A Study of Neurological Organization Procedures and Megavitamin Treatment for Children with Brain Dysfunction

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Children suffering from any significant form of brain dysfunction face a doubly serious situation. The concomitant language disabilities of serious brain dysfunction handicap the children in their ability to understand many incoming stimuli from the outside world. Further, individuals in the outside world often find it difficult to understand the handicapped children. Therefore, therapeutic programs for these children assume critical importance in assisting the individual with brain dysfunction to actualize his potential and relate in satisfactory ways to other people.

With these goals in mind, various therapeutic programs have attempted to deal with brain dysfunction. Two of the most controversial therapies are neurological organization procedures (NO) and megavitamin treatment (MV). Both are utilized by the New York Institute for Child Development (NYICD) which disdains dealing with "symptoms" of brain dysfunction and espouses programs which purport to alter the structural aspects of the central nervous system as well as its functional aspects.

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Neurological Organization: Rationale

NO procedures were originated by Fay (e.g., 1955) who built upon concepts and practices dating back to the work of Itard, Seguin, and Montessori.

To NO rehabilitationists, satisfactory neurological organization is seen as the result of an uninterrupted ontogenetic development (Delacato, 1959) and is defined by LeWinn (1969) as the process by which the organism, subject to environmental conditions, achieves "the potential inherent in its genetic endowment."

Unsatisfactory neurological organization may be the result of congenital factors but is more likely the result of damage to the central nervous system (e.g., cerebrovascular or neoplastic lesions, traumatic brain injury, inflammation due to infectious disease). Poor neurological organization may also be due to developmental anomalies or inadequate environmental stimulation (Delacato, 1963).

The therapeutic procedures carried out by NO rehabilitationists consist of introducing neural patterns (e.g., crawling, creeping, response to sensory stimulation) felt to be omitted during the child's development. In exceptionally severe cases, the missing patterns are physically imposed on the passive child (i.e., "patterning").

The rationale for NO procedures holds that there are critical periods for the appearance of perceptual-motor activities, and that these generally occur in a certain order, ending in unilateral cerebral dominance. Although some children apparently can omit an activity without displaying later handicaps (presumably because they are able to compensate in other ways), most persons will be unable to develop higher level skills if the lower level skills have not been mastered.

This line of reasoning rests heavily on Hebb's cell assembly and phase sequence theory of perception (1949) which hypothesizes the production of neural pathways and neural firing patterns in the brain. Hebb (1949) further suggests that the richness of neuronal interconnections represents the neuroanatomical substrate of behavior; as one's experiences provide functional contact between two neurons, developmental patterning occurs which appears to be related to later behavioral maturity and flexibility.

NO procedures also lean upon the concept that remedial procedures should progress with the individual's own fluency with any given series of movements, with complexities being added gradually to maintain his attention (Luria, 1961). The concept of "critical periods" (Montessori, 1965) is regarded as important, with remediation sometimes being directed to activities which were apparently missed during a "critical period."

NO rehabilitationists are influenced by Lashley's position (1938), that equipotential exists within a given area of the brain, and Pribram's concept (1971) of the brain as a hologram. Lashley insisted that an individual's performance does not depend on the location of a brain lesion but upon the quantity of cerebral matter destroyed. In other words, the various parts of the brain responsible for such behaviors as movement act as a unit; if one portion of the brain in a given area is damaged, the remaining areas could take over its function. To Pribram (1969), the individual is constantly matching the outside world to a neuronal model of experience built up in his brain. If this model is damaged, there are mismatches between the model and what is coming in, unless the brain can make readjustments of some sort.

This rationale has been criticized by Perkins (1964) who points out that "there is current interest in evidence on critical periods from ethology, but there are many contradictions in material from this field and very little evidence on human behavior." NO rehabilitationists who support the "critical period" concept point to animal research in which environmental stimulation at specific developmental stages promoted neurological growth (e.g., Schapiro and Vukovich, 1970). Penfield and Roberts (1959) have concluded that there is a "biological time table for language learning" and that the most intensive learning takes place between the ages of two and four.

