulation of object	21
Rolling from back to stomach	24
Approximate creeping movement without intention	24
Sitting securely without support	27
Rolling over freely	30
Pull self to knees	32
Draw self forward, flat on stomach	33
Daily pulling to feet	35
Creeping backward	36
First walking movements	36
Play with single hair	38
Differentiation of forefinger	40
Rapid and free creeping	40
Stand alone a few seconds	41
Letting self down by hands from chair	42
Stepping along, holding to support	43
Pulling self up step	44
Rising to feet without help	45
Stand alone securely	45
Creeping on hands and feet instead of on hands and knees	46–52
Walk when led by one hand	47
Climbing up and downstairs	48
Walk a few steps alone	50
Walk across room alone	54

APPENDIX 9 — *Continued*

AFTER BÜHLER, 1930

REACTION	AGE IN MONTHS
Hold up head while prone	2
Return adult glance with smile	2
Quieted by touch	2
Cry when adult leaves	2
Hold up head and shoulders while prone	3
Smile at adult	3
Disturbed when approached	3
Return glance with "lalling"	3
Attempt to push forward while prone	4
Quieted by caress	4
Disturbed by sight of people	4
Raise head and shoulders while in a dorsal position	5
Rest on palms while prone	5
Attempt to raise self by hands	5
Turn from back to side	5
Neglect play when meeting glance of adult	5
Sit with assistance	6
Turn from prone to dorsal position	6
Turn from side to side	6
Sit without assistance	8
Raise self to sitting position	8
Successful crawling	8
Stretch arms toward adult	8
Strive for attention by "lalling"	8
Kneel	9
Strive for attention by movement	9
Pull at adult's clothes	9
Offer object to adult	10
Organized play activity	10
Raise to standing posture with help	11
Show amazement	11
Walk with help	12
Stand alone	12

APPENDIX 9 — *Continued*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: CAPTIVE-BORN CHIMPANZEE

AFTER WHITE, 1929

REACTION	AGE
Eyes bright, no focusing	Early weeks
Sensitive to touch	Early weeks
Hearing acute	Early weeks
Look at person who stood near, talking, and follow person if he talked after moving away	1 month
Focus vision	6 weeks
Smile	6 weeks
Sign of temper, scream for bottle	6 weeks
Recognize White and keeper	6–8 weeks
Grunt or bark	2 months
Differential response to people: soft "ooh" at White and keeper, excited bark at strangers	2 months
Scratching	3½ months
Turn back to side in play	5–6 months
Attempt to draw bottle to mouth unaided	5 months
Play with toes	Not stated
Put up arms to be taken when White approached	Not stated

AFTER JACOBSEN, JACOBSEN, AND YOSHIOKA, 1932*

REACTION	AGE IN WEEKS
Lifting head, chin free, when on stomach	3
Lifting head, chest free, when on stomach	5
Lifting head when lying on back	5
Knee pushing or swimming	7
Rolling	8–10
Rocking, pivoting, worming along; some method of making progress	11
Sitting alone momentarily	12
Sitting alone	13
Standing, holding to furniture	15
Pulling to standing position by means of furniture	15
Walking when led by a person	17
Standing alone	20
Walking alone	25–29

* C. F. Jacobsen, M. M. Jacobsen, and J. G. Yoshioka. "Development of an infant chimpanzee during her first year." *Comp. Psychol. Monog.*, 9:1–94. 1932.

APPENDIX 9 — *Continued*

Developmental Sequence in Human and Animal Infants: Monkey

After Lashley and Watson, 1913

Reaction	Age
Sustain weight by reflex clasp	0–3 days
Crying	1 day
Sound response	2 days
Eye following	3 days
Grasp object	5 days
Hold up head	5 days
Eye-hand coordination	6 days
Attention to sound	11 days
Attempt to walk	12 days
Attempt to crawl	12 days
Run	14 days
Scoop up object	3 weeks
Thumb opposition	5 weeks
Pick up corn	6 weeks
Crumple paper	8 weeks
Adult vocalization	9 weeks

APPENDIX 9 — *Continued*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: KITTENS

AFTER TILNEY AND CASAMAJOR, 1924

REACTION	AGE
Postural reaction	2 minutes after birth
Crawling approach	8 minutes after birth
Sucking	10–12 minutes after birth
Synergizing reaction	7 days
Primitive escape	7 days
Eye opening	7 days
Eye- and head-turning	14 days
Sitting	20 days
Walking	22 days
Scratching	23 days
Backing away	25 days
Running	26 days
Pawing	26 days
Washing face	26 days
Turn head to sound	26 days
Lapping	29 days
Escape-defense	29 days
Climbing	31 days

