Effects of Intensive Tactile and Vestibular Stimulation on the Development of Reflex Control and Eye-follow

by

Mary C. Pflueger

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements for the Degree
of Master of Education

Department of Educational Psychology
Winnipeg, Manitoba
May 15,1978

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Abstract

This thesis investigates the effects of added tactile and vestibular stimulation on a group of twenty seven institutionalized, multiply handicapped children between the ages of two and eight. The greatest disability of each of these children had been judged to be mental retardation. All these children live in the same institution and their routine is similar. This routine includes many and varied activities. Three randomly selected groups were randomly assigned to one of three programs. The first received individual, added, specific tactile and vestibular stimulation from a therapist for a twenty minute period five days a week for six weeks. The second group spent a similar amount of time with the physical education director. This program was carried out in a small group setting. The third group received no added program.

Although selected largely from one ward, the nature of "multiple handicap" makes it almost impossible to divide these children into matched groups. It was found that group two was both higher functioning (physically and mentally) and more homogeneous than either of the other groups. Group three was more homogeneous than group one.

All the children were assessed for reflex status and the ability to follow a moving object with their eyes twice before the treatment period and twice immediately following it.

The results of the study were inconclusive. Two members of the experimental group showed gains in their ability to follow a moving object with their eyes. These gains were not statistically significant.

It was concluded that the method os assessment used to determine the individual's ability to control primitive reflexes was not dependable for this type of child. Factors which may have influenced the dependability of the method, which include size of the child, willingness or ability to cooperate, seizures and medications are discussed in the final chapter. There are definite implications for therapists and class room teachers who work with children of this nature which are also dealt with here. Finally indications of need for further studies and the direction these studies might follow are considered.

Acknowledgements

I wish to thank D. Richard Carriero for his guidance and advice during the time I have studied in the Department of Educational Psychology, to Dr. Loren Sandols and to Dr. Michael Newman, my most sincere graditude. I greatly appreciate the administration of the St. Amant Centre who kindly allowed me to work with their children, with special thanks to the staff of the physical medicine department and also to Mr. Dan Johnson, the physical education director.

I am also grateful to my husband for his patience and consideration.

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Chapter I

Could only one characteristic be used to distinguish the mentally retarded from the normal child, that characteristic might well be the mentally retarded child's lack of lively, productive curiosity concerning his environment. We know that from birth the normal human baby begins to explore his world. Why then do some children not show this typical response to their surroundings?

The infant is born with stereotyped patterns of movement, reflexes, which dominate his activities. In the normal child the brain receives consistent information concerning this movement. It is able to organize, interpret, use and store this information by a process known as integration. In this way the information received from body movement, initially reflex, is used to initiate further movement which within a few days becomes less stereotyped and more purposeful. Some children seem to be incapable of such integration and retain some or all of the stereotyped patterns. These dominate their actions and interfere with the development of purposeful movement, which would enable them to explore and learn from their environment.

The central nervous system (CNS) develops in an orderly fashion from the spinal cord up to the cerebral cortex. In the developing human, oral tactile function develops one to seven weeks after fertilization, followed by vestibular function, twelve to seventeen weeks after fertilization (Gottlieb, 1971, pp. 67-128). This development, even in intrauterine life, is dependent upon sensory stimulation and use for normal development, and upon gene-dependent physical development of the CNS itself.

Under certain circumstances a child is unlikely to make the transition from stereotyped to purposeful movement because faulty sensory information is reaching his brain. It has been hypothesized (Ayres, 1973) that besides outright non-function of a sense organ, the organ may be so sensitive to sensation that the whole organizm is overwhelmed, in which case the child avoids activities which impose that sensation upon him. On the other hand the organism may need stronger stimulation to produce a recognizable experience. This sensation the child will ignore because it is subliminal. The system itself may be faulty and/or the stimulus may produce inconsistent feedback. The child disregards this stimulus as meaningless. He may also find himself in an environment in which there is a dearth of stimulus-provoking material to investigate. This may well happen to the physically handicapped child who is limited in ambulatory and/or manipulative skills.

Although the human brain is not mature before the late teens or early twenties (Moore, 1973, p. 29) touch, the vestibular system, sight and audition are capable of function at birth (Gottlieb, 1971, p. 89). Should one or more of these systems not be capable at this time, the baby is deprived of the tools of investigation:"The learning of movement is entirely dependent on sensory experience; sensory input which not only initiates but guides motor output." (Fiorentino, 1972, p. 7.) "He functions as a . . . sensory-integrative-motor-sensory-feedback-system" (Moore, 1973, p. 22).

The nervous system develops and matures through use. There are at least three factors to be considered: genetic endowment, the environmental demands and rewards, and the interplay of these two upon one another.

To quote Sperry (1965)

> Between the strictly inherited organization of the behavioral networks and the strictly acquired, we recognize an important intermediate realm of nervous development in which function and growth go on simultaneously with mutual interactions. The anatomical effects of functional influences during these stages may not be large or even visible under the light microscope, but the minute differences may be critical in terms of behavior, especially with reference to human childhood.

The tactile and vestibular systems are the first senses to become functional. Because of this and the fact that they both feed heavily into the arousal, or alerting, system, Ayres (1973), deQuiros (1976) and Webb (1969) have postulated that normal development and optimal use of the brain depend on the integrity of these systems. They advocate treatment programs which depend on tactile and vestibular input given at the highest level acceptable to the child. They feel that such input will encourage and enhance the integrative abilities of the brain so that higher centres will be able to submerge and integrate reflex patterns into purposeful, coordinated movement.

Statement of the Problem

This raises the question: will a program of high tactile and vestibular input, administered over a period of time, influence the child's ability to control reflex activity and enhance coordinated use of the eye and eye-hand coordination. Can this be observed in a number of institutionalized children each of whose greatest problem is described as mental retardation?

The term "haptic processing" is sometimes used to refer to the integration of tactile information with information concerning the body's position in space, kinesthesia. Kinesthesia in the early stages of development if largely dependent on the integrity of the vestibular system. Chalfont and Scheffelin (1969) say, "there is need also to determine if training can improve the selection and organization of kinesthetic impulses for bringing about increased control over voluntary movement (p. 46)," and "a major issue which needs to be resolved is whether or not it is possible to improve tactile-kinesthetic abilities in children whose tactile-kinesthetic sensory modality is distorted or deficient" (p. 47).

In the following chapter this paper will review the literature as it concerns 1) the relationship of reflex activity to CNS maturity and integrative ability; 2) the tactile system and its influence on the child's ability to explore the environment; 3) the vestibular system and its relationship to the ability of the CNS to integrate information from the other senses, as well as the influence of early motor experience on this system; 4) the visual system and its imponse to sensory input shown by atypical children and 6) similar studies.

In chapter three will be found 1) an outline of the purpose, and observations to be made during the study; 2) a description of the sample, its limitations and the method used in its selection; 3) a description of treatment techniques and their application; 4) and a description of the measuring tool and how it was used.

Chapter four will report the results and show them in table form.

Chapter five will 1) discuss the results and implications of the study; 2) endeavor to account for some of the difficulties encountered; and 3) suggest possible avenues for further study.

The reader may find it convenient to refer to the following definition of

Central Nervous System - (CNS) that part of the nervous system enclosed within bone: the brain and spinal cord.

Eye follow - the ability to maintain focus on an object as it moves within the range of vision.

Reflex - automatic, fixed motor responses to sensory stimulae (Noback & Demorest, 1975).

Reticular formation - a diffuse network of nerve cells and fibers which extend through the spinal cord, brain stem and diencephalon.

Reticular system - the functional system which utilizes the reticular formation. It appears to be responsible for the relative state of alertness of the organism (sleep-wake patterns) as well as having an inhibitory or facilitory effect on the motor systems.

