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A STUDY OF THE EFFECTS OF CERTAIN PHYSICAL ACTIVITIES ON
THE PROGRESS OF READING COMPREHENSION,
WORD KNOWLEDGE, AND RATE



A Thesis
Presented to
the Graduate Faculty
Central Washington State College



In Partial Fulfillment
of the Requirements for the Degree
Master of Education



by
Neil Allen Cummings
August, 1968

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

The great majority of a child's success in school is dependent upon his ability to read. Those having difficulty in this area too often develop a negative attitude towards any type of reading assignment. This makes any corrective steps all the more difficult. As Thorndike and Woodyard put it:

It is a matter of common knowledge that a mind which for any reason becomes engaged in an activity and finds itself repeatedly and persistently failing therein, is impelled to intermit or abandon it. The person does abandon it unless this compulsion is counter balanced by some contrary force, such as hope of a turn of the tide toward success, or an inner sense of worth from maintaining the activity or a fear that worse will befall him if he stops (50:241+).

Probably the most common treatment for a remedial reader is to differentiate him from the rest of the class by sending him to a reading specialist. The child's reactions to such a situation will most likely be one of contempt for the teacher that has referred him for this special help, a feeling of being inferior to the other members of the class, and an even greater negative attitude towards reading because the child is expected to improve a skill by working at something he does not like.

It has been the writer's feeling that such problems might not need to be handled outside of the classroom, that

there must be another way of improving reading without having to force the child to read extensively.

I. THE PROBLEM

Statement of the problem. It is the purpose of this paper (1) to study the affects of certain physical activities (creeping, crawling, balancing and rhythm) related to the improvement of comprehension, vocabulary, and rate of reading; (2) to compare the amount of progress in reading of the boys to the progress of the girls; and (3) to compare the amount of progress of the high, middle, and low reading groups.

It is the intent of this study to test the following null hypotheses:

1. Crawling, creeping, balancing, and rhythm will have no effect on reading comprehension.
2. Crawling, creeping, balancing, and rhythm will have no effect on reading speed.
3. Crawling, creeping, balancing, and rhythm have no effect on reading vocabulary.

Importance of the study. In the last few years there has been much research in the field of reading and the slow learner. Such people as Delacato, Frostig, and Kephart believe that there can be some hope for the remedial reader without involving him in extensive reading activities. These authorities feel that many reading problems result from a

lack of development of physical coordination. This deficiency, they feel, can be corrected through activities that would involve hand-eye coordination. If this is true, then many children suffering from this disability can be given the necessary activities to improve their coordination by a competent physical education teacher.

While participating in this physical education program, the child will have a great opportunity to improve his self-concept. This is not a program where the uncoordinated run the record player while the more able are participating. It is very important that those with lesser visual-motor coordination be expected to try to perfect the activities that they are having the most difficulty with. In doing so the child may benefit in two ways. The first would be an improved visual-motor coordination which might lead to improved reading skills. The second is an improvement of self-concept because of his ability to master certain hand-eye coordination activities. The ability to master these activities should lead the child to believe that he might also succeed in other areas of difficulty if he just puts forth the effort.

II. DEFINITIONS OF TERMS

Creeping. Creeping may be defined as a means of propelling the individual's body by use of his hands, knees and feet while in contact with the surface.

Crawling. Crawling may be defined as locomotion with the abdomen in contact with the surface.

Balancing. Balancing involves those motor skills necessary to maintain a standing position, an inverted position (head stand), or an upright position when both feet are off the surface (trampoline).

Rhythm. Rhythm, for the purpose of this study, is movement in which some action, step, etc., is regularly done.

High reading group. The high reading group consisted of those children reading at the seventh grade level or above.

Middle reading group. The middle reading group consisted of those children reading at the fifth and sixth grade levels.

Low reading group. The low reading group consisted of those children reading below the fifth grade level.

CHAPTER II

REVIEW OF THE LITERATURE

During the last decade there has been much concern over the retarded reader. Determining the degree of retardation is difficult due to a lack of agreement, by reading authorities, as to what constitutes reading retardation. Some consider a pupil retarded if his reading score is considerably lower than the average for his chronological age, or for his grade in school. Others believe that he is retarded if he falls below the norms for his mental age. Some feel that as long as the child achieves the average for his grade, he can't be considered a retarded reader. This writer chooses to classify a child as "retarded" if he has the capacity to perform at a higher level.

Estimates of reading retardation in the elementary schools vary greatly. DeBoor and Dallman (11:267) give conservative approximations at 10 to 12 per cent of the pupils while others place the estimate at 30 per cent or more.

With the increased scholastic pressure placed on the children of today it becomes apparent that we must, more than ever before, discover methods for helping the retarded reader. Many methods are being used to help the retarded reader and much experimentation is being conducted to develop new techniques to aid those who do not benefit from methods already in use.

It has only been in the last few years that some authorities in reading have turned to specific physical activities as a means to help the retarded reader. Such people as Marion Frostig, Glenn Doman, Carl Delacato, and Newell Kephart have developed reading improvement programs based on various physical activities. They have made claims of successes with their programs while others have tried their methods and have failed to note any significant improvement in reading ability of their subjects.

The purpose of this study was to examine some of the various theories and methods used by the aforementioned people, to select some physical activities to be given to fifteen children of the experimental reading group, and to test the progress made by the experimental and control groups at the end of one school year to determine if the physical activities of crawling, creeping, balancing, and rhythm have an effect on reading comprehension, speed, and vocabulary.

I. READING THEORIES

Perhaps the men who have created the greatest controversy over a theory are Glenn Doman and Carl Delacato. Though the neurological approach to teaching reading has been publicized in recent years, Doman and Delacato began the studies in this field over twenty years ago.

A group of specialists working outside of the reading field in areas related to reading treating brain-injured children were not satisfied with the results achieved in their respective fields. They united to concentrate their efforts on the treatment of 104 brain-injured children for three years. This group included Glenn Doman, a physical therapist, now Director of the Institutes for the Development of Human Potential at Philadelphia; Dr. Carl Delacato, Ed. D., present Director of Language Disability at the Institutes; Dr. Robert Doman, Medical Director at the Institutes; a physical therapist; a psychologist; a speech therapist, and a nurse; Dr. Temple Fay, Neurosurgeon, deceased.

Their three years of work proved to be a failure. Having tried all known methods of treatment for brain injury with the experimental group, the children of the experimental group were no better off than those of the control group.

The group spent three months of re-evaluation of their methods. Sister Joseph Cecilia summarized their research:

. . . this team concluded that the injury occurs in the brain, and that the brain should be treated, not the symptoms. The common practice was to treat the eyes, ears, nose, mouth, arms or legs, but these were only the symptoms not the cause of the impairment.

In studying hundreds of brain-injured children and hundreds of normal children, the team developed theories, experimented, collected and evaluated the results. Their re-theorization resulted in the following theories:

1. From conception to about eight years of age the nervous system develops through the spinal cord and all other areas of the central nervous system up to the cortex of the brain in the following progression:

- a. development of a spinal cord and medulla - (movement but no mobility)
 - b. development of pons - (crawling on stomach)
 - c. development of mid-brain - (creeping on hands and knees)
 - d. development of cortex - (walking and talking)
 - e. development of cortical hemispheric dominance - (the use of the right ear, eye, hand and foot, or the left eye, ear, hand and foot).
2. Neurological organization can be measured in six areas:
 - a. mobility
 - b. speech
 - c. manual skills
 - d. auditory skills
 - e. visual skills
 - f. tactile skills
 3. Children develop at various speeds through these areas.
 4. Children who fail to develop each stage in order exhibit problems of mobility or communication.
 5. Neurological growth can be slowed down by deprivations in environment and stopped by brain injury.
 6. Those areas of neurological organization not completed or absent can be developed by passively imposing them upon the nervous system thus helping brain-injured children to perform at normal levels, and normal children to increase their mental ability. The I.Q. does not actually change but the capacity to express the real I.Q. is increased day by day (8:17).

Based on these theories, experimentation and research, The Institutes treat injured brain seven non-surgical and six surgical ways.

Dr. Carl H. Delacato explains the outline mentioned above in greater detail. His explanation of neurological organization is as follows:

Neurological organization is that physiologically optimum condition which exists uniquely and most completely in man and is the result of a total and uninterrupted ontogenetic neural development. This development recapitulates the phylogenetic neural development

of man and begins during the first trimester of gestation and ends at about six and one half years of age in normal humans. This orderly development in humans progresses vertically through the spinal cord and all other areas of the central nervous system up to the level of the cortex, as it does with all mammals. Man's final and unique developmental progression takes place at the level of the cortex and it is lateral (from left to right or from right to left) (15:19).

Delacato's chart clarifies his theory of neurological organization and its progression in man (13:66-67).

	Highest Neurological Level	Mobility	Vision	Audition
Newborn Infant	Medulla	Trunkal movement	Reflex	Reflex
Fish	Medulla	Trunkal Movement	Reflex	Reflex
Four-month old infant	Pons	Homolateral crawling	Bi-ocular	Bi-aural
Amphibian	Pons	Homolateral crawling	Bi-ocular	Bi-aural
Ten-month old in- fant	Mid-brain	Cross pattern creeping	Binocular yoking	Binaural
Reptile	Mid-brain	Cross pattern creeping	Binocular yoking	Binaural
One-year old infant	Early cortex	Crude walking	Early Fusion	Early Stereo- phonic
Primate	Early cortex	Crude walking	Early Fusion	Early Stereo- phonic
Eight-year old (who speaks, reads and writes)	Cortical Hemispheric Dominance	Cross pattern walking	Stereopsis with predomi- nant eye	Stereophonic hearing with predomi- nant ear

According to Dr. Delacato (13:85) at the first level of neurological organization, most children, unless brain damaged and severely disabled, have the simple trunkal movements which display neurological organization of the spinal cord and the medulla.

Gesell (22:18+) indicates that the tonic neck reflex (t.n.r.) underlies most of the four-week old infant's postural behavior, and that it is part of the "ground plan of the total reaction system." Piaget (35:32) even goes further. He feels that reflex patterns form the basis for intelligence and through use they are reinforced, and because of the development of higher levels of accommodations they are assimilated. Delacato (16:28+) feels that the t.n.r. and what it connotes in terms of total neurological organization is a critical factor in the evaluation, treatment and prevention of language disabilities.

To evaluate the neurological organization at the level of the spinal cord and medulla, Dr. Delacato observes the child while sleeping in a prone position. The posture the child assumes indicates the degree of neurological organization at the first level.

Delacato (16:344) feels that only with a proper posturalization basis can the individual achieve the more complex neuro-muscular unity and organization required by cortically controlled accommodations. He believes that such

unity is prerequisite to skilled cortically controlled sensory motor functions which operate in a wholistic and serialized pattern. He also feels that such unity is prerequisite to the development of efficiency of communication.

Delacato lists the proper posturalization steps in the prone position (these patterns are also relevant in the supine position but are reversed):

1. The eyes looking toward the subdominant hand.
2. The arm and leg flexed on the side which the child is facing.
3. The opposite (dominant) arm and leg extended.
4. The hand near the mouth (subdominant) should be palm down with the thumb pointing to the mouth.
5. The extended hand (dominant) should be palm up and near the hip (16:34+).

