MOTOR DISABILITY AND MENTAL GROWTH:
THE PSYCHOLOGICAL EFFECTS OF A CEREBRAL BIRTH PALSY*

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1. INTRODUCTION

Double athetosis of severe grade arising out of a birth injury to the basal ganglia and associated with cerebral palsy constitutes one of the most disabling handicaps to which the human nervous system can be subjected. The remarkable degree of normal mental development which is achieved in spite of profound motor handicap cannot fail to have import for psychological theory.

Over a period of ten years the writer has been following the developmental career of a boy who was stricken with cerebral palsy as a result of obstructed cerebral blood supply at the time of birth. The patient first came to our notice at the age of 4 years. In body length and weight he was slightly in advance of the average for his age. He had suffered only a few minor illnesses; slept well, and was not markedly fatiguable. His features and torso were well formed. His countenance was normal, attractive, and expressive for brief intervals when not in the throes of involuntary activity. He could not hold up his head, sit up, creep, reach, nor manipulate. At times he was quiescent, but under the least excitement, arms, head, fingers, also face, mouth, tongue—and to a lesser degree, legs and toes—went into apparently aimless extensions, flexions, and rotations, with antagonistic muscles shifting their ascendancy. Occasionally the double athetosis became extreme, the movements on the right side being most pronounced and abrupt. There was recurrent spasticity. Crossing of the legs disappeared on relaxation and was not associated with marked contracture. Right and left abdominal, cremasteric and Babinski reflexes were present; eye grounds and pupillary reflexes were normal; knee jerks were variably moderate or hyperactive. Spasms of the pharyngeal, lingual, and associated muscles made swallowing, mastication, and phonation difficult. There was frequent salivation. These latter characteristics combined with the motor disability had led a previous physician to a diagnosis of mental deficiency.

This boy was never committed to an institution. He received devoted and intelligent care from his family, and special educational

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measures were undertaken in his behalf. He died a few months before the age of 14 years of appendicitis. His nervous system came to necropsy, and has been minutely investigated. A detailed report of the correlations of the behavior characteristics and neuropathological findings will be published in a joint study from the Clinic of Child Development and the Department of Pathology of the Yale School of Medicine.

The present paper limits itself to a summary of the mental development which took place between the fourth and the fourteenth year.*

2. EARLY BEHAVIOR STATUS

A developmental survey of A. C. at the age of 56 months yielded the following ratings, on some 30 items. The assigned developmental levels represented clinical judgments based upon close observation; but unassisted by language, for even a clear cut distinction between a *no* or *yes* gesture was beyond his motor capacity. The ratings in the field of motor control must not be taken too literally, because the disorganization of movement was so great as to permit only crude comparison with normal abilities.

Developmental Items	Assigned Level	Developmental Items	Assigned Level
Physique		17. Comprehension	48-60 mos.
1. Chronological age	54 mos.	*Adaptive Behavior*	
2. Height	60 mos.	18. Form and size	48-60 mos.
3. Weight	60 mos.	19. Color	48-60 mos.
4. Dentition	60 mos.	20. Number	36 mos.
Motor Control		21. Autocriticism	48-60 mos.
5. Swallowing	5 mos.	22. Attention span	60 mos.
6. Head posture	3 mos.	*Personal-Social Behavior*	
7. Body posture	3 mos.	23. Bowel control	36 mos.
8. Body control	6 mos.	24. Bladder control	36 mos.
9. Locomotion	9 mos.	25. Emotional control	56-60 mos.
10. Grasping	3 mos.	26. Affection	56-60 mos.
11. Reaching	3 mos.	27. Sociability	56-60 mos.
12. Holding	12 mos.	28. Humor sense	48-60 mos.
13. "Crayon control"	12 mos.	29. Social insight	48-60 mos.
Language		30. Play interests	36-48 mos.
14. Vocalization	4 mos.	31. Story interest	36-48 mos.
15. Vocabulary	18 mos.	32. Educational attitude	60 mos.
16. Gesture	18 mos.		