Chapter II

Review of the Literature

Reflexes

A divergent group of professionals (Ayres,1973; Clements and Peters,1962; Fish,1971;Frand and Levison, 1973;Colbert,Kaegler and Markham,1959; Kennard, 1960; MacCulloch and Williams,1971;Ornitz,1974; Ornitz and Ritvo, 1968; de Quiros,1976;Schilder,1950: and Webb, 1969,have looked at the problems of adjustment of children,physically, socially, emotionally and educationally from a viewpoint of normal physical development. All children are born with certain reflexes (mediated through the spinal cord or brain stem) which may be divided into two classes--tonic (static) or phasic. Because the stimulus for the phasic reflex is removed by the motor response these reflexes cause few or no problems. However, as tonic reflex responses do not remove the stimulus, the child is locked in a non-functional position for an extended period of time or may find it harder to perform a purposeful movement because of increased muscle tone in the muscle antagonist to that movement. Tonic reflexes, presumed to have been survival mechanisms at some time in man's phylogenic development, are not in themselves functional. For example, the asymmetric tonic neck reflex (ATNR) (Figure 1) may, if not under control of higher centres,automatically turn

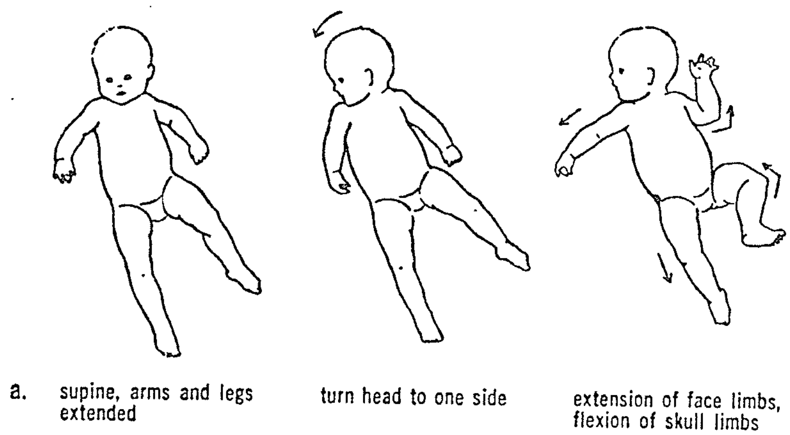


Figure I A T N R

(Mysak 1969)

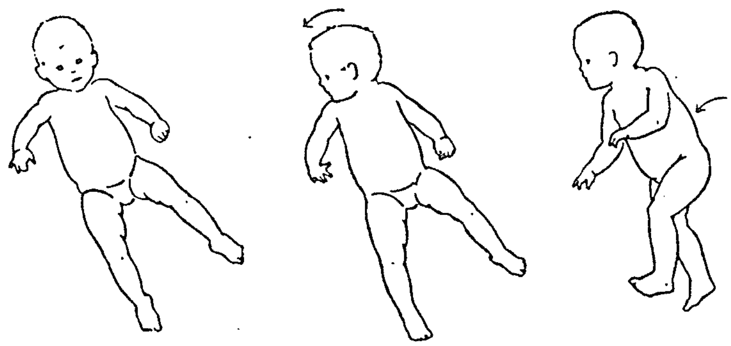
the child's face and mouth away from a flexed elbow, thereby making the use of both hands together in the midline impossible. This destroys one of the basic mechanisms for development of eye-hand coordination. It also interferes with skills of daily living, including self-feeding.

Righting reflexes

At approximately three months of age the child develops the earliest righting reflex, neck righting. When the head is turned to one side this reflex causes the body as a whole to follow it (Figure 2). Schilder (1950) associated the twirling of schizophrenics with the immature neck-righting reflex. He felt that this reflex perpetuates itself as the neck receptors are alternately stimulated by head and then body turning. This interpretation has been accepted by Ayres (1973), Clements and Peters (1962), and Silver (1952), all of whom used Silver's adaptation of a test devised by Schilder to indicate organic problems in children whose behavior is atypical. The more mature infant (six to eight months) uses a body on body righting reflex, (Figure 3). The head turns to one side, then the shoulder girdle and finally the pelvis. This pattern is no longer present at three years.

Protective extensor thrust

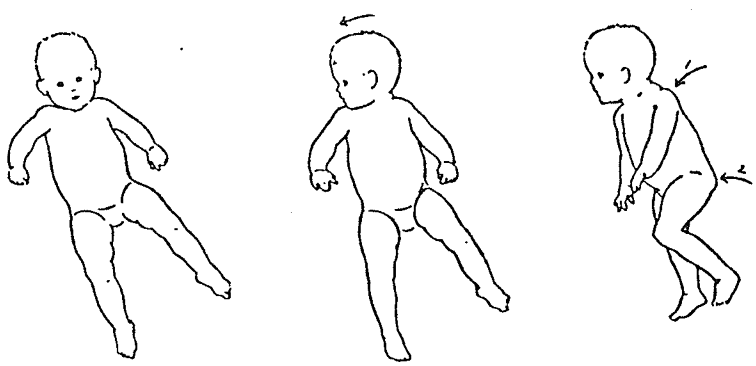
Protective Extensor Thrust [P.E.T. , Figure 4] of the arms starts at about four months, is



a. supine, arms and legs extended | rotate head to one side | body rotates as a whole in same direction as head

Figure 2 Head on body righting

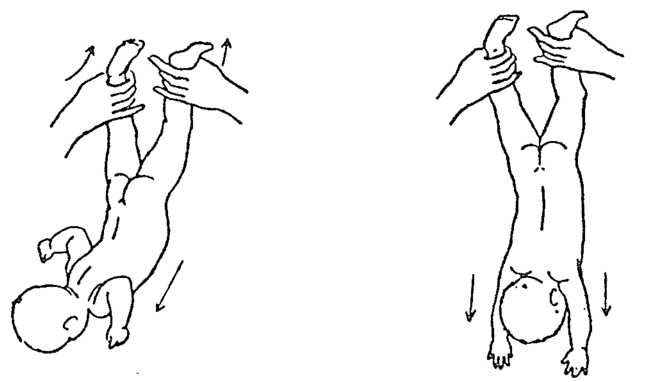
(Mysak, 1969)



c. supine, arms and legs extended | turn head to one side | head turns, then (1) shoulders, (2) pelvis

Figure 3 -Body on body righting

(Mysak, 1969)



lift freely in air by ankles and move suddenly downwards

arms extend, fingers extend and abduct

Figure 4 - P E T (Mysak, 1969)

> strong at six months and remains active through life. To elicit; place the individual in a prone position, lift him freely in the air by his ankles and move him suddenly downward. Or with an older person, place him in a prone position, raise his body off the floor by holding onto the pelvis and then move him downward. A positive response is marked by an immediate extension of the arms with abduction and extension of the fingers. (Mysak, 1968, p. 26).

It is an automatic protective response to danger.

Equilibrium reactions

Equilibrium reactions (Figure 5) occur when muscle tone is normal or near normal: they provide for body adaptation in response to a change in the center of gravity of the body. Prone equilibrium reactions are first noticed at six months, supine at seven to ten months.They are elicited by tilting the subject from a prone or supine lying position.

The presence of P E T and the equilibrium reactions indicates that the C N S is sufficiently mature to adapt to gravity in a functional manner, automatically and without conscious effort. This ability frees the cortex to learn further from the environment.

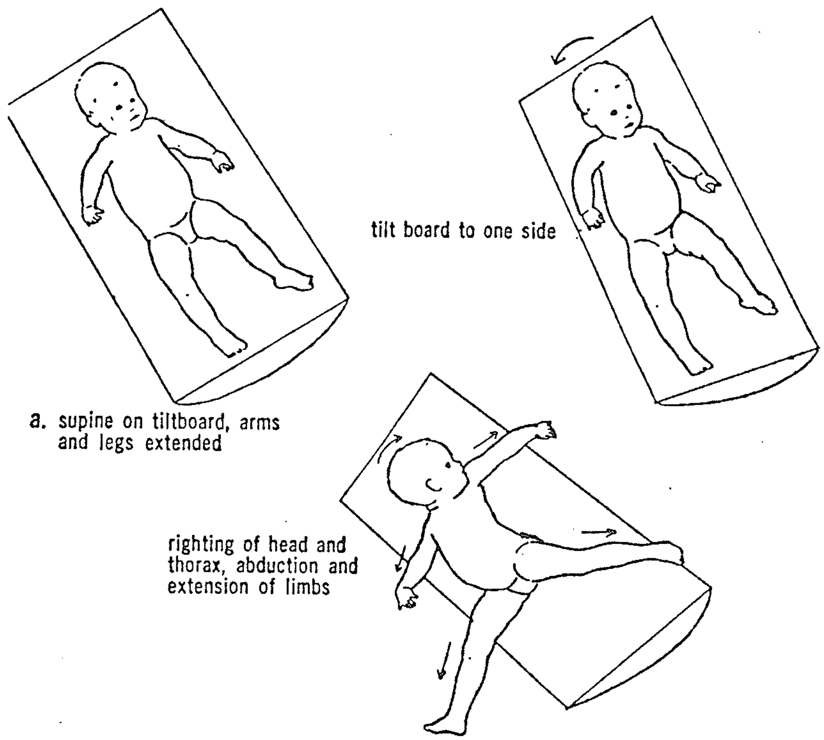


Figure 5 - Equilibrium Reactions

Supine (Mysak, 1969)

Use of Reflex Testing

Tests to evaluate reflex levels may be used by a number of professionals; special educators, psychologists, psychiatrists, physical educators, doctors, therapists, and others. Most of these tests form part of developmental rating scales, e.g., Denver Developmental Screening, Gesell Developmental Schedules, Routine Developmental Examination of Normal and Retarded Children - Milani-Comparetti, and the Vulpe Assessment Battery. Fiorentino's Reflex Testing Methods for Evaluating CNS Developmental is one generally accepted test which tests reflex responses only. This method suggests only one application of the stimulus.

