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LATER DEVELOPMENT OF CHILDREN SPECIALLY TRAINED DURING INFANCY
JOHNNY AND JIMMY AT SCHOOL AGE

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INTRODUCTION

In 1932 Johnny and Jimmy, twins, became the subjects of an intensive study of behavior development at the Normal Child Development Study of the Babies Hospital, Columbia-Presbyterian Medical Center. Before the study had been under way for two years, it attracted wide interest because of the reports of a baby less than a year old swimming with his face under water, ascending steep inclines and by the time he was sixteen months old moving around with considerable skill on roller skates. These were the achievements which gave the study a popular interest, but such performances were incidental to the primary objectives which were 1) to analyze the sequential phases or changes through which a growing infant passes in the achievement of a given performance, and 2) to determine whether these phases are altered by certain prescribed conditions, viz., the daily stimulation of activity on the one hand and the restriction of activity on the other.

Such an investigation was timely because of the current pediatric and psychiatric notion that infants should not be over-stimulated and because of a general assumption following a co-twin study by Dr. Gesell (1) that the immature nervous system of the infant is unresponsive to practice effects and that development during infancy is essentially a matter of neural maturation. It is proverbial that among older children and adults practice leads to improvement in performance. If the infant is unresponsive to practice-effects, and if, on the other hand, the adult is responsive, it is a reasonable assumption that there must come a time in the course of the child's development when improvement by virtue of experience begins. It therefore seemed to the writer that if one began soon after birth to stimulate one member of a set of twins in certain activities and within certain limits to restrict the activities of the other, it might be possible to ascertain that period in life when the individual begins to profit by experience or repetition of performance. Johnny and Jimmy were selected as the subjects for this investigation and a group of 57 infants, examined at weekly or bi-weekly intervals, served as controls. The general procedure during the first twenty-two months of life was to observe both babies in the laboratory five days a week from nine until five. During this time Johnny was stimulated daily to engage in activities to the extent of his capabilities, whereas Jimmy was left with a few toys unhindered in his crib except for disturbances accompanying routine care. When they were twenty-two months old, Jimmy was given a period of two and one-half months of intensive practice in those same activities in which Johnny had been given earlier and more prolonged exercise. A detailed report of this investigation was made in 1935 in "Growth: A Study of Johnny and Jimmy" (2).

In this report it was pointed out that there is no one age period or developmental stage which clearly demarcates an earlier state of immaturity during which the child is incapable of improving through practice from the subsequent state in which improvement through practice becomes feasible. The impossibility of identifying such a critical period in the development of the individual

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results, it would seem, from the fact that the nervous system does not mature uniformly. There are critical periods dependent upon the maturational status of the nervous system, but these periods vary with respect to the particular activity under consideration. Before training or practice can be economically provided, it is essential to determine, by the observation of behavior symptoms, the periods of greatest susceptibility for each type of activity. It will be recalled that while Johnny was induced to roller-skate with considerable skill by the time he was sixteen months old, repeated daily practice in a seemingly simple activity like tricycling evoked no improvement either in technique or performance until he approached nineteen months of age. The discrepancy in these two activities affords a striking example because under ordinary conditions a child learns to tricycle much younger than he does to roller-skate.

It has been four years now since this special study of Johnny and Jimmy was discontinued. Although they have at specified intervals during these four years been given follow-up examinations at the laboratory, their life at home has otherwise been comparable to that of other New York children of their socio-economic status. However, an immediate question arises as to the sequelae of their contrasting experiences during the first twenty-two months of life. Now that they are just attaining school age, when a new chapter of a child's life is opened, it is desirable that we consider their relative development to date in the light of their earlier experiences.

At the time of the original report, before there had been an opportunity of observing the subsequent influence of special exercise, the writer commented, "The permanency of the expansion which an action-pattern gains through additional exercise is contingent upon the degree of fixity the behavior pattern had achieved at the time the modifying agent, i.e., the factor of special exercise, was withdrawn. It does not necessarily follow that a performance which has been developed under special conditions will be retained after those conditions are removed. Unless the behavior-pattern has become fixed, it is only reasonable to expect that there will be a loss in performance when the conditions which brought it about are discontinued. Correspondingly, if the growth of a behavior-pattern has been hindered through restriction, it is to be expected that recovery will be evident when the restrictions are removed" (3). The early investigation brought out the fact that certain activities of infants can, through exercise, be brought to a much higher level of achievement than is normally assumed, but it will require new and longer studies to determine the extent to which practice should be enforced in order to render its results comparatively permanent. It is well known that many adults who learn a performance such as bicycling in childhood can, after a lapse of years without practice, pick it up in fairly short order. On the other hand, an adult resuming his attack on a language which he has not spoken since early childhood will show more than an initial awkwardness in re-learning the language although he may acquire it with greater facility than someone who had never been exposed to it before. In other activities an adult often appears to be a virtual tyro despite his childhood accomplishments in a given field. An adult's loss of childhood skills in marble-shooting, ball throwing, etc., is such a common occurrence that it is a familiar subject for the cartoonist and other humorists. General conclusions concerning the permanent effects of practice are therefore impossible since different types of skills exhibit wide variation in their tendency to be retained or lost.

In evaluating the permanency of practice effects with Johnny and Jimmy, we shall consider first those laboratory activities in which Johnny had been given long and intensive training during infancy but in which Jimmy had received only two and one-half months of intensive training beginning when he was twenty-two months old. During the past four years, they have been examined in these same performances at intervals varying from two weeks to six months.

LABORATORY STUDIES

Tricycling. One of the most interesting attainments of Johnny and Jimmy during their period of intensive study was that of manipulating a simple tricycle. The initial practice period was begun with Johnny when he was eleven months old. It was pointed out in "Growth" (4) that this activity was initiated before his neuro-muscular mechanisms were ready for such a performance, as it was eight months before he began to show distinct comprehension of the situation. After he showed some degree of mastery he acquired an easy, skillful performance in about two months. It was also pointed out that Johnny had apparently suffered by his long and futile practice periods. Jimmy, whose training began when he was twenty-two months old - presumably when his neuro-muscular mechanisms were in a state of readiness - accomplished an easy performance in a shorter time than did Johnny. After the period of intensive training was discontinued, both boys were observed at the laboratory in their tricycling behavior, and at no time did either of them show any distinct loss in this particular skill. The twins were living at home during this time. Although they did not possess a tricycle in their own home it was impossible to ascertain whether they had had access to one in the nursery school or on the playground. On the other hand, it may be that tricycling, like bicycling, automobile driving, etc., is a type of skill which does not deteriorate appreciably through lack of practice once it has been definitely acquired.