* Several members of the staff of the Yale Clinic of Child Development participated in the study and the training of A. C. We are particularly indebted to the observations and assistance of Drs. Elizabeth Evans Lord, Burton M. Castner, and Ruth W. Washburn. Mrs. Mary McGrath had immediate charge of the intensive educational program, when A. C. was 10 years of age.

The above tabulation gives indication of a most unusual complex of abilities and disabilities. The total behavior picture could not be construed as one of feeblemindedness in any true clinical sense. Although the motor performance was at an infantile level, A. C. never gave an impression of infantilism. His general somatic development, and particularly his personality traits, indicated that he was potentially of normal or even superior capacity and that the birth injury had inflicted a selective rather than a pervasive damage to his behavior equipment. In spite of the extreme motor discoordinations, his personality remained relatively well integrated with well sustained and discriminating emotional attitudes toward his social environment. He won for himself a circle of friends among children of his own age, who visited him and managed to play with him on their own level of social maturity.

These personality characteristics must be given important weight, if we are to arrive at a just correlation of the behavior picture and the neuropathological picture. He was able with great efforts to express yes and no by crude head gestures which were so ungoverned that they resembled each other, but which his family could sometimes differentiate. He was practically unable to combine a consonant and a vowel, but he managed to make a few slightly distinctive vowel sounds associated with different meanings. A single brief incident must suffice to convey an impression of the most normal aspects of his behavior.

He liked to be propped up at the window so that he could participate in the life about him. On one occasion (age 4 years) he was watching some construction work on the street. He saw the neighbors' children having great fun crawling through the big drain pipes lying by the side of the road. He became greatly interested. Though unable to articulate he ejaculated "I-I" in no uncertain terms. This was his most vivid utterance used whenever he was able to muster it, in all situations in which he wished to call attention to his own stake in any event or plan. It was his unmistakable way of indicating that *he* wished to crawl through those pipes too. Doubtless he had enough "autocriticism" to know that he could not crawl; but he also had enough imagination and drive to desire all possible experience, from sliding down a banister to riding horseback. With the aid of his sisters he was brought to the entrance of the pipe, and by their combined efforts and his struggling cooperation, he was propelled through the big drain pipe tunnel, to his great delight.

His personality sense was so robust that he wished to have the

same school-going status as his playmates. Partly for this reason and also to determine his learning capacities we devised from time to time lessons in "reading," "drawing" and "number work." There was little difficulty in enlisting the pupil attitude. By the age of 7 years he gave sustained attention for 30 minutes in a reading lesson.

A normal infant, 4 months old, lying on his back can hold his head in the midposition, watch intently a rattle dangled above his chest; and can moreover bring both arms to the midline, close in on the rattle, and grasp it. A. C. was never able to execute this most elementary act of prehension; and yet he used his oculo-motor muscles with alertness and perceived incongruities in a caricature drawing of a man. The limitations of his experience in manipulation and locomotion did not inflict a drastic arrest of his perception and appreciation of spatial relations.

Likewise in the field of language. His actual utterance was at a meagre, infantile level; but his comprehension of words and even verbal nuances was at a normal level. In number comprehension he distinguished betwen two and three telephone rings and probably had a concept of four. His humor sense, his amusement at accidental absurdities in the home life, his story and play interests, all suggested a considerable approximation to normality in the perception and appreciation of social relations.

3. LATER BEHAVIOR DEVELOPMENT

On the basis of the behavior picture at 56 months of age, it was not easy to predict the subsequent course of development. To what extent were the foregoing indications of normal though atypical behavior characteristics borne out in the subsequent nine years of life?