He (16:37) goes on to say "We find that good readers do have a specific sleep pattern. In this pattern the good reader sleeps facing the subdominant hand with the subdominant leg flexed." Delacato (16:30) claims that the reason that poor readers do not sleep in such a position is because of a lack of organization which prevents the serialization required in this pattern. "Poor readers have all of the component reflexes and skills required for the reflex, but their neuro-muscular systems are not organized so that the serialization of the various neural components can take place." He further feels that this helps to explain at least in part why poor readers are found by many investigators to seem to be uncoordinated in running, jumping, walking, and writing.

The second neurological level is that of the pons. At this level, states Delacato (13:14), the child's mobility consists of crawling on his abdomen in a homolateral pattern. That is, the child propels himself by flexing the arm and leg on one side of the body while extending the arm and leg on the opposite side. His head also turns towards the side of the body that is flexed. As he moves, the entire body position is reversed. Delacato goes on to explain the crawling process in this way:

Mobility is a two-dimensional function aimed at seeking vital and basically crude comfort. This body position places the eyes in such a position that the infant is bi-ocular in visual performance. That is, as his right arm and leg come up his right eye looks at the right hand, the left eye does not. It remains in contact with the crawling surface. As the position is reversed, the left eye looks at the left hand, and the right eye has no part in the visual process. At this stage the child operates visually biocularly, using only one side of his body at a time in the homolateral pattern (13:14).

Because the tonic neck reflex governs early homolateral crawling, Delacato (15:22) evaluates the level of the pons as he does the first neurological level. Children who are well organized at the level of the pons sleep in a prone position and in a homolateral pattern.

The hand-eye coordinations are initiated at the third level. At about nine months of age the normal child's mobility will be under the control of the mid-brain, writes Delacato (13:92+). He explains that the child at the level of the mid-brain must be permitted to develop proper hand-eye

coordination because hand-eye relationships are prerequisites to language development.

At this third level the child shows further progress in his mobility. Delacato (15:15) explains that the child goes from the crawling movements to creeping on his hands and knees with his abdomen no longer in contact with the floor. Now, as the child moves, the opposite appendages are used. First the right hand and left knee then the left hand and right knee are used to propel the child. The child has thus changed from a homolateral (one-sided) organism to a cross-patterned organism who is bilateral or two-sided.

Dr. Delacato explains briefly the proper method of creeping:

His creeping should be smooth and rhythmical. It must be in cross-pattern, that is, the right hand and left knee should strike the floor simultaneously. The hands should be palm down and flat and the fingers should point straight ahead (15:22).

In vision, at this stage, the child begins to use both eyes in concert, rather than one eye at a time. He has progressed from biocular vision to binocularity.

Delacato explains:

The older children who exhibit a lack of good binocularity are those who have not been given enough opportunity to develop adequate Neurological Organization, which is the functional responsibility of the midbrain. Children who are not given adequate opportunities for creeping later develop problems in which binocularity is a variable (15:10).

Delacato (13:11) writes that the child's visual development is greatly enhanced by his cross-pattern creeping. As the child moves his head turns to look at the forward hand. The constantly changing head and neck position offers constantly changing sensory-motor cues for the eyes. This stimulation is a prerequisite for the development of yoking of the two eyes so that they can function together.

In summary of the third level Delacato claims:

Children who are not afforded the opportunities for development at the level of mid-brain in the area of vision, mobility and audition at the ages of seven to nine months are beginning to develop significant problems in communication. If they lack binocularity, binaural function and mid-brain overall responsiveness, we have started them on their way toward a disability in language (14:33).

From the age of one year to 18 months the child operates at an early cortical level. The neurological development at this level progresses at a much slower rate. It takes about seven more years to complete the neurological development of the cortex.

Delacato (13:56+) states that the child becomes increasingly proficient at bilateral activities and progresses to a new level of stereo function. The two separate visual perceptions received by both eyes are fused into one. The ears develop stereophonic hearing. There is a growing fondness for music which, at this time, is developed by using both hemispheres of the brain. As laterality progresses, musical activities become relegated to the sub-dominant hemisphere.

According to Delacato, this is a very crucial period in the child's development.

One of our great errors in the rearing of children has been the tendency to further accelerate the very rapid development of the first year of life.

He continues:

We have seen many children with reading and speech problems who had inadequate neurological organization because they were pushed by parents (13:59).

Delacato evaluates the early cortex level by observing the child walk. The child has now progressed from cross-pattern creeping to cross-pattern walking. As the child moves the right foot forward his left arm should move forward. The left hand should point slightly at the right foot and the child looks at the left hand. As the steps are taken the process is reversed. The movements should be carried out in a smooth rhythmical way.

Delacato (13:88) claims that "Children with language difficulties have historically been categorized as poorly coordinated. . . . They tend to use the arm and leg on the same side of the body at one time for moving forward."

While the child progresses towards laterality or cortical hemispheric dominance, Delacato (13:84) feels that involvement in musical activities, whether it be singing, playing an instrument, or listening, should be discontinued. Continuing musical activities while developing dominance, the child develops both hemispheres of the brain rather than

just the dominant hemisphere. Delacato (13:84) states, "We find upwards of 90 per cent of our cases who cannot establish cortical hemispheric dominance perform above the mean in music."

The final step in neurological organization is that of superimposing upon developmental continuum cortical hemispheric dominance.

At this stage, states Delacato (13:64), the organism becomes totally human being right handed, right footed, and right eyed with the left hemisphere of the brain controlling the skills and the right hemisphere of the brain assuming a sub-dominant role. With the left handed individual the dominant and sub-dominant hemispheres of the brain would be reversed.

Delacato (16:23), Roberts (38:17+) and Orton (34:1095+) believe that visual records or engrams, found in the dominant hemisphere of the brain are used in making symbolic associations.

Orton explains the structure of the brain and the engramic theory in this way:

Structurally, however, there is no such contrast between the two hemispheres. The non-dominant associative area is as well developed in size and complexity as is the dominant, and current neurologic belief (neurobiotaxis) would imply that this silent or inactive area must have been irradiated equally with the active to produce an equal growth. Such an irradiation, moreover, would presumably leave behind it some record in the cells of the non-dominant side which one may call an "engram". The engram in the non-dominant side would be opposite in "sign," however, from that of the dominant; i.e., it would

form a mirrored or anti-tropic pattern. Under usual circumstances only one of these reciprocally paired engrams operates in association with the concept in reading, and its antitropic or mirrored mate is elided or remains inoperative. If, however, the physiologic habit of complete elision of these engrams of the non-dominant hemisphere were not established, their persistence might readily serve to explain the failure to differentiate between "p" and "q" and between "was" and "saw", and also to account for facility in mirror reading and mirror writing, and thus to explain those confusions of direction which have been extensively recorded in the literature and which as here described seemed to characterize all the cases of my own series. (34:10+)

Delacato (15:48+) found, in groups of good readers, more than 60 per cent are completely one-sided. In groups of superior readers the figure ranges from 60 to 80 per cent who are completely one-sided.

On the other hand, Delacato made a study of 92 pupils with reading problems who were at the Institute of Reading Disability. He found six per cent to be completely one-sided and five per cent were found to demonstrate mixed laterality. Of the remaining students, 56 per cent demonstrated right handedness and mixed eyedness, six per cent demonstrated left handedness and mixed eyedness, and 25 per cent demonstrated mixed handedness and mixed eyedness.

Delacato stresses the importance of each child having the opportunity to reinforce their sidedness so that he develops complete unilaterality. Adequate opportunity results in one-sidedness for handedness, footedness and eyedness. As Delacato (15:16) puts it, "Only as he develops complete one-sidedness can the child begin the process of becoming

completely human in terms of his receptive and expressive abilities." He (15:29) further states that a program of neurological organization, stressing sidedness, has been of great help in improving the reading performance of the mixed dominant child.

To review briefly Delacato's whole process of development of readiness to read we must begin at the child's birth (spinal cord and medulla). From there he progresses to the level of the pons, which functions in an alternating one-sided manner. Next he progresses to the level of the mid-brain, which is two sidedness, then to the level of the cortex, which involves the stereo functions. Finally the child at about the age of six to eight years reaches complete cortical hemispheric dominance.

The second theory reviewed by Sister Cecilia (9:17) is the measurement of neurological organization. Delacato evaluates neurological organization by observing tactile skills, auditory skills, manual skills, speech, and mobility. The means by which Delacato evaluates these areas was discussed briefly in the previous pages dealing with Delacato's five levels of neurological organization. These areas will be treated in greater detail in Part II of this chapter and in Chapter III.

The third theory that children develop at various speeds is accepted by most authorities. Delacato's belief

in this theory is demonstrated in his writings of the various neurological levels. The writer noted that Delacato did not state a specific time at which a neurological level was to be completed and another to begin. His chart would indicate this but in reading his explanation of the chart, Delacato (13:68+) would state "at about the age of" or "between the months of" etc.

A fourth theory of Delacato (13:13) states that children who fail to develop each neurological level in the proper sequence exhibit communication or mobility problems. He goes on to say that such problems are not hopeless. He continues to theorize:

Those areas of neurological organization which have not been completed or are absent are overcome by passively imposing them upon the nervous system in those with problems of speech and reading. When the neurological organization is complete the problem is overcome (13:7).

This fifth theory is the basis of Delacato's program of reading improvement. Children are observed while participating in various neurological tests. From the observations those areas of weakness are noted. A program is then developed to reimpose missed neurological development.

According to Delacato (14:34) there are no shortcuts to these developmental processes. Only by going through the process can the individual form good perceptual abilities.

The final theory stresses the importance of environment on the neurological growth of the child. A child that is not afforded the opportunity for development in the area of vision, mobility, and audition, at the early ages of seven to nine months, begins to develop significant problems in communication (15:16). Orton stresses the importance of environment in child development also when he writes:

. . . there are certain periods in a child's development--notably between two to three, and six to eight years of age--which are critical in the development of the language function, and interference with inherent handedness patterns at these times seems much more prone to give rise to difficulties than at others (34:64).

Delacato gives many ways that may correct the environment to aid in neurological development. Some of these will be listed in Part III of this chapter.

It has been this author's intention to explain in some detail Dr. Carl H. Delacato's theories. Though there are other authorities in this field, none have raised as much controversy as Delacato.

Newell C. Kephart in his book The Slow Learner in the Classroom has also stressed the importance of certain physical activities in correcting reading problems. Though these men are in general agreement as to etiology of disfunction they differ in areas of emphasis in treatment. Kephart focuses treatment on environmental deprivation, and is concerned with the child's orientation to his environment.

Delacato, however, places environmental deprivation as only a sub-category of brain damage.

As has been noted Delacato follows explicitly stated rationale, Kephart does not. Kephart's treatment procedures are designed to improve the child's relationship to his environment. To function successfully in his environment, the child must be oriented to gravity as well as being aware of his position in space.

Kephart concerns himself with neurological development up to the level of the cortex but does not consider hemispheric dominance a vital concern. He contends that hemispheric dominance occurs naturally without direction or encouragement from structured environment. Delacato, on the other hand, encourages dominance by training individuals to be one-sided.

Kershner (30:13) cites two statements of Kephart which indicates a significant departure from Delacato. Kephart states, "It is important to remember that educator's interest is not in the development of specific motor activities. There are no specific motor functions which are essential to the development of learning." In the second statement Kephart openly conflicts with the rationale and treatment of the Neurol-psychological Theory when he says,

It is easy to assume that in the education of the brain-injured child one simply goes back developmentally to that stage where development broke down and recapitulates the normal development of the child. Such a simple solution to the problem, however, does not exist.