Skating. In some of the other gross motor skills we find a different story. It was pointed out in the earlier report that Johnny, who began his roller-skating experience when slightly less than a year old, enjoyed an advantage over his twin, whose practice in this activity was begun at the age of twenty-two months. This advantage appeared to be attributable to several factors. In the first place, from purely mechanical considerations, a child who is just learning to walk possesses because of his relatively wide base and short legs greater static equilibrium than does the child who is older and therefore taller (5). In the second place a child who is just beginning to walk, has ample experience in falling, less distance to fall, and is therefore less disturbed when he falls on skates than is the older child. Furthermore, a child's achievement in a particular skill like skating is determined to some extent by the number of distracting or interfering interests which play upon a performance at a given time. The toddler of a year is less responsive to the world about him than is the child of two years or older. Johnny was at the threshold of independent walking when the skating practice was initiated and apparently experienced an advantage in static equilibrium. Also, having had less general experience at the age of twelve months, he was less hindered by distractions and emotional factors and therefore could exert himself to the limit of his neuro-muscular abilities, whereas Jimmy's performances at the age of two years were modified considerably by interference from broader interests, so that his activities at the time were not the result of optimum neuro-muscular coordinations. Even after a practice period of two and one-half months, Jimmy had still not acquired a well-integrated skating movement.

The children were given skates as a present shortly after their daily laboratory visits were terminated, but these skates were demolished within a few weeks and their parents report that they have had no other skating experience except for the follow-up laboratory tests. Their performances on these occasions corrobate the parents' report. In brief summary of the notes which have accrued on their skating behavior during these four years, it may be said that soon after their practice period both children began to show a loss in skill and disorganization of the skating pattern. When the children were about three years old, it was noted that the chief source of their difficulty was in maintaining

the erect posture when on skates. The aspect of balance had undergone greater disorganization than the actual progressive movements. Disorganization of the skating behavior was more pronounced in Johnny's performances than in Jimmy's. This difference, however, appeared to be due to Johnny's attitude of abandon and a tendency to lunge forward even though he had lost in equilibrium, whereas Jimmy adhered more to the short, stiff strokes characteristic of his early practice period. Despite this difference both children began to show an increased tendency to lose their balance and tumble, when compared with their earlier performances. Neither of them skates well today. The fact that the children showed no loss of skill in tricycling but complete disorganization of roller-skating raises the question as to why certain skills deterioriate through lack of exercise and others do not. The answer to this question is, of course, problematical since the factors which control a growing behavior are multiple and were not in this study controlled by laboratory measurement. However, from observations of other children in our study as well these particular boys it seems clear that at least three factors play an important role in determining the permanency or deterioriation of a motor skill when no special exercise of the function has occurred during a period of years. The first factor is the lack of practice per se; the second is the influence of the child's attitude toward the performance, and the third is the changing configuration of the bodily structures as a result of physical growth. It is impossible to evaluate the effect of disuse of function without taking into account the factors of attitude and organic structures. From direct observation of the twins' skating behavior the writer is of the opinion that changes in bodily proportions were of considerable significance in the disorganization of skating behavior. Actually the child of five or six years, because of his relatively long legs and narrow base, has a set of structures with which to perform the task of skating different from those of the toddler. With the set of structures characteristic of the toddler, Johnny developed a well coordinated skating movement. Johnny's attitude toward skating continued cooperative and favorable during the entire four years. There are other motor activities in which he showed no appreciable loss of skill despite the lack of exercise. It seems reasonable to infer, and certainly the character of his behavior indicated, that the disorganization was brought about not solely because of disuse of function but also because during the non-practice period important growth changes occurred in the bodily mechanisms which function in the act of skating. It is reasonable to assume that if the practice had continued he would have altered his behavior gradually to meet the new and slowly developing structural demands. Jimmy, who was less skillful in skating than Johnny at the end of their practice periods, has also shown deterioriation. The fact that both began to show marked difficulty in balancing at about the same age lends support to the contention that physiological growth was an important influence in the disorganization of their skating behavior.

Slides. Another activity which seems to have undergone alteration in the course of years, though it was not so completely disorganized as roller-skating, was that of ascending steep slopes. It may be recalled that (6) at the end of the experimental period, Johnny was able to ascend easily a slope of 70 degrees and Jimmy could with somewhat less ease, scale the incline of 61 degrees. For some months immediately following their practice period Johnny showed, on follow-up examinations, no loss in motor skill in mounting even the steepest slopes. Jimmy, on the other hand, showed some initial loss, but then began to improve both in motor skill and in persistence. Alterations in their methods of ascending the slides became most obvious when the children were about three years old. At this time it was noted that they had great difficulty in managing their longer legs. They would attempt to ascend on their knees while grasping the ridges and

pulling vigorously with their upper extremities. The most outstanding individual difference was Jimmy's persistence in trying to ascend in this manner while Johnny, after a few trials, would shift to the more efficient method of using his toes. He also climbs the steep slopes with greater ease and muscular coordination. He gives the impression of having better gripping power in his toes than Jimmy or most six year old children whom we have had occasion to observe in this activity.

At the present time the writer is less impressed as to the extent to which daily practice might have functioned in Johnny's achievements on the slopes than she was at the time of the original report. Practice undoubtedly operated in his ascending slopes of 61 and 70 degrees respectively. Other infants in our laboratory, however, have ascended slopes as steep as 40 or 48 degrees without great difficulty even when they had not been given systematic practice in such performances. To the experienced observer, it is obvious that infants can more easily ascend slopes of this order than can older children. The advantages enjoyed by the infant appear to be due somewhat to differences in body configurations. The center of gravity in the infant's body is relatively higher and his legs are relatively shorter. It is therefore possible for him to get his chest, and thereby his center of gravity, nearer to the slide without raising his pelvic girdle too high. It is also possible that the texture of infant skin is such as to create a higher friction coefficient between his hands and feet and the underlying surface. Whatever the reasons may be, the fact remains that the babies can stick to and ascend these slopes with greater facility than the older children. The difficulties of older children are manifested by slipping or a deficient gripping power in the toes and in managing their long legs. Alterations in the slide climbing behavior of Johnny and Jimmy during the past four years were of a similar nature. It is a reasonable inference, therefore, that growth changes in body proportions played a large role in altering their method of ascending slopes. Any permanent effects of the early practice which Johnny enjoyed are general, as indicated by superior motor coordinations, except for the comparative readiness with which he shifted from an inferior to a more effective method of managing his long legs and using his toes.

In descending these slopes neither Johnny nor Jimmy at any time showed any distinct loss of motor skill or alteration of method. During the first few months following the practice period Jimmy was more timid and required greater urging to descend but after the first three or four months he overcame this hesitancy and manifested no lack of motor skill subsequently.