Even before the age of five years, as already suggested, A. C. showed a certain eagerness to be going to school. For this reason his early contacts with the clinic had been converted into blackboard lesson periods which served him as a substitute for school, and gave us an opportunity to observe his response to the teaching of words and numbers. Ordinary methods could not be used. We had to rely on his rather ambiguous yes-no head gestures, on crudely differentiated phonations, on facial expressions, to establish communication. With the aid of the blackboard it was possible to present words, incomplete sentences, incomplete drawings, numbers, and sums. By devising games it was possible to test with varying degrees of certainty his powers of recognition and memory.

In a few sessions he learned to distinguish simple words like *ball, cat, hat, man.* By the age of 7 years he had learned to recognize with variable success perhaps 35 words. In listening to stories his interest had advanced from *Black Sambo* to *Three Bears* to *Grimm's Fairy Tales.* There was hope that with greater maturity he might learn to read. He had even made some progress in holding a large crayon thrust in his hand, but had made no gain in directing it. His attention span and his social maturity showed a slight, steady increase. His "lessons" at home and at the clinic were irregular and occurred about once a week. At the age of 8½ years his attainments were reviewed and it was concluded that he showed essentially the same ability to deal with printed words and numbers which he had shown at the age of 5 years. He gave no convincing evidence that in power of abstraction or true ability to read he was equal to the intellectual level of a normal six year old.

For another year his "schooling" continued in a rather desultory manner. His articulation improved slightly. At favorable periods of relative relaxation he could "pronounce" numbers up to 10, with crude phonetic discrimination of the vowel values. He had scarcely any command over consonants. At the age of 9½ years he had a recognition reading vocabulary of about 50 words.

In spite of the limitations revealed by this rate of progress, it was decided that the potentialities of intellectual development could only be determined by a more systematic teaching program. It might well be that A. C.'s training thus far had been too incidental and irregular to overcome his profound handicap. A skilful teacher was engaged over a period of 6 months to give training five times a week in two-hour sessions. As a stimulus and to satisfy his ambition to attend a real school, the lessons were conducted in a separate room of an elementary school. A reading frame was placed athwart his perambulator; interest provoking devices were used, but the earlier playful approach gave way to a more serious attack. He made a good adjustment to the new regime. He soon was scanning with his eyes seven successive pages of the book supported in the reading frame. The eye movements accompanied by vocalization, inflections, and tongue movements gave the appearance of silent reading.

His behavior and his story interests were more mature than they had been. By the end of the 6 months he increased his reading vocabulary to 101 words. But again it was not clear that he read with full insight. His progress in simple number operations was meagre. He showed only occasional spontaneous interest in reading

by himself at home. The significance of these limited responses to more intensive training will be discussed later.

During the four remaining years prior to his death he made no considerable academic gains. He matured however in his emotional life and his social interests. He learned to play a simple game of checkers, attending closely for 20 minutes. He named his moves by vocalizing the number of a checker and indicated right or left by yes or no. He showed a preference for boy companions of his own age, and also gave signs of pre-adolescent bashfulness. He could read the clock and was permitted to play the part of monitor in a rural school room which he attended daily for an hour.

His neurological symptoms were only slightly ameliorated in spite of the fact that physiotherapy treatments were faithfully continued for years. His cooperation in the muscle training was excellent both at home and at the hospital, and he showed morale in enduring the pain involved. The spasticity of arms and hands somewhat diminished. He learned to open his hand voluntarily on many occasions. He was able to sit for a half hour supported by pillows, without pitching. Salivation decreased and articulation was slightly improved. In the intellectual sphere his rate of later development was distinctly slower than it had been during the first five years of his life. There is evidence that in the emotional and social spheres his development was slowly advancing and that he would have continued to mature during the period of adolescence.