A critique of the role that cerebral dominance plays in NO rationale has been presented by Robbins and Glass (1969) who attack its emphasis on the importance of establishing a dominant sidedness, its attempt to relate dominance with such language functions as reading performance, and its insistence that an individual's dominant eye be on the same side as his dominant hand. They state (1969:346):

The concept of consistent dominance is used as a cornerstone for both the theory and practice of neurological organization. Advocates of this rationale have not been able to demonstrate its validity . . .

Robbins and Glass (1969:346) conclude, "As a scientific hypothesis the theory of neurological organization is without merit."

Neurological Organization: Research

Several studies in which NO procedures were utilized with reading disability children have yielded statistically significant results (e.g., Delacato, 1966b), while others have produced non-significant changes on the part of the poor readers (e.g., Robbins, 1966; O'Donnell and Eisenson, 1969). Critics of NO procedures (e.g., Robbins and Glass, 1969) claim to have detected flaws in the experimental designs of supportive studies, while NO advocates (e.g., Delacato, 1966a) point out that NO techniques were incorrectly applied in the studies producing non-significant results.

An experimental project by McCormick, Schnobrich, and Footlik (1969) attempted to overcome both sets of objections by randomly assigning, at mid-year, all first-grade pupils in an elementary school into NO and control groups. At the end of nine weeks, it was reported that experimental (i.e., NO) pupils who had been reading at grade level when the study began demonstrated no significant gain in reading test scores over the control (i.e., non-NO) pupils who had been reading at grade level. For pupils whose reading test scores were in the lowest third of the distribution, those in the experimental group made significantly higher progress than those in the control group. In other words, NO may be more effective with non-achieving pupils than with those who are making satisfactory progress in school.

In several instances, NO techniques have been used with handicapped children. For children with severe non-genetic brain injuries, NO purportedly produced results "better than those achieved by the authors with previous methods" (Doman, et al., 1960). Sechler, et al. (1963) reported on six severely brain-injured children with whom NO procedures were used for 10 months; it was claimed that all children demonstrated "marked improvement" in such areas as intellectual development, motility, and emotional control.

Statistically significant results were reported in a study involving the effects of NO on trainable mentally retarded children (Ker-schner, 1968). A pre-test/post-test design was employed for the 14 subjects in the experimental group and the 16 subjects in the control group. For 74 consecutive teaching days, the experimental group engaged in NO activities (e.g., crawling, creeping, visual training, auditory training, tactile stimulation, gustatory-olfactory stimulation) while the control group engaged in traditional activities which involved being given time and attention which equaled that of the experimental group. The experimental group demonstrated a significant 12-point gain in IQ scores as measured by a brief individually-administered intelligence test (Dunn, 1959). The control group did not make significant gains in IQ, nor did they make significant improvement on a motility scale devised for the study and on which the NO group made significantly higher scores.

Fredericks (1969) examined the effects of NO and behavior modification procedures in a nine-week study with Mongolian (Down's syndrome) children. Motor-coordination test scores were significantly higher among members of the behavior modification group at the end of the experiment. This was not true of the NO group, but Fredericks noted that the shape of the learning curve indicated significant improvement might have been achieved if the time had been extended.

Lavin (1971) studied 42 pre-school children from a low-income area in Harlem who were randomly assigned to two groups. There were no initial differences between the two groups in scores on an individually-administered intelligence test (Dunn, 1959) and an individually-administered test of language skills (Kirk, McCarthy, and Kirk, 1968). The control group was untreated while the experimental group engaged in NO activities five days per week. At the end of six months, all children were retested; there was no significant difference in the mean post-test IQ between groups, but the NO group had made a nine-month gain in language skills which was significantly higher than the five-month gain made by the control group.

Of possible pertinence to NO therapy are data emerging from animal research studies involving sensory-motor stimulation. Cats undergoing turntable rotation demonstrated greater neurological growth, when their brains were examined, than cats not receiving this stimulation (Klosovskii, 1963). Rats given enriched sensory-motor experiences showed gains, over a control group, in several areas; the typical rat from the experimental group (when compared to the typical control group rat) had a heavier and thicker cerebral cortex, a better blood supply to the brain, larger brain cells, greater degree of myelinization of nerve fibers, an increase in the number of glia (connective cells), and an increased activity of brain enzymes such as acetylcholinesterase (Bennett, et al., 1964; Rosenzweig, et al., 1962).