The basic conflicts between the "educational" approach and "physiological" treatment have been stressed in the previous paragraphs. Having discussed physiological treatment of reading difficulties, the next several pages will be devoted to the educational approach.

Kephart states that many children are entering our schools lacking in basic perceptual motor skills.

As a result of this basic lack, they are less able to participate in the formal educational activities which are arranged for them and they are less able to learn from these activities. They become slow learners in the classroom.

For many of these children, artificial means may have to be devised to provide additional practice in perceptual-motor skills. We may have to arrange for additional experimentation, extending that which we are accustomed to assume has been adequate. We may have to bring the equivalent of ladders to climb, fences to walk, or horses to ride, into the classroom and help the child to build up the sensory-motor skills which are required by the more complex activities of reading, writing, and arithmetic (28:16+).

Marianne Frostig's program is similar to Newell Kephart's. To supplement the work sheet exercises, which train only eye-hand coordination, she includes a physical education program with several aims:

- (1) to develop coordination between vision and skills involving the arms and hands (catching and throwing a beanbag or a ball, rolling and catching a hopp);
- (2) to develop skills involving the lower limbs (running, jumping, hopping, skipping);
- (3) to develop strength and flexibility in the trunk (bending, jumping from a crouched position to a stretched one and vice versa, duck-walking with forward bending trunk, bending backward before throwing a large ball forward with both hands and thus using the body as a spring, trying to touch toes with fingers,

bending to each side in turn, climbing). Such a program provides training for every muscle group, and involves the coordination of vision with musculature (20:17).

Kephart explaining his program states:

Most of the tasks which we set for the child are complex activities combining many basic sensory-motor skills. If basic skills necessary to this complex of abilities are lacking, the total activity may break down. If these basic deficiencies could be supplied, they might make it possible for him to profit from the teaching activities which are presented to him and hence to increase his achievement (28:32+).

Balancing activities play an important part in Kephart's program for developing motor skills. These balancing activities are controlled by what Kephart calls "postural mechanisms" which are located in the so-called lower brain centers. From these postural mechanisms, states Kephart (28:39+), all movement patterns, and consequently all behavior, must develop.

Strauss and Kephart (47:197) explain that the posturing mechanisms are largely under the influence of the cerebellum. A feedback mechanism is located between the cerebellum and the higher centers of the cerebral cortex. When complicated behavior patterns are worked out in the cerebral cortex, action patterns resulting from the problem-solving situation are sent down through the brain stem to the muscles. As these patterns pass through the brain stem, they are acted upon by the cerebellum. If the behavioral patterns would interfere with postural adjustment, a veto is enforced at the brain stem level to prevent the behaviors from occurring.

There is a "short-circuiting" mechanism which sends these patterns back to the cortex to be reworked. Nature, therefore, assures us that no behavior will pass through and eventuate into action if it is contrary to the very basic postural mechanisms.

Kephart (28:39) cites an example of the control the postural mechanisms have on behavior. Stand about five feet from a table. Now reach out and try to pick up something from the table without moving your feet. As you lean forward you soon find yourself in danger of losing your balance. Don't let this disturb you. Tell yourself that this is an experiment and that you can certainly reach the object if your entire body were extended laterally. Having intellectualized the problem, go right on leaning until you fall on your face. Such a response is impossible. The normal person finds it impossible to lean forward past the point of balance.

The basic postural mechanism in the so-called lower brain centers have vetoed your fine intellectual solution and their veto stands. No further overt action in the dangerous direction is permitted. As a result, no further action can be performed. Thus, the mechanisms of posture dictate the final decision for action.

It follows from the discussion above that all movement patterns and consequently all behavior, must develop out of the posturing mechanisms. Movement not in accord with basic posture cannot be performed. Learned movement patterns and learned responses can only result from the elaboration and reorganization of the basic posturing adjustments. This process assures that posture is maintained and that it remains the core of the behavior pattern (23:39+).

Newell Kephart (29:42+) believes that a basic step towards reading is the child's development of directionality. The first of these directions to develop appears to be that of laterality, right and left. Laterality can be learned only through experimenting with two sides of the body. By experimenting with the movement of the two halves of the body, observing and comparing the differences in sensory impressions, and so forth, we sort out the right side from the left side. Kephart believes that the primary pattern out of which the child differentiates between the right and left sides is that of balance. He continues:

When experimenting with the balancing problem, the child must learn right and left, for he must learn how to innervate one side against the other, how to detect which side has to move, and how it has to move, in order to execute the appropriate compensatory movements as his balance varies from one side to another. Out of these and similar activities, he learns to differentiate the right from the left side. (29:43)

The importance Kephart places on balancing activities led this writer to believe that balancing activities should be incorporated into this study as part of the motor activities that the experimental group would experience.

Kephart does not wish to confuse handedness or right and left with laterality. He (29:44) states that laterality is an internal awareness of the two sides of the body and their differences. Laterality is extremely important because it helps us keep things straight in the world around us. The only difference between "b" and "d" is laterality.

According to Kephart (29:46+) when the child develops laterality within himself he is ready to project these directional concepts into external space. His eyes now play a very important part. Directional concepts which were formerly received through kinesthetic activity can now be supplied through vision. The child learns that when his eyes point in a given direction, this means that the object lies in that direction also. In order to learn this, he must make complicated matches between the position of his eyes and the position of his hands in contacting an object. Perfecting these complicated matches of the hands and eyes will permit the child to use his eyes as a projection device to determine directionality in space outside the reach of his hand.

Kephart, Frostig, and Delacato are in agreement as to the importance of hand-eye coordination in the development of reading skills. Each of these authorities have developed special techniques for developing this skill.

Roach summarizes by saying:

The establishment of laterality, perceptual-motor match, and directionality is the result of motor movement patterns becoming generalized. Knowledge of movement patterns has long been recognized by physiologists as very important to the individual organism; the understanding and description of movement patterns, however, has frequently evaded the scientist's effort. Motor patterns are complex movements which are more than the sum of individual, specific skills. There are many motor actions available to the individual which permit him to respond

and relate to environmental stimuli in a meaningful, consistent manner. Without such basic patterns, he has difficulty in the generalization of learning experiences (37:4).

Schilder has emphasized the importance of the body image in learning. He points out that it is necessary for the initiation of any movement. Thus, Schilder writes:

When the knowledge of our own body is incomplete and faulty, all actions for which this particular knowledge is necessary will be faulty too. We need the body image in order to start movements. We need it especially when actions are directed toward our own body. Every trouble in agnosia and in perception generally, will lead to a change in action. We have again and again emphasized the close relationship between the perceptive (efferent-impressive) side of our psychic life and the motor (afferent-expressive) activities. Consequently peripheral changes in the sensibility must lead to disturbances in actions. Central disturbances like agnosias will also be disturbances of action (41:45).

Kolson and Kaluger (31:33) write: "Disorientation may be related to the body schema of the younger child's own body or to the body of another, and/or to conceptual or verbal elements in an older child."

Kephart and Frostig stress the importance of developing a proper body image. They provide motor activities to guide the child's motor development toward an awareness of his body in space and what it can do. Such activities as climbing ladders or a jungle gym, walking on a beam, or bouncing on a trampoline provide the child with experiences of space and gravity. These activities and others will be discussed in Part II of this chapter and Chapter III.

As was mentioned earlier, one of the points that Doman-Delacato and Kephart disagree on is that of rhythm. Kephart (29:235+) believes rhythm is an important activity to aid kinesthetic and tactual problems. He feels that many of the problems of auditory span, temporal order, series information and the like, may be related to weakness in ability to establish and/or maintain rhythm patterns. Contrary to Delacato's dominance theory, Kephart believes that rhythm must be developed by each side of the body and with both sides of the body. Only when both sides of the body become equally skilled in rhythmical patterns can the child gain the total benefits from rhythmical activity.

Delacato (13:84) encourages rhythmic activities until the child begins developing a dominant side. At that neurological level rhythmic activities should be at a minimum, because such activities develop the non-dominant hemisphere of the brain.

Other research has been conducted on rhythm at Berea College, Kentucky and at Fryeberg Academy, Maine. According to Drake (18:202+), research from both institutes indicate that those children having extreme difficulty in "decoding" words and who exhibit bizarre spelling and written patterns usually have very little sense of rhythm. Drake continues:

When rhythmic training is combined in remedial reading, there seems to be some transfer of rhythm into the reading process. Those students who show the greatest growth in rhythmic development usually show the greatest gain in reading ability. Conversely, students who are unable to attain a normal growth pattern in rhythm can be expected to achieve poorly in reading (18:205).

Though some experimental research appears to confirm the theories previously discussed, there is perhaps as much that does not confirm these theories. Part III of this chapter will present research and experimentation which supports and discourages the use of physical activities as an effective method for treating those children suffering with reading problems.

II. READING PROBLEMS AND THEIR TREATMENT

This portion of the chapter is intended to point out various reading deficiencies and the means by which the educational approach and the neurological approach treat such problems.

Herman found that certain children with a reading disability attending his clinic seemed to be characterized by the following:

1. Children in this group seemed to have a defective acquiring capacity for reading.
2. The defect was often accompanied by a difficulty with other symbols such as notes in music, Morse code, and numbers.
3. Since the defect seemed to have a familial history, it seemed to be dependent upon constitutional factors.
4. However, there were no apparent intellectual defects, or defects of the sense organs.
5. There seemed to be, in the beginning, no internal or external inhibitory factors.
6. The disability persisted into adult life (25:17).

Bryant lists several neurological dysfunctions that he found characteristic in many cases of reading disability.

They are:

1. Motor impairment (below the norms for his age on the Lincoln-Oseretsky Test of Motor Development--usually not identified in a pediatric or neurological examination.)
2. Left-right confusion or history of confusion past age of seven or eight.
3. Abnormal or borderline EEG.
4. Aphasoid confusion with respect to time, size and distance estimation, months and seasons.
5. Inability to consistently perceive spiral after-image effects. This may represent distractability since subjects must fixate for 30".
6. Lack of certain perceptual skills (ignore details within known words when the words are flashed at 1/10" and even when encountered in sentences).
7. Sound-symbol association difficulties as reflected in reading errors and defects in learning new words (6:4).

Using an electroencephalogram, Grey and Walter (29:88) have recorded brain waves. They state that there are five waves: delta, theta, alpha, beta and gamma. Grey and Walter claim that the regular wave of adults during the time they are awake is the alpha. Walter discovered that in two-thirds of the people the alpha wave disappears when the eyes are closed. From this he classified people into three groups: persistent alpha, responsive alpha, and minus alpha. Two-thirds of the people comprise the responsive alphas. They can learn through a visual approach. The minus alphas have no regular alpha pattern. The persistent alphas are those whose alpha waves continue after the eyes are closed. They learn best through kinesthetic, auditory and tactile perceptions.

Kolson and Kaluger (31:22) account for the various means for treating reading problems. There are two different types of reading problems rather than the assumed one type. One type of reading disability case has a congenital cause. This group has been labeled as having a "primary reading disability." Such cases cannot be taught reading by visual or look and say method. "Instead, the program should consist of the employment of all the senses in such a way as to bring about some orderliness neurologically" (31:79).