Validity and reliability

The only reference found to validity or reliability of these tests was in Knoblock and Pasomanic's 1974 revision of Gesell and Armatrudos Developmental Diagnosis. They say "The long term procedures of testing reliability --- and then validity was done and then replicated by the current editors on seven or eight thousand additional infants"(p.x.). This statement seems to refer to given performance norms for various age levels rather than to the testing method.

Banus, (1971) in her book, The Developmental Therapist, says "Fiorentino provides a useful clinical tool in her illustrated procedure manual for examining and recording reflex development." Rider, (1974, p. 352), says

> "Reflex testing is a more objective procedure than those in many other parts of the neurological examinations. Reflexes may be reinforced or decreased voluntarily or in hysterical states, but are less under control of will than other functions tested. Reflexes are not as dependent upon the attention, cooperation, or intelligence of the patient as many other neurological functions are, and consequently can be evaluated in confused individuals, those of low intelligence, and infants and children even when other tests cannot be carried out on such."

Illingsworth (1975) in discussing the conducting of a developmental examination of the child says, "first it is essential to gain the cooperation of the child" (p. 164). "It is wrong to conduct a developmental examination on an epileptic child after a major convusion or when he is under the influence of sedative drugs" (p. 167). The only reference found to the possible effect of the child's emotional state to his response to such an examination was in Parmalee and Michael's (1971) article. "The responses of an irritable baby will be quite different from those of a baby asleep."

In recent study Lewko, (1976), polled representatives of twelve different professions engaged in testing motor behavior in facilities where services were offered to disabled or potentially disabled children. These included severe mental retardates. Fiorentino's method was the sixth most commonly used test. Two of the tests more frequently used (Denver Developmental Screening and the Gesell Developmental Schedules), both have a component of reflex testing. Only one percent of the people using the

Fiorentino Test were dissatisfied with the results. This study also reports that a number of examiners were using reflex testing evaluations which they had compiled themselves.

Pain, Brazelton, Donovan, Drorbough, Hubbell and Sears, (1964), state that the ATNR is "diagnostically the most valuable postural response after one month."

Rider, (1972, p. 132), says

> determination of reflex level is used by physicians and the therapists to assess the developmental level in the diagnosis of neural subnormalities. --- Many investigators feel that a marked persistence of the ATNR beyond the first year is invariably a sign of prognostic significance.

Based on their study of normal newborns, Vassella and Karlsson, (1962), stated that, "the statistical probability of observing an ATNR pattern on one trial is 3/16; the probability against is 13/16." Since the publication of this study, Fiorentino, (1973), Illingsworth, (1975), Knobloch and Pasomanic, (1974), Millani-Comparetti and Gidoni, (1967), Mysak, (1968), and Vulpe (1977), have all compiled tests or rating scales which have not suggested repeated testing. Paine et al, (1964), did use ten trials and considered a positive response in six of these trials as indicative of the presence of the reflex.

Although all investigators do not agree as to the exact age at which the presence of the ATNR is an indication of neurological pathology, investigators state that it should no longer be evident in the normal at one year, (Gesell and Ames, 1950, p. 165; Fiorentino, 1972,

p. 72; Illingsworth, 1975, p. 89; Knoblock and Pasamanic, 1974, pp. 41-42; Paine et al, 1964, p. 1039; and Vaselle and Karlsson, 1962, p. 365).

Lewko, (1976), reports the use of reflex testing with mentally retarded as do Millani-Comparetti and Gidino, (1967), Paine, (1964), Webb, (1969), and Vulpe, (1977). The 1968 Vulpe test is specific to severe and profound mental retardation.

Tactile System

Receptors

The tactile receptors are situated in the skin, which develops from ectoderm as does the CNS. The normal child responds to, and learns from, touch (light or deep). Information received through these receptors is said to be largely responsible for the development of body image (knowledge of one's body and its parts), and body scheme (body image plus a knowledge of how these parts function to interact effectively with the environment) (Ayres,1973, p. 168).

Tactile stimulation is carried by the nervous system not only to brain centres where it may be identified and localized, but also to the general alerting system, the reticular activating system (RAS), where it may exert either an excitatory or inhibiting effect, depending upon circumstances.

Tactile development

Touch is the first sensory function to develop in man.

It is highly developed in the newborn and continues to develop rapidly during the first six months.

"A limb without tactile sensation will not be used spontaneously, no matter how capable the motor system to that limb may be." (Jones, 1960). Yendovitskaya, Zinchenko and Ruskaya (1971, p. 3) quote Arshavsky's theory that skin receptor stimulation is responsible for muscle tonus and so for posture in the young child.

For the first six months of life, touch is the dominant learning media of normal children. During this period touch evokes and guides visual perception. After this, vision gradually takes over and the hand is guided by the eye. The child now reaches for what he sees rather than looks at what he handles. Towards the end of the sixth month tactile receptors are largely mature. (Yendovitskaya et al 1971, pp. 15-16).

Frank (1957) points out that much tactual experience goes into all motor learning. This is especially true of hand skills. Frank goes even further, and on the basis that touch is the primary mode of communication for the infant, says, "denial or deprivation of these early tactile experiences may compromise his future learning, such as speech, cognition, and symbolic recognition" (p. 225).

Peiper (1963, p. 80) quotes Palaquai:

> Tactile sense must be regarded as our original sense . . . as the root of our whole sensitivity. The other senses would be unable to create a basic knowledge of the outside world without the aid of the tactile sense.The sense of touch is the only complete sense. All others only complement it. With the aid of

autistic child, says, "when I held Ella, she became more definite and purposeful (p. 198)."

Frank (1957) says that

> Babies especially require close, firm holding. Prolonged deprivation of such tactual contacts and soothings may establish in the baby persistent emotional affective responses to the world, since his initial biological reactions to threats have not been allayed and hence may become chronic (p. 220).

Many handicapped children are not picked up, played with, and cuddled as are their normal counterparts, especially if the handicapped child is delicate or overtly ill, as many of them are in infancy. Ambrose (1969) notes that prior to the extensive use of incubators, more premature babies survived in Michael Reese Hospital, Chicago, where they were handled often. He suggests more handling of all infants.

Treatment of the tactile system

Although it is of such vital importance to development and learning, intact tactual sensation is largely taken for granted and little was found in the literature concerning possible pathology in the tactile system of the immature, mentally retarded, or non-speaking child. Treatment of such pathology, if it were found, also seems to be largely missing from the literature.

Tachdjian and Minnear, (1958), found a high correlation between deficiencies in tactile sensation and disuse of the limb in cerebral palsied children. This would visual perception we transfer the optic image of an object to the space where we can feel it with our tactile sensation.

The dual tactile system

Both Frank (1957) and Ayres (1964 and 1973) refer to Head's (1920) concept of a dual (cutaneous) tactile system -- the "protopathic system", a phylogenetically old system designed to warn man and defend the organism against potential danger, and the "epecritic system", which is newer and concerned with discrimination.

Ayres (1964, 1973) postulates an innate deficit which results in the protective system dominating the child's responses whereby all incoming tactile information is interpreted as threatening. A firm touch which reaches the deeper receptors is more tolerable to these children. The dominant fear response prevents the discriminatory system from developing, and thereby interferes with all learning through the other senses as well as through touch. She calls this "tactile-defensiveness." Children so designated react to touch with fear and/or anger. Because the warning system feeds heavily into the RAS this response is cumulative, long-lasting and may influence the pituitary gland which would then perpetuate the high arousal state. Ayers feels that this is a basic component of autism as seen in some children.

Schopler (1962), in discussing the treatment of one lead to less than normal exploration of the environment. Jones, in 1960, confirmed this correlation and added that although direct teaching of the recognition of tactile sensation had been encouraging, very little was being done in this area of rehabilitation.

In 1969, (p. 47), Chalfont and Scheffelin suggested that while most of the literature discusses the use of tactile sensation to reinforce the other senses no one has investigated the possibility of improving tactile and kinesthetic perception and interpretation.

Problems of testing the tactile system

There is also the problem of a method for testing tactile sensation in the young or non-verbal child. The lack of language makes it impossible to use the commonly used media, two-point testing, stereognosis, identification of textures and forms, etc. Even temperature tests are not feasible because these children do not understand the concepts of hot and cold. Tests for position sense also are not useable for the same reasons. However, if recognition and integration of tactile sensation is as basic as the literature indicates, investigation into methods, first of evaluation of the integrity of the tactile system, and then of remediation is urgent.