Getting Off Pedestals. Post-practice behavior of the children in getting off pedestals is similar to that of descending the slides, since no definite deterioriation of motor skill was manifested by either of the boys. The pedestals ranged in height from 14-1/2 to 63-1/4 inches. At no time during the four-year interim has Johnny shown any loss of skill or hesitancy in getting off these pedestals. At the time the practice period was terminated Jimmy was easily and deliberately climbing off the 63-1/4 inch pedestal. During the months immediately following his two and one-half month practice period, there appeared a regression in his general attitude or emotional adjustment to the situation which interfered with his motor performance. He would complain even on the lower pedestals and would refuse to get off the higher ones. Behavior of this character continued more or less until he was about four and one-half years old when his attitude seemed to change to cooperation and some enjoyment of the situation. The failure of Jimmy to get off the higher pedestals was not so much a deterioration of the motor coordinations formed during his practice period, but rather a recurrence of attitudes established prior to his practice period. Once he could be induced to climb down he could do so with considerable ease. He has never, however, attained the agility which Johnny manifests in

this performance. At the present time the individual differences are indicated not so much in terms of their achievements as in the degree of coordination which they show when performing the same act. This superior motor coordination on Johnny's part is reasonably attributable, in a measure, to the difference in amount of exercise the children received in the activity during their first two years of life. Climbing off pedestals is another type of performance, the motor aspects of which do not suffer appreciable loss through lack of exercise once the motor habits are well established.

Jumping. In the report of early behavior of the children in the jumping activity (7), it will be noted that in this type of performance the attitude of the child played a major role in determining the somatic response. At the end of the experimental periods the investigator felt not only that Johnny had established a cooperative attitude, but that the integration of the essential movements in jumping had been accelerated. Jimmy, on the other hand, even after two and one-half months of daily exercise could not be induced to jump off a tall pedestal into the outstretched arms of an adult. It seemed unquestionable that Johnny experienced an advantage in this performance by having had practice in the activity before his increased perceptive and emotional capacities added complexities to the somatic or motor aspect of the behavior. During Jimmy's two and one-half months of practice (at two years of age) his attitude became definitely more acquiescent, but the alteration of attitude was not sufficient to effect an integrated jumping performance. At the end of the exercise periods, when they were 26 months old, Johnny was gleefully leaping from tall pedestals with even a slight "spring" as he threw himself forward. Jimmy, happy enough, would stand on the pedestal, shifting his weight from one foot to the other, squatting, and in other ways indicating his urge to go forward, but was not quite able to consummate the performance. During the first few months after their practice periods were terminated, Johnny began to show a less cooperative attitude and for a while there was even less motor skill in his action, that is, when he did jump there was noticeably less grace in his movements. This loss or deterioration was, however, temporary and intermittent, appearing at intervals over a period of six or eight months. After that relatively brief period jumping was again one of his most enjoyable activities and he subsequently showed no distinct loss in motor coordinations. It appeared to the experimenter that this early change in attitude was due in part to imitation of his brother's behavior rather than to real hesitancy in carrying out the act.

For some months after their practice periods terminated Jimmy showed a definite regression in his behavior. He would cling tenaciously to the adult, refuse to stand up on the pedestal and cry lustily. When he was about three years old, however, his attitude became more acquiescent, and his behavior comparable to that manifested during his exercise period. He would stoop or squat on the pedestal, reach toward the adult, and if the adult was only about eight or ten inches away he would throw his shoulders forward. He has steadily shown improvement and is now willing to jump, but he has not manifested the abandonment nor been willing to jump as far as Johnny. In this activity there has been a definite residual of the early training period in Johnny's favor.

Purposive Manipulation of Graded Stools. "Growth" (8) offers an analysis of the children's development in manipulating stools of various heights in order to obtain lures which had been placed out of reach. At the time the experimental or practice period terminated, neither of the children had attained the maximum degree of proficiency in this activity. At that time Johnny would juggle eight different pedestals, ranging from 7-1/2 to 63-1/4 inches in height, in order to climb up and obtain an object hung some nine feet above the floor. However, he still had a tendency to push all the stools in a cluster, not seriatim, usually with the tallest one beneath the lure. On a few occasions he had shown some tendency to eliminate unnecessary pedestals, but this aspect had not become

a fixed part of his behavior activity when the practice period ended. Jimmy, on the other hand, was, at the same time, able to manipulate two or three stools successfully in order to obtain the lure placed upon the 63-1/4 inch pedestal, but he had at no time successfully obtained the object hung from the ceiling, which arrangement demanded his making use of the taller pedestals for climbing. Johnny's practice period began in this activity when he was eighteen months old, and Jimmy's when he was twenty-two and one-half months old. It was pointed out in the original report that the time span between the inception of the practice periods for the two children was not great and therefore came nearer to striking the critical period for both children, i.e., that period when development in this type of activity would be most susceptible to advancement.

It would require too much detail in order to delineate the various changes in their performances in this situation during the four years they have been returning to the laboratory for follow-up examinations. It is sufficient to state that at the present time, as a rule, Johnny and Jimmy both arrange the pedestals purposively to obtain the lure when it is hung at least nine feet above the floor. Both children carefully discriminate in placing the tallest pedestal under the object. Johnny, however, carelessly and dexterously pushes all the other seven pedestals in a cluster about the tallest one with no definite order or arrangement. He then goes clambering up two or three of the stools, as may be necessary, for him to gain the top of the tallest one. He shows no hesitancy or difficulty in bridging wide gaps in order to pass from one stool to another when they are not in juxtaposition, and he shows no hesitancy in standing erect on the tallest stool in order to reach the lure. It never seems to trouble him that he has pushed all the pedestals in a cluster although he makes use of only two or three for the purpose of climbing.

Jimmy, in contrast, works diligently arranging the stools in a graded sequence with the tallest one carefully placed under the object. Once he has them arranged in a stairway he will climb up and stand on the one next to the tallest pedestal, but it is only rarely that he can be induced to climb up on the tallest one so as to obtain the lure. He has definitely less courage and less motor coordination in handling his body. It is the writer's impression that Johnny's failure to arrange the pedestals in order according to their relative height is a residual of his habits established earlier when his discrimination was inadequate to allow him to do so. The fact that it is not lack of discrimination at the present time was brought out one day when he was shown some movies of his performances taken before he was two years old. This particular reel included an occasion when he had arranged most of the pedestals in stair formation. Johnny's remark was, "That isn't me. I didn't put them straight like that." With his greater agility he doesn't feel the need of an orderly arrangement, whereas Jimmy, who is more cautious in climbing, tries to make that aspect of the situation as easy as possible. The impression that the tendency of Johnny and Jimmy to employ all eight stools, even though three properly selected ones would have sufficed, is a residual of their early practice in this situation was substantiated by the behavior of a small group of children from six to eight years of age who had never been exposed to this particular situation before. At this stage of maturity these children would make use of only a few of the pedestals, even if they were not properly chosen. In other words, they had developed beyond the stage of thinking an additional one would help solve the problem.