The other type of reading disability, state Kolson and Kaluger (31:21+) has been labeled "secondary reading disability." Children suffering from this problem can be helped by various remedial programs to the point where they may return to the regular classrooms.

Continuing they cite various methods used by authorities for the treatment of secondary reading problems.

The problem of remedial treatment for secondary reading disability cases is an interesting one. There are as many methods suggested as there are people in the field. Smith and Dechant submit that what is remedial for one child may be developmental for another child. Bond suggests the use of a Visual-Auditory-Kinesthetic-Tactile approach. Monroe advances a phonic approach. Gates recommends the employment of the more traditional methods of teaching reading skills. Young claims the method employed is unimportant; the teacher is the important factor. Cooper would have the remedial treatment centered around the tracing of words in a sand tray. Regardless of the method used there always seems to be some success with secondary reading disability cases (31:21).

Carl Delacato (14:18) bases the diagnosis of reading problems on the degree to which the child has developed the neurological organization required for reading.

Delacato (14:29+) gives three reasons for reading problems:

1. Mixed dominance
2. Brain injury
3. Inadequate environmental stimulation

Continuing, Delacato states that the largest group, by far, is the third group. This group has been deprived of an adequate exposure to the stimuli which develops adequate neurological organization.

Doman and Delacato tested forty-five boys referred to the clinic. Each boy was diagnosed and taught for at least six weeks and each characteristic below was evaluated as to its presence or absence in each boy.

The following were titled Common in that each existed in thirty to forty boys in the group of forty-five.

1. Poor penmanship
2. Poor gross coordination
3. Poor manual dexterity
4. Tendency to read or write backwards in the first grade
5. History of a severe childhood illness or head injury

The following were titled Universal in that each existed in forty or more of the group of forty-five.

1. Early childhood thumbsucking of the thumb on the dominant hand
2. Posturalization during sleep with the sub-dominant hand prone, or no posturalization
3. Made a better score on test 5 or 6 (whichever tests the sub-dominant eye) than on test 5 or 6 (whichever tests the dominant eye) on the Telebinocular.

4. Gave some evidence of perceptual confusion in spelling and reading.
5. Some birth complications or longer period of labor than other children in the family
6. Some lack of unilaterality
7. Understood and used many more words than he could read

Upon evaluating the fairly common, common and universal factors one can easily deduce that these factors seem to be physical or developmental in nature (15:7+).

Kolson and Kaluger are not in agreement, however, with Delacato's symptoms. They state:

Delacato has identified these children through a group of symptoms which he claims has a neurological basis. A survey of his list of symptoms, however, shows them to be symptoms which can be found among normal achievers as well as the disabled readers" (31:77).

Newell Kephart agrees with two of the three reasons for reading problems Delacato lists. He does not take into account the dominance theory. Strauss and Kephart (47:1) feel that we must give increasing attention to the disturbances which are a product of the disruption of the total functioning of the organism rather than concentrating solely upon part or parts in which the defect occurs.

Kephart explains his reason for the use of physical activities as a means of treating reading disabilities in the following statement:

Because of the cyclical nature of the process, physical education becomes a part of reading and the too frequent dichotomy between muscular or motor activities and intellectual activities becomes untenable. Since we cannot separate the perceptual and the motor in the processes of the child, we should not attempt to separate them in teaching him (29:65).

Doman-Delacato's (14:25) treatment of reading difficulties is based on the assumption that experience affects the brain. They also assume that specific types of activities affect specific levels of the brain. A brief review of the various neurological levels and the treatment at each level is as follows:

Doman-Delacato begin treatment for reading problems at the level of the pons. At this level proper posturalization while sleeping and homolateral crawling is stressed. At the midbrain level creeping on hands and knees is developed. Early development of the cortex involves walking, vision, audition, and speech. Any form of play activity which requires the use of large muscles at this level is very helpful. At this time the use of the trampoline is extremely beneficial. While jumping Delacato (13:118) states ". . . various levels of the nervous system become dominant as he progresses from the beginning of the jump to the apex and back to the beginning of the next jump." The final level, cortical hemispheric dominance, is developed by creating a totally one-sided individual. Activities which are required involve the use of only one side of the body. An eye patch, for example, might be desired to promote the use of an eye which does not function in a dominant way.

If Delacato's theories are correct, each one of the levels mentioned above must be mastered before progressing to the activities of the next level. Skipping or only partially perfecting neurological development at one level will affect the remaining levels to be developed.

Newell Kephart's approach to treating reading problems is one of concern for educational difficulties rather than with etiology. Thus he directs his procedures toward the remediation of the problems of the "slow learner in the classroom."

Kephart's treatment procedures are designed to improve the child's orientation to his environment. To accomplish this orientation the child becomes involved in gross motor control, eye-hand coordination, temporal spatial translation, and form perception activities.

The child should experiment with drawing or copying to enhance his eye-hand coordination. Orientation to gravity and balance is achieved through practice on the trampoline or walking beam. Form perception and spatial relationships are attained through the use of puzzles and peg boards. The child's body image and motor coordination are enhanced by practicing various body movement patterns before a mirror or through imitating of various animals in a way differing from the normal walking or running.

According to Kephart (29:224+) one of the most helpful training devices for coordination and muscular control is the trampoline. The trampoline also provides a rhythm that the child must maintain to perform properly. There are very few activities that can demand such strict adherence to rhythm.

The trampoline also provides an experience with gravity, body image and direction. After being thrown clear of the canvas the child must develop a new sense of balance. He becomes aware of directions other than right and left. Using his body in various ways to perform the more complicated stunts, the child develops his body image and spatial relationships within the body.

Another apparatus Kephart uses for balance is the walking board. Kephart explains:

The primary function to be observed with the walking board is that of balance. We can also observe postural flexibility since the balance problem also creates a situation in which movements which cannot be predicted far ahead of time must be performed without losing basic postural adjustment. Laterality is involved in maintaining balance itself and is approached more specifically when we ask the child to walk the board in the sidewise directions. When we introduce the backward direction, we require difficult spatial orientation and spatial projections (29:123).

Rhythm is also an important part of Kephart's treatment of reading disabilities. Kephart (29:237) believes that the rhythms should be perfected by each side of the body and with both sides functioning at once. The vocal cords must also produce sounds which correspond with the rhythms.

Kephart explains the use of rhythm in this way:

Rhythm is important in kinesthetic and tactual problems since much of the information which we obtain from the senses is probably aided and militated by ability to establish and maintain rhythm relationships. In the auditory field, information is kept classified and organized through the imposition of rhythm upon auditory stimuli.

It is felt that many of the problems of auditory span, temporal order in series information and the like, may be related to weaknesses in ability to establish and/or maintain rhythm patterns. As in all other perceptual activities, rhythm in various sensory-motor areas must be integrated so that the child has a concept of rhythm in the total organism. Kinesthetic rhythms must be integrated with tactual rhythms and with auditory rhythms. In any complex task, all of the rhythmic relationships in all of the areas must coincide and the same rhythm pattern must be dominant throughout (29:235).

The purpose of this section was to point out some of the basic symptoms and treatments of reading disabilities of the educational and neurological approaches. What has been presented is by no means the extent of the programs offered by Carl Delacato or Newell Kephart.

III. RELATED RESEARCH AND EXPERIMENTATION

In recent years two allegedly divergent approaches to the treatment of children who exhibit certain learning problems have been presented to the educational community. Claims for the success of the educational and the physiological approaches has led to the confusion of conscientious educators. Questionable research designs and poor reporting have further obscured the issues involved.

The purpose of this portion of the chapter is to present research and experimentation that is related to the approaches presented by Doman-Delacato and Kephart.

The first portion of information presented will be in support of the educational and physiological approaches, while the latter portion presents studies that reject these approaches.

Jersild (27:147) and Sherrington (43:169) agree that mental and physical activities are closely related and that the mind develops out of physical activity. Weintraub (53:369), Bucher (7:38+), Ray (36:129+) and Seegers (42:104+) found that a physical ability is closely related to intelligence. Ray (36:140), in a study of 432 high school boys, stated within the limits of an I.Q. group, his study found physical ability a more reliable predictor of academic standing than the I.Q.

A neurological explanation for the relationship motor activity has to reading might best be explained by Penfield. Roach and Kephart (37:2) cite Penfield's statement that ". . . every sensory stimulus received on the post-central gyrus (sensory) is accompanied by an activity on the pre-central gyrus (motor)." This means that for every stimulus going to the cerebral cortex, an accompanying activation is noted in the motor area.

Myklebust and Johnson (32:18) noted in a study of 100 consecutive cases of dyslexic children, that 75 per cent showed positive neurological problems. This was true of the electroencephalographic findings as well as the results from the neurological examination.

Brossard (4:16+; 5:38+), in his two articles, writes of a nine-year-old boy who had been struck by a car and received massive brain damage. Doctors saved the boy but he was unable to move any part of his body. The parents were advised to place the boy in an institution for if he lived, he would be a "vegetable" for the rest of his life.

They were wrong continues Brossard. After observing David's therapy at the Rehabilitation Center at Philadelphia, Brossard came back two years later. At that time the boy could walk several yards, his eyesight was back to normal and his vocabulary seemed endless. Because he is around adults constantly, David's mind has matured beyond his years. He will eventually be completely normal. The methods used on David were those of Glenn Doman and Carl Delacato.

Delacato (15:75+) has devoted Chapter eleven to a dissertation written by Sister Marian O.P. The study consisted of 203 fifth grade children in reading disability groups from three socio-economic areas of Chicago. The children were tested on the basis of intelligence, achievement and Neurological Organization.

Sister Marian found:

(a) high incidence of neurological disorganization and (b) reading disability of neurologically disorganized children does differ from the reading disability of organized children. Neurologically disorganized children scored significantly lower in (a) comprehension in context, (b) visual and auditory recognition and (c) oral reading performance.

Bird (3:72) indicates that a number of ophthalmologists now are using body coordination exercises, including creeping, in the treatment of children whose eyes aren't well organized for reading.

An investigation of binocular vision by Doman and Delacato of more than 500 patients with and without symptoms of reading difficulty, defects of speech and allied visual motor disorganization led them to form the following hypothesis:

1. When the controlling eye in binocular vision is on the side of the handedness, no chain of symptoms referable to eye-hand confusion is likely to occur.
2. When the controlling eye in binocular vision is on the side opposite the handedness, some part or all of the chain of symptoms is likely to occur.
3. When two hands are used, the stronger the relative control of one eye (if the controlling eye is on the side opposite the more commonly used hand) the more likely symptoms are to occur. Reversely, if the use of a second hand disrupts a well-established eye-hand pattern on the opposite side, symptoms are likely to occur (16:62).

Halpern, Tellegen, and Thorpe (24:138) as well as Cohn (10:153+) and Eames (19:506+) found in their studies of children with language disability that many of the children had neurological problems.

Kershner's (30:441+) study of the Doman-Delacato Theory brought forth interesting results. In motor development no significant difference was found between the experimental and control group. Comparisons on mobility (creeping and crawling) and I.Q. yielded statistically significant gains in favor of the experimental group. The results of the study did not, however, support the Doman-Delacato position that recapitulation of early perceptual motor developmental sequences is prerequisite to the performance of more sophisticated perceptual motor skills that are not practiced. It was found that similar improvement can occur through other types of physical activity programs. This would tend to support Kephart's views which recommend nonspecific activity rather than the ontogenetic phylogenetic sequences of Doman-Delacato.