AFTER WINDLE, 1930

Righting response; crawl to mother cat, using fore legs like paddles; move head from side to side; suck, using hind legs for bracing and fore legs for pressing; swim; lift fore part of body with fore legs, hind part with hind legs	Birth
Lift body almost off floor with four legs; spontaneous alternation of fore legs and hind legs, but fore legs used to better advantage; crawl backward	7–10 days
Stand, hind legs less steady than fore legs; back away from noxious stimuli; visual pursuit of objects; coordination of fore and hind legs for walking, hind legs unsteady	14–15 days
Stand and sit steadily; walk, tremor in hind legs; sometimes turn in air to fall on feet, climb with fore legs on screen; turn head to sound and light	21 days
Stand steadily; walk without ataxia of hind legs; right self in air when dropped; some playfulness	28–30 days
Postural and progressional responses assume adult characteristics; climb, run, play, fight, land on feet when dropped	Second month

APPENDIX 9 — *Continued*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: RABBIT

AFTER KAO, 1927

REACTION	AGE IN DAYS	NO. OF CASES
Fetus		
Muscle twitch at electrical stimulus	26	6
Respiratory gasps	26	
Response to pressure, pain	26	
Response to needle prick	26	
Spontaneous gasps	27	7
Roll from side to back	27	
Pain response to heat	27	
Response to tactual stimulus	27	
Continuous breathing	28	4
Roll from side to belly	28	
Crawl	28	
Scratch body with hind leg	28	
Response to cold stimulus (ether on skin)	28	
Vocalization	28	
Sucking	28	
Scratch or wipe body with fore paws	20	3
Birth		
Lid reflex	2	71
Jerk	4	
Response to odors	4	
Support weight on four legs	6	
Lick	8	
Opening of external meatus	8	
Response to clang	11	
Response to tuning fork	11	
Pupillary reflexes	12	
Eyes opened	12	
Hop	12	
"Wash face" reflex	15	
Nibble articles of food	15	
Fear	16	
Avoidance of obstacles	17	
Stand on hind legs	17	
Play	20	

APPENDIX 9 — *Continued*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: POUCH-YOUNG OPPOSUM

AFTER LANGWORTHY, 1925

REACTION	AGE IN DAYS
Crawl into pouch	Birth
Head movements	Birth
Suck	Birth
Mass contractions, general squirming	10
Support weight by fore leg, hanging to gauze	10
Swim	10
Vocalization	35
Righting reflex (turn from back to belly)	35
Grasp cord; no coordination of hind and fore legs	36
Fore paws more active and larger than hind paws	41
Cling to rope by fore paws	46
Support weight hanging by tail	46
Stand, after a fashion, fore legs offering good support	41–49
Crawl	54
Normal posture	55
Walk poorly	55
Walk well	63
Climb well	67
Run well	75

APPENDIX 9 — *Continued*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: FETAL GUINEA PIGS

AFTER AVERY, 1928

REACTION	FETAL AGE IN DAYS
Twitch to electrical stimulus wherever applied	45
Gasp	45–47
External ear open	45
Kick to pain stimulus	48
Spontaneous kick	50–53
Eyes open	57
Contraction of leg to needle prick	58
Lid reflex (blink)	57–58
Vocal response	58
Scratch reflex	59
Response to heat	59
Pupillary reflex to light	59
Roll side to back	60
Hold up head	60
Draw to haunches	60
Crawl	60
Swallowing	60
Auditory response	60–62
Scratch	61
Stand	63
Walking	63
Stretch	64–65
Withdraw at noise, etc.	64
Run to own kind	64
Suck	65

APPENDIX 9 — *Concluded*

DEVELOPMENTAL SEQUENCE IN HUMAN AND ANIMAL INFANTS: WHITE RAT*

AFTER SMALL, 1899

REACTION	AGE IN DAYS
Suck	1
Hitch, kick, or wiggle to belly or side if placed on back	1
Move tail	1
Vocalize	1
React to odors by convulsive movements	1
Wipe offending food from lips with fore paws, accompanying act with whole body movement	1
Wriggle and jump to heat stimulus	1
Turn from back to belly quickly	4
Try to crawl under each other	4
Crawl with vigor	5
Squeak as sign of pain	5
Jump to lift entire body off floor when toes are touched	7
Seek to get close together, huddle	8
Run about cage	14
Cling to finger of experimenter	14
Wash face	14
Scratch head with hind foot	15
Walk firmly	17
Fear	17
Sit on hind legs	18
Play	19
Sham fight	24

* W. S. Small. "Notes on the psychic development of the young white rat." *Amer. J. Psychol.*, 9: 80–100. 1899.

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