Purposive Manipulation of Graded Boxes. This situation (9) called for the stacking of two or more boxes of different size on top of each other in order to obtain a lure suspended from the ceiling. When the practice periods were discontinued Johnny was skillful in stacking three boxes in order and had occasionally successfully stacked four boxes, but he was actually lacking in physical height to stack the fourth box easily. Jimmy, by contrast, at the same

chronological age and after a period of two and one-half months' practice, had not arrived at the stage of placing one box on top of another for the purpose of climbing up to reach the lure. Therefore, in this situation neither child had attained his maximum development in performances of this order, though Johnny was considerably advanced beyond Jimmy.

In the four year interim during which they have been given follow-up examinations in this situation Johnny has shown many fluctuations, the details of which would be too laborious for the reader if reported here. Jimmy was three years old before he began placing one box on top of another, and it may be that this is about the age when children would normally begin to engage in activities of this order if they were not given specific stimulation to do so. At the present time both children usually pile all four boxes on top of one another in order to obtain a suspended lure. Jimmy is more careful in arranging the boxes in order according to size, that is, with the largest one on the bottom and the smallest one on the top. He often shows a reluctance to climb up after he has neatly arranged the boxes. Johnny, who is careless and less discriminative in the order of arrangement, shows greater skill in climbing and maintaining his balance on even a quite unstable structure. It would seem that in this particular situation Johnny's advanced motor skill and courage operate to make him either careless or less discriminative of the relative sizes and placement of the boxes. Again, Jimmy, who has less courage in motor performances, is more meticulous in making arrangements, so that the motor aspect will be as easily accomplished as possible.

When a long range view is taken covering the twin's behavior in these several laboratory situations, during the past four years, it is clear that there are at least three different situations in which Johnny showed no loss of proficiency and in which any loss which Jimmy might have shown could be attributed more to his emotional or attitudinal status than to motor inadequacy. These activities are (a) tricycling, (b) getting off pedestals, and (c) descending slides. When we examine these activities we are struck with the fact that their mode of performance has suffered no major alteration. In other words, so far as the motor aspect of these performances goes, the twins had achieved a high degree of integration or maturity at the time the practice periods were terminated. Given relatively the same heights and slopes and a tricycle of relatively the same size, the two year old and the six year old child tend to get off pedestals or go down slides in essentially the same manner, and also to propel a tricycle in the same fashion.

In at least two different activities, and in certain aspects of a third, the mode of performance seems to have changed primarily because of alterations in the boys themselves as an aspect of physical growth, specifically because of their relatively longer legs and the shift in their centers of gravity. These alterations are especially noted in skating and in ascending steep slopes. The influence of changes in bodily growth upon behavior was also observed in the way in which the boys manipulated graded pedestals to obtain suspended lures. Actually, because of his short stature, the two year old child who strikes the tall pedestals nearer their base is less liable to tip them over and can, therefore, move them with greater ease than can the six year old whose contact point in pushing strikes the pedestal nearer its center of gravity.

Purposive arrangement of pedestals and manipulation of boxes were activities which were probably in the most fluid state at the time the special practice periods were terminated. For that reason the performances of both children have shown greater fluctuations in these situations than in activities which were more stabilized. While the achievement difference of the two boys were great when special practice was abandoned their relative efficiencies have, during the past three years, approached each other though the two children adopt somewhat

different methods in demonstrating their merits. As might be expected there is comparatively less diversity in their present achievements in those activities which were not so stabilized when practice was abandoned.

Jumping from a tall pedestal seems to stand in a class by itself. It appeared that through practice the motor aspects of this performance had been greatly accelerated in Johnny. However, his performance had reached a high degree of fixity and suffered only a temporary loss immediately following the practice period, whereas, the attitude which prevailed with Jimmy during his period of isolation had become so fixed that the two and one-half months of practice he experienced when he was about two years old were inadequate to counteract it. With increasing maturity Jimmy's emotional disturbance was somewhat abated, but it has never become sufficient to eliminate obvious muscular tension in his performance even though he will complete the jump.

Swimming. No follow-up study has been made of the swimming behavior. It will be recalled that the original investigation of this activity (10) terminated when the children were seventeen months old. During the ensuing four years there have been three or four occasions when their aquatic behavior was observed. Until the age of six years Johnny showed noticeably greater fortitude in jumping into the water and playing about, though he was not able and was not urged to engage in independent swimming. However, on the last occasion they were taken to a lake, when they were a little more than six years old, Jimmy was quite brave about jumping into the water with a ring around him for support, whereas Johnny showed some inhibition about doing so. Just why this change in attitude should have taken place is a matter for conjecture. An interesting difference was noted in their swimming strokes. When supported by a ring, both would venture out beyond their depth, but Jimmy maintained a vertical position as he made rapid treading movements with his legs. Johnny, on the other hand, assumed the horizontal position and engaged in graceful crawl strokes of the more advanced swimmer. Just why he should have taken up a method of movement which by experts is considered to be more efficient than the natural dog paddle of beginners, is beyond present explanation as no attempt was ever made to teach Johnny strokes during his period of infantile swimming and at that time he used the typical dog paddle. It is unfortunate that this behavior could not have been studied further, especially since it appears that this is another activity in which the body proportions constitute a large influence in determining the manner of behavior. An infant, whose head is relatively heavier with respect to his total body, cannot maintain his face above the water level. Beginning swimmers between the ages of four and six years have a tendency to maintain a vertical position, if allowed artificial support, and their first movements without support are of the struggling order.

Interpretation. In the light of their subsequent behavior, both in and out of the laboratory, it is safe to state that at the present time Johnny usually manifests greater motor coordination and daring in physical performances. Jimmy, who is more awkward and timid, exercises devious methods of rendering more easy the motor aspect of a given activity, so that both children may end up with the same result in terms of final accomplishment.

It has been pointed out that the degree to which an accelerated activity may retain its advanced status after the modifying factor of intensive exercise has been withdrawn is proportional to the degree of fixity the behavior pattern had attained when practice was discontinued. Fixity in this connection means whether the manner of performance had stabilized into a well integrated movement. Examples of well stabilized activities which manifested no major alteration through lack of practice are tricycling, getting off pedestals and descending slopes. Manipulating pedestals and boxes was in a fluid state, and their subsequent performances have shown many fluctuations.