Howe (26:352+) offers support to Kephart's program of balancing activities. His study of 43 normal children and 43 mentally retarded found the normal children consistently superior in a variety of motor skills. In the balancing activity which required balancing on one foot, the children were measured in seconds up to one minute. The mean score for the retarded boys was 21.7 seconds as compared to a 51.4 second mean of the normal boy. The retarded girls' mean was 15 seconds as compared to a 53.9 mean for the normal girls.

Drake (18:202+) writes of the research conducted on rhythm by Berea College, Kentucky, and the Fryeburg Academy, Maine. Research from both institutions indicate that children having extreme difficulty in "decoding" words and who exhibit bizarre spelling and written patterns usually have very little sense of rhythm. Drake cites Joseph Firszt, professor in the department of Music at Berea and director of the Lexington Symphony Orchestra, as saying, "Almost without exception when I observe a child having difficulty reproducing the handclapping patterns I am teaching, it turns out later that the pupil is also poor in the language symbolization area."

Drake (18:202+) writes:

Those students who show the greatest growth in rhythmic development usually show the greatest gain in reading ability, conversely, students who are unable to attain a normal growth pattern in rhythm can be expected to achieve poorly in reading.

The previous studies and statements would tend to support the theories of Doman-Delacato or Kephart. There appears to be, however, as much literature which opposes their programs.

Perhaps the greatest critics come from the medical profession. In the May 31, 1968, edition of Time, ten major medical and health organizations stated categorically that patterning was "without merit" and chided its inventors (Doman and Delacato) for claiming cures without documentation. The

organizations include the American Academy for Cerebral Palsy, the American Academy of Physical Medicine and Rehabilitation, the American Congress of Rehabilitation Medicine, the Canadian Rehabilitation Council for the Disabled, and the National Association for Retarded Children.

Newsweek (33:98+) states that Dr. Roger D. Freeman of Temple University Medical questions all these heady claims for success. "Many physicians," he notes, "observed children with severe brain damage who have achieved partial or apparently complete recoveries of function without either conventional physical therapy or the methods of the Institutes." Moreover, he notes, retardation may be mistakenly diagnosed, particularly in young children. In short, Freeman says some of the successes claimed by Doman and Delacato could be attributed to spontaneous recovery, misdiagnosis or plain chance.

Robbins (39:200), an intern at the Institutes in 1963, was an enthusiastic advocate of Doman-Delacato's methods until he conducted a study of the Institutes for his Ph.D. at the University of Chicago. His study showed that the reading skill of a group of second-graders had no relationship to their ability to crawl or creep or whether they had mixed or uniform cerebral dominance.

Robbins (40:517+) also chose some 250 youngsters from third through ninth grade who were enrolled in a summer remedial reading course sponsored by the Chicago Roman Catholic

Archdiocese and divided them into three groups. One was given the Doman-Delacato reading program, another was placed in a "sham" program that included exercises, the use of special lenses, and other procedures vaguely resembling the Institutes' techniques, and the third group received the regular summer reading program without special additional treatment. At the end of the summer, Robbins found, there were no significant differences in the reading skills of the children.

Robbins, in this study stated six null hypotheses.

They were:

1. Creeping is not related to reading beyond chance expectancy.
2. Mean reading differences between subjects who are lateralized and those who are non-lateralized do not exceed chance expectancy.
3. Mean differences in reading between subjects who are lateralized and those who are not lateralized do not exceed chance expectancy when controlled for differences in creeping.
4. Mean post-test differences in reading between the group exposed to the experimental program and the other groups are no greater than chance expectancy after pretest score differences have been controlled.
5. Mean post-test score differences between reading and arithmetic within the experimental class do not exceed chance expectancy when pretest score differences are controlled.
6. The proportion of subjects lateralized after exposure to the experimental program does not exceed by greater than chance expectancy the proportion lateralized before the program was introduced (40:519+).

The results of Robbins' study supported all six of his null hypotheses. None could be rejected. Robbins (40:523) states "The fact that the theory was not supported by any of the findings casts doubt upon its validity."

Glass and Robbins further discount Delacato's claims:

The position taken here is that extravagant claims have been made for the validity of experiments which Delacato has reported as supporting his claims. Without exception, these experiments contained major faults in design and analysis. About half of the experiments were so inadequate that they are not acceptable as evidence by the standards against which educational research is presently evaluated. Sources of bias and probably invalidity have been identified in the remaining experiments which make the reported results questionable. At best, uncontrolled factors inflated small, but legitimate effects due to Delacato's therapy in each of the experiments; at worst, these uncontrolled influences were the sole sources of gains or differences between experimental groups. Either extreme is possible. Enough doubt has been cast on the results of all of the experiments that either replications of them under improved conditions or the publication of adequate research reports will be required before the conclusions drawn from them are admissible (25:5+).

Bird states of the Doman-Delacato approach:

The principal criticisms are that: (1) the system over-simplifies the problems of retardation and their solution; (2) the theory of neurological organization has not been scientifically proven; and (3) the Doman-Delacato treatments have not been subjected to large-scale, impartially conducted tests--that case histories of recoveries don't, of themselves, constitute ironclad proof (3:28).

There has been considerable testing done on the topics of laterality and dominance. The following studies have indicated that little if any relationship exists between laterality and dominance and reading disability.

Balow (1:323+) individually tested grade one children in thirteen randomly selected classrooms using the Harris Tests of Lateral Dominance. Subjects were classified according to hand and eye preference as either right dominant,

left dominant or mixed dominant and were tested for reading ability. Results showed that hand preference and eye preference, singly or in interaction, were not significantly associated with readiness or with reading achievement. When subjects were classified according to preference and to knowledge of right and left, reading achievement was not found to be significantly related to any of these factors.

Two hundred nine- and ten-year-old Scottish boys were subjects of the study by Belmont and Birch (2:57+). Of these, 150 were poor readers and fifty were control pupils matched for school placement and age. Retarded readers were not found to differ significantly from normal readers in any type of mixed dominance. No consistent relationship between lateral preferences and the level of reading performance was noted.

In the Stevenson and Robinson (46:85+) study, achievement test results given at the beginning of grade three revealed that pupils with mixed eye-hand preferences read as well as those with consistent right eye-hand preference.

Sixty-seven disabled readers in grades two, four, and six were identified by Tinker (52:300+) and each was matched with a normal reader of the same sex, grade, and I.Q. Foot, hand and eye preference tests, and two measures of reversal tendency were administered to both groups. When the data were analyzed, the author concluded that they did not

support the view that laterality is a factor in reading disability.

Stephens (45:418+) grouped 89 beginning readers according to eye-hand preference patterns and studied their readiness scores for differences in achievement. Five tasks assessed hand preference, including two in actual observed situations of eating and drawing. Four groups were formed: two unilateral preference groups (R-R and L-L) and two crossed eye-hand preference groups (R-L and L-R). Results showed that subjects with crossed eye-hand preference had no greater difficulty with reading readiness measures than did the children exhibiting unilateral eye-hand preference.

Smith (44:321+), Cohen and Glass (11:343+), and Gates and Bond (21:450) found in their studies that dominance was not a factor in reading ability.

In Carney's (8:30) study of Delacato's procedures, Carney filmed and studied thirty fifth grade children while creeping and crawling. Fifteen subjects having speech disorders were compared with fifteen children having no speech, reading, or receptive vocabulary disorders.

The films of the thirty children were analyzed by six trained observers and a statistical analysis was made. The analysis indicated that:

. . . all observed difference between the subjects having articulation disorders and those with no speech, reading or receptive vocabulary disorders could be accounted for by chance alone. Therefore, if the neurological organization of children having speech disorders and those having no speech, reading or receptive vocabulary disorders is different, it was not evident in their crawling and creeping behavior in this study (8:30).

Until sufficient testing, research, and experimentation is done in this new area of treating reading disabilities, there will continue to be much criticism and arguments from both sides of this educational problem. The fact that there is a new approach to reading that has created such controversy should, in itself, attract much more investigation within the next few years.

CHAPTER III

GROUPS STUDIED AND MATERIALS USED

The study was conducted over a period of one school year, September 1966 to June 1967, using two sixth grade classes at Seward Elementary School in Seattle, Washington. To eliminate some of the variables from the experiment both classes were given identical reading instruction by the same reading teacher and physical education activities by the author. Because the Physical Education Department of Seattle was interested in the activities and their possible effect on fitness, the children were told that the author was conducting a physical fitness experiment to determine which physical education program developed the most physical fitness. Thus, none of the students were aware of the reading experiment.

Finally, to discount the possible effect of having a class at a given time during the day, the groups exchanged periods at mid-year so that the control group took the experimental group's reading and physical education period and the experimental group took the control's reading and physical education period.

The two groups were given fifty minutes of reading each day. Each class was divided into a high, middle, and low reading level with each level in the control group

reading the same basal reader as the corresponding level in the experimental group.

With both groups receiving the same reading instruction in the morning, they were sent to the author's physical education class in the afternoon. There, both groups were given twenty-five minutes of activity each day, but the activities varied between groups.

The control group participated in all the seasonal sports such as football, basketball, and baseball. They also played such team games as soccer, kickball, soak 'em, and volleyball.

The experimental group played very little of those games previously mentioned except when the author felt that they would be a welcomed change from their everyday physical activities.

The activities experienced by the experimental group served three purposes. The crawling, creeping and sleep pattern exercises were used to develop neurological organizations as far as the mid-brain level. The trampoline, tumbling activities and balance beams were needed to develop balance. The rope jumping and bamboo pole dancing activities were included to develop rhythm.

I. EQUATING THE MATCHED PAIRS

During the spring of 1966 the author worked with the fifth grade teachers to organize the sixth grade classes for the study the following fall. Each sixth grade room was given approximately the same number of high, average, and low students based on their academic achievement and reading ability. Both classes had the same number of boys and girls.

When school opened in September of 1966, the author found that several children had moved during the summer and that new students had entered the district. The new students were placed into the sixth grade classes where there was a need to balance the class enrollments.

During the third week of September, 1966, both groups were given the Gate-MacGinitie Reading Tests Survey D Form 2M. These tests measured the students' abilities in reading speed and accuracy, vocabulary, and comprehension.

The Speed and Accuracy Test measures how rapidly students can read with understanding. This test contains thirty-six short paragraphs of relatively uniform difficulty.

Each paragraph ends in a question or an incomplete statement, and a choice of four words follows. The student's task is to choose the word that best answers the question or completes the statement. The number of paragraphs he completes in the six minutes allowed provides a measure of how rapidly he reads. The time limit is so short that few students were able to complete all the paragraphs.

The Vocabulary Test samples the student's reading vocabulary. This test contains fifty items, each consisting of a test word followed by five other words. The student must choose the word that most nearly means the same as the test word.

The Comprehension Test measures the students' ability to read complete prose passages with understanding. It contains twenty-one passages in which a total of fifty-two blank spaces have been introduced. For each blank space there are a choice of five completions offered. The student must decide which of the five completions best conforms to the meaning of the whole passage.

This series of tests were recommended by Seattle Public Schools Testing Office because this one series measured all that the author planned to evaluate.

In October, 1966, the two groups were administered the Lorge-Thorndike Intelligence Tests Level 3 Form B. This test was used to measure the verbal and non-verbal intelligence of the students in both groups.