Extrapolating from his animal research data, Rosenzweig (1966) has suggested that the "animal studies indicating that differential growth of cortical regions can be induced by specific programs of experience" may eventually assist in adding "cubic centimeters to human brains." He has expressed regret that there has been an absence "of human data concerning relative development of cortical areas in relation to . . . heightened experience" although "this might be a valuable line of research to pursue." Because NO procedures claim to heighten the experience of the handicapped child in ways that foster the development of his brain, research into the results of NO training assume both clinical and theoretical importance.

Megavitamin Treatment: Rationale

Megavitamin treatment is closely associated with the work of Hoffer and Osmond (1960). It is one aspect of the modification of biochemically-related maladaptive behaviors through Orthomolecular psychiatry (Pauling, 1968).

The use of vitamins to combat and prevent bodily illness and dysfunction dates back to the serendipitous discovery by oceanic navigators that sailors who had eaten citrus fruit on a regular basis did not develop scurvy. It was later discovered that vitamin C could be used to combat scurvy. In the treatment of certain types of schizophrenia, doses of vitamin B3 ranging from 3 to 18 grams per day have been used (Hoffer, 1962). As the minimum daily requirements of vitamin B3 for most people are under one gram, the massive doses prescribed for schizophrenics became known as the "megavitamin treatment" (Hoffer and Osmond, 1966).

MV procedures and concomitant dietary alterations are advised for those individuals who are unable to utilize vitamins in the ordinary way because of faulty body biochemistry, e.g., disorders of enzyme synthesis, difficulties in absorbing vitamins, excessive oxidation (Hoffer, 1965).

The rationale held by MV therapists is that large amounts of vitamins will enable the body to fulfill its requirements despite the existing disorder (e.g., if there is a difficulty in absorbing vitamins, a large dose will enable the body to absorb what it needs, although most of the vitamin would be excreted). Hoffer and Osmond (1966) see many schizophrenics as suffering from a biochemical disorder that affects those parts of the brain which integrate, stabilize, and maintain the constancy of sensory perception. As a consequence, the individual's phenomenological experience is dramatically changed.

A biochemical explanation is offered for this type of schizophrenia (Hoffer and Osmond, 1966). For most children, a portion of the adrenalin in human tissue is converted into adrenochrome, then (because of his high reactivity) into 5:6 dihydroxy-N-methylindole. In many schizophrenics, however, the adrenochrome is converted into adrenolutin, due to biochemical dysfunctions which are generally genetic in nature. Adrenochrome is one of the most potent inhibitors of glutamic acid decarboxylase

(Osmond and Hoffer, 1966). Because this substance assists synaptic transmission, an inhibition of it would disrupt transmission of neural impulses and produce abnormal neurophysiological activity. Adrenochrome is also a potent inhibitor of acetylcholinesterase; inhibition of this enzyme would impair proper brain functioning.

Megavitamin Treatment: Research

MV treatment has been 'sharply criticized by Oken (1968) while Durell and Schildkraut (1966) refer to it as "a matter of controversy." In rebuttal, proponents of MV treatment cite an unpublished study (Lehmann, 1969) in which chronic schizophrenics undergoing MV treatment made a significantly greater improvement than chronic cases receiving traditional treatment. In addition, four double-blind studies have been presented in which the MV treatment groups made significantly more progress than the control groups (Denson, 1962; Herjanic, 1967; Hoffer, 1962, 1972). On the other hand, preliminary results of four unpublished studies in which MV treatment did not improve the functioning of schizophrenics have been reported by Tuma (1970).