It is the author's impression that this has not yet been done and results published. The method referred to by Jones and a similar method now being used by Poulson, (1976), in an unpublished study, requires the cooperation of an intelligent child. There are methods described by Ayres, (1974), which seem suitable for the non-cooperating child. Other methods for application of tactile stimulation have been described by Farber and Huss (1974), Rood (1954) and Stockmeyer (1967).

Vestibular System

Anatomy and physiology

The vestibular or labyrinthine organ is situated in the same bony cavity as the inner ear. It is stimulated by the position of the head as seen in motion itself, the direction of that motion, and the position of the head as indicated by gravitational pull. The vestibular system is the newborn's only source of knowledge concerning his relationship to gravity. This is gradually, in the human, taken over in part by the eyes. The role of the vestibular system as opposed to that of the eyes is indicated by the fact that a person whose vestibular system is damaged is disoriented in the dark or when swimming under water. This system controls through information carried by nerves, parts of the cerebellum, all of the extrinsic muscles of the eyes and the muscles of the neck, and influences the muscles which maintain posture and balance in the rest of the body. It also feeds heavily both directly and indirectly into the RAS -- the arousal system (Barr, 1974, ch. 22).

The mechanism for conducting messages involves a number of way stations or nuclei where impulses from the vestibular system are registered, influenced by other information, and then sent on to influence posture and balance. "Our co-ordinated movement is highly dependent on the sensory input from the vestibular system" (Erway,1973, p. 4). Hubbard (1971) said that normal vestibular function is basic to the establishment of spatial organization and emotional equilibrium.

It seems apparent that any break in this system either in the functioning ability of the vestibular organ itself, the nerve paths, (tracts), which conduct the information, or in the coordinating centres, (nuclei), will affect the efficiency of its ability to integrate information from various senses.

Significance to normal development

A number of investigators (Ayres, 1973; Denny-Brown, 1975; Erway, 1973; Frank and Levison, 1973; Hallpike, Harrison and Slater, 1951; Jenkyn, Walsh, Walsh, Culver and Reeves, 1975; MacCulloch and Williams, 1971; Ornitz, Brown, Mason and Putnam, 1974; de Quiros, 1976; Van Bogaert and Marin, 1974, both theoretically and clinically oriented, have considered the possible causes and results of vestibular malfunction.

Colbert, E. G., Koegler, R. R., and Markham, C. H., 1959; Erway, 1973; Hubbard, 1971; MacCulloch and Williams, 1951; Ornitz and Ritvo, 1968; and Ornitz et al, 1974, associate vestibular malfunction with autism. Schizophrenia and autistic and schizophrenic-like behavioral disorders, difficulty with interpersonal relationships, and self-stimulation.

Ayers (1967) says that without normal development of the vestibular system, which she feels stimulates the development of the integrative systems in the mid-brain, the brain itself will fail to develop normally. Similar views are held by Kennard (1960), de Quiros (1976), and Webb (1969). This will mean that the higher mechanisms which control purposeful movement, in part by supressing the tonic reflexes, will not develop normally. Not only does this limit the child's motor development, and so limits his exploration and through this his experience and understanding of the environment; it also limits his adaptive capabilities in the context of the social expectations of his age group, his alerting and attention behavior, and his ability to interact with people.

Malfunction of the system may show itself in inability to cope with normal input or need for excess input to respond normally.

Motor deprivation

Much has been written about deprivation, both sensory and maternal. Since Harlow's early primate studies, emphasis has been placed on each child's need for a mother figure. Mason's work (1968) compared the infant monkey reared with a moving surrogate with the infant reared with a stationary surrogate. The former did not develop the stereotyped movement patterns shown by the latter, nor were they as impaired socially (p. 83). This study has created an interest in the infant's need for passive motion (stimulation to the vestibular system) in order to develop useful active motor patterns of his own.

Prescott (1970), who theorized from animal studies, suggests that abnormal social development, often associated with maternal-social deprivation, may have a strong component of somato-sensory deprivation. He proposes the cerebellum, a primary projection field for vestibular afferents, as intimately involved in these disorders. He cites deafferentation studies which would indicate a neural mechanism in the regulation of arousal, affective motor behavior, and expression of social motor behaviors. This system includes the cerebellum, limbic system, inhibitory fore-brain structures and the RAS. The cerebellum is immature at birth and therefore extremely vulnerable to early insult or lack of sufficient stimulation.

Erway (1973) raised laboratory mice with congenitally imperfect vestibular apparatus and found among other things that they were hyperactive, and over sensitive to change. He concludes that the vestibular system may be uniquely important among all of the sensory organs, in the development of normal, integrative functions of the brain (p. 23).

There is an intrinsic danger in generalizing from these and similar animal studies to human rearing. It is difficult to do this type of work with human infants but some conclusions have been drawn from the subsequent behavior of hospitalized and institutionalized infants. Solomon (1959) says, "part of the human contact that these children have missed has been the stimulation of the vestibular apparatus" (p. 650). "We can say that purposeful action motion develops with facility and pleasure when the passive motion imparted by the mother has been satisfactorily internalized as an integrated inner object" (p. 651).

In a number of studies, premature or "at risk" babies and institutionalized children have been given extra stimulation, vestibular and tactile (Neal, 1968; Scarr-Salapatek and Williams, 1974; Solkoff, Yaffe, Weintraub and Blase, 1969; and Webb, 1969). Casler (1965) restricted his input to stroking of the skin. Not all of these studies have shown statistically significant gains in all areas over control groups, but in physical growth, developmental maturity on the Gesell scale (which would indicate development beond the primitive reflex level, and normal use of tactile input and the eyes);and emotional maturity, all have shown greater gains than the controls.

Eye Follow and Reach

Eye-hand coordination is an important component for successful independent function. This cannot be accomplished without control of the neural elements which control the hand and eye muscles.

Development of eye control

Anatomical control of the extrinsic muscles of the eyes is closely associated with vestibular input. The ascending portion of the medial longitudinal fasciculus (the path between the vestibular nuclei and the nuclei of the intrinsic muscles of the eye), "provides for synchronized movement of the eyes, coordinated with movement of the head, in order to maintain visual fixation", (Barr, 1974, p. 316). Grusser and Grusser-Cornehls,(1972), say that their research indicates that "the vestibular visual integration occurs at a rather early state of the central visual system." They suggest as two possible interpretations of their research: (1) "a non-specific arousal effect; (2) an indication of a meaningful interaction of vestibular and visual signals in the visual system." Either of these effects, if developed, would be of great advantage to most mentally retarded children.

Developmentally, use of the eyes progresses from fixation and following a bright object for a few seconds at one month, to fixation and recognition at three to four months with good following ability. (Noback and

Demorest, 1975, p. 129). The ability to follow a quickly moving object develops at about one year, (Illingsworth, 1975, p. 142).

Concerning the ability to focus, Peiper (1963, p. 65) says

> "A higher cerebral center in which the visual processes are digested is a prerequisite for the ability to focus. Severely retarded children are not yet able to focus after the first year; some will never be able to do so."

According to Yendovitskaya et al, (1971), the dependence for information shifts from tactile to visual by the following time-table: "during the first month the child explores by tactile search." At the same time, "the appearance of visual and auditory fixation is of critical importance for the further development of the analyzing activity and of the behavior of the child as well".(p.10) "During this period (the third month) visual perception is the main medium for getting acquainted with the surrounding world and is tightly linked to the emotional sphere of the child." (p. 11).

> Towards the end of this period [five to six months] the relationship between visual perception and movements of the hand undergoes a change. Whereas before touch evoked visual perception and seemingly guided - now to the contrary, visual perception provokes movement of the hand towards an adult or towards an object and regulates the duration of such movements in respect to direction and form (p. 15).

Allen (1977, p. 411) says Boersma and Muir (1975) "have shown that eye movements can be used to differentiate between normals and retardates." This quote relates to smooth follow of the eyes independent of head movement, fixation and transfer of fixation from one object to another.

Importance of eye control to formal education

Kephart, (1971), in his theories relating ability to understand and control one's body to learning, stresses the part which the eye plays from understanding directionality to reading and writing.

Banus, (1971, p. 284), says that by the time a child enters kindergarten he should be able to move his eyes independent of his head. Ilg and Ames, (1955, p. 280-281), advise that a child should not enter school until he has good eye control.

Allen (1977 p. 411), says "It seems likely that digitizing ability (good eye movement control) is necessary for sophisticated visual learning such as reading.