Fixity in mode of behavior, however, is not the only factor determining the permanency of acceleration. Another important factor,- viz: organic change within the individual, - has been recognized only by the analysis of later performances in skating and ascending slides. Johnny's mode of performance in these activities when he was two years old was highly skillful and of an order comparable to that of the efficient adult engaging in a similar activity. If one considered the activity in the abstract, one would say that his skating and slope-climbing behavior had attained a high degree of fixity. Yet these activities suffered alteration, or loss in skill. This loss of skill appears to have been due primarily to change in bodily proportions. Thus it seems that a child may, in a given activity, attain a high degree of skill and his manner of operation may be the most approved or efficient with the organic structure he has to work with at the time. If, however, at a later age he has a different set of organic structures for performing the same activity, then his behavior may show disorganization characteristic of the novice. Retention of general muscular coordination may persist but the actual patterning of the particular skill or behavior will be interrupted until the child has learned to operate the new set of body mechanisms. The comparative behavior of Johnny and Jimmy in roller-skating illustrates this point. Even though the activity became disorganized in both children as they grew taller, superior general motor coordinations could be detected in Johnny's movements.

Johnny's superior motor coordination is evinced not only in adaptive skills as mentioned above but also in the common, more organic motor movements, such as the assumption of an erect posture, walking and falling. Quantitative determinations of their efficiency in walking were ascertained periodically at six month intervals from the time they were about two years old. While these measurements are too scattered to justify elaborate treatment, they do show that Johnny was consistently a little ahead of Jimmy, and to that extent these objective measurements corroborate the observational data.

In summary it might be said that the alteration or deterioration of performance, particularly motor performance, through lack of exercise or practice over a long period of time is determined 1) by the state of maturity the activity had attained at the time the practice was withdrawn 2) by alteration in body mechanics or other physical changes which necessitate an alteration in the form of the behavior pattern, 3) by change in emotional or attitudinal adjustment which operate as an inhibiting or facilitating factor in a particular performance.

ATTITUDES. In evaluating the influence of attitudes upon somatic performances we have ordinarily considered only the attitude prevailing at a moment and concomitant with a particular motor behavior. It is well to consider also the persistence of a characteristic attitude which seems to predominate from day to day when the child is confronted with the same situation. That is, if a child week after week is placed on a pedestal and requested to jump to an adult and if on each occasion he stoops, clings to the adult and cries, then it may be said his characteristic attitude for the period of time is one which inhibits the motor performance of jumping. If, however, after a period of months he begins to show more fortitude not only in the jumping situation but in all comparable activities, then the possibility of general increase in emotional control warrants consideration. More specifically is the older child, because of his physiological maturity, capable of attitudes and adjustment which could not be evoked from the infant or younger child. It was pointed out in "Growth" (11) that an attitude, at a given moment, may arise from some developmental imbalance of the neuro-muscular system. For example, the baby who pulls himself up beside the bed and stands crying lustily may do so because he has not developed the concomitant coordination of letting himself down to the sitting position. The attitude arises from the organic status of his neuro-muscular development and

not from some personal disagreeable experience associated with that situation. Likewise, it would seem, a change in attitude may be brought about not through direct and individual experience in a specific situation but through the integration of other aspects of development i.e., as a result of general physiological development. It is common observation that the period of greatest irritability, negativism, temper tantrums, etc., is around twenty-four to thirty months. These common observations are substantiated somewhat by the investigation of Reynolds (12), who shows that there is a diminishing manifestation of negativism after two years of age. Anderson, (13) interpreting Olson's (14), study of "Problem Tendencies in Children," regards the period between two and four years as one in which "a fanning out of emotional life" takes place. It seems evident from Anderson's discussion that he has in mind not only diminishing emotional flare-ups in the older child but increasing differentiation and specificity of emotional expression. The older child gets angry at things which should make him angry, while it is common observation that the younger child may go into a tantrum when apparently everything is being done to appease him. It is also common knowledge that the intellectual and motor abilities of the two year old child have not attained equilibrium.

It seems reasonable to ascribe this characteristic and trigger irritability of the toddler to the many developmental behavior potentials which he has acquired during the first two years of life, but which have not been organized into adequate social responses. When these behavior potentials become integrated, then the child achieves a degree of emotional maturity regardless of his personal experiences in particular situations. In other words, emotional maturity may arise from increasing integration of intellectual and motor development as well as from direct personal and conditioning experiences. These statements sound tautological. It is difficult to make them otherwise since the different aspects of a behavior activity are interdependent and mutually influential. Illustrations may add some clarity to the analysis: A child who is just beginning to walk may leap off a tall pedestal without hesitancy because he has not developed adequate powers of height discrimination to appreciate all the possibilities of the situation. A little later, when his powers of discrimination have advanced, he squats and refuses to jump. Again it must be emphasized that his behavior has changed not because of an unfortunate personal experience but because of development in another aspect of his behavior. At this time he has adequate motor mechanisms for jumping but he has achieved powers of discrimination and for a time the one functions to inhibit the other. Subsequently when the two types of development become organized and well integrated he will again leap from the pedestal and his attitude is acquiescent or cooperative not for lack of discrimination but because he can exercise his motor functions in terms of his discrimination.

In a discussion of the gross chronological periods when the most rapid development occurs during the first two years, the following categories were suggested in "Growth" (15):

> "During the first four or five months the behavior of the baby is still at an infracortical level. Therefore, the greatest increment of development in behavior at this time consists of a gradual recession of some overt primitive reflexes as behavior-patterns of a higher order begin to emerge.
>
> "Growth during the second period is shown largely by an ever increasing control of the individual infant over motor activities in the upper part of the body, that is, in the region of the head and shoulder girdle.
>
> "During the third period the greatest increments in behavioral

development are observed in the motor activities involving the lower part of the body - in the region of the pelvic girdle and lower extremities.

"During the fourth period great strides are evident in the development of an understanding of relationships - associational, conditional, and symbolic - of retention and recall of these relations, of comprehension and use of language, imitative tendencies, et cetera."

If a multitude of behavior potentials have been acquired during the first two years, it is a reasonable inference that in the immediately following years rapid development will be in the nature of integration or organization of these more or less independent behavior potentials. A concomitant development of this integrative process will be an increased degree of emotional stabilization. General observations of children's behavior support this hypothesis.

A study of the notes on Jimmy's attitudinal adjustment to the laboratory situations during the last four years indicates that a general maturing began to take place when he was about three years old. During the first year after they left the laboratory his attitude on return visits was infantile, comparable to that manifested during his period of restriction. He would cling to the experimenter, cry and refuse to go through with many of the performances for which he obviously had adequate neuro-muscular development. At about the age of three years, he began to show a more interested and cooperative attitude; the change was shown in practically all the laboratory situations. His motor performances began to improve and have continued to improve to the present time.