Cott (1970) has presented a summary of his clinical work with children:

In the past 4 years, I have treated 175 children who are ill either with schizophrenia, autism or brain damage. With the vitamin treatment, results are frequently quick in starting and dramatic in nature, but in most instances three to six months is the usual time in which significant changes are seen . . . Those children whose treatment begins early in life — age 3 to 7 or 8 — respond better than those further advanced in age. Those in the age group 11 or 12 and older have the dimmest prognosis . . . All of these children have already been tried on all other available treatments and on all available psychoactive drugs, with negative effects or with results not in the least comparable to that produced by the vitamins. Preliminary reports have been released for two MV studies involving children. In one, MV treatment (i.e., vitamin B3 alone) was described as “ineffective" for 15 autistic, schizophrenic, and epileptic children (Roukema and Emery, 1970). The other study involved 200 autistic and schizophrenic children, half of whom "showed marked improvement" when treated for four months with massive doses of five vitamin compounds (Rimland, 1970).

MV treatment has been used in the treatment of alcoholics (Hoffer, 1965), senility (Hoffer, 1962), arthritis (Hoffer, 1959), hypercholesterolemia (Boyle, 1962), and hypoglycemia (Cott, 1970). The use of MV treatment for brain-injured and learning disability children is a more recent application of the therapy (Cott, 1971; von Hilsheimer, 1970).

No experimental studies have been reported concerning the effect of MV treatment on the performance of brain-injured individuals. However, certain animal studies could be interpreted to lend supportive evidence. Enesco, et al. (1968) found that injections of vitamin B12 markedly enhanced learning in rats. An absence of vitamins B3 and B12 has been identified as a possible cause of brain dysfunction in animals (Brin, 1967; Brozek and Baes, 1961). Vitamins and other nutrients have been found to play an important role in brain maturation (e.g., Howard and Granoff, 1968).

In research with humans as well as in animal research, neurological and biochemical functioning has been found to be closely related (Wyke, 1963). Whereas NO procedures attempt to improve the neurophysiological aspects of the organism, MV treatment attempts to improve its biochemistry. The two therapies, if valid, may work well together because of the close association between neurology and biochemistry in human behavior.

Subjects

Subjects (Ss) for this study were 100 children diagnosed as suffering from brain dysfunction by the staff of the New York Institute of Child Development (NYICD), 36 East 36th Street, New York City. The NYICD is a nonprofit clinic which specializes in NO and MV treatment. The Ss represent the first 100 Ss seen since the opening of NYICD in 1969 who had returned for at least one revisit. Seven Ss could not be used because their test data were incomplete.

The diagnosis of brain dysfunction was made on the basis of a report from the child's physician, a developmental history, interviews with the child's parents, an examination by a pediatrician, an examination by a NO rehabilitationist, and the administration of various tests. The tests which were administered varied from child to child; often included in the battery were intelligence tests, diagnostic reading tests, social maturity scales, and tests of language development. However, every S was administered the Doman-Delacato Developmental Profile (Doman, Delacato, and Doman, 1964). An interdisciplinary conference was held by the NYICD staff members; if a diagnosis of brain dysfunction was made, and if it was decided that the child would profit from NYlCD's therapeutic program, he was placed into one of several therapeutic groups:

Group One. The 41 Ss (28 boys, 13 girls) in this group had begun therapy before the experimental project was initiated. They only received the NO procedures and were not given MV treatment. The mean chronological age (CA) for this group at their first visit was two years, two months (2-2) with a range of 0-10 to 3-1.

Group Two. The 14 Ss (6 boys, 8 girls) in this group were assigned randomly (i.e., every third referral) once the experimental project was initiated. These Ss only received NO procedures and never were given MV treatment. The mean CA for this group was 1-10 with a range of 0-0 to 3-1.

Group Three. The 14 Ss (10 boys, 4 girls) in this group were selected by random procedures resembling those which were used for Group Two. These Ss received NO and MV treatment, beginning with their first visit to the NYICD. The mean CA for this group was 2-5 with a range of 1-5 to 3-2.

Group Four. Chosen by similar random procedures, the 24 Ss (18 boys, 6 girls) in this group received NO and MV treatment. However, MV treatment was not initiated until each S's second revisit to the NYICD, i.e., four months after the original visit and diagnosis. The mean CA for this group was 4-7 with a range of 1-0 to 14-5. (The S whose CA was 14-5 was the only adolescent in this group, the next oldest S was 9-5).