Tests used

The test used in this study are essentially the same as those described by Banus, (1971, p. 282), Kephart, (1971, p. 386), Roach and Kephart, (1966, p. 58), and Vulpe's Assessment Battery (undated and 1977).

Reactions of the Atypical Child to Stimulation

There appear to be, among those identified as mentally retarded, especially those with autistic tendencies or schizophrenic behavior, two diametrically opposed reactions to sensory input. Luria, (1963), emphasizes that it is wrong to think that the mentally retarded form a homogeneous group which can be handled by one method. They are not normal children with diminished mental powers (p. 197). He divides the mentally retarded, whom he calls child-oligophrenics, into several groups, two of which are of interest here: those in whom excitatory processes dominate . . . these children over-respond to stimulation, fail to differentiate between significant and non-significant stimuli in the environment, and tend to movement perseveration . . . and those in whom the inhibitory processes dominate . . . they tend to be inert and unresponsive.

Shopler, (1964, 1965), differentiates between autistic and schizophrenic infants on a similar basis. The autistic infant's threshold against both intraceptive and extraceptive stimuli was found to be unusually high while that of the schizophrenic infant was unusually low.

Frank and Levison, (1973, p. 692), found children who showed "spontaneous and positional nystagmus, dysmetric occular pursuits as well as both hyper and hypofunction to directional preponderance of one labryinth to the other in the presence of normal ear, nose, and throat, and audiographic findings."

Ayres (1973) speaks of the low threshold group as being "sensory defensive". In her book she describes these children and suggest treatment methods. The tactile defensive child is dealt with at some length and references are made to auditory and visual defensiveness.

Silverman, Buchsbaun and Henkin (1969) refer to these needs as augmenters or reducers of sensory stimulation.

Bergman and Escalona (1949) cite five cases in which children were seen to have one or more abnormally sensitive sense. They deviated greatly from normal in their general development. Four of these children were later judged to be psychotic, one mentally retarded.

These groupings are not consistent, but they do indicate that there is a distinct, describable, pathological difference in response to stimulation among atypical children. These responses to incoming information will seriously interfere with the learning process. In order that these children may develop more nearly normal sensory integration, they must be handled differently than the typical child.

Similar Studies

Despite the length of time which has elapsed since normal tactile and vestibular input has been linked with integration at the brain stem level and so to the suppresion of postural reflexes, with the normal development and use of the other senses and with behavior problems, little has been found in the literature concerning rehabilitation programs which provide vestibular input to help suppress primitive reflexes, and so increase voluntary motor control.

Webb (1969) worked with thirty-two profoundly retarded children one hour a day, four days a week, for from five and a half to ten and a half months. She used tactile and vestibular input along with taste, odor, sight, and sound in the hope of developing sensory integration. At the end of the period she found significant increased awareness and improvement in movement patterns, reach and grasp, and ability to relate to people. Webb had no control group, which makes it difficult to distinguish the effect of extraneous and dependent variables.

Davis and Ware (1967) treated one child who was diagnosed as autistic. They saw him twice weekly for one hour sessions which included tickling and playing games and allowed him the opportunity to explore people and objects around him. During the same period he was on a similar home program. At the end of two months the attending psychiatrists reported that he was better able to tolerate frustration and that his ability to relate to people had improved.

In 1975 Norton reported on the progress of three profoundly retarded, multiply handicapped children who were on a mother administered, clinically-supervised, treatment program for nine months. The mothers had been previously instructed in methods intended to give the children multisensory experience during the daily routine care and in specific periods totalling one hour during the day. At the end of the nine months these children were more advanced in postural reactions and showed changes in affect and in their response to objects.

Neither Norton nor Davis and Ware had controls.

The value of adequate functioning of both tactile and kinesthetic systems cannot be over-emphasized. As Chalfont and Scheffelin (1969) pointed out, "most school tasks, as do most acts in everyday life, require both touch and movement". (p. 41).

Chapter III

Research Procedures

Research Hypothesis

A regular program of high tactile and vestibular input over a period of six weeks will have a significant effect on the reflex maturity of the multiply handicapped, mentally retarded child.

This will be investigated in relation to changes seen in three groups of children, Group I being the experimental group; Group II, the first control, children who participated in a physical education program for the same number of hours per week; and Group III, the second control, who had no additional program.

Observations will be made to determine:

1. changes in the amount of control higher centres exert over tonic reflex activity;
2. changes in the child's ability to follow a moving object with his eyes;
3. changes in the child's ability to cross the mid-line with his hands and eyes;
4. changes in the child's ability to use his eyes to guide his hands in reaching;
5. changes in the child's method of response to tactile stimulation to the back of his hand and forearm.

The Sample

The subjects in this study were twenty-seven multiply handicapped children residing in the St.Amant centre for mentally retarded children. St.Amant centre is a residential institution in Winnipeg, Manitoba for children who for some reason cannot live in the community.

Limitations of the Sample

The impetus for this and similar studies has been given by Ayres' theory, which is supported by generally accepted previous neurological research (Ayres, 1973, chapters 1, 2 and 3). The theory hypothesizes that sufficient tactile and vestibular input can favourably affect the ability of the brain stem to integrate incoming information, and through this, change reflex activity levels which may in turn free higher centres for academic learning.

Ayres herself applies her work to children with learning disabilities--by definition, children with normal intelligence (Kaluger and Kolson, p. 81, 1969). Others have considered the application of these and similar premises to the mentally retarded (Cassler, 1965; Davis and Ware, 1967; Norton, 1975; and Webb, 1969).

The possibility of working with children who fell more clearly into the category described by Ayres was investigated, considering:

(a) physically and/or multiply handicapped children attending public school; and

(b) children diagnosed as learning disabled, who are segregated for short periods of intensive remediation.

With both groups the same problems arose:

(1) The work would need to be done during the regular school term. As these children live in widely dispersed areas of the city, transportation and space would be a problem at any other time.

(2) During the school term, the amount of weekly time available for treatment was insufficient. The only practical way to use the available time was in group activity which did not seem to be satisfactory for an investigation of this type of treatment.

(3) Especially for the group of children with learning disabilities, the problem of securing satisfactory control groups seemed insurmountable.

Although the children from St. Amant are designated mentally retarded, this appeared to be a satisfactory group with whom to test the part of Ayres' theory which surmises that large amounts of tactile and vestibular input will favourably affect the reflex status of the child. There were some further advantages inherent in working with these children:

(a) Because St. Amant is a residential centre, even the children attending school could be treated individually, every day, both during the school term and into the vacation period.

(b) The children live under a similar regimen. This made it practical to secure reasonable control groups.

(c) Because of the developmental lag acknowledged as present in all of these children, they would be more likely to exhibit primitive reflexes.

This slow development factor also works to the disadvantage of the study as it means that little change can be expected in a six-week treatment period.

The sample is limited as to size. With only twenty-seven children available for the study it seemed more advantageous to divide them into three groups so that the possibility of individual attention and handling as an influencing factor could be considered, than to divide them into only two groups--treatment and control.

Selection of the Sample

Twenty-seven children, resident at St. Amant Centre Ward 2E and 3E were selected by the administration of the centre for this study. The name of each child on 3E was put on a slip of paper. The first six names drawn were assigned to group I, the experimental group; the next six were assigned to group II, the first control group, which received the physical education program; and the remainder were assigned to group III and received no additional program.

A similar procedure was followed for the children on 2E allotting two children to each group.

Description of the Sample

All groups are diverse diagnostically (Table 1) both as to physical disability and mental capability. They also differ as to functional ability (Table 1). Different evaluators have used different terminology to describe the children's functional levels. Some children are described as mildly, severely or profoundly retarded, while others are described in terms of percentage of normal function--physical and mental. This makes comparison of the groups less accurate.

Along with the problem of descriptive terms is that of extensive overlap of diagnostic entities. One cerebral palsied child may be mentally normal while another will be profoundly retarded. Either or both of them may have seizures. There is nothin in a diagnosis of autism which necessarily contraindicates or includes hydrocephalus or cerebral palsy. The multiply handicapped child is truly multihandicapped. These problems exist whenever multiply handicapped children are considered--match on one criterion will produce mismatch on another criterion.