4. THE MOTOR BASIS OF MENTAL GROWTH

The approximation to a normal as opposed to a feeble-minded mental organization was most convincingly shown in the field of social and emotional behavior. Here A. C. gave evidence of undergoing a steady progress toward mature levels of functioning. He advanced in his play interests; he changed as just noted in his attitudes toward children and adults; he showed characteristic pre-adolescent attitudes toward his mother. In spite of the inevitable dependency inflicted by his handicap he showed considerable morale in trying situations. To be sure he also showed traits which would have been regarded as childish in an unhandicapped child, but it seems important to stress here those behavior characteristics which proved that his central nervous system was not uniformly arrested by the ischemia which so extensively damaged the functions of his tactile-motor system. The vitality and fullness of the mental growth of A. C. were

truly remarkable when we consider the paucity and disfigurement of his kinesthetic experience.

How can we explain this significant approximation to a normal although impoverished realization of mental growth? A thorough-going motor theory of psycho-genesis would seem to be inadequate to account for the degree of mental growth which was attained. In many respects the handicap of A. C. was more devastating than that of Helen Keller. And he was denied those experiences in the field of kinesthesia and active touch whereby Helen Keller overcame her sensory defects. He was almost postureless and lacking in the simple postural sets which normally lie at the basis of attention and mental adjustment.

It may be argued that the fullness of A. C.'s development depended upon the intactness of his auditory and particularly his visual functions. Visual experience was probably least affected by his brain injury. His eye grounds were normal and the early internal strabismus was self-corrected. He even attained the ability to make eye movements of a reading type. It is possible that the kinesthetic data furnished by his 12 oculo-motor muscles supplied the main scaffolding for his mental equipment.

These muscles, it may be contended, were able to muster and maintain within themselves a degree of postural set. By such reasoning the motor theories of mental growth retain their strength. The argument simply states: (a) there is a tendency toward optimal realization and integration of potentialities; (b) this tendency caused the total mental growth complex of A. C. to organize itself about a nucleus of oculo-motor experience. It seems to us, however, that this interpretation somewhat strains both the theory and the facts.

How shall we explain the numerous propensities and strivings toward attainments for which this handicapped boy had no equivalent motor realization or even possibility of motor execution? Even at the age of six months he showed an unmistakable propensity to reach for objects, an amazing fact for he never in his whole life time attained a neuro-motor equipment sufficient to execute prehension or to exercise in a controlled way the function of active touch.

In reviewing his life history one definitely gets the impression that his neurological growth did not altogether depend upon the stimulation of motor experience. It is because the unimpaired regions of the brain realized such a full measure of their potential growth that he gave no impression of suffering from a form of secondary amentia.

This does not of course mean that his intellectual life was not im-

poverished. As he grew older his motor abilities took a cumulative toll, although his verbal comprehension at a concrete level remained relatively normal. He understood conversation about ordinary domestic affairs but he showed limited curiosity about affairs remote. He detected verbal incongruities and reacted to them with a sense of humor, but he did not show abstract interest in words nor did he demand silent reading or reading aloud to increase the scope of his information. Verbal auditory imagery apparently was present but it lacked the context and vitality of articulatory kinesthesia. He was crippled with respect to "carriers" of notions and ideas. He suffered from a kind of intellectual reduction due to faulty proprioceptive implementation. But even this reduction never brought him into the category of feeblemindedness strictly defined. In spite of his intellectual poverty he retained normal modes of thought and a certain perspicacity which clinically was inconsistent with either amentia or dementia.

We infer therefore that the insurance factors of maturation brought about a considerable degree of neurological growth in unimpaired regions of the brain even though these regions are cut off from normal subcortical (tactile-motor) impulses. Such insurance factors enable the organism to some extent to build bricks without straw. It is difficult to think of mental organization apart from tangible (tactile-motor) components. But the new concepts of growth chemistry permit us to believe that the protein molecules of the central nervous system may undergo considerable elaboration and electro-dynamic organization without the stimulus of patterned motor reactions.

With such concepts the evidences of normality in certain cases of cerebral palsy become less enigmatic. There is after all no inner necessity why profound motor disability should create or produce an equivalent measure of mental defect.