Since no definite effort was made during this time to re-educate his attitudinal adjustments, it is assumed that the change was a result of gradual development in understanding and integration of his behavior in general. Jimmy's responses both in and without the laboratory are more representative of the typical child of his age than are Johnny's. This period of development in emotional and social adjustment achieved by Jimmy parallels the period for such development in children in general as ordinarily observed.

One attitudinal difference in the two children which was marked during their experimental period persists even today, though the difference is less marked than it was when they were about two years of age. Jimmy has always been more concerned with end result and Johnny with modus operandi. It cannot be said that Johnny's greater interest in the way things work rather than in obtaining lures arose from the more extensive laboratory experience. It is however reasonable, from the very nature of the laboratory experience, to assume that it was not without influence in developing such an attitude. Here he learned to work for the sake of performance even when the lure had no particular appeal. The fact that this difference in their interests was more marked during the experimental period than it is today would in part justify the opinion that the laboratory experience influenced Johnny's development in this respect. At the present time a sort of rivalry exists between them, but it is counter-balanced by their spirit of comradeship. In the main, they appear to be less sensitive to failure than most children of their chronological age who have come under the observation of the writer.

PERSONALITY DEVELOPMENT. In view of the importance attached to the early experiences of life in determining later personality makeup, and in consideration of the rather popular notion that over-stimulation during infancy forecasts a neurotic child, two attempts were made to evaluate the personality and social adjustments of the children as of six years of age. Dr. William S. Langford, through psychiatric interviews with the mother and children, arrived at the following evaluation of the children's emotional and social adjustments as of today:

"It is difficult to discuss these two children without stressing the differences between them and without speculating as to possible causes of these differences. Johnny and Jimmy both are regarded by the mother as happy children who benefited by their experiences in the Normal Child Development Clinic. There are no particular difficulties in home management with either of the boys. The mother believes that both, as a result of the clinic experience, are able to meet with people and adjust better in social contacts outside of the home than do her other children. When playing with the older siblings, they both are able to adapt their play to the situation; when playing with the girls it is dolls, and when playing with the boys it is guns and cowboys; they are equally happy at each type of play.

"There has been a difference in the attitude toward the two children at home, in part coming out of the fact that Johnny was the 'subject' in the clinic. This difference in attitude would seem important in the genesis of some of the differences between the two boys. Although the family tried to realize that the selection of Johnny for the conditioning experience in the clinic was not because of any favoritism, it was difficult for them not to favor Jimmy and not to try to make up for some of the things he did not get. During the latter part of the second year, after newspaper reports of the experimental studies had been published, they would, among other things, take Jimmy and encourage him to jump off the icebox. However, the experiences in the home, which would seem to have given Jimmy the greater security there, were more a result of circumstance. In their infancy when, at the end of the clinic day, they were returned home, Johnny would be tired and go to sleep; Jimmy on the other hand would be wide awake and ready for play and socialization with his parents and siblings. For a time Jimmy would strike Johnny and take away his toys; Johnny would not seem to dare to hit back. One wonders strongly if this, too, was not a result of attitudes in the home.

"Jimmy seems to be more at ease in the home situation where he is the leader of the two boys. He usually bosses Johnny about. Jimmy is quite apt to come home with tales about Johnny and tell what he had done outside. The parents, one feels, do not particularly encourage him in this activity. Jimmy wakes up quickly and is on the go all day as a rule chattering a blue streak about whatever comes into his mind. He seems closer to his mother; talks more with her and likes to sleep with her. When he is put to bed with another sibling, he will frequently come into his mother's bed. He definitely prefers his mother to his father and feels that she likes him best. He is helpful about the house and likes to assist his mother in tidying up and washing dishes. Jimmy cries easily when things do not go his own way or if he is scolded. He indulges in mild temper tantrums consisting of stamping his feet when he cannot get what he wants. Earlier, at about two years of age, he went through a period of severe temper outbursts with breath-holding.

"Johnny gives evidence of some tension; he has always been a nail-biter, and the mother states that he is a 'wiggler', cannot sit still in a chair and from time to time displays quite restless sleep. In addition, Johnny has always been enuretic nightly. This is difficult to interpret as enuresis seems to be a family failing. There was difficulty in establishment of the day habit with all of the older siblings and one brother did not stop his bedwetting until nearly eleven years of age. Jimmy still wets his bed occasionally although

the mother did not tell of this until some time after the initial interview. In addition, an adult member of the family will occasionally wet his bed. The mother feels that this tendency comes from the father's family where all the members have a tendency toward urinary frequency and urgency. Johnny, among all of the Woods children, is a thumb sucker; this began in early infancy and continues at bedtime even today although it used to be more marked and occur in the daytime also. He sucks the left thumb, and as an accessory movement pulls his own or bed partner's hair with the other hand; usually the latter. The sucking is rather vigorous and the accessory movement is so pronounced that most of the siblings prefer not to sleep with him. Johnny is somewhat ashamed of this habit and was disinclined to discuss it at first. Johnny is the quieter of the two children and rarely holds conversations with the other members of the family. Mother believes he is 'deeper' and 'when you least expect it Johnny will say something'. He is dependent on his mother in being washed and dressed and tends to play in his bath. One feels that this slowness is more a result of preoccupation than of a desire to have the mother do these things for him as the mother becomes irritated at his slowness and finally does it herself rather than wait for him to complete it. Johnny is not thoughtful or helpful about the house, but tends to be 'destructive and throw things around'. The mother feels that Johnny has no fears and thinks that he would be better off if he were a little more cautious, especially in his attitude towards dangerous occupations, such as crossing streets. In the home, Johnny has a philosophical attitude and takes things as they come; he is not upset when he cannot get his own way. There are no temper outbursts and he rarely cries. During the past year he has shown a tendency to play with fire, but otherwise has shown no overt behavior difficulties. Both children when observed in the interview were friendly and cooperative and talked freely. Both boys, in common with two older siblings, speak indistinctly with a lisping difficulty in articulation suggestive of 'baby-talk'.[2]

"Jimmy showed a good deal of spontaneous chatter, but was quite apt to grow almost incoherent in the rapidity with which he spouted out detail after detail and leaped from topic to topic. He showed no marked preoccupations, but reacted to the questions immediately without taking thought as to how he answered. He talked a good deal of Johnny and showed a warm affection towards him. At the same time, he tended to bring out Johnny's bad points, telling of his enuresis and hair pulling and stating that Johnny is 'the bad one at home; bad at home and bad in school'. He said that Johnny wanted to be a drunken man when he grew up. He likes to play with Johnny best, and brags about how funny he is. Many of Jimmy's statements seemed to be made for effect and with a desire to produce a laugh as he would immediately contradict himself. His general attitudes and behavior seemed quite typical of an outgoing, exuberant and quite usual six year old boy. He reacted without thinking and was responsive to environmental changes. In one interview when the examiner was weary, Jimmy reflected the subdued and more quiet atmosphere. Jimmy in his drawing drew a watch which he then cut out and pinned to himself, strutting around with evident pleasure at his self adornment.