The chronological ages of the children in the sample range from two to eight. Their physical functional levels range from complete dependence for all daily care to supervised self-dressing and feeding. Eight of the children are

Table 1

Description of the Sample

	Group 1 Experimental	Group 2 Placebo	Group 3 Control
Number	8	8	8
Age range (chronological)	8-11	8-11	8-11
Age means (chronological)	4.7	4.3	5
Sex	M5 F3	M7 F1	M4 F1
Diagnosis according to medical records			
Profound mental retardation	0	0	2
Severe mental retardation	6	6	7
Moderate mental retardation	2	2	2
Seizures	2	5	4
Hydrocephalus	1	2	0
Cerebral palsy	2	2	1
Autism	1	2	5
Downs Syndrome	3	0	3
Other	4	2	2
Function according to rehabilitation records			
Useful speech	1	0	0
Doesn't walk	3	3	2
Walks with assistance	2	1	2
Walks independently	3		7
Attends nursery school	1	3	3
Attends school	2	1	1
Attends Physical Medicine	5	6	3
Level of overall function			
(mental & physical) Range	12%-60%	30%-50%	12%-50%
Mean	30.2%	38.1%	29.5%

completely non-ambulatory, five move in ambulation aids, and fourteen walk independently. None of the children use speech as a main communication tool and only four use any intelligible words. Few even babble; none are mute. Mentally they range from profound to mild retardation. Although most of the children have physical problems, mental retardation is considered to be the greatest handicap of each of these children. Diagnostically they include six children with Downes syndrome, six autistic children, five cerebral palsied children, and three hydrocephalic children. The remaining children have either minimal physical problems or obscure diagnoses. Four attend the school, which is part of the St. Vital school district. The seven children who attend nursery school do so at different times of day and for a program structured specifically for their individual needs.

Twenty children are seen regularly in the physical medicine department for therapy. These treatments vary widely in time and content.

Extraneous variables were minimized to some extent by the fact that all of the subjects were resident in one institution and largely in two wards of that institution. The daily routine on each ward is very similar for each child on the ward. Although different staff members care for different children, every effort is made to establish a good child-staff match and to keep child-staff relationships constant. On both wards the children lead busy lives and when not scheduled off the ward, play in a supervised playroom. This play is not structured.

Treatment Techniques

The children in groups II and III were seen by the experimenter only during pre- and post-testing. The program carried out by the physical educator and his staff with group II consisted of two one-hour periods weekly. These sessions included swimming, gym activities and outdoor recreation. This program was carried out in small group settings.

Group III had no added program.

The children in group I were seen on an individual basis. One occupational therapist and three physiotherapy senior interns treated the children. Each child was seen by the same therapist for twenty minutes a day, five days a week, for six weeks. Because of the individual children's differing responses to input, and in adherence to the principle that no child should be subjected to any experience which frightened him (Ayres, 1973, pp. 116 and 120), no overall, routine treatment plan was used. All the children had shoes, socks, long trousers and shirts removed prior to each session.

Tactile input was given to all exposed parts of the child's body, beginning with hands, arms, legs and feet.

The therapist used his/her hands, terrycloth, nylon pot scrubbers, rough and soft sponges, fur, velvet and satin, and also brushes of various kinds, including nail, clothes, hair and scrub brushes. A small fountain of cold water was available. The children dabbled their hands in this, felt the rough rocks and the pressure of water rising in the fountain. This cool water was also rubbed on their arms by the therapist. They played in a sand box of dry navy beans. They walked, crawled and crept on carpet, linoleum, wood, sisal mats and corrugated rubber mats.

The vestibular input was given through the use of a variety of media. Individual children's programs differed more during this part of the session because the children's reaction to vestibular input was more varied than to tactile input. Some were placed face down on a large ball (four feet in diameter) and held by the feet and/or knees. The ball was then rolled forward or sideways. To encourage extension of arms and neck and back from this position, a small ball and a series of bells were hung just within the child's reach as he was rolled forward. The children were encouraged to roll down a smooth plastic wedge and then rolled across a carpeted floor. One child took the initiative and rolled himself. A hammock swung from one point was used. (Figure 6) Sitting or lying supine in this, the children were swung backward

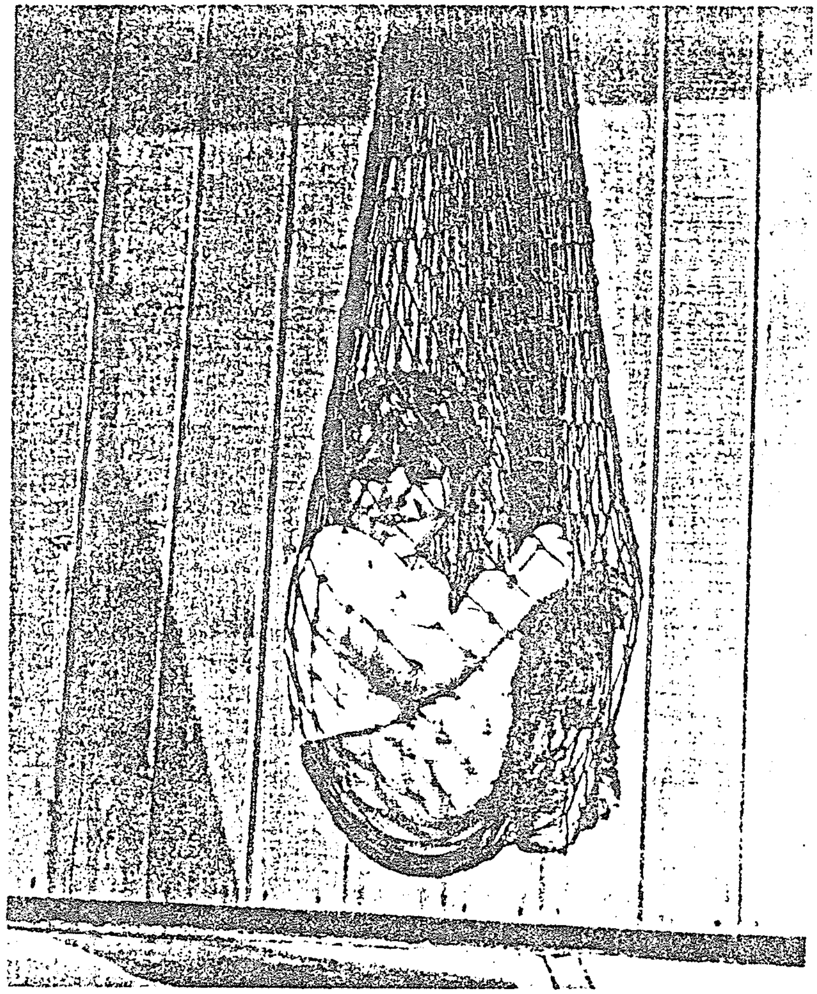


Figure 6

HAMMOCK (Ayres,1973)

and forward and from side to side. They were also whirled. They were allowed to play on a four-foot high playground slide; rocked; encouraged to roll themselves, hands and head first over a padded bolster, eighteen inches in diameter. They were pulled and whirled prone on a padded scooter board which also encouraged neck, arm and leg extension in prone.

Programs for two widely differing children will be found in Appendix A.

Description of the Measuring Instruments

The reflexes used as criteria in this study are considered to be responses to gravity and to the position of the head in space. For this reason, testing depends primarily on the position of body parts, particularly the head, in relation to the earth's axis. Normally, reflex testing is carried out largely on babies or co-operating larger people.

As not all of the children in the study would assume a position and hold it while the stimulus was applied, alternate methods had to be used. It was not expected that the method used would jeopardize the findings. Mysak, (1968), in his discussion of testing for reflex responses, suggests, "where appropriate, apply the stimulus in different positions and situations" (p. 11).

Method of assessment

All children were assessed twice immediately prior to the treatment and twice immediately following the treatment. The pre-testing was done by two physiotherapy students and the author. Tester and child were matched by random number. The post-testing was done by the author and two volunteers. The author made all observations on the post-tests. All observations were recorded on the form shown in Table 2. The raw data from these records is in Appendix B. In no way could the second post-test be considered to be a retention test. In every case it followed the first post-test by no more than five days.

The following tests were used:

Asymetric tonic neck

A net hammock with both ends hung together from one ceiling hook was used for this test. The child was placed in the hammock prone, with shoulders and head extending from one end. The child's head was then turned to one side, being careful to neither flex nor extend the neck. If there was overt flexion of the arm on the skull side and extension of the arm on the face side within thirty seconds, one point was given. If not, the arms were tested for changes in tone by passive flexion and extension of both arms. If resistance was felt to flexion in the skull arm and extension in the face arm, two points were given. Three points were given if these changes were seen when the child resisted the head position or if the tester applied assisted resisted movement to the head (Mysak, 1968). Four points were given if no tone changes were seen. This was repeated with the head turned to the other side.

Protective extensor thrust

The child was placed prone on a large exercise ball, with the examiner holding his legs. He was thrust quickly forward. The examiner looked for extension of the arms and wrists, extension and abduction of the fingers. If this was seen, four points were given. If it was not seen, no points were given.