With the results from these two tests and matching the children according to sex, the author was able to match eighteen of a possible thirty pairs. Three of the pairs, however, had to be dropped from the study due to the moving of three students from our school. Thus, the study consisted of fifteen matched pairs, nine pairs of girls and six pairs of boys.

During the first week in June, 1967, the experimental and control groups were retested. The test administered was the Gates-MacGinitie Survey D Form 1 M. The results for the speed and accuracy, vocabulary, and comprehension tests were obtained.

II. MATERIALS USED

The experimental and control groups were each divided into high, average, and low reading levels. The high reading groups read from the Ginn and Company, Doorways to Discovery, and the Laidlaw Brothers' book, New Horizons, Book 2. These books had a reading range of about seventh and eighth grade level.

The average and low reading groups read from the American Book Company's Adventures Now and Then, and the Ginn and Company's Wings to Adventure. Both books were written for the sixth grade reading level. The stories read by the average and the slow reading groups were the same but the assignments given took into consideration the particular reading level.

The physical education equipment included in this study were five tumbling mats, a trampoline, thirty-five nine foot jump ropes, six long bamboo poles and four 2" x 8" x 12' balance beams.

III. PHYSICAL ACTIVITIES USED

During the month of September while the control group was working on baseball skills, the experimental group was improving their skills in crawling, creeping, and the sleep pattern. These three activities, as previously mentioned, are a part of the Doman-Delacato exercises for reading improvement. Marianne Frostig (20:22) also uses crawling as part of her program to improve reading skills.

Delacato explains that homolateral crawling (14:14) and the sleep pattern (14:22) are a function of the level of the pons. Thus to further develop the neurological organization at that level, the crawling and the sleep pattern must be perfected.

Homolateral crawling is a means of locomotion with the child's abdomen in contact with the mats. As the child moves forward with the arm and leg on the same side of the body extended, the arm and leg on the opposite side of the body will be flexed. His head turns towards the side of the body that is flexed. As the child moves, the entire body position is reversed.

The "sleep pattern" activity was used as a five minute exercise on the average of one day a week. Delacato describes this activity when he states:

A right-handed child should sleep on his abdomen with his head turned toward his left hand and with the left arm and leg flexed, while the right arm and leg are extended as the dominant position in sleep. Although positions vary during sleep, this is the most used position by right-handed children who are well organized at the level of pons.

A left-handed child who is well organized at this level sleeps on his abdomen with his face turned toward his right hand, with his right arm and leg flexed while his left arm and leg are extended (14:22).

When the group appeared to have mastered the skills in crawling they began working on the next neurological level, that of the midbrain. Delacato (14:22) evaluates neurological development at this level by observing the child creeping on his hands and knees in cross pattern. To creep in a cross pattern the child's right hand and left knee should strike the ground simultaneously, then the left hand and right knee and so on.

Delacato's instructions for teaching children to creep are as follows:

1. Teach the child to look at his forward hand as he creeps, first the right hand, then the left. Have him turn his head slightly towards the forward hand as he looks at it. Looking at his forward hand as he creeps reinforces his binocularity.
2. Be sure the palms of his hands are flat and that the fingers point straight forward.
3. Never allow the knees to cross. Be sure they are at least ten inches apart as he creeps.
4. Be sure he raises his knees with each forward move and be sure that he drags his feet. His knees are raised with each move, but his feet are in constant contact with the floor (14:26).

During the months of October and November the experimental group worked on skills in tumbling. Tumbling activities were selected by the author to help the children develop an awareness of the left and right sides of the body and how the sides of the body must function to maintain a balanced position.

Kephart emphasizes the importance of balancing activities in this way:

When experimenting with the balancing problem, the child must learn right and left, for he must learn how to inervate one side against the other, how to detect which side has to move, and how it has to move, in order to execute the appropriate compensatory movement as his balance varies from one side to another. Out of these and similar activities, he learns to differentiate the right from the left side (29:43).

When the child can differentiate the right side from the left, he has developed laterality. This laterality is very important in reading for as Kephart (29:45) explains, "The only difference between b and d is one of laterality."

The tumbling activities selected provided the children with various situations to use both sides of the body. The activities used are as follows:

1. The forward roll. To perform this stunt properly the child will have to be able to overcome dizziness and develop balance. He must also use both sides of his body to keep his series of rolls in a straight line.

2. The backward roll. To perform this stunt the child has to overcome the same problems as in the forward roll. These problems, however, are greater because it is more difficult to roll backwards in a straight line and the dizziness tends to increase.
3. The headstand. The child is expected, in this stunt, to maintain his balance in an inverted position while balancing on his head and hands. Both sides of the body play an important part in this stunt.
4. The headspring. This is the most difficult stunt. It takes timing, coordination, and cannot be performed unless both sides of the body are working in unison. The stunt involves approaching a rolled mat while running, placing the head and hands on the mat, flipping the feet over the head, and landing in a standing position.

Most of the children in the class were able to execute all of the stunts. Three children, due to their large size and lack of sufficient strength, were unable to execute the headstand. They were encouraged by the author to continue practicing the stunt at home. Because the author felt that the students would probably not perfect the headstand, they were permitted to progress to the next activity with the rest of the class.

The months of December and January were devoted to developing rhythm through the skills involved in rope jumping. By adding music to the activities the children were provided with additional rhythmical experiences.

Drake (18:202-05) mentions that research at the reading institute at Berea College, Berea, Kentucky, and at Fryebury Academy, Fryeberg, Maine, indicates that children who have extreme difficulty in "decoding" words and who exhibit bizarre spelling and written patterns usually have very little sense of rhythm. Drake (18:202-05) goes on to say,

During six years of testing, observation and research, it became apparent that the development of rhythm is intimately related to the acquisition of reading, writing, and spelling skills. A failure to develop rhythm usually predicts a failure in symbolic functions.

Drake's article recommended several activities to develop rhythm. Among them was rope jumping.

The children were taught to jump to two speeds, single time and half time.

Jumping at half time would apply to a slow moving rope where the child has sufficient time to jump and make a quick second hop or rebound before he jumps the rope the next time. The rhythm would be jump rebound, jump rebound, etc. Jumping at single time would apply to a faster moving rope. The child only has time to make each jump. The rhythm would be jump, jump, jump, etc.

The children, by the end of the second month of rope jumping, showed tremendous improvement in rhythm, coordination, and endurance.

The month of February was devoted to acquiring skills of balance while performing on the trampoline. Because one of the Seattle High Schools lent the trampoline to the author, the trampoline skills had to be acquired within a month's time. The author would have preferred to have spent two months on the apparatus.

Kephart (29:224), Delacato (13:118), and Kolson and Kalager (31:80) agree that the trampoline is an effective tool for those children having reading problems. They do not, however, agree as to why. This was not of major concern to the author. His interest was in the activities that aid in correcting the reading problems not in how the reading problems are corrected.

Due to size of the class and the short twenty-five minute period, the class was divided into two groups. One day a group would work with the trampoline. The next day it would review previously learned skills. Dividing the class into two groups meant that each child had about two minutes of jumping every other day. Though this time seems insufficient, marked improvement was noted in each child's coordination in use of the trampoline at the end of the month.

While developing skills of balance and rhythm in jumping, the children learned to perform a seat drop and a seat drop with a 180° turn.

To perform the seat drop the child must hit the bed of the trampoline with his trunk erect, legs together, toes pointed, and hands slightly behind and to the sides of the hips on the bed.

The 180° turn was added because it required considerably more coordination.

All of the children acquired sufficient skills to execute all of the trampoline stunts.

During the month of March the children continued developing skills of balance while walking on the balance beam. The balance beams were twelve feet long, eight inches deep, and two inches wide.

The children were told that they could not go on to the next activity until they were able to complete a series of balance beam tests. The tests included:

1. Walking forward the length of one balance beam, making a turn and returning without falling.
2. Walking backward to the end of the beam, turning, and returning walking backward. Kephart (29:219) states that this is the most difficult stunt for a slow learner to accomplish.

3. The third test was to walk forward along four twelve-foot beams organized in a square.
4. The fourth and most difficult test was to walk backwards along the four beams organized in a square.

The children were expected to complete the tests without falling. If they fell the test had to be taken again until the child succeeded.

Tests three and four were added because of the greater amount of balance the students developed prior to the balancing activities.

Kephart says of the balance beam or walking board:

The primary purpose of the walking board is to aid in teaching the child balance and postural responses. Maintaining balance on the board requires an accurate knowledge of the difference between the right side of the body and the left. The technique thus aids in the development of laterality. As we have seen, laterality is necessary in such activities as reading (where a left-to-right progression across the line of print must be sustained) and writing. It is probable that many reversals of words or letters are due to inadequate laterality.

The board also aids in the development of directionality. Added to the experiences of right and left in maintaining balance are the experiences of forward and backward in progress across the board. Lateral direction is separated from fore and aft direction. The former is used in balance, while the latter figures in the goal of the activity (29:220-21).

As each child completed the series of tests they progressed to the final activity, the Philippine Bamboo Dance (Tinikling). This activity was selected because of its rhythmical nature and its value in developing coordination.

Two bamboo poles and two people are required. The poles must be beat in a steady 1-2-3-rhythm. Beaters sit at each end of the parallel poles holding them at about a shoulder's width apart. On the first two counts the poles are struck down on the floor. On the third count, the poles are struck together. The dancers must maintain the 1-2-3 rhythm while stepping in and out of the clashing poles. If the rhythm of the dancer isn't maintained his feet will be caught between the poles. The beaters must also be able to keep a steady rhythm or the dance is impossible.

This activity then develops rhythm in the legs while dancing and the arms while beating.

May was devoted to reviewing all of the skills previously learned with the exception of the trampoline. The children were told that they could work on any skills they wished but should concentrate on those skills they felt weakest in. A skills test was administered during the first two weeks of June. Final physical education grades were determined on the basis of test results.

CHAPTER IV

RESULTS OF THE STUDY

During the last week of September 1966 the experimental and the control groups were given the Gates-MacGinitie Reading Tests, Survey D, Form II M, for the purpose of finding individuals from both groups who achieved similar reading comprehension, speed, and vocabulary scores. To match the pairs even more accurately, both groups were administered the Lorge Thorndike Intelligence Tests, Level 3, Form B, during October 1966.

From the test results the author was able to match fifteen pairs of students, out of a possible thirty pairs, as to their sex, reading ability, and intelligence. In a few cases, several points difference was noted between paired children. The differences fell within the error of measurement of the particular test given. Because of the number of variables to be matched (5), the point advantage on one test was most often diminished by the three other tests. The fifth variable was that of sex.

Table I shows the results of the Gates-MacGinitie test administered in the fall. Each pair was given a number, for the purpose of identification, and the students within each pair have been designated E for being in the experimental group or C for the control group.