"Johnny in the interview presented a quite different picture from

[2]*Early nursing habits of the two children seem to have been about the same. The mother believes that Jimmy would go to sleep at the breast during the first three or four days but this was not corroborated by the hospital record.*

that of his brother. He was friendly and cheerful but not so spontaneous. Attention was difficult to hold; he would be distracted by extraneous noises, but more often by passing thoughts of his own which would result in a seemingly irrelevant answer. He was thoughtful in answering questions and seemed to weigh his answers. His interviews came after Jimmy's and he seemed to feel that he should have everything that his brother had had; making sure that he sat in the same chair, had his words written down, drew pictures, and took home a pencil as a gift. His attitude towards the members of the family was somewhat different from Jimmy's. He definitely prefers his mother and sister whereas Jimmy prefers the 'toughest' brother to the sister whom he soundly denounces as being dumb. Johnny is quite fond of his twin brother, but does belittle Jimmy's ideas of wanting to grow up twice; he himself would prefer to keep on growing until he became a giant. He did tell of a dream which he was careful to point out was 'make believe' in which an old witch hits Jimmy. Johnny talks of most of his difficulties quite freely, but is hesitant about mentioning the hair pulling. He shows a definite tendency towards self evaluation and self criticism which is not present in his brother's output. He also shows good imaginative ability and reveals in his stories evidence of a rich phantasy life although he will not express these when questioned directly. His drawings are rather well done and are not, as were Jimmy's copies of something he sees, but rather a product of his own imagination.

"Attitudes of both children toward the clinic were those of its being a pleasurable experience with the exception of having to take their clothes off. Jimmy, however, tended to protest that he liked Dr. McGraw better than Johnny, although both felt sure she had no preferences. In the clinic situation it would seem that Johnny has the greater security and tends to be the leader and to boss Jimmy about. His reactions at the birth of Dr. McGraw's child would tend to bear out his need to be wanted there.

"In conclusion one might say that the boys present quite different pictures. Johnny exhibits in the home certain evidences of tensions; nail biting, motor restlessness, persistent thumb sucking as well as enuresis. The last symptom, however, is difficult to evaluate because of its prevalence in the family, and it is also present to a lesser degree in Jimmy. These symptoms could well come out of Johnny's lessened security in the home situation where his brother has been preferred and given more attention, and earlier, a greater amount of affectional demonstration. It would not seem that the 'conditioning' in the clinic had much to do with these. The restlessness, nail biting, and sucking do not occur in the clinic setting, and the boy has great security in his relationship with the clinic personnel, especially Dr. McGraw. I should not feel that undue pressure for success in various accomplishments was a factor in this as the boy enjoyed his work. This latter, however, would seem of importance in giving Johnny his attitude of evaluating and looking over a situation.

"Jimmy is the outgoing, helter skelter type of child who lives for the moment. Johnny is the more serious, thoughtful and contemplative youngster who looks to the consequences before he acts. Jimmy reacts mostly to external stimuli, Johnny as a result of his more active inner life reacts in a less direct manner to external stimuli and frequently gives the impression of preoccupation. Johnny gives the impression of being capable of weathering more serious environmental difficulties without blowing up because of his greater capacity for working

things through; but once upset, he would respond more slowly to efforts for readjustment. Neither child seems to have suffered from the experimental study. Both make adequate social adjustments although in different fashions. The differences in their personalities may well be largely constitutionally determined and not entirely the result of their diverse earlier experience. However, one feels that these experiences are of importance. I should feel that the home attitudes were of great importance as well as Johnny's 'conditioning' and they do seem a little easier to evaluate."

Dr. Langford is in a peculiarly favorable position to make these interpretations since he knew the children during their experimental period and has had occasion to see them from time to time around the laboratory in addition to the specified psychiatric interviews. It is especially interesting that the opinion concerning the personality make-up of the two children as expressed by Dr. Langford is corroborated by an interpretation of their reactions to the Rorschach test. These tests were administered by Miss Jane Sills and a blind analysis was made by Dr. Z. Piotrowski. Excerpts from Dr. Piotrowski's reports referring to Jimmy's record state "this boy probably makes the impression of a rather typical average child of his age, emotionally immature. Toward the environment he appears to react in a rather self-centered and labile emotional manner, and he seems to have a rather poorly developed inner life. His reasoning power is not above the average, and he does not seem especially observant. He appears to lack the capacity to preoccupy himself with imaginative and instructive games. Compared to his brother's record, he is childish, as one would expect a child of his years to be. His brother appears more independent in his actions, more individual, while this boy seems to be more dependent, more appealing to adults who like to play the role of protectors to young children." Concerning Johnny's record Dr. Piotrowski writes, "The complete lack of color responses in the presence of a good human response suggests that the child's reactions to the environment are determined by promptings from within himself rather than by changes in the outward situation. Probably, the child tends to be rather impersonal in his relations with people, and one might find a certain lack of emotional warmth in his attitude toward people. Although his reactions seem to be rapid, he is fairly well aware of his psychic experiences. Occasionally he is given to feelings of insecurity and uneasiness, and it is my impression that at such times the boy tends to be brave against his liking. Intellectually he seems to be above the average since only the intelligent among the small children tend to have a human movement response. Since the boy seems to lack the capacity for an immediate and effortless emotional adjustment to the environment, it is the intellect which carries the burden of adjusting. It is probably best to make a contact with him on a rather intellectual and impersonal basis. His thinking would appear to have a common sense quality with occasional excursions into imaginative fantasies. His mental independence does not, however, seem to be characterized by negativism or aggression. On the whole, this child is rather self-confident and probably would impress one as capable of taking his future into his own hands. He probably gets along well with only a few children while his brother fits in better with any children's group." On the basis of the child's reactions Dr. Piotrowski correctly surmised Johnny's record to represent that of the "trained" twin since from the nature of Johnny's earlier experiences "he would have had a better chance to develop his inner abilities and the habit of self-observation for the purpose of avoiding future mistakes in well standardized situations."