Supine equilibrium reactions

The child was again placed on the ball in a supine position. The arm and the leg on the right side were held. The ball was quickly rolled towards the child's left. The examiner looked for bending of the head and arching of the body to the right and abduction and extension of the legs and arms on the left. (Similar changes of tone might be felt in the right arm and leg.) Four points were given if this was seen, none if it was not. The child was held on the left side and rolled to the right. Scoring remained the same.

Prone equilibrium reaction (P E R.). The child was placed in a prone position on the ball and the examiner proceeded as for S.E.R.

Eye follow. The child was seated. The examiner slowly moved a shiny rattle at eye level in front of the child from right to left and from left to right at least three times. The rattle was moved in an arc to keep the distance constant so that the child would not need to refocus to follow. If no fixation was observed, no points were given. If the child followed in a jerky manner, not crossing mid-line, two points were given. If the child followed smoothly with his head and eyes to across the mid-line, three points were given. If he followed smoothly with his eyes only across the mid-line, four points were given.

Response to tactile stimulus. The back of the child's forearm and hand were firmly stroked by the examiner. If he drew away before thirty seconds, one point was given. If he became restless before sixty seconds but did not pull away, two points were given. If he pulled away between thirty and sixty seconds, three points were given. If he tolerated the stroking for sixty seconds, four points were given. This method was used by Wright (1975).

Two other responses were recorded but not scored.

Neck or body righting. The child was placed supine and watched. If he rolled over it was noted whether he used a head on body or a body on body righting pattern or sat up in a mature manner.

Method of reaching. After the child had been tested for eye-follow, he was encouraged to reach for the rattle. Note was made of whether he looked where he reached, changed hands when the rattle crossed his mid-line, or crossed his mid-line with his hand to reach.

The testing procedures described above were used for pre-testing. Each child was tested at two separate times. A schedule was set up according to the times when the children were available. The observer of the testing team was chosen by random number.

One variation was made in post-testing. Because the exercise ball had been used as treatment, a different method was used to test for P E T. The child was placed in a sling which supported him between his armpits and his hips. This sling was then attached to a rope and pulley. (Figure 7). The child was held in this position and then allowed to drop suddenly.

The characteristics of the children who make up the groups assumed to be random will be discussed in chapter five. The results will be examined for the validity and reliability of the testing implement, using Pearson's product movement correlations. The same method will be used to compare averaged pre-test and post-test scores to indicate amount and direction of change. Finally one-way anovas will be shown on difference scores between pre-test and post-test average scores.

Chapter IV

This chapter will present the results of the study. A discussion of these results will be found in chapter 5.

The form on which it was recorded and the raw data are shown in Appendix B.

Table 4 gives the same information found in table I but in percentage form. This is done to stress the differences which occur within the groups that were originally assumed to be equivalent.

As the two pre-tests were spaced not more than three days apart and were intended to measure the same variables, it was assumed that an averaged score of these two tests for each of the variables, for each subject, would represent a more accurate and reliable estimate of that variable than either of the observations alone. The two individual scores for each of these two tests for each variable were added and the sum was dividided by two. The same method was used to estimate the status of the subjects at the time of the post-test. The averages of these collapsed, mean pre-test and post-test scores and their standard deviations are shown in table 5.

Table 6 shows the number of children in each group who started with optimum scores. This table is included to indicate the difficulty of gaining significantly improved scores on some of the variables.

Table 4

Description of the Sample in Percentages

Number	Group 1 Experimental 8	Group 2 Placebo 8	Group 3 Control 8
Diagnosis According to medical records			
	%	%	%
Profound Mental Retardation	--	--	18
Severe Mental Retardation	75	75	64
Moderate Mental Retardation	25	25	18
Seizures	25	63	36
Hydrocephalus	12.5	25	--
Cerebral Palsy	25	25	9
Autism	5	25	45
Other	50	25	18
Function according to rehabilitation records			
Useful speech	5	--	--
Doesn't walk	37.5	38	18
Walks with assistance	25	12	18
Walks independently	37.5	63	64
Attends nursery school	12.5	12.5	9
Attends physical medicine	63	75	27

Table 5

Means of Averaged Scores and Standard Deviations

Variable	Pre-test Treatment Group I	Pre-test Placebo Group II	Pre-test Control Group III	Post-test Treatment Group I	Post-test Group II	Post-test Group III
A.T.N.R.L.	3.8750 (.3536)*	3.6875 (.5939)	3.3636 1.0023)	3.3125 (.9978)	3.3750 (1.0607)	3.3182 (1.2303)
A.T.N.R.R.	3.5625 (.6232)	3.1875 (1.0670)	3 1818 (1.0553)	3.5625 (.6781)	3.0625 (1.2082)	3.3182 (1.2303)
P.E.T.	1.2500 (1.8323)	1.0000 (1.5119)	1.4545 (1.8091)	1.0000 (1.0690)	1.7500 (1.6690)	1.4545 (1.2933)
E.F. to L.	1.4375 (0.8634)	2.3750 (0.5175)	1.7000 (0.8882)	1.6250 (1.0264)	2.3750 (1.0938)	1.4500 (1.2349)
E.F. to R.	1.5625 (0.8210)	2.4375 (.4955)	1.7000 (.8882)	1.8125 (.7990)	2.3750 (1.0938)	1.7000 (1.1595)
Tact. L.	3.5000 (0.9636)	2.5625 (1.3212)	2.2273 (1.2721)	3.3750 (.7906)	3.1250 (1.0938)	2.3636 (1.1638)
Tact. R.	3.3125 (0.9978)	2.7500 (1.2536)	2.0909 (1.1362)	3.1250 (1.0938)	3.1250 (1.2748)	2.0000 (1.1180)

* indicates standard deviations

Table 6

Number of children with optimum scores on pre-test

Pre-test	Group 1 N=8	Group 2 N=8	Group 3 N=8
A.T.N.R.L.	7	6	7
A.T.N.R.R.	5	4	7
P.E.T.	2	1	3
E.F.L.	0	0	0
E.F.R.	0	0	0
tact L	6	3	3
tact R	5	3	2

Pearson's product movement correlations, which indicate the strength of the linear relationship (r) between two variables, were calculated on group raw scores, pre-test one with pre-test two. These are shown, with their significance values, on table 7. Thorndike says that this measurement "presumes that both variables are scores on some kind of a measuring instrument .... [it] summarizes the degree and relationship between one continuum (multi-category) variable and another continuous variable" (Bolton, 1976, p. 51).

The same calculations were performed on raw scores from post-test one and post-test two. These are shown on table 8 along with their significance values.

Using the same averaged scores as used for table 5, correlations for the pre-test scores with their corresponding post-test scores were calculated. These correlations with their significance levels are shown on table 9.

Table 10 shows one-way analysis of variance, F values, on difference between averaged pre-test and averaged post-test scores and their probability levels.

Table 7

Correlation of Averaged Scores

Pre-test against Pre-test

	Pre-test I	Pre-test II	Treatment	Placebo	Control
A.T.N.R.L.	1	8	99.00	99.00	.3003
A.T.N.R.R.	2	9	.2582	.3402	.3462
P.E.T.	3	10	.7303*	.3333	.6708*
E.F.L.	4	11	.4949	.0000	.4502
E.F.R.	5	12	.5983	.2928	.4502
Tact. L.	6	13	.4523	.8665*	.4903
Tact. R.	7	14	.2582	.6453*	.3727

* $p < .05$

Table 8

Correlation of Averaged Scores

Post-test against post-test

	Post-test 1	Post-test II	Treatment	Placebo	Control
A.T.N.L.	15	22	.2857	.5949	.7698*
A.T.N.R.	16	23	.1890	.6484*	.7698*
P.E.T.	17	24	.2928	.4472	.1491
E.F.L.	18	25	.0000	.8930**	.4878
E.F.R.	19	26	.3769	.9177**	.5031
	20	27	.3381	.9177	.4487
	21	28	.3010	.7268*	.4781

* $p < .05$

Table 9

Correlation of Averaged Scores

Pre-test against Post-test

	Pre-test	Post-test	Treatment	Placebo	Control
A.T.N.R.L.	1	1	.2784	.8930**	.2215
A.T.N.R.R.	2	2	.0106	.7653*	.1050
P.E.T.	3	3	.1459	.3397	.5440*
E.F.L.	4	4	.4130	.8517*	.7446**
E.F.R.	5	5	.2382	.7742*	.6581*
Tact. L.	6	6	.5157	.0432	.5127
Tact. R.	7	7	.4500	.2905	.4330

