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Two divergent approaches to the treatment of children with nonprogressive brain injury (the medical or neuropsychological and the educational or perceptual-motor) are discussed and compared by treatment rationale, models of the perceptual process, etiology, and organization theory. A guide to a comprehensive theory of development, based on stimulation of the central nervous system, is presented, and, by placing the two theories in perspective, a treatment rationale is derived from the similarities of their methods. The design of a theoretical model based on the latest neurological findings is suggested. Recommendations for research, a pilot study on the neuropsychological method, a developmental profile chart, and a 33-item bibliography are included. (DF)

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Neuropsychological and Perceptual-Motor  
Theories of Treatment for Children  
with Educational Inadequacies

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The opinions expressed herein reflect the views of the authors and are not to be construed as the expression of an official position taken by the Department of Public Instruction regarding the theories under investigation.

The Bureau of Research, Department of Public Instruction, Commonwealth of Pennsylvania is committed to the spirit of scientific inquiry. New ideas, especially controversial ones, need to be exposed to rigorous research.

The Neuropsychological and Perceptual-motor theories of treatment could be potentially useful to educators. At the present time, however, no conclusive experimental evidence exists to reject or accept hypotheses deduced from either theory. It is with the purpose of stimulating research in the area capable of yielding data of practical educational value that the present investigation is undertaken.

## Preface:

Due to the universal employment of the term "mental retardation" the authors wish to express adherence to the official definition of "mental retardation" as presented by the American Association on Mental Deficiency, 1959: "Mental retardation refers to subaverage general intellectual functioning which originates during the development period and is associated with impairment in adaptive behavior (20)." The definition is concluded by the statement, thus: ". . . an individual may meet the criteria of mental retardation at one time and not another. A person may change status as a result of changes in social standards or conditions or as a result of changes in efficiency of intellectual functioning, with level of efficiency always being determined in relation to the behavioral standards and norms for the individual's chronological age group (20)."

However, in the light of current usage which often departs from the official definition and to better clarify the scope of the theories under investigation, the authors chose "Children with Educational Inadequacies" instead of "Mental Retarded Children" for the title of the paper. Recent progress in the behavioral and biological sciences along with the awareness these advances have produced of the complex nature of human developmental and learning problems, necessitates discretion in the use of terminology. It may be that "mental retardation" is an educational anachronism. The term can no longer be used in ascribing the cause to a dysfunction or as a symptom implying a specific etiology.

The term "mental retardation" . . . "appears, at present, to be the most preferred term among professional personnel of all disciplines (20)." Application of the term, however, varies between states, among schools, and from person to person. Evaluative deficiencies are an additional detriment to a situation that is not likely to be mitigated by varying the classification level of a term in degrees of inclusiveness - exclusiveness.

Presently, the same child could be diagnosed as having any one of a legion of ambiguous and overlapping dysfunctions all of which are representative of a variety of taxonomic levels. The contemporary morass of nondefinitive terminology includes: (1) cerebral palsy, (2) mental retardation, (3) mental illness, (4) amentia, (5) chronic brain syndrome, (6) feeble-mindedness, (7) mental deficiency, (8) mental subnormality, and (9) brain damage. Yet, definitive differences are implied whenever one term is employed to the exclusion of others.

The authors' opinion is reiterated by Jones and Wepman when they say:

. . . the term mental retardation probably should be dropped . . . a sizable proportion of those now considered mentally retarded and perhaps as many as half of those called emotionally disturbed--actually have a learning problem. It is probably organic in the sense that a certain part of the brain--a certain pathway, probably--did not develop in the usual way (22).

The Neuropsychological and Perceptual-Motor Theories are centrally concerned with children exhibiting nonprogressive brain injury including:

- a. traumatic brain injury
- b. inflammatory damage of the brain associated with infectious diseases
- c. cerebrovascular lesions
- d. neoplastic lesions
- e. developmental anomalies

In the authors' opinion these children can be found in classes for the 'mentally retarded', other special classes, institutions, and in normal classes when the child's involvement is minimal.

For the purposes of this investigation, children who are not able to function at the optimum level of their genetic potential, when sufficiently motivated, in general or very specific functions, assuming no structural defects or progressive pathology, are exhibiting educational inadequacies that are within the scope of the theories under investigation.

## Introduction

In recent years two allegedly divergent approaches to the treatment of children who exhibit certain learning problems have been presented to the educational community, pointing up the need for further research in that area. Various claims for the efficacy of each approach have led to the confusion of conscientious educators. Questionable research designs and poor reporting have further obscured the issues involved. The result has been the generation of factions among educators whose support or rejection of the concept seems based on emotion rather than on logical analysis of the reliable empirical and experimental evidence.

The nature of the controversy involves an "educational" approach to children with learning problems against a "medical" or "physiological" treatment technique. The educationally oriented group, including such persons as Kephart, Frostig, and Getman, accuse the other school of approaching an "educational problem" physiologically. Those who advocate the physiological approach contend that Kephart treats a neurological difficulty "peripherally" rather than "taking the central approach to the central problem."

Doman and Delacato, the alleged "medical treatmentists" categorize non-normalcies which cause learning inadequacies as:

- (1) brain injury\*
- (2) psychosis
- (3) familial genetic deficiency

That our technology is not sensitive enough to detect qualitative differences among the three is a generally accepted belief. To further obfuscate diagnosis there is a critical gap in child psychology between what is considered normal and what is considered non-normal development (9). Some empirical evidence for normal development exists but precisely where this departs from or how this differs from non-normal development remains to be answered. Empirical data indicating non-normal development endemic to specific functional non-normalcies is needed before the hiatus can be filled.

Doman and Delacato contend (recognizing that much overlapping among categories does occur) that brain injury without psychotic involvement or genetic impairment is the most prevalent of the three non-normalcies. Their treatment, therefore, is aimed at the Central Nervous System -- the site of the injury. Explicit in the Doman and Delacato rationale is the hypothesis that relatively few educationally inadequate children are truly impaired genetically. Implicit is the contention that those children with genetic aberrations can be helped by the Doman and Delacato procedures to the degree that they may also have had an unfavorable neurological environment. Certain emotional disturbances may also, according to the Doman and Delacato rationale, be secondary manifestations of brain damage. Because the Doman and Delacato procedures are well-structured in a comprehensive rationale with some philosophical and empirical support their procedures are:

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\*Includes neural underdevelopment, nondevelopment, or atrophy due to inadequate environmental stimulation or pretermitted development stages.



- (1) amenable to rigorous experimental test,
- (2) potentially useful in alleviating some of the present diagnostic ambiguities, and
- (3) potentially capable of yielding useful empirical data to aid in closing the gap between what is considered normal and what is considered non-normal child development.

Kephart, accused of taking a "peripheral approach," is concerned more with manifest educational difficulties than with etiology. Thus, he directs his procedures toward the remediation of the problems of the "slow learner in the classroom." Kephart identifies four causes of learning inadequacies:

- (1) low genetic endowment
- (2) inadequate environment
- (3) organic damage
- (4) emotional disturbance

Hence, Kephart and Doman-Delacato are in general agreement as to etiology of dysfunction. The difference is one of emphasis. Kephart's treatment focuses upon environmental deprivation (note separate category) and is concerned with the child's orientation to his environment, whereas Doman-Delacato include deprivation of environmental stimulation as a subcategory of brain damage. In referring to children with motor learning problems Kephart says: "It is assumed that no medical or physiological reason for his problem exists (24)." Similar to Doman-Delacato, implicit in Kephart's treatment is the assumption that children with emotional disturbances and low genetic endowment can be helped to the degree that they are also environmentally deprived and/or brain damaged. Kephart's procedures are not, however, committed to an explicitly stated rationale.

The fact that one school emphasizes the Central Nervous System and the other school emphasizes the environment has led to the confusion of the role of medicine and the role of education. In the opinion of the authors, each school recognizes the importance of the whole child in relation to his environment, indicating that the apparent controversy between the schools may have been prompted more by protocol and tradition than by actuality. This serves to illustrate the vulnerability of a dicotomy of educational from medical practices. It may well be that the imputed labels of "medical approach" or "educational approach" are vestigial in origin and a reflection of the nature-nurture polemic in which psychologists engaged themselves for decades.

Attempts by psychologists and biologists to separate heredity, environment, and maturation have all resulted in failure, for these elements, in the view of modern science, are inseparable. Basic even to Darwin's theory of natural selection was the assumption that the environment interacted with hereditary traits and maturational sequences to produce dominant phenotypic and genotypic expressions.

Gestalt psychology has long recognized the importance of considering the "whole" person within a particular environmental setting. Educators, as

well as psychologists, should recognize the fact that development is the result of a complex interaction among the hereditary, maturational, and environmental (experiential) variables. Educators who attempt to separate these elements by accusations of "medical" approaches to "educational" problems are overlooking a fundamental fact of developmental psychology. Woodworth and Sheehan acknowledge the inseparable nature of those variables when they say,

Untangling the influences of nature and a nurture is a delicate operation that is never completely successful, and on the question of their relative contributions to perceptual development, research findings can be offered in support of either position (33).

Shaffer advocates a similar position when he concludes, "The fact remains that it is impossible to discuss heredity except in terms of environment, or environment except in terms of heredity (29)." In spite of these warnings, educators continue to speak of these items as though they were separable variables. A misconception of this sort is exemplified when Herman concludes that "heredity is a decisive factor in the occurrence of constitutional dyslexia, whereas environmental factors are of minor importance (4)."

The authors' intensive study of the Doman-Delacato Theory of Neuropsychology which has as its basic tenet the Doman-Delacato concept of Neurological Organization and the Newell Kephart Theory of Perceptual-Motor Development has brushed aside many of the concealing details and revealed what has been referred to by Bronowski as "hidden likenesses." A common element in both theory and practice serves to link the two together so that above all of the turmoil and confusion created by vociferous spokesmen, some hope for a comprehensive and integrated rationale remains.

What is presented in this report does not represent a final statement; rather, it is a guide for the construction of a comprehensive theory of development based on stimulation of the Central Nervous System. No attempt has been made to present such a comprehensive rationale in this paper. What has been attempted is a clarification of the issues that are tending to obscure the real problem and delay the construction of a complete theory of development which creates no artificial boundary between medicine and educational findings and which is within the grasp of present scholars. Doman and Delacato may be the first practitioners to attempt a logical, neuropsychological treatment rationale which precisely defines the etiology of certain learning problems and directs treatment at the origin of these difficulties - the Central Nervous System.



## The Theories in Perspective

Both the Neuropsychological method and the Perceptual-Motor method are directed to the remediation of possible omissions in perceptual and neurological development. The premises upon which both theories rest are derived from the physiological basis of perception. The first, the Doman-Delacato approach, developed at the Institutes for the Achievement of Human Potential, Philadelphia, Pennsylvania, emphasizes the need for Neurological Organization which in normal children is the result of uninterrupted ontogenetic development. Recommending in severely involved cases, the physical imposition on passive subjects of skipped developmental stages, the Doman-Delacato technique relies heavily on D. O. Hebb's "Cell Assembly and Phase Sequence" theory of perception which hypothesizes the production of "neural pathways" and "neural firing patterns" in the brain. Doman and Delacato therefore advocate the introduction of neural patterns which were omitted during the neurological development of the child in order to compensate for these missing links. In less severely involved children this is done through a program of stimulation in which the child is actively involved.

The Perceptual-Motor Theory which is being applied at the Vanguard School, a private school in suburban Philadelphia, owes its educational application to Newell C. Kephart. This approach also stresses the complete perceptual-motor development of the retarded child. Agreeing with the idea of neural patterns and nervous impulses set up in the brain, the Perceptual-Motor Theory explains learning difficulties as a result of a "breakdown" in the perceptual-motor development of the child. This breakdown is a result of two factors (1) the incomplete integration of present and past stimuli, and (2) the incomplete feedback from the muscle system to the brain to compensate for errors in perception. Thus, even though the Perceptual-Motor approach deals with development and organizes experiences designed to recapitulate developmental stages, it does not advocate the physical imposition of neural pathways through structured movement patterns consistent with the idea of ontogeny recapitulating phylogeny. Rather it attempts to orient the child more fully to the environment in order that he will successfully make perceptual-motor matches, the absence of which retards and prevents learning.

Even though both practices have a partially common theoretical background, it is apparent that the actual procedures which are employed differ. Recognizing that the spokesmen and procedures are at odds, there is a need to compare and determine the applicability of the procedures to a school population. The assumption that these procedures apply to a school population is based on the empirical observation that a vast majority of educationally inadequate children, including retarded readers, are deficient in some phase of their developmental patterns. And as a result of reading retardation, other areas of the cognitive domain are affected. If successful, the procedures identified as optimal in the improvement of physical and mental characteristics may be applied to children who possess either or both deficiencies. A program for children with educational inadequacies based on the theoretical implications of these theories may therefore provide a new tool for the treatment of learning problems.

The basic problems that accrue from these philosophically convergent but procedurally divergent theories are (1) to compare the physical procedures

used by both in order to identify those which result in the greatest improvement in the physical organization of the child, and (2) to compare the effect that these physical practices have on the reading and total intellectual development of the students.

## Treatment Rationale

The dysfunctions which the treatment procedures advanced by Kephart and Delacato attempt to correct are perceptual. Performance of motor skills is dependent upon continuous feedback from auditory, visual, muscular, and joint senses (13, 17), so perceptual processes are an integral part of any motor activity. Both Kephart and Gesell contend that there is no simple distinction between a perceptual skill and a motor skill. Kephart has gone so far as to propose the term "perceptual-motor" be used when referring to these skills. Delacato and Kephart agree that if training in perception improves perceptual and motor abilities, then because perceptual and motor abilities are inextricably related, perceptual training should alleviate the perceptual-motor problems involved. Voluminous evidence does support the contention that perceptual training improves perceptual ability (28, 15, 21, 1). Little evidence, however, has been presented which supports Kephart's basic assumption which states that perceptual-motor training increases ability to perform perceptual-motor skills.\*

The cortex is not the only structure in the Central Nervous System (hereafter referred to as C.N.S.) involved in the perceptual process. Lower members of the C.N.S. such as the cerebellum, medulla, and spinal cord also play an integral part in the perceptual process. Perception, according to both schools, involves an intricate interplay of the entire C.N.S. and the elements of the stimulus complex. It is important to note that both schools are concerned with the C.N.S. as a fully functioning interdependent biological mechanism which interacts with the environment. Also, it is a fact recognized by neurologists that in order for the organism to perceive correctly, all structures in the C.N.S. must be fully developed and physiologically "ready" to integrate stimulus and response patterns (24, 5). Both schools are built on the basic assumption that perceptual-motor training, which takes advantage of the relation between sensory processes and motor responses, acts through the cortex and lower brain centers to improve perceptual and motor processes (24, 5).

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\*A pilot study conducted at Ebensburg State School and Hospital tested one aspect of the evaluative and treatment procedures consistent with the Doman and Delacato Theory. Included is a copy of that research project (p.20). This study not only tested an important assumption underlying the Doman-Delacato rationale, but also tested the basic assumption of the Kephart theory, i.e., perceptual-motor training increases ability to perform perceptual-motor tasks. A final section of the paper is devoted to general and specific recommendations regarding the Doman-Delacato and Kephart rationales. The more precise statement delineating future research directions is, in part, an outgrowth of the results of the Ebensburg Pilot Project.

## Model of the Perceptual Process

Because each school is concerned with the perceptual-motor process, it may be propitious to examine a theoretical model which is in agreement with both Kephart and Delacato. Cybernetic models illustrate the perceptual process in terms of input, output, and feedback. If the Doman-Delacato and Kephart theoretical models of the perceptual process are superimposed on this cybernetic paradigm the following observations are apparent:

**Input:** Both agree that input is in the form of neural activity activated by the sensory receptors.

**Processor:** Integration of sensory and motor pathways occurs in the association area of the cortex, but the process is not understood.

**Output:** A neural pattern on the motor area of the cortex, which results in an overt or covert response, is identified as a factor associated with every response, i.e., the output is a neural pattern, not necessarily an observable overt response.

**Feedback:** From the efferent neurons and proprioceptive receptors in the muscles, information in the form of neural impulses is fed back to the brain for constant adjustment of the motor responses.

## Basic Premises

In the above discussion of the perceptual process essentially no disagreement on the nature of the perceptual phenomenon can be found between the two schools. It is possible that the difference between the two may be found in a different major premise upon which the theories have been built. Doman says:

The development of sensory pathways precedes those of corresponding motor tracts. This fact is fundamental to the concepts upon which the Institutes base their treatment of brain injury (7).

This statement reflects the underlying premise of the Doman-Delacato rationale which states that the brain attains its full functional achievement by means of stimulation which in turn causes permanent changes in the nervous system (5). Delacato refers to D. O. Hebb's theory of neural firing patterns which are the result of structural changes in the neurons as the most plausible neurological explanation of the process of learning (5).

Does this premise differ from that advanced by Kephart? Kephart writes:

It seems probable that experiences which the organism undergoes leave more or less permanent alterations in the

function of the neural units themselves (boutons or synaptic knobs, Hebb, 1949: Lorente de No 1947) (24).

Note that Kephart cites Hebb as a principal source. He says of Hebb:

It would appear, however, that the point of view of Russell, Hebb, and others has sufficiently important implications for education to warrant serious attention (24).

### Etiology

Turning to a more detailed account of the etiology of educational inadequacies as a possible difference between the two schools, the reader should note that various levels of sophistication, or complexity, of stimuli which enter into the C.N.S. as input are possible. Gesell, Kephart and Delacato recognize that the proper integration of complex stimuli with motor responses will depend upon previous experience with less complex stimuli. Kephart and Delacato perceive the importance of experience with varying stimulus complexities when they hypothesize environmental deprivation as a causal factor associated with educational inadequacies. They contend that a restricted sensory environment limits the opportunity that the child has for experimenting with simple stimuli thus limiting his ability to deal with more complex stimuli. Kephart summarizes this notion when he says:

An enormous amount of such random experimentation is necessary. The child needs first to try out all the possible muscular responses of which his body is capable in order to find out what his body and its parts can do and what neurological patterns he has to develop in order to cause them to do so (24).

According to Kephart, civilization decreases the opportunity for the child to explore his environment and gain experience, thus preventing his perceptual and neurological development which is dependent upon sensory stimulation. Evidence for the detrimental effect of sensory deprivation on the functioning of the nervous system is also given by Dr. Doman in his treatment rationale. Kephart and Delacato are not alone in their concern for sensory deprivation, for Gesell and Amatruda point out the hazards of environmental deprivation due to institutionalization (12).

In addition to environmental deprivation as an etiological factor in perceptual-motor dysfunction, trauma, emotional pressure, and structural defects have been identified as possible causes. Identification, however, of the specific cause of a perceptual problem is difficult if not impossible at the present time. Present neurological examinations, though elaborate, fail to reveal minor brain damage (19, 3, 4, 10, 11). Gesell recognizes this deficiency in the identification of minimal brain damage as a possible cause of educational dysfunction when he says:

Because of the inaccessibility of the underlying neuropathology, it is frequently impossible to demonstrate causal relationships between cerebral injury and the imperfections of human behavior (12).



Continuing his discussion on cerebral injury, Gesell states:

The mildest form of injury which we have called cytologic impairment is so delicate that it must be conjectured on the basis of clinical manifestations. The impairment may be visualized as a deformation or curtailment of molecular structure which produces bio-electric alterations and which disturbs directly or by remote action (and deflection of action) the integrative and attitudinal functions of the cerebral cortex (12).

Graham and Berman studied the data on behavioral tests and concluded "Measurement difficulties lie less in the ability of investigators to devise ingenious techniques than in stubborn problems of defining a brain injured group (18)." Paine stressed that "there is a syndrome of minimal brain damage, with subclinical affections in each of four areas, which may be stated as motor, mental, sensory, and convulsive (30)."

Voluminous evidence supports the assumption that minimal brain damage is an etiological factor in perceptual-motor disturbances. This fact is particularly important when considering the so-called "normal child" with learning problems, because he often exhibits the same types of perceptual anomalies shown by the detectably brain-damaged child. It is, therefore, a distinct possibility that a percentage of retarded students have a minimal amount of brain damage since it is estimated that between 70 per cent and 80 per cent (and, quite possibly, 100 per cent) of the normal population have some degree of brain damage (7). Spokesmen from both groups agree that the greatest percentage of the children with nonspecific perceptual malfunctions are suffering from this disorder due either to environmental deprivation or to brain damage. Even though diagnosis is tenuous, both agree that treatment is beneficial (as measured by increased perceptual-motor performance and academic skills to all children with such behavioral disorders).

A valid, but perhaps exaggerated, criticism of the identification of minimal brain damage as an etiological factor in perceptual-motor disorders has been the assertion that the behavioral anomalies evident in such disorders may be attributed to emotional disturbances. Thus emotional disturbance has been hypothesized as a factor in the etiology of perceptual-motor disorganization and indirectly attached to reading and other learning problems through the former irregularities. Eisenberg aptly comments on that notion,

I suspect that even among cases in the emotional category there is some degree of cerebral dysfunction, which accounts for the selection of reading as the locus for the expression of the emotional disorder (8).

If the notion is accepted that any procedure which stimulates the organism is inherently a treatment of the C.N.S., then to say that a treatment is "peripheral" is to commit a semantic error. Perhaps Kephart does not specifically identify the very early motor responses of the child: thus many of the Kephart procedures are considered to be inadequate by Doman



and Delacato because they are based on a rather sophisticated level of perceptual-motor skills. It may be true that Kephart has identified a logical sequence for perceptual-motor development, but what he seemingly fails to explicate is the very early natural developmental sequence of the C.N.S. which is basic to the development of those skills. Kephart refers to basic motor patterns but does not explicitly define them. It is a necessary condition that the nervous system be functionally "ready" for the more sophisticated treatment advocated by Kephart. Experimental evidence supports the contention that development of the C.N.S. is dependent upon stimulation (29, 2). The development of the C.N.S. takes place with the onset of stimulation and proceeds through a normal sequence if the environment is not restrictive. Injury or a restricted environment may delete or prevent the "normal" development of the child so that he is not physiologically ready for advanced skills. Arnold Gesell says,

Growth, therefore, is constantly creating its own conditions as it proceeds. The products of present growth influence later growth. The manner in which an organism functions today must have some effect on how it will function tomorrow. For this reason the resultant patterns and limits of growth are never completely predetermined. In the prognostication of development, surely, much depends upon what happens to a child (12).

Stimulation, then, may be correct or incorrect depending upon the "normal developmental sequence of the child." Doman and Delacato along with Gesell and others have made empirical observations and have described the normal development of the child. Based on these observations, Doman and Delacato have proposed their Developmental Profile that provides a normative model to which every child can be compared in order to determine whether or not he is functionally ready for advanced perceptual-motor skills.

Empirical support for the Doman and Delacato theories is evidenced in literature dating back almost ninety years. Kawi and Pasamanik postulated "a continuum of reproductive casualty extending all the way from death in utero and in the neonatal period to minimal cerebral damage resulting in minor behavioral disfunction (23)." Gesell and Amatruda suggested that "cerebral injury might account for a considerable but indeterminable number of children suffering from personality deviations, dullness, various forms of inadequacies and subclinical defects and deficits (23)." As early as 1878, Kussmaul "postulated a neurological basis for reading problems implicating damage to, or lack of, normal ontogenetic development of, or dysfunction of, any part of the brain, and problems of cerebral dominance as the major underlying pathology (23)."

### Treatment\*

The treatment rationale from which the Doman-Delacato procedures are derived is based on the Concept of Neurological Organization. Neurological

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\*For a complete discussion of evaluative techniques and treatment procedures, the reader is referred to Newell Kephart's The Slow Learner in the Classroom (24) and Carl Delacato's The Diagnosis and Treatment of Speech and Reading Problems (5) in which the authors discuss their respective techniques.

Organization is defined by Delacato:

that physiologically optimal condition which exists uniquely and most completely in man and is the result of a total uninterrupted ontogenetic neural development. This orderly development progresses vertically through the spinal cord and all other areas of the C.N.S. 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 is lateral. This progression is an interdependent continuum, hence if a high level of development is unfunctioning or incomplete . . . lower levels become operative and dominant . . . . If a lower level is incomplete, all succeeding higher levels are affected both in relation to their height in the C.N.S. and in relation to the chronology of their development . . . . In the totally developed man, the left or right cortical hemisphere must become dominant, with lower prerequisite requirements met, if his organization is to be complete (5).

Basic to the concept of Neurological Organization is the assumption that ontogeny recapitulates phylogeny: thus each person exhibits during his ontogenetic development all of the characteristics which have appeared in the phylogenetic evolution of man. If man does not follow this schema, he experiences problems of mobility or communication. In order to overcome such problems one evaluates the subject via the neurological schema derived from the observation of ontogenetic-phylogenetic sequences.

Doman and Delacato, however, have gone beyond Gesell and have identified minute refinements of Gesell's crawling and creeping developmental stages. They have detailed very specific movement patterns in addition to Gesell's that may or may not be consistent with the Doman-Delacato theoretical model. It is the refinement of Gesell's gross motor movements that has led to much confusing research. Recent experimenters, in ostensibly critical analyses of the Theory of Neurological Organization, have used measurement scales for mobility competence containing anywhere from six to twenty-five measurement criteria. Diagnosis and treatment based upon a variable range of from six to twenty-five factors purporting to measure the natural ability to creep and crawl can only lead to inconsistency and ambiguity. Proponents of the Neuropsychological approach differ in what they believe the degree of creeping and crawling qualification should be. Also a few movement patterns advocated as critical by some are not considered by others as truly a phylogenetically derived ontogenetic motor pattern. The authors believe research of a basic nature that scrutinizes assumptions and independent variables is needed before additional projects which can only yield contradictory results are initiated.

Another impasse to the successful testing of the Theory of Neurological Organization is the questionable amount of structure to be used in the mobility treatment procedures. Programs for some children are rigidly structured, i.e., the child is given explicit verbal and imitative

instructions to enable him to precisely perform the correct creeping movements. In terms of the Doman-Delacato neurophysiological model these instructions are followed by the child on a "cortical brain level." However, regardless of the site of injury conscious adherence to the instructed movement patterns cannot be considered as indicative of a remediation of the child's dysfunction. This presents a problem when evaluating; i.e., the evaluator must be able to detect the pseudo-improvement manifest when the child is consciously following instructions. Only if the movements are natural can they be considered a recapitulation of ontogenetic development and an indication that the injured area has been affected.

In the authors' opinion, the Doman-Delacato rationale behind structuring the mobility program of treatment is as follows:

- (a) Performance of movement patterns on a conscious level, which in the normal child is a non-conscious natural developmental process, if continued for an extended period of time will eventually stimulate the cells in the C.N.S. responsible for natural movement.
- (b) If the treatment of stimulation is successful the verbally structured, unnatural movements will eventually become natural, i.e., the child will creep and crawl without thinking about specific movements.
- (c) Treatment should be more successful, Neurological Organization more complete, and evaluation more valid without rigid structure in details of movement, but an unstructured program of stimulation via an environment conducive to correct gross movements would involve more time than the proponents of Neurological Organization believe practical. In addition, severely involved children could not easily participate in an unstructured program.

Delacato proposes that in order to determine if a subject went through all of stages shown in Figure 1, which outlines the normal sequence in r , the investigator observes the performance of the subject on each of the tasks and evaluates his efficiency. If the subject has either skipped or prematurely terminated a developmental phase, his behavior on the task is below normal. For remediation of such difficulties, Doman and Delacato prescribe a recapitulation of the developmental sequence from the lowest level at which performance is poor to the highest level which they identify as critical hemispheric dominance. For example, if a child fails on mobility at the pons level, Doman and Delacato advocate putting the child on the floor and teaching him to crawl, first homolaterally and then progress through the creeping and walking stages. For remediation of failure at the midbrain level of mobility, Delacato recommends cross-pattern creeping. Failure at the cortex on the mobility scale demands practice in cross-pattern walking which has been identified as the highest level of mobility.

As a second example, if the child fails on the visual scale at the pons level, they recommend ocular training concurrent with the normal

Phylogenetic Counterpart	Structure in the C.N.S. in man	Age of Man (Ontogenetic)	Mobility	Vision	Audition
Fish	Medulla	Newborn	Trunkal movement	Reflex	Reflex
Amphibian	Pons	4 months	Homolateral crawling	Bi-ocular	Bi-aural
Reptile	Midbrain	10 months	Cross-pattern creeping	Binocular yoking	Binaural
Primate	Early Cortex	12 months	Crude walking	Early fusion	Early stereophonic
Man	Cortex-Hemisphere dominance	8 years	Cross-pattern walking	Stereopsis and predominant eye	Stereophonic hearing and predominant ear

Figure 1 The Developmental Profile



function for the level, e.g., monocular training in which one eye is occluded and the other follows the hand on the same side of the body in a prescribed manner. Delacato says that monocular control is prior to binocular control in the normal developmental sequence; therefore, one must train the child in monocular pursuits before he undertakes binocular treatment.

Other specific procedures used for ocular training are as follows:

Midbrain - Subject's both eyes follow the hand of another person in a predetermined manner.

Cortex - Subject's both eyes follow his own hand in the same predescribed manner as designated for the midbrain training.

Cortical Hemispheric Dominance - Three methods of establishing hemispheric dominance have been identified by Delacato. The first is by direct occlusion of the nondominant eye which is identified through tests on the Keystone Telebinocular Charts. The second is through a filtering process in which the function of the subdominant eye is suppressed by filtering reflected light through a piece of red cellophane mounted on eyeglasses while the subject writes using a red-ink pen. In this way the dominant eye sees the writing but the subdominant does not. The final method is accomplished by using a special device called the Delacato Stereoscopic Reader which suppresses the subdominant eye but does not threaten the binocularity of the child.

Turning to the treatment procedures used by Newell Kephart, one finds many similarities with the Doman-Delacato techniques. One cannot fail to notice the outstanding likeness in treatment procedures used in monocular training. Kephart recommends occlusion of alternate eyes with pursuit by the nonoccluded eye of a target held by the examiner.

In his rationale for eye training, Kephart is in agreement with the Theory of Neurological Organization. Kephart writes:

In the normal course of development of ocular control in young children, the child develops control of a single eye first, and when control of each eye separately has been established, he integrates the two eyes together and establishes binocular control. For this reason we would expect, normally, that monocular control would come before binocular control. It is essential that the child develop the skills necessary to control each eye separately and that he integrate these skills for binocular control (24).

Kephart's treatment procedures are designed to improve the child's orientation to his environment. In order for the child to function successfully in his environment he must be oriented to gravity in addition to being aware of his position in space and time. According to Kephart, in order to accomplish this orientation, gross motor control, eye-hand coordination, temporal-spatial translation, and form perception are critical abilities that

the child must develop to cope with his surrounding environment. If he fails in any of these perceptual-motor skills, he becomes a "slow learner in the classroom." To overcome this handicap Kephart recommends various perceptual-motor training activities.

Kephart contends that the child should experiment with movement patterns by scribbling on a chalkboard or by finger painting. Eye-hand coordination is enhanced by drawing or copying. Orientation to gravity and balance is attained through practice on a balance board, walking beam or trampoline. Form perception and spatial discrimination abilities are improved through the use of puzzles and peg boards. The child's body image and motor coordination are enhanced by practicing various body movement patterns while looking into a mirror.

In short, many activities may be devised which are thought to improve perceptual-motor coordination. The rationale which is basic to these developed procedures is unstructured. Because of the unstructured nature of the rationale, Kephart has difficulty training professionals to use his procedures. This shortcoming places a limitation on the feasibility of using the procedures on a large scale. The most urgent need in perceptual-motor training is for a well-defined and rigidly structured rationale which lends itself to transmission to professionals and modification by them if new knowledge indicates the need for change.

A possible limitation of the Kephart ideas presents itself in his failure to discuss hemispheric dominance. The rationale of Neurological Organization purports to solve the problem of dominance by encouraging the development of a dominant hemisphere. Activities encouraging the development of a dominant hemisphere exemplify one of the basic differences in rationale and in treatment between the Theory of Neuropsychology and the Perceptual-Motor Theory. In order to attain complete one-sidedness, stimulation to the subdominant hemisphere is greatly restricted, i.e., music and tonality are deleted from the environment as much as possible, nondominant eye and ear may be occluded, and unilateral activities involving the dominant side are encouraged. Kephart concerns himself with neural development up to the cortex but does not consider hemispheric dominance a vital concern. He contends that hemispheric dominance occurs naturally without direction or encouragement from a structured environment. Delacato, on the other hand, advances the idea of encouraging dominance by training subjects to be one-sided.

Kephart contends that the accumulation of motor information is prerequisite to all other perceptual-motor skills. Kephart believes that with slow learning children it is frequently necessary to return to basic motor patterns to permit the child to recapitulate the process of development by which finer and more complex patterns are achieved (24). He identifies five basic motor generalizations the child must make:

- (1) balance and maintenance of posture - involving those activities by which the child maintains his relationship to gravity,
- (2) locomotion - involving observation of the relationships between objects in space,



(3) contact - involving those activities by which the child manipulates objects,

(4) receipt - involves those activities by which the child makes contact with a moving object,

(5) propulsion - involves those activities by which the child imparts movement to an object (25).

Kephart departs significantly from Doman and Delacato when he says:

It is important to remember that the 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.

Kephart refers to his procedures as "developmentally oriented (25)." However, there is a major difference here compared to the ontogenetic development of Doman and Delacato. Kephart explains:

The initial body of motor information becomes the basis, through the perceptual-motor match, for the more extensive perceptual space-time structure. In similar manner the perceptual information becomes the basis of the conceptual structures which will develop later. It is important that each level of this development becomes solid and substantial before the next level is built upon it (25).

Kephart openly conflicts with the rationale and treatment of the Neuropsychological 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 (25).

and: ". . . we cannot think in terms of norms such as Gesell's . . . (25)." Kephart, then, advocates a recapitulation of basic movement patterns but is not referring to an ontogenetically-phylogenetically derived recapitulation. In addition to being based upon ontogenetic exploratory movements Kephart advocates a recapitulation specifically adapted to each child's prior experience implying the production of non-normal neurological changes that result from non-normal perceptual-motor development.

In the opinion of the authors there exists another covert but major difference in treatment between the two schools that reflects the basic difference in rationale. Kephart assumes that improvement in performance of perceptual-motor skills and cognitive functioning will occur

if the skills are taught in his prescribed developmental manner. There is much conscious learning of a variety of perceptual-motor skills on the part of the child. On the other hand, Doman and Delacato assume that if the correct ontogenetic developmental sequence is recapitulated, even without verbal instructions or imitative-type instructions, improvement will occur in performance in the six areas of the Departmental Profile and in cognitive functioning. The rationale of an unstructured program is as follows: (a) If the impaired child is given enough time and the proper environmental stimulation, according to the Doman-Delacato Theory, the child should progress naturally through the ontogenetic sequence, receiving only proprioceptive reinforcement spontaneously improving in all areas. (b) If the child has a brain injury he is expected to function naturally up to his level of injury. Then development will be slower and require more stimulation of the C.N.S. Eventually, however, the underdeveloped, or injured cells will either be rehabilitated or their function assumed by other or newly generated cells. Joseph Altman, one of Dr. Teuber's associates, is among those who support the possibility of neurons undergoing mitosis where he states: ". . . new neurons might nevertheless arise from undifferentiated precursors, embryonic cells that might differentiate, becoming neurons, after multiplication (32)."

Another difference in treatment arises from the fact that some of the children treated by Doman are more severely involved than those included in Kephart's treatment procedures. Therefore, Doman imposes movement patterns on children who are not able to satisfactorily move by themselves. On severely traumatized children Doman increases their carbon dioxide retention by masking, thereby causing the child to rebreath much of the air he has exhaled. Delacato says: "This method of increasing carbon dioxide content at the cortical level is a well known chemo-physiological aid to the cortex's making better use of the oxygen which is supplied (6)." In addition Doman and Delacato advocate control of fluid intake of those children suffering from severe cortical trauma.

In the investigators' opinion, most of the skills above the basic motor patterns which Kephart is attempting to establish are relatively complex perceptual-motor skills. Whether these skills need to be built upon specific phylogenetically derived ontogenetic patterns or on a variety of ontogenetic patterns based on Kephart's developmental sequence is a question that is amenable to experimentation. Research aimed at answering that question is not likely to yield conclusive results, however, until Kephart more clearly explicates his rationale and his methodology and Doman and Delacato define more clearly the ontogenetic, phylogenetically derived creeping and crawling movement patterns and how structured they should be in treatment. Perhaps proponents of both schools are awaiting research that questions basic assumptions and scrutinizes single variables. Through small, well-controlled, basic research Kephart could further develop his rationale and Doman and Delacato could delineate specifics within precise limits of statistical confidence.

## Basic Recommendation

A recommendation which the present investigators wish to make is the design of a theoretical model based on the latest findings in neurology. This model would take into consideration the entire perceptual-motor development of the child. Included in this perceptual-motor development are of course not only hereditary factors, but also factors related to the maturation of the C.N.S. and environmental variables which enhance this natural development. This new rationale would be based on stimulation of the C.N.S. in such a prescribed manner that myelination and physiological readiness would follow the normal ontogenetic developmental sequence. In addition to proper stimulation, a concurrent and advanced program of perceptual-motor training would be instituted that would begin with normal neurological development and advance this development beyond the level suggested by the Developmental Profile. What is suggested here is a program directed at the total development of the child (i.e., hereditary, maturational, and environmental) using the procedures as they are currently conceived by Delacato and Kephart and modifying them as new knowledge is gained.

A theory based on the assumption that stimulation of the C.N.S. may increase the probability of that system's reaching its full potential has firm backing in current research findings. It is a fact that mental development and behavioral development are intimately related. Experimental evidence supports the idea that organic growth yields behavioral growth. Levi Montalcini has found, for example, that certain protein nerve growth factors are critical in embryonic development. When development has reached a certain stage, even in the embryo, certain behavioral responses are possible (27). In addition, further evidence supports the assumption that optimal stimulation maximizes structural and functional growth in the visual system (29). Once again, the basic assumption underlying these systems of development is that stimulation does bring about a permanent change in the C.N.S. Gesell found that cerebral damage to oculomotor areas may cause serious gross motor problems (14). Gesell, however designates the disorientation of the organism due to impaired sight caused by occipital damage as the specific etiological factor in the motor problems.

Future research dealing with the concept of Neurological Organization should be of a basic nature and directed at validation of the Developmental Profile. Considering the quality and extent of the research done up to this time in validating the Profile, one must conclude that the attempt to test the relationship of the Concept of Neurological Organization to reading ability in normal children is premature.

According to the Neuropsychological approach of Doman and Delacato certain cases of reading retardation are the result of neurological disorganization. Level of Neurological Organization is measured by the Doman-Delacato Developmental Profile in six areas: visual, tactile, and auditory reception; language, manual, and mobility expression. Particular emphasis is given to mobility and cortical hemispheric dominance (laterality).

To clarify the authors' recommendation of more basic research they wish to reverse the hypothesis 'mobility and laterality training enhances

reading ability" and, for illustrative purposes, hypothesize "reading training enhances mobility competence and laterality." With reading as the independent variable, in the opinion of the authors, the effect of the experimental treatment on reading ability needs to be ascertained before researching its effect upon dependent variables further removed. Indeed, in the authors' hypothetical illustration, the experimental treatment may retard reading ability. If the reading training consists of thirteen variables, each univariable must be experimentally scrutinized before testing for a synergic effect upon distant dependent variables. Research will continue to yield inconclusive and contradictory results until assumptions are experimentally supported. Research that has not questioned certain underlying assumptions is well illustrated in recent publications.

Robbins (31) in an attempt to test for the relationship of reading ability to creeping and laterality found none existed beyond chance expectation. Delacato's rationale assumes the experimental treatment will increase ability to creep and will lateralize children. Robbins' interpretation of Delacato's treatment appears to have strengthened mixed-dominance rather than laterality and he did not test for the affects of creeping on creeping ability. In addition, the scale used to measure creeping ability has not been validated or standardized. On the other hand Glaeser, DeWaide, and Levi (16), implementing a program of physical activities consistent with the theory of Neurological Organization, found a significant improvement in reading. It is interesting to note that although their hypothesis stated "reading improvement may be brought about by increasing physical coordination," data indicating that physical coordination was indeed increased is not presented.

Basic research must be done using the profile and other tests in the same areas to determine the validity of the profile. Before attempting to use the profile as an instrument for detecting reading disabilities, research should be done which establishes the accuracy of the profile as a measuring and detecting device in those areas for which it was originally constructed, i.e., visual, tactile, and auditory reception; language, manual, and mobility expression.

It is very difficult to advance recommendations at this time, for our understanding of the human nervous system is very limited and tenuous. Indeed, until the tools of neurology are developed to a level sophisticated enough so that valid and reliable identification of all brain-damaged individuals can be made, positive evidence can be acquired only through the investigation of children who exhibit detectable brain damage. It should be remembered, however, that the information gained from this identifiably brain-damaged population can be generalized to a limited number of children who exhibit the behavioral symptoms and have a history that would indicate possible brain damage but evidence negative results on today's standard neurological examination. The Doman-Delacato Developmental Profile is described not only as an instrument that measures the degree and specificity of brain damage from diffuse and severe to localized and mild, but as a reliable instrument for detecting behavioral nuances which reflect the possi-



bility of minimal damage. A program dealing with children who exhibit some behavioral dysfunction based on an experimentally and empirically supported Profile provides the most feasible solution to the problems of children with educational inadequacies.

## Specific Recommendations

a. Identify through further observation those procedures used by Kephart that are distinctly different in basic rationale and proposed treatment procedures from those advocated by Delacato.

b. Develop a rationale for what is to be considered the normal developmental sequence and what is to be considered a non-normal developmental sequence based on present neurological findings and empirical observations. This rationale should explain the normal development of the child from infancy to maturity in terms of environment, heredity, and maturation. Such a rationale would need to indicate factors that affect development in addition to prescribing specific treatments for remediation of those areas that indicate non-normal development.

Research is needed to determine if this treatmental sequence should be prescribed after the ontogenetic-phylogenetic sequence, a sequence based upon gravity, space and time, and adapted to specific anomalies, or an integration of the two theories. Research should be aimed at prevention as well as remediation.

Through an integration of the Doman-Delacato and Kephart Theories a comprehensive rationale for the treatment of children exhibiting educational difficulties is possible. The Developmental Profile could be used as a basic criterion with skills such as form perception, space discrimination, and body-image taught at later stages, since they are more sophisticated. Once developed, the program of activities would be useful in meeting the need, identified by the AAHPER\* as critical, for a structured, sequentially planned and experimentally supported physical education program for the mentally retarded.

Such a rationale would be based on the premise that if a single link of training is missed in the development of the child, the entire process of further development is retarded. In order to overcome or at least partially alleviate the retardation, a program of perceptual-motor and neuropsychological procedures that recapitulate the normal phylogenetic-ontogenetic or exploratory-ontogenetic developmental sequence of the child would be instituted. Basic to this rationale, as it is to both the Kephart and Delacato rationales, is the redundancy in functional units that is present in the C.N.S.

c. Since many of the procedures advocated by both schools are extremely similar, and the most obstrusive difference between the two schools is in rationale (i.e., Kephart has not ordered nor specifically stated his rationale), the present investigators recommend that rigorous experimental designs be developed to test the validity of the Doman-Delacato rationale.

Selectively choosing from the many research approaches suggested by the present investigation, the authors propose a study be conducted in public school day-care classes for trainable mentally retarded children. Very few educationally inadequate children could not be helped to some degree

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\*American Association for Health, Physical Education and Recreation.



according to the Doman and Delacato rationale. Therefore, regardless of etiology or degree of dysfunction, an investigation of the Doman and Delacato procedures in such a setting is warranted. Since the trainable mentally retarded children attending public schools are considerably less severely involved and less hyperactive than the sample of children in the Ebensburg Pilot Project (p.20), the public school teacher-child ratio will be sufficient to maintain the control necessary to justify the experimental activities.

The authors recommend two experimental groups and one control group. If two experimental groups are not possible, group B should be omitted. Experimental Group A will participate in a program of activities consistent with the Theory of Neurological Organization. The procedures employed will include tactile, visual, auditory stimulation and perceptual-motor mobility activities derived from the Developmental Profile. The movement patterns will be highly structured via verbal instruction and teacher imitation. Experimental Group B will participate in a program of activities identical in almost every respect to Group A. The only difference will be in mobility structure. The activities derived from the Mobility Scale will not be structured in Group B.

Pre- and post-testing will employ the following criterion measures:

- (1) A clearly outlined mobility scale derived from the Developmental Profile. The scale will utilize, in addition to those stages identified by Gesell, the more refined movements identified by Doman and Delacato. Such a measure will experimentally question the very basic assumption that creeping and crawling performance improves through participation in the experimental treatments. Inclusion of the unstructured group in the evaluation will serve to question several basic tenets of the Theory of Neurological Organization. If ontogeny recapitulates phylogeny through proper environmental stimulation and if Doman and Delacato have correctly identified that developmental sequence, then improvement of the unstructured group should occur. If improvement of group B does not occur, it may be that the theory is at odds with the methodology.
- (2) A well-validated motor development scale that measures perceptual-motor abilities. The contention that basic motor development is prerequisite to the performance of more sophisticated perceptual-motor skills and that perceptual-motor development is directly a function of the degree of Neurological Organization will thus be tested.
- (3) A test of intellectual development. Such a measure will ascertain the assumed relationship between cognitive and psychomotor functioning made by Kephart and Doman-Delacato in addition to being a check for the pseudo-improvement in Neurological Organization possible in the structured group.

Ebensburg Pilot Project

ONE ASPECT OF THE THEORY OF  
NEUROLOGICAL ORGANIZATION AS  
IT APPLIES TO THE PERCEPTUAL-  
MOTOR PERFORMANCE OF TRAINABLE  
MENTALLY RETARDED CHILDREN

John R. Kershner

Initiators and  
Principal Investigators

David H. Bauer

**Purpose:**

This study was conducted to test one aspect of the evaluative and treatment procedures integral to the Doman-Delacato Theory of Neurological Organization. The mobility continuum beginning with crawling and culminating in cross-pattern walking is identified as the normal developmental sequence. Mentally retarded children, due to their impairment, often score below normal on mobility tasks. Therefore, two of the fundamental stages of the mobility continuum, crawling and creeping, were chosen as the dependent variables investigated in this study which dealt with retarded children.

## Background:

The central concept of the Doman-Delacato theory (5, 6) is Neurological Organization. Neurological Organization assumes that ontogeny (the process of individual development) recapitulates phylogeny (the process of species development). This development proceeds in an orderly, anatomical way through the medulla and cord, pons, midbrain and cortex, and culminates in cortical hemispheric dominance. According to this rationale, the individual's development of mobility, manual competence, tactile competence, vision, audition, and language parallels, and is functionally related to his anatomical progress.

It has been further reasoned that differences in mobility, ranging from movement of arms and legs without bodily movement to using a leg in a skilled role consistent with the dominant hemisphere, are a function of Neurological Organization. By measuring the level of Neurological Organization according to described techniques, it becomes theoretically possible to prescribe activities aimed at enhancing this Neurological Organization, and consequently preventing or eliminating mobility dysfunctions. It must be emphasized, however, that mobility problems cannot be isolated from problems of language, vision, audition or tactile competence in either diagnosis of the level of Neurological Organization or the treatment aimed at achieving a higher level of Neurological Organization. According to the rationale, the total person must be evaluated and treated tout ensemble via all sensory pathways.

Application of the concept of Neurological Organization has resulted in the Neuropsychological method of treatment for the mentally retarded. According to this approach, academic functioning is related to physical development. Furthermore, one of the important causes of mental retardation is impairment to the nervous system, especially the brain. Proponents of the Neuropsychological approach described above believe that it is possible to restore functions of the brain that have been destroyed or that have never properly developed by subjecting the child to a treatment program designed to achieve proper neurologic functioning. It is their contention that learning disabilities of an organic causation have their origin in the brain, therefore efforts to help overcome the learning deficit should be directed toward the brain. They believe that the brain impairment may result from (1) brain injuries or (2) factors that interfere with orderly neurologic development.

Kirk summarized the research related to the motor abilities of the mentally retarded as follows:

Surveys on motor proficiency show quite clearly that retarded children are inferior to normal children in this so-called nonintellectual ability. The effects of training in physical education or motor proficiency have not yet been determined. In view of Sequin's earlier efforts with the physiological method of training defectives and sporadic attempts to use physical activities as an educational media, research in this area has been seriously neglected. With the recent interest in the concepts of Piaget and the methods of Montessori, a fresh approach to this question should be in the making. (cited in (26))

There is need to investigate:

1. The effectiveness of a specialized program of physical education activities on the physical fitness of the mentally retarded as measured by improvement along the developmental mobility continuum.
2. The effectiveness of a specialized program in creeping and crawling on a group of trainable retarded children attending state institutions for the retarded.

**Problem:**

Does a program of specialized physical activities, creeping and crawling, which is consistent with the Doman-DeLacato Theory of Neurological Organization, contribute to the perceptual-motor abilities of institutionalized trainable mentally retarded children?

**Null Hypothesis:**

There is no significant difference in mean perceptual-motor improvement between experimental and control groups.

**Procedure:**

Location - The children selected for the study attend the Ebensburg State School and Hospital, Ebensburg, Pennsylvania.

Sample - Two groups of six children each were selected as follows:

1. Experimental Group - A class of six children (three boys and three girls) classified as trainable retarded (I.Q. 30-50) ranging in age from 6 to 9 years.
2. Control Group - A class of six children (three girls and three boys) classified as trainable retarded (I.Q. 30-50) ranging in age from 6 to 9 years.

Instrument\* - A 14 point scale derived from the Doman-DeLacato Developmental Profile Mobility Scale - reliability computed at .93 by Raymond Taylor, Director of the Research Institute, Institutes for the Achievement of Human Potential, Philadelphia, Pennsylvania.

\* A sample of the evaluation instrument follows this page.



EVALUATION SHEET

NAME \_\_\_\_\_

BUILDING NO. \_\_\_\_\_ WING \_\_\_\_\_

TOTAL SCORE \_\_\_\_\_

SCORE \_\_\_\_\_

CRAWLING

SCORE

1. Crawling without pattern.
2. Crawling homologously.
3. Crawling homolaterally.
4. Crawling cross pattern.

CREEPING

SCORE \_\_\_\_\_

1. Creeping without pattern.
2. Creeping homologously.
3. Creeping homolaterally.
4. Creeping cross pattern.
5. Creeping cross pattern serialization.
6. Creeping cross pattern base.
7. Creeping cross pattern rotation.
8. Creeping cross pattern palm.
9. Creeping cross pattern motion.
10. Creeping cross pattern head position.

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Selection of Subjects\* - The following were the criteria for the experimental population:

1. Subjects are ambulatory (ability to walk without dependence).
2. Subjects score below 11 (pretest) on the instrument derived from the Doman-Delacato Mobility Scale.
3. Subjects have developmental histories that indicate minimal emotional involvement as interpreted by the principal investigators and the Ebensburg professional staff.
4. Subjects have developmental histories that do not indicate endogenous brain damage.
5. Subjects have developmental histories that do not indicate encephalitis, athetosis, severe anoxia, epilepsy, micturition, diarrhea, or non-cooperative behavior.
6. Subjects are not on drugs such as tranquilizers, etc.
7. Subjects are exogenous brain-damaged hyperactive children.

From the total population who met the criteria, a sample of 12 children was randomly drawn. These 12 were then randomly assigned to control and experimental groups. The only stratification was on the basis of sex, with the sample having 6 boys and 6 girls.

\*A sample of the chart used by the principal investigators in the selection of subjects follows.

## Bauer-Kershner Study

1. Name
2. Age
3. I.Q.
4. Dx
  
5. Pre-natal  
Peri-natal  
Post-natal
  
6. EEG
  
7. Seizures
  
8. Rx  
Regime
  
9. Crawling  
Creeping
  
10. Behaviorisms  
including toilet training
  
11. Remarks

Exclude if  
indicated:

- a. Encephalitis \_\_\_\_\_
- b. Athetosis \_\_\_\_\_
- c. History of severe anoxia \_\_\_\_\_
- d. Non-ambulatory \_\_\_\_\_
- e. Genetic involvement \_\_\_\_\_
- f. Non-cooperative behavior \_\_\_\_\_

## Program Supervision:

A professional member of the Ebensburg nursing staff, Mrs. Helen McCloud, R.N. was appointed Administrative Coordinator of the "Special Activities Program". The Administrative Coordinator received one week of intensive orientation to the concept of Neurological Organization at the Philadelphia Institutes for the Achievement of Human Potential (the experimenters had previously attended). The experimenters became Program Supervisors and as such did not take an active part in the daily treatments.

The experimenters and the Administrative Coordinator trained two Ebensburg staff members in the proper techniques for creeping and crawling and prepared them for conducting the experimental group treatment. Two additional Ebensburg staff members were trained to give attention to the control group, equal in amount to the attention received by the experimentals.

## Programs:

A pretest post-test design was used. The control group, in addition to controlling for the effects of the experimental treatment, also controlled for the "Hawthorne Effect". This was accomplished by duplicating the experimental attendant-child ratio and by having the attendants in the control group play with the children for the same amount of time and during the identical time periods as the experimental.

The experimental group was given one hour of creeping and one hour of crawling per day. The treatment was divided into  $\frac{1}{2}$  hour of creeping and  $\frac{1}{2}$  hour of crawling in the morning (9:00 A.M. to 10:00 A.M.) and  $\frac{1}{2}$  hour of creeping and  $\frac{1}{2}$  hour of crawling in the afternoon (1:30 P.M. to 2:30 P.M.).

The experimental treatment was effected in a room approximately 20' x 40' with two 9' x 12' gym mats covering the terrazzo floor. Two transparent plastic windows were on one wall of the room for the convenience of administrators and evaluators. The directions given to the children were, "Now we are going to get down on our hands and knees and creep." and "Now we are going to get on our bellies and crawl". It was necessary for the attendants to creep and crawl the entire time because imitation of them was an incentive for the children to do likewise and the only way many of them understood what they were to do. The children were never given specific instructions on how to creep or crawl, but, were kept moving in either the creeping or crawling position.

The control group was given two hours of unstructured play activities (walk in woods, feeding rabbits, ball playing, etc.) per day. This time was divided into one hour in the morning (9:00 A.M. to 10:00 A.M.) and one hour in the afternoon (1:30 P.M. to 2:30 P.M.).

The program was in effect Mondays through Fridays, May 23 to June 20, 1966.

#### Procedures in Treating Data:

Because the sample failed to meet the assumptions of the  $t$  test, the nonparametric Mann-Whitney U Test was used. (An ordinal measurement of the gain scores had been achieved with ties occurring only between two or more observations in the same group thus unaffacting the value of U).

#### Discussion:

As emphasis in this experiment centers upon the mobility continuum alone, the principal investigators wish to make it explicit that the results could not be interpreted as attesting toward or against the validity of the rationale of the total therapy of Neurological Organization. The theory, in its comprehensive entirety, is not amenable at the present time to rigorous experimental control. There are numerous underlying assumptions that have never been questioned by experimenters or educators in the field of perceptual-motor ability. These assumptions are vital to contemporary methodologies in their approach toward normal children as well as children with educational dysfunctions. The principal investigators, by isolating one of the basic aspects that is consistent with the Doman-Delacato theory, have tested one of these underlying assumptions for which there previously was no experimental evidence.

It should be pointed out that, although the experimental treatment was not comprehensive in that it did not involve the total structured therapy, creeping and crawling do involve considerable tactile stimulation, visual stimulation, and some auditory stimulation. Despite the fact that the treatment omitted the improvement of vital capacity and fluid control entirely and was only structured for mobility, it is believed that the mobility continuum is basic and extremely vital to the total treatment.

#### Findings:

Experimental results are not reported by agreement with the Department of Health, Commonwealth of Pennsylvania.

By design, the study was to aid in determining the feasibility of conducting future research along similar lines.

#### Problems:

Following are the significant problems encountered, actions taken to rectify procedural shortcomings, and recommendations for the future:



1. Because of the severe involvement of many of the children at Ebensburg, the desire for a homogeneous population from which to choose a sample, and the rigid criteria for admittance to the population, selecting those qualified for the population proved to be a laborious and time-consuming task. The histories and medical records of the children were incomplete, ambiguous, and contained numerous contradictions.

It was necessary for the principal investigators to spend time in direct association with the children and the attendants. The attendants who worked with the children daily invariably knew more pertinent information than all other sources combined. Also, seeing the children and associating with the children was necessary procedure, by clarification and refutation, of supplementing the medical and developmental histories.

Future studies of this nature should be cognizant of the time involved in the rigorous selection of a population. In order to obtain children who are amenable to the experimental treatment and who, by the nature of their disabilities, are sufficiently homogeneous, a systematic well-planned selection process should be adapted to meet the specific needs of the project.

2. The children in the project were drawn from seven self-contained residences. During inclement weather it was necessary to use a car to transport the children to the experimental room. This involved extra personnel as the children needed stricter supervision because of the safety hazards involved in such a trip. On one particular day extremely intense rain with high winds resulted in a considerable delay of the experimental and control treatments.

To obviate difficulties of this kind, the children in each treatment should be kept in the physical plant designated for that particular treatment for the duration of the project.

3. The experimental treatment was disrupted on numerous occasions when administrators and staff personnel came to observe.

All distractions should be minimized even if it means taping windows, isolating the treatments in a remote area, and severely restricting observers.

4. Both treatments maintained an attendant-child ratio of 1:3. The control group encountered no difficulties, but the experimental treatment was not fulfilled to its potential because supervision was not considered adequate.

With the hyperactive child chosen for the study, a ratio of 1:1 for future endeavors is recommended. If a 1:1 ratio is not practical, the findings of this study indicate that a ratio of 1:2 might be adequate. A study using less than a 1:2 attendant-child ratio cannot justify instituting the experimental treatment in question.

5. The children became bored with the length of the experimental treatment.

Crawling and creeping periods should not exceed 15-20 minutes.

6. Some of the children became attached to attendants working in the wards and were reluctant to leave them to participate in the treatments.

Children should have the same people care for them who are involved in the treatment.

7. At the onset of the experiment the gym mats in the experimental room were covered by .004" polyethylene sheets. These were totally destroyed during the first day of the study.

Either soft foam rubber, vinyl mats (ideally wall to wall) or basketball-type knee pads to be used with the conventional gym mats are recommended for future studies.

In summary, the study does not appear feasible with hyperactive, institutionalized trainable mentally retarded children. A sample large enough to provide statistically significant results would require more manpower than is now available for experimental purposes at state institutions, or for that matter in public schools. However, the idea of testing basic aspects of the Theory of Neurological Organization as it applies to perceptual-motor ability is one that should be pursued and, in the light of the present study, is feasible. Integral to the correct application of the scientific method to the study of behavioral change is the determination of the influence of one variable at a time upon the performance measure under consideration. It is propitious for certain basic assumptions that have never been questioned to be exposed to rigorous experimental test.

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