In the main, these two interpretations of the personality differences of the children are in agreement. They are also in accord with the general opinion of

the writer, whose observations of the children during their entire life has been both intensive and extensive. According to the writer's observations, outstanding personality differences are Johnny's stoical and rather philosophical attitude in disagreeable situations, and his escape by indulging in his own phantasies. Jimmy is more loquacious, is more conscious of, and bids for the approval of his audience. Consequently, he is more appealing to the casual observer. Since infancy he has looked and played the part of a clown. He is rather happy-go-lucky, and reflects his home environment more directly. Johnny employs a more subtle method of revealing his feelings. It appears that the less frequent contacts with the laboratory after the age of two years have been a handicap to Johnny. Apparently having heard that younger twins came here, he spontaneously inquired "Dr. McGraw, why did you need another baby when you sent me home?" When they left here, Jimmy went to a home admittedly more favorable to him; he also had less of an adjustment to make. In some ways Johnny's experience here was poor preparation to meet the rough and tumble of a large family life. He had learned in many ways "to take it" and the reports indicate that he has had more than his share of taking. At home and at school Jimmy is rather the bully, often casting aspersions on Johnny and threatening his confidence. For all that, the affection between the two boys is warm. Despite the amount of public notice they have received, they are remarkably free from self-consciousness.

To evaluate the extent to which these personality differences are constitutional, or determined by their early experimental experiences or their later home environment, is beyond achievement at the present time and will probably remain beyond the scope of actual determination for all time. However, their experiences and behavior have been studied and chronicled as to detail in a way which is not obtainable for the average school child. If these reports and opinions serve a useful purpose in guiding the educational careers of these two children, they may at the same time be of even greater significance in showing the extent to which knowledge of early childhood experiences is of educational and psychiatric value in the adjustments of the adolescent or adult.

INTELLECTUAL AND PHYSICAL DEVELOPMENT. Both Johnny and Jimmy have consistently rated within the normal range on standardized intelligence tests. The Rorschach test indicates that Johnny is somewhat accelerated in intelligence. This paper is not the occasion to discuss the correlation of the Rorschach with the Stanford-Binet, the Minnesota, or other well-known intelligence scales. It may be that the Rorschach taps a quality of intellectual processes which is not measured by the items included in these various tests.

There is one fairly common opinion among the laity at least which might at this occasion be corrected. Some have labored under the belief that special training during the first few years of a child's life will in some way raise his general intellectual endowment. It has been previously pointed out that the effect of training or exercise as applied in these studies was highly specific to those activities in which the child received daily practice. Certainly, whatever are the factors measured by standardized intelligence tests, they have not been appreciably altered by the different experimental experiences to which the twins were subjected.

There is one aspect of mental development which deserves mention, although it has no direct bearing upon the training program. In parlor discourse the earliest individual memory is a common topic. Psychologists are usually skeptical of reports of direct memories of experiences which have occurred during infancy. The usual explanation is that the person had heard the experience referred to and therefore could not distinguish between direct and verbal memories of it. Because of the peculiar circumstances of the twins' first two years, it is possible to know precisely whether reference had been made to certain incidents in their early experiences. There are several instances in Johnny's

behavior indicating remote memory. When Johnny was sixteen and seventeen months old, he would skate through the tunnel joining Babies Hospital and Neurological Institute as he journeyed to the swimming pool in Bard Hall. These journeys through the tunnel were terminated when he was seventeen months old, and he never entered the tunnel again until he was 43 months old, i.e., twenty-six months later. On this occasion he was walking with three other children. As he entered the tunnel his eyes widened and he suddenly remarked, with a sweeping gesture, "This is where we go skating." This recall is interesting beyond the mere indication of memory for early experiences. At the time the tunnel journeys were ended Johnny had no verbal means of expressing the act of skating. He recognized skates by name, but he had no word in his own vocabulary to indicate them. Here his remote memory is entirely integrated with verbal expression which was acquired at a later date. A year later, when he was four and one-half years old, Johnny was again escorted to the tunnel. On this occasion he asked, "Where's the bathroom?" When told he would have to wait until he returned to the laboratory, he replied, "Oh, there's one way, way down there," pointing in the direction of Neurological Institute. It was then recalled that when Johnny was seventeen months old he was being trained in toilet habits, and as soon as he arrived at Neurological Institute during those days, he was rushed to the toilet. Another instance illustrates his incorporating into his vocabulary recollection of an experience which occurred before he had language facilities for expressing such experiences. Johnny and Jimmy were just two years old when they entered the elevator of an apartment house alone and Johnny pulled the lever, sending the elevator to the basement. The occasion was subsequently never referred to, and other persons who have been associated with the children did not even know about it. More than three and one-half years later, as Johnny sat somewhat meditatively watching the dial indicate the floors of the elevator in Babies Hospital, he quietly remarked, "Dr. McGraw, remember when Jimmy and me went in your house in the elevator and it went down boom!" These incidents are cited because they are comparable to citations of many parents in reporting the early memory of their children; and because of the peculiarity of experiences to which the twins were exposed during their first two years, it is possible to know definitely whether or not subsequent reference had been made to the situations. If the direct memory of experiences during the first two years of life are as indelible as these incidents indicate, then the weight attributed to influences imposed upon the infant and young child gains significance.

There is nothing of experimental significance in the physical history of the two children. Although Johnny was smaller during the first seven months of his life, he began at about eight months to maintain a superior weight gain as compared to that of Jimmy. This advantage in body weight he has sustained during the four years they have been at home. While Johnny began to show this superiority in weight gain about the same time as he showed improvement in motor performances, there is no claim of a direct relationship between the two. Their health records compare favorably with those of other children of their socio-economic level, and their value to this study is only in so far as they indicate no serious sequelae of their experimental experiences during their first two years of life.

SUMMARY

Studies of the performances of Johnny and Jimmy in particular laboratory situations indicate that the amount of retention of a motor performance, once the factor of repetition has been reduced or abandoned, is contingent upon the state of fixity the activity had attained at the time the practice-factor was withdrawn. Activities which have attained a high degree of integration may be

appreciably altered if the body mechanisms are so modified through growth as to introduce new structures or elements into the situation. The natural and gradual maturing of emotional or attitudinal factors seems to influence appreciably the somatic or motor performance in particular activities.

In general endowment the two children have consistently fallen within the normal range as measured by the standardized intelligence tests. There is no reason to believe that exercise in special activities will accelerate mental functions as measured on standardized scales. There seems to be a superiority of general muscular coordinations on the part of Johnny, who received the longer and more intensive practice in motor activities. In general personality make-up, Johnny also appears to be more complex as indicated both by psychiatric interviews and by analysis of responses to the Rorschach ink blots. There is no way to evaluate the extent to which their early experimental experiences operated in determining their respective personality components.

The two boys today present the picture of lively, normal six year old children who show no deleterious sequelae of the different regimes to which they were subjected during the first two years of their lives.

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