* = p> .05

** = p> .01

Tact. R. = Tactile response on Right

Tact. L. = Tactile response on Left

E.F.R. = Eye follow, Right

E.F.L. = Eye follow, Left

Difference Scores

Table 10

Averaged pre-tests with Averaged post-tests

Source	df	ss	ms	F Ratio	F.Probability
Var. 1 ATNRL					
Between groups	2	1.2519	.6295	.478	.6257
Within groups	24	31.4148	1.3089		
Total	26	32.6666			
Var. 2 ATNRR					
Between groups	2	.3203	.1601	.113	.8934
Within groups	24	33.9204	1.4134		
Total	26	34.2407			
Var. 3 PET					
Between groups	2	.275	.138	.705	N.S.
Within groups	24	4.687	.195		
Total	26	4.963			
Var. 4 EFL					
Between groups	2	.8678	.4339	.584	.5658
Within groups	23*	17.0937	.7432		
Total	25	17.9615			
Var. 5 EFR					
Between groups	2	.4447	.2224	.281	.7578
Within groups	23*	18.2187	0.7921		
Total	25	18.6635			
Var. 6 Tact.L.					
Between groups	2	1.9349	.9674	.586	.5645
Within groups	24	39.6392	1.6516		
Total	26	41.5740			
Var. 7 Tact.R					
Between groups	2	1.4879	.7439	.461	.6363
Within groups	24	38.7528	1.6147		
Total	26	40.2407			

*one blind child

df=degrees of freedom
ss=sum of the squares
ms=mean square

Chapter V

Discussion and Conclusion

This chapter will discuss the implications of the individual tables and will then consider the factors which may have had bearing on the findings. Finally, implications for therapists, class room teachers and further study will be dealt with.

Although the individual groups for this study were selected from a larger group presumed to be homogeneous, the nature of these children makes any matching of groups with regard to diagnosis and functional abilities difficult if not impossible. Table 4 shows the percentage of children in each diagnostic and functional category. It should again be mentioned that placing a child in any one of these categories does not preclude his being placed in one or more other categories. They are in no way mutually exclusive.- Ferguson (1971, p. 165) says "Concerning the null hypothesis" very simply, this hypothesis asserts that no difference exists between the two population means .... In general regardless of the particular statistics used, the null hypothesis is a trial hypothesis asserting that no difference exists between population parameters". This is not true of the groups in this study. This table shows a number of extraneous variables, suspected of influencing the dependent variable which are unequally represented within the groups

For example, the presence of seizures had an unequal distribution among the groups.

A further difference in the groups should be noted. Table 3 shows under the heading 'level of overall function';group 1 - mean 30.2% with a range of 12%-60%, group 2 - mean 38.1% with a range of 30%-50%, group 3 - 29.5% with a range of 12%-50%. This shows group 2 not only to be the highest functioning group but also the most homogeneous group.

Table 5 which shows means and standard deviations for each sub test for each group, also shows discrepancies in performance on the pre-test. This would further indicate that the groups were not equally representative of the universe from which they were selected.

This table shows that with few exceptions the pre-test scores were higher than the post-test scores. Factors to consider in the explanation of this are; the questionable reliability of the method used to test reflexes; (This will be more fully discussed later.) The somewhat subjective judgments involved in scoring in this area; the different examiners used in the pre and post tests; and the very small range in score possibility.

It should be noted that the exceptions mentioned above pertain to the scores of the experimental group on tests four and five which do not evaluate a reflex response, but rather the ability to follow a moving object with the eyes. As this is the variable most closely related to formal education it will be more fully discussed later.

Table 6 shows the number of children in each group who showed optimum scores on the pre-tests in each test category. The high proportion of optimal scores on some of the tests makes any significant improvement impossible. The theory of regression towards the mean might explain some of the lower post-test scores.

Table 7, which shows correlation and the significance of averaged scores between pre-test one and pre-test two for the same variable, reveals few significant relationships between scores on these variables over a three day period. The same is true for the figures in table 8. It is assumed that the variables mentioned are constants at any given developmental level. These figures tend to confirm Vassela and Karlsson's findings that the statistical probability of observing an ATNR on one trial is 3/16. This may also be true of other tonic reflexes. The score obtained by the use of two trials, averaged, has proven unreliable in this study and would not have detected change. These findings may also reflect the use of somewhat subjective judgment on the part of the testers.

Table 9, which shows correlation and significance level between averaged pre-test scores and corresponding averaged post-test scores, indicates a closer correlation between these scores for the placebo and control groups than for the experimental group. In the placebo group five of the seven tests showed a correlation at the .05 level (two of these at the .01 level). The control group scores show a .05 level for three of the seven tests (with one at the .01 level), and one further score which closely approximates the .05 level. In the experimental group no scores showed significance levels below .09. Correlations higher than the .05 level indicate no relative statistically significant difference in scores. If the groups were matched originally, and the score differences (for individuals in all groups) were similar one could expect significant relationships between pre and post scores in all three groups. This, however, has been shown not to be true, therefore it may be assumed either that there was more change in group 1, as the hypothesis assumed or that the greater homogenuity in group 2 increased the correlations of this group. Group 3 is more homogeneous than one but not strikingly so. This would tend to indicate that there actually was more change in group 1, in respect to the relative position of the subjects before and after treatment.

Table 10 shows a one way analysis of variance between the three groups with a separate anova for each of the eight dependent variables. These figures show no significant change between the post-test scores and the pre-test scores of these 3 groups following treatment. It should be noted however that De Cecco (1968, p.553) says "In using the F ration, we assume that the scores are normally distributed and that variances within the groups are statistically the same. You should recall that in the F test, if the variances within the group vary widely, the likelihood of finding significant differences between groups is greatly reduced." This bias in sampling difference between groups has been clearly shown.(Table 5 and table 4.)

The statistics from this study indicate that the null hypothesis "A regular program of high tactile and vestibular input over a period of six weeks will have a significant effect on the reflex maturity of the multiply handicapped, mentally retarded child, is rejected.

There are a number of factors which may have had a bearing on the results of this study: (1) the tests themselves; (2) the way in which these tests were used; (3) the population used in the study; (4) the treatment method and its application; (5) and the length of time over which the treatment was applied. These factors will be discussed first as they apply to reflex testing and then as they apply to the development of eye-follow and eye-hand coordination. The problems of interpretation of response to tactile stimulation and the implications for formal learning inherent in lack of equilibrium reactions will also be discussed.

Reflex Testing

The tests used. The method of testing as it was applied in this study appears to be unreliable. Reflex testing is widely used by doctors, psychologists, physical educators, special educators, therapists and others. It is considered to be a good indicator of C.N.S. development. The literature at least implies that the majority of these professionals apply the stimulus once and record the results. Vassell and Karlssons' findings of 1962 seem to have been largely disregarded except by a few workers. Most references also presuppose a relaxed, responsive, relatively small child, none referred to the problems of testing non-cooperative, non-responsive, hyperkinetic, or large children.

Way in which the tests were used. With a few changes, the methods of assessment used were those of Fiorentino (1973) and Mysak (1968). The method of application of the test for A.T.N.R. was somewhat changed from the traditional starting position. As the A.T.N.R. is only tenuously, if at all, related to position, as it affects labyrynthine stimulation, this position change should not have influenced the results. The P.E.T. was tested from the generally accepted position, although pre- and post-test methods differed slightly. The pre-testers, one a therapist (with a number of years of experience) and two students with considerable background in recognition of muscle tone change, were all capable of making objective judgments. The therapist made all the judgments on the post-test.

The population used in the study. The population used in this study was not ideal. In the only statistically significant studies found on the use of this treatment method, the subjects were physically sound and intellectually normal. With few exceptions, the children in this study had more than one disability, although mental retardation is considered the prime disability of each. This makes it impossible to determine whether a physical disability, mental retardation, or both influenced the speed of developmental change.

While mentally retarded children develop through the same sequences as mentally normal children, they do so much more slowly. Physical handicaps will further retard the speed of developmental change. These children will never reach mental maturity and many, especially the multiply-handicapped, will never reach physical maturity. Some of the children in this study may have obtained their optimum level of C N S control of automatic movement prior to being tested. This is especially true of those who had passed the chronological age of five (eleven children), at which the average normal child is mature in terms of reflex status.

Illingsworth (1975, p. 167) suggested that the period following a major convulsion was not an appropriate time to examine a child for reflex status. He also advised against examination when the child was under the influence of sedative drugs. Eleven of the children in this study do have seizures and either of the pre tests or post tests have been administered at a time when the results were not typical of their normal response behavior.

Nothing further was found in the literature which referred to the effects of medication on the results of reflex testing. These children are almost all on medication which affects the CNS. Routines for administering drugs are closely adhered to at St.Amant. Testing was done at the convenience of the ward and on a totally random time basis. Because of this, any child could have been tested when his medication was having its peak effect and again when it had almost worn off. Although more drugs are now of a long-lasting nature, it