TABLE I

GATES-MacGINITIE READING TESTS SURVEY D FORM 2M**

Pair	Sex	Vocabulary		Speed		Comprehension	
		E	C	E	C	E	C
1	F*	26	23	15	14	40	28
2	F	32	29	17	19	40	37
3	F	45	50	30	32	47	50
4	F	35	32	15	21	36	38
-5	F	31	34	20	23	35	40
6	F	39	46	26	19	49	50
7	F	38	35	17	28	48	43
8	F	35	31	23	24	50	40
9	F	42	37	31	35	51	47
10	M	24	20	12	12	36	25
11	M	44	45	24	24	50	49
12	M	33	30	24	19	30	35
13	M	16	19	11	11	27	29
14	M	37	39	17	23	44	40
15	M	43	38	26	29	47	45
Total		524	508	308	333	630	596
Mean		34.93	33.86	20.53	22.20	42.00	39.76

- Identical Twin Girls

* Abbreviations:

E - Experimental Group

C - Control Group

F - Female

M - Male

**Raw Scores

The author was fortunate in having identical twin girls as a part of the sample being tested. The pair designated as number 5 had the greatest divergence in the I.Q. scores of any of the pairs tested. The performance of the twin girls on the Gates-MacGinitie reading tests, however, indicated that their reading skills could be equated quite closely.

The results given in Table I, page 64, show that the experimental group achieved a raw score mean of 1.07 greater than the control group in reading vocabulary and a raw score mean of 0.27 greater in their reading comprehension. The control group excelled, however, in their reading speed with a mean raw score of 1.80 greater than the experimental group.

The author chose to use the raw scores in all the tables because the standard scores, percentiles, and the grade equivalents were not as reliable a measurement of growth.

The I.Q. scores of the two groups are noted in Table II. The mean scores would indicate very little difference between both groups in intelligence. The mean of the control group was 107.80 whereas the experimental group's mean was 108.33, only 0.53 of a point difference.

Table III, page 67, shows the results of the Gates-MacGinitie Tests administered in June, 1967. The mean raw scores for the control group were 34.86 for vocabulary, 23.46 for speed of reading, and 38.60 for comprehension.

TABLE II
LORGE THORNDIKE LEVEL 3 FORM B**

Pair	Sex	Verbal I Q		Non Verbal		Total	
		E	C	E	C	E	C
1	F*	92	86	91	94	91	90
2	F	101	106	112	110	106	108
3	F	142	150	135	132	138	141
4	F	102	108	114	101	108	104
-5	F	98	101	18	119	98	110
6	F	122	123	119	120	120	121
7	F	100	100	111	95	105	97
8	F	120	114	119	117	119	115
9	F	123	110	116	115	119	113
10	M	84	81	81	88	82	84
11	M	116	122	129	128	122	125
12	M	113	96	89	105	101	100
13	M	77	81	105	92	91	86
14	M	107	106	96	101	101	103
15	M	126	115	117	116	121	115
Total						1,622	1,617
Mean						108.33	107.80

- Identical Twin Girls

* Abbreviations:

E - Experimental Group

C - Control Group

F - Female

M - Male

**Raw Scores

TABLE III

GATES-MacGINITIE READING TESTS SURVEY D FORM IM**

Pair	Sex	Vocabulary		Speed		Comprehension	
		E	C	E	C	E	C
1	F*	36	28	15	14	37	21
2	F	40	39	15	14	40	41
3	F	47	50	35	36	50	51
4	F	41	32	20	19	49	40
-5	F	35	36	21	29	39	39
6	F	40	47	27	32	49	46
7	F	37	39	18	30	48	42
8	F	45	36	24	31	48	42
9	F	43	39	35	31	51	50
10	M	34	11	14	17	36	16
11	M	47	44	25	26	49	47
12	M	41	33	26	19	28	37
13	M	18	14	12	14	32	17
14	M	43	44	19	22	45	45
15	M	44	31	27	18	49	45
Total		591	523	333	352	650	579
Mean		39.1	34.86	22.20	23.46	43.33	38.60

- Identical Twin Girls

* Abbreviations

E - Experimental Group

C - Control Group

F - Female

M - Male

**Raw Scores

The experimental group raw scores of 39.1 on the vocabulary portion, 22.20 for speed in reading, and 43.33 in reading comprehension were obtained.

I. COMPARISON BY TOTAL GROUPS

Due to the small sample the author was able to match, he elected to evaluate, statistically, the difference between the two mean scores of the experimental and control groups. The formula used by the author is presented in the book Basic Statistical Methods by N. M. Downie and R. W. Heath.

To compute, using this method, the following steps must be taken:

1. Compute the sum of the squares for D (differences).

$$\sum d^2 = \sum D^2 - \frac{(\sum D)^2}{N}$$

2. Find the standard deviation of these differences.

$$S_D = \sqrt{\frac{\sum d^2}{N}}$$

3. Then the standard error of the mean difference is found.

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N-1}}$$

4. Finally the usual z score is computed.

$$z = \frac{\text{Mean difference}}{\text{Standard Error of mean difference}}$$

After computing the z score the table for the distribution of t probability is consulted to determine the level of significance. This is possible for Downie and Heath (17:138) state:

The t ratio is defined in the same fashion as z. In other words, it is a deviation divided by a standard deviation; the difference between the means is the deviation, and the standard error of the difference between the means is the standard deviation.

The results for the application of the z test for the experimental and control groups' raw score means in reading vocabulary are presented in Table IV.

As shown in Table IV, the differences between the two groups in reading vocabulary was found to be statistically significant, at the .05 level of confidence, in favor of the experimental group. The experimental group achieved a mean vocabulary score of 4.23 higher than the control group. The obtained z score was 2.343, well within the required z score of 2.145.

As shown in Table V the control group showed the greatest mean gains in reading speed. The obtained z score .877, however, was not significant at the .05 level of confidence.

TABLE IV

COMPARISON OF RAW SCORE MEANS BETWEEN THE MATCHED PAIR
GROUPS FOR READING VOCABULARY

Group	Obtained Means	D	D ²	Obtained z	Required z at .05 level
C	34.86				
E	39.10	68	1094	2.343	2.145

TABLE V

COMPARISON OF RAW SCORE MEANS BETWEEN THE MATCHED PAIR
GROUPS FOR READING SPEED

Group	Obtained Means	D	D ²	Obtained z	Required z at .05 level
C	23.46				
E	22.20	19	455	.877	2.145

TABLE VI

COMPARISON OF RAW SCORE MEANS BETWEEN THE MATCHED PAIR
GROUP FOR READING COMPREHENSION

Group	Obtained Means	D	D ²	Obtained z	Required z at .05 level
C	38.60				
E	43.33	71	1147	2.409	2.145

Table VI shows the experimental group having a 4.73 mean score advantage in comprehension over the control group's score. The obtained z score was 2.409 which is well above the required z score to make it significant at the .05 level of confidence.

II. COMPARISONS BY SEX

Table VII gives the results of the Gates-MacGinitie reading scores and the Lorge Thorndike Intelligence Tests of the girl pairs. Nine girl pairs were matched as closely as possible based on their scores on the tests previously mentioned. The control group achieved a mean I.Q. score of 111 as compared to the 111.55 of the experimental group.

On the Gates-MacGinitie Reading Tests the greater divergence of means scores was in reading comprehension. The control group achieved a mean score of 41.44 while the experimental group scored a mean of 44. The difference in mean scores (2.56) is well within the standard error of this test. The experimental group also scored a higher mean than the control group on the reading vocabulary portion of the test. The experimental groups mean score was 36.22 as compared with a 35.22 mean score for the control group. The control group achieved a higher mean score, however, on the reading speed section of the test. The control groups mean score was 24.11 as compared to the 21.55 mean score of the experimental group.

TABLE VII

LORGE THORNDIKE LEVEL 3 FORM B AND GATES-MacGINITIE
 READING TESTS FORM 2M GIRLS**

Pair	I. Q.		Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C	E	C
1	91	90	26	23	15	14	40	28
2	106	108	32	29	17	19	40	37
3	138	141	45	50	30	32	47	50
4	108	104	35	32	15	21	36	38
5	98	110	31	34	20	23	35	40
6	120	121	39	46	26	19	49	50
7	105	97	38	35	17	28	48	43
8	119	115	39	31	23	26	50	40
9	119	113	42	37	31	35	51	47
Total	1004	999	327	317	194	217	396	373
Mean	111.55	111	36.22	35.22	21.55	24.11	44.00	41.44

* Abbreviations

E - Experimental Group

C - Control Group

**Raw Scores

Table VIII gives the I.Q. scores from the Lorge Thorndike Intelligence Tests and the reading scores from the Gates-MacGinitie Reading Tests for boys.

Six pairs of boys could be matched on the basis of these test results. The boys were matched almost as closely as the girls on their I.Q. mean scores and even fewer differences were noticeable on the reading scores attained. The mean I.Q. of the control group was 102.16 as compared to 103 I.Q. of the experimental. Here as in the girls test results, the experimental group had achieved scores higher in I.Q., vocabulary, and comprehension. These differences, however, were negligible. The experimental group scored a vocabulary mean of 32.83 as compared to a 31.83 mean of the control. In comprehension the experimental group achieved a mean score of 39 while the control group scored a mean of 37.16. The control group again scored higher on the reading speed with a 19.66 mean score as compared to a 19 mean score of the experimental.

During June the groups were given only the Gates-MacGinitie Reading Tests and not an I.Q. test, for it was the purpose of this study to test the effects of certain motor activities on reading ability and not its effects on the I.Q. of the subjects. Tables IX and X therefore do not contain any I.Q. test results.

TABLE VIII

LORGE THORNDIKE LEVEL 3 FORM B AND GATES-MacGINITIE
 READING TESTS FORM 2M BOYS**

Pair	I. Q.		Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C	E	C
10	82	84	24	20	12	12	36	25
11	122	125	44	45	24	24	50	49
12	101	100	33	30	24	19	30	35
13	91	86	16	19	11	11	27	29
14	101	103	37	39	17	23	44	40
15	121	115	43	38	26	29	47	45
Total	618	613	197	191	114	118	234	223
Mean	103	102.16	32.83	31.83	19.00	19.66	39.00	37.16

*Abbreviations

E - Experimental Group

C - Control Group

**Raw Scores

TABLE IX
GATES-MacGINITIE READING TESTS FORM 1M GIRLS**

Pair	Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C
1	36	28	15	14	37	21
2	40	39	15	14	40	41
3	47	50	35	36	50	51
4	41	32	20	19	49	40
-5	35	36	21	29	39	39
6	40	47	27	32	49	46
7	37	39	18	30	48	42
8	45	36	24	31	48	42
9	43	39	35	31	51	50
Total	364	346	210	236	411	372
Mean	40.44	38.44	23.33	26.22	45.64	41.33

* Abbreviations

E - Experimental Group
C - Control Group

**Raw Scores

- Identical Twin Girls

TABLE X
 GATES-MacGINITIE READING TESTS FORM 1M BOYS**

Pair	Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C
10	34	11	14	17	36	16
11	47	44	25	26	49	47
12	41	33	26	19	28	37
13	18	14	12	14	32	17
14	43	44	19	22	45	45
15	44	31	27	18	49	45
Total	227	177	123	116	239	207
Mean	37.83	29.50	20.5	19.33	39.83	34.50

* Abbreviations

E - Experimental Group
 C - Control Group

**Raw Scores

Table IX, page 75, presents the test results obtained from the girls on the Gates-Macginitie Reading Tests Form 1M. As was the scoring results in September, the control group's mean score was higher than the experimental group's in reading speed but lower in comprehension and vocabulary. The control group achieved a mean reading speed score of 26.22 compared to a 23.33 mean of the experimental group. The experimental group scored a mean of 40.44 on vocabulary and 45.64 on comprehension as opposed to the mean scores of 38.44 and 41.33 for the control group.

Table X, page 76, presents the June reading test results of the boys. The control group in all three areas showed less achievement than the experimental group. The control group achieved a mean of 29.50 in vocabulary as compared to a mean score of 37.83. In reading speed the control groups mean score was 19.33 compared to the 20.5 mean of the experimental group. Finally in comprehension the control group scored a mean of 34.50 as compared to the 39.83 mean score achieved by the experimental group.

The comparisons made by sex were not treated statistically. The sampling, six boy pairs and nine girl pairs, was not of sufficient size to be of any importance statistically.

III. COMPARISON BY ABILITY GROUPS

In the comparison of ability groups a statistical analysis was not made. The number of pairs within the ability groups were insufficient for proper analysis. The number of pairs in each group ranged from six pairs in both the high and middle reading groups to three pairs in the low reading groups.

Table XI presents the I.Q. and the reading results of the high reading groups. The groups were quite closely matched with the greatest difference in mean scores being 1.5. The mean I.Q. score for the experimental group was 123.16 as compared to the 121.66 mean I.Q. score of the control group. The experimental group achieved higher mean scores in vocabulary and comprehension also. The mean scores for that group were 42 and 48.33 respectively. For the control group a 41.16 mean vocabulary score and a 46.83 mean comprehension score was found. The control group achieved a higher mean score of 27.50 in reading speed as compared to a 26.66 of the experimental group.

Table XII presents the I.Q. and reading test results of the middle reading groups. The mean differences ranged from a 3.50 in reading speed to an identical mean score in comprehension.

TABLE XI

LORGE THORNDIKE LEVEL 3 FORM B AND GATES-MacGINITIE
 READING TESTS FORM 2M HIGH READING GROUP**

Pair	I. Q.		Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C	E	C
11	122	125	44	45	24	24	50	49
15	121	115	43	38	26	29	47	45
3	138	141	45	50	30	32	47	50
6	120	121	39	46	26	19	45	50
8	119	115	39	31	23	26	50	40
9	119	113	42	37	31	35	51	47
Total	739	730	252	247	160	165	290	281
Mean	123.16	121.66	42.00	41.16	26.66	27.50	48.33	46.84

*Abbreviations

E = Experimental Group

C = Control Group

**Raw Scores

TABLE XII

LORGE THORNDIKE LEVEL 3 FORM B AND GATES-MacGINITIE
 READING TESTS FORM 2M MIDDLE READING GROUP**

Pair	I.Q.		Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C	E	C
12	101	100	33	30	24	19	30	35
14	101	103	37	39	17	23	44	40
5	98	104	31	34	20	23	35	40
2	106	108	32	29	17	19	40	37
7	105	97	38	35	17	26	48	43
4	108	104	35	32	15	21	36	38
Total	619	616	206	199	110	131	233	233
Mean	103.16	102.66	34.33	33.16	18.33	21.83	38.83	38.83

* Abbreviations

E - Experimental Group

C - Control Group

**Raw Scores

The control group's mean score in reading speed was 21.83 while the experimental group scored a mean of 18.16. The reading comprehension mean scores were identical with a 38.83. In I.Q. and reading vocabulary, the experimental group achieved higher means than the control group. A mean I.Q. score of 103.16 was reached by the experimental group as compared to a 102.66 mean score for the control group. The mean vocabulary scores were 34.33 for the experimental and a 33.16 for the control.

The I.Q. and reading results for the low reading groups are found in Table XIII. The greatest difference between mean scores was found within this group. The results from the reading comprehension portion of the Gates Macgintie Reading Tests shows that the experimental group achieved a mean of 34.33 as compared to the 27.33 mean score of the control group. In the other areas of testing they were matched more closely.

In I.Q. the experimental group had a mean of 88 and the control group an 86.6. The vocabulary results favored the experimental group with a mean of 22 while the control group scored a mean of 20.66. There was very little difference in the means of the reading speed with the control group scoring a 12.33 mean as compared to a 12.66 mean of the experimental group.

TABLE XIII

LORGE THORNDIKE LEVEL 3 FORM B AND GATES-MacGINITIE
 READING TESTS FORM 2M LOW READING GROUP**

Pair	I. Q.		Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C	E	C
10	82	84	24	20	12	12	36	25
13	91	86	16	19	11	11	27	29
1	91	90	26	23	15	14	40	28
Total	264	260	66	62	38	37	103	82
Mean	88	86.6	22.00	20.66	12.66	12.33	34.33	27.33

* Abbreviations

E - Experimental Group

C - Control Group

**Raw Scores

Tables XIV, XV, and XVI give the final test scores taken in June. Table XIV gives the results of the high reading groups.

The control group of the high ability group, achieved a mean in vocabulary of 41.16 which was the same mean they had achieved in the fall. The experimental group's mean score was 44.33 for a 2.33 mean gain.

In reading speed the control group's mean score was 29 or a 1.5 gain over their fall score. The experimental group's mean score 28.33 is a 1.55 gain.

The control group, in comprehension, achieved the same mean score (46.83) that they had in the fall. The experimental mean score improved .77 to 49.10.

The middle reading groups improved in all the areas tested as Table XV indicates. The control group showed a mean improvement in vocabulary of 3.08 or a mean score of 37.14. The experimental group improved 4.17 or achieved a mean score of 39.50.

In reading speed the control group's mean score was 22.16, a .33 improvement. The experimental group's mean score was 19.83 for a 1.5 gain.

The two groups showed approximately the same gains in comprehension. The control group achieved a mean score of 41. for a 2.67 gain, while the experimental group scored a mean of 41.5 for a 3.17 gain.

TABLE XIV
 GATES-MacGINITIE READING TESTS FORM 1M**
 HIGH READING GROUP

Pair	Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C
11	47	44	25	26	49	47
15	44	31	27	18	49	45
3	47	50	35	36	50	51
6	40	47	27	32	49	46
8	45	36	24	31	48	42
9	43	39	35	31	51	50
Total	266	247	173	174	296	281
Mean	44.33	41.16	28.33	29.00	49.10	46.83

* Abbreviations

E - Experimental Group
 C - Control Group

**Raw Scores

TABLE XV
 GATES-MacGINITIE READING TESTS FORM 1M**
 MIDDLE READING GROUP

Pair	Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C
12	41	43	26	19	28	37
14	43	44	19	22	45	45
5	35	36	21	29	39	39
2	40	39	15	14	40	41
7	37	39	18	30	48	42
4	41	42	20	19	49	40
Total	237	223	119	133	249	244
Mean	39.50	37.14	19.83	22.16	41.50	41.00

* Abbreviations

E - Experimental Group

C - Control Group

**Raw Scores

TABLE XVI
 GATES-MacGINITIE READING TESTS FORM 1M**
 LOW READING GROUP

Pair	Vocabulary		Speed		Comprehension	
	E*	C	E	C	E	C
10	34	11	14	17	36	16
13	18	14	12	14	32	17
1	36	28	15	14	37	21
Total	88	53	41	45	105	54
Mean	29.50	17.66	13.66	15.00	35.00	18.00

* Abbreviations

E - Experimental Group
 C - Control Group

**Raw Scores

Table XVI shows the growth and lack of growth of the low reading groups. The control group in every area tested except reading speed failed to achieve at the level they had in the fall. The experimental group, however, achieved mean scores higher than their fall scores. These gain's were not great except in the vocabulary test where there was an improvement in mean scores of 7.50 for a 29.50 mean. The control group dropped 3.0 points to 17.66.

The control group's mean reading speed score was 15.0 which was a 4.77 point improvement over their fall score. The experimental group's mean was 13.66 for an improvement of 1.0.

In comprehension the control group had the most difficulty. Their mean score was 9.33 less than the fall mean score of 27.33. The experimental group, however, showed a slight gain of .77 for a mean score of 35.00.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. SUMMARY

The intent of this study was to test the null hypothesis that the physical activities of crawling, creeping, balancing, and rhythm have no effect on reading comprehension, speed and vocabulary.

The study was conducted over a period of one school year, using two sixth grade classes. Fifteen pairs of children were matched as to sex, I.Q., and their test scores on reading comprehension, speed, and vocabulary. Both groups had the same reading teacher and physical education teacher. The reading assignments given to both groups were identical; only the physical activities differed.

The control group's physical activities consisted of the seasonal sports of football, basketball, and baseball. They also played such games as soccer, kickball, soak 'em, and volleyball.

The activities given the experimental group included creeping, crawling, postural exercises, tumbling, trampoline and balancing activities, rope jumping, and the bamboo pole dance.

The selection of the activities for the experimental group was based on the author's review of literature. Delacato and Doman use the creeping, crawling and postural exercises. The trampoline and balancing activities are a part of Kephart's program. Rope jumping and other rhythm activities were recommended in Drake's article "Reading, Riting, Rhythm." Rhythm activities are also a part of the Doman-Delacato and Kephart programs. The tumbling activities were included because the author felt they would aid in developing balance, coordination and body image. Activities which would correct dominance problems were omitted because the correction of mixed dominance would appear to be a medical treatment, not an educational one.

II. CONCLUSIONS

The control group achieved a higher raw score mean than the experimental group in reading speed. The mean raw score for the control group was 23.46 as compared with a mean of 22.20 for the experimental group. The differences between the two scores did not prove to be significantly in favor of the control group at the .05 level of confidence.

The experimental groups' growth was statistically significant in reading vocabulary and reading comprehension. The difference in vocabulary raw score means favoring the experimental group was 4.24. This resulted in a z score of

2.343 which was significant at the .05 level of confidence. A mean difference in comprehension raw scores favoring the experimental group was 4.73. This resulted in a z score of 2.409 and was significant at the .05 level of confidence.

A comparison of vocabulary, comprehension and reading speed by sex indicated very little difference between the achievement of the girl groups. The boys in the control group failed to achieve the fall scores in every test. The boys in the experimental group showed growth over the fall scores in all three tests.

A comparison of the three reading levels showed more growth at each level by the experimental group than the control. The greatest variation in scores was noted at the lowest reading level. These groups also had the greatest variation in scores in the fall. The low reading level of the control group showed a mean raw score gain of 1.67 in reading speed. The mean raw score in vocabulary was 3 points lower and in comprehension was 9.33 lower than the fall score. The low reading level of the experimental group showed a mean raw score gain in vocabulary of 7.50, in reading speed of 1.0, and in comprehension of .67.

The results of this study would indicate that the null hypothesis, crawling, creeping, balancing and rhythm will have no effect on reading comprehension and that the null hypothesis, crawling, creeping, balancing, and rhythm

have no effect on reading vocabulary must be rejected. The evidence in this study indicates that there is a relationship between crawling, creeping, balancing, and rhythm activities and reading vocabulary and comprehension. A greater raw score mean was achieved by the control group in reading speed which would lead to the acceptance of the null hypothesis, crawling, creeping, balancing, and rhythm will have no effect on reading speed.

The author supports the statement made by Kershner (30:18), "Through an integration of the Doman-Delacato and Kephart Theories a comprehensive rationale for the treatment of children exhibiting educational difficulties is possible."

III. RECOMMENDATIONS

Upon completion of the study, the author would make these suggestions for further research: (a) select a larger sampling of children; (b) the children should be in the primary grades and having reading difficulties; (c) have two physical activity periods a day for the primary children; (d) include Frostig workbook materials and suggested board-work activities of Kephart's as part of the reading program; (e) greater use should be made of the trampoline; (f) an achievement test should be used that can measure all reading levels that the group studied might have.

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