In summary, 93 Ss took part in this study. There were 41 Ss in Group One, 14 in Group Two, 14 in Group Three, and 24 in Group Four. It was decided to compare the improvement of Ss in each group in terms of the number of revisits they made to the NYICD.

Instrument

The only measure taken of all Ss in this study was the Doman-Delacato Developmental Profile (DDDP). Thus, the DDDP was used as the evaluation instrument.

The DDDP consists of 42 blocks of information from which a S's "neurological age" (NA) is determined. S's NA was divided by his chronological age and multiplied by 100 to yield a "neurological quotient" (NQ). The NQ became the basic datum for the study. Tests of statistical significance were run to determine whether the average NQ of each group (broken down in terms of revisits) improved during NO and/or MV treatment. A further inspection of the entire sample was made in terms of DDDP categories.

Items for the DDDP were selected on the basis of their developmental significance, their cultural significance, their ability to be readily observed, their ability to be easily measured, and the probability that they reflect a human being's neurological organization (LeWinn, 1969). The items were assigned to six categories: competence in mobility, competence in speech, manual competence, visual competence, auditory competence, and tactile competence. Each category (or function) contains seven sets of items (or levels) producing 42 blocks of information from which a child's NA can be determined. These 42 informational blocks can be briefly described

Competence in mobility:

1. Moving backward, pivoting in a circle, rolling over;
2. Crawling;
3. Creeping;
4. Walking without pattern, using arms to balance;
5. Walking without pattern, with arms freed from the balance role;
6. Walking in cross-pattern (i.e., left arm swinging forward as right leg swings backward and vice versa);
7. Using, in a skilled role, a leg which is consistent with the dominant arm, etc.;

Competence in speech:

8. Birth cry;
9. Vital crying in response to threats to life;
10. Vocalization of meaningful sounds;
11. Two words of spontaneous, meaningful speech;
12. 25 words of speech plus two-word couplets;
13. 2,000 words of speech plus short sentences;
14. Full speech vocabulary plus proper sentence structure;

Manual competence:

15. Grasp reflex;
16. Vital release;
17. Prehensile grasp;
18. Cortical opposition in either hand;
19. Cortical opposition, bilaterally and simultaneously;
20. Bimanual function with one hand in a dominant role;
21. Writing with dominant hand;

Visual competence:

22. Light reflex;
23. Outline perception;
24. Appreciation of detail within a configuration;
25. Convergence of the eyes resulting in simple depth perception;
26. Differentiation of similar but unlike visual symbols;
27. Identification of visual symbols and letters within experience;
28. Reading words by means of a dominant eye consistent with the dominant hemisphere;

Auditory competence:

29. Startle reflex;
30. Vital response to threatening sounds;
31. Appreciation of meaningful sound;
32. Understanding two words of speech;
33. Understanding 25 words of speech and two-word couplets;
34. Understanding more than 7,000 words of speech and simple sentences;
35. Understanding full speech vocabulary and properly structured sentences;

Tactile competence:

36. Tonic skin reflexes;
37. Perception of vital sensation (painful);
38. Perception of gnostic sensation (non-painful);
39. Tactile perception of three-dimensional objects which appear to be flat visually;
40. Tactile differentiation of objects without use of vision;
41. Tactile identification of objects without

use of vision; 42. Tactile differentiation and identification of similar objects using dominant hand.

The DDDP contains interview questions, observational tasks, and/or tests for each item (e.g., having S attempt to tactually differentiate between a block and a ball for item 40).

Three reliability and validity studies have been reported for the DDDP Taylor (1968) has presented the interexaminer reliability (based on two examiners and 45 Ss) for each of the DDDP's six categories (i.e., Pearson product-moment correlation coefficients of .92, .87, .96, .95, .88, and .91). The coefficient for the Total Profile was .93. Harvey (1965), in a concurrent validity study of the DDDP, found it to correlate significantly with the Stanford-Binet. Taylor and Van Nolde (1969) obtained significant results in a predictive validity study with the DDDP and reading achievement test scores. The issues involved in the face validity of the DDDP have been presented by LeWinn et al. (1966).

Thomas (1967, 1969) has made a case for basing the diagnosis of a faulty central nervous system primarily on DDDP scores, holding that a child performing below his chronological age level on any of the DDDP categories manifests a "disorder of function." However, the NYICD staff uses the DDDP as one of several indicators that a child's neurological behavior is functioning poorly. LeWinn (1969:163-164) states that:

When NA and CA are congruent, the individual's NO is within the range of his peers. If NA falls below CA, NO is abnormal, inadequate, or delayed. The wider the discrepancy between NA and CA, the more obvious is the behavioral difficulty of the child. Furthermore, the broader the range of involvement on the DDDP, the more extensive is the child's neurological disorganization.

Such DDDP findings "point clearly to the presence of cerebral disorder” (LeWinn, 1969:204). LeWinn (1969:166) concludes that the DDDP is "an invaluable instrument which is an important advance in the measurement of human behavior."

The DDDP was originally devised for clinical work with NO procedures, not with MV treatment. Although MV treatment attempts to ameliorate many of the same maladaptive behaviors noted upon administration of the DDDP, the fact that this study represents the first application of DDDP data to MV treatment must be kept in mind.

The mean NQ for Croup I was 66.1 at the inception of treatment with a range of 7.0 to 133.0. For Group II, the mean baseline NQ was 69.0 with a range of 8.8 to 177.8. For Group III, the mean baseline NQ was 76.2 with a range of 33.3 to 139.5. In the case of Group IV, the baseline NQ was 62.2 with a range of 13.3 to 100.0.

Therapeutic Procedures

Initial visits to the NYICD lasted for three days. Upon the completion of tests and interviews, the parents were informed whether the NYICD staff thought it could assist the child. If so, the parents were instructed in the physiological and psychological components of NO therapy. Parents practiced these procedures under supervision, then took their child home and applied these procedures daily. Another visit to the NYICD occurred in two months at which time the child was re-tested and the therapeutic regime was altered accordingly.

The children in Group Three were prescribed vitamins upon their first visit while Group Four children were prescribed vitamins upon their third visit. Upon subsequent visits, the vitamin dosages, as well as the dietary programs, were altered, depending on the NYICD staffs observations of the child and his progress.

The typical daily program for those Ss undergoing NO procedures involved two 20-minute periods of cross-patterned crawling and/or creeping, one 20-minute period of visual-motor coordination exercises, one 15-minute period of language stimulation, and one five-minute period of each of the following activities: visual stimulation, auditory stimulation, tactile-kinesthetic stimulation, and gustatory-olfactory stimulation. These procedures are described in detail by Thomas (1969, Chapter 13).

The typical daily MV treatment consisted of one gram (per 50 pounds of body weight) of vitamin B3, one gram of vitamin B1, 200 milligrams of vitamin Be, 3 grams of vitamin C, and dietary alterations to increase the consumption of protein and to decrease the consumption of carbohydrates. If a "flush" reaction to the nicotinic acid form of vitamin B3 occurred, the nicotinamide form was substituted (Hoffer, 1969).

Individual differences were taken into account when the original programs were outlined and when Ss returned for re-evaluation.

Results

The results of this study are presented in Table I. It can be seen that Croup I and

Table I

Changes in Neurological Quotients (NQs) on the Doman-Delacato Developmental Profile by Four S Croups Undergoing Neurological organization Procedures and Megavitamin Therapy Using NQ on First Visit as Baseline, Utilizing t-test Technique for Evaluation.

	Group I (NO only, not randomly assigned)	**Group II (NO only, randomly assigned)**	**Group III (Both NO andMV treatment)**	**Group IV (MV added after 4 months of NO)**
Number of Re-visits	t&df	t & d f	t & d f	t&df
1 re-visit (2 months of treatment)	1.06 (14 df) (11 M, 4 F)	0.27 (5 df) (4 M, 2 F)	1.50 (5 df) (6 M, 0 F)	0.04 (1 df) (0 M, 2 F)
2 re-visits (4 months of treatment)	1.32 (16 df) (10 M, 7 F)	1.25 (4df) (0 M, 5 F)	0.62.(3 df) (2 M, 2 F)	1.25 (5 df) (6 M, 0 F)
3 re-visits (6 months)	1.02 (4 df) (5M, O F)	NoSs	2.22* (3 df) (2 M, 2 F)	1.99* (8 df) (7 M, 2 F)
4 re-visits (8 months)	1.47 (3 df) (2 M, 2 F)	1.63 (2 df) (2 M, 1 F)	NoSs	2.31** (6 df) (5 M, 2 F)
Total N	41 Ss (28 M, 13 F)	14 Ss (6 M, 8 F)	14 Ss (10 M, 4 F)	24 Ss (18 M, 6 F)

* Statistically significant at the .05 level. **Statistically significant at the .025 level.

Table II

Changes in Neurological Quotients from First Visit to Final Re-visit Computed for Each Category of the Doman-Delacato Developmental Profile for 93 Ss Undergoing Neurological Organization Procedures and Megavitamin Treatment, Using Analysis of Variance for Evaluation.

Category	Factorial Analysis of Variance F
Competence in Mobility	28.2*
Competence in Speech	12.1*
Manual Competence	31.7*
Visual Competence	45.6*
Auditory Competence	50.1*
Tactile Competence	36.6*

* Statistically significant at the .001 level (93 & 5 df)

Group II Ss did not attain statistically significant changes in NQ between their first visit and any subsequent revisit. However, Group III and Group IV Ss who had spent six months in therapy attained a statistically significant change in NQ. Although no Group III Ss had been in therapy for eight months, those Group IV Ss who had been treated for eight months also made a significant change in NQ. Both Group III and IV Ss received MV treatment as well as NO procedures in their therapeutic program.

A factorial analysis of variance was done for the entire sample of 93 Ss to measure improvement on each category of the DDDP. Table II presents the results. It can been seen that improvement on each category reached high levels of significance from Ss' first visit to their final revisit. An additional analysis also revealed that more progress was made by younger than by older Ss; this finding is an important one in view of the fact that the two MV groups (Groups III and IV) were somewhat older than the two NO groups (Groups I and II), yet made significant progress, while the other groups did not.

In other words, the group as a whole showed improvement on the tasks measured by the DDDP. However, when MV treatment was added to NO procedures, Ss in those groups attained significant improvement which was not seen when NO procedures alone were used.

Discussion

The results of this study are suggestive rather than conclusive in nature due to four limitations in the research methodology:

1. A greater variety of tests and measurements would have produced additional information concerning the change in Ss' perceptual-motor skills, language ability, and intelligence. In addition, tests with more adequate validity data would have been useful to verify the DDDP results.*

*** These methodological refinements were built into a research proposal (Number NS-HD-10052-01) submitted ot the National Institute of Mental Health in 1971. When the proposal was turned down, it was decided to proceed with a more modest study, using the cited S groups and test (i.e., DDDP).**

2. There was no group in which MV treatment alone was utilized. Therefore, it is difficult to determine whether the significant

results obtained were due to an interaction of NO and MV, or to MV alone. The addition of a group in which neither NO nor MV was used would have permitted an additional comparison to be made.**

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3. Ss in each of the four groups were heterogeneous. More homogeneous groups (especially as regards age, socio-economic background, and extent of disability) would have eliminated a number of confounding factors allowing a clearer examination of the results of therapy.

4. A longer follow-up period may have resulted in significant gains for the NO group. It may well be that NO procedures exert a significant effect less quickly than does MV treatment.***

***** The four groups in this study will be followed up for another two years and the results presented at a later date.**

Further studies of the rate of improvement due to NO and MV therapies could be compared with the rates of improvement due to more widely used treatment modalities (e.g., psychoactive drugs, behavior modification).

Another essential line of research would involve which children can benefit from NO, which from MV, which from a combination, and which from some other type of treatment. Many types of brain dysfunction exist and it would be simplistic to expect one therapy to be equally applicable to all cases.

In any event, the fact that MV treatment was associated with significant results in this study justifies further research into this type of therapy. The data are all the more provocative when it is realized that the results were obtained on a test that measures 42 aspects of a child's behavior but which was not developed for utilization with MV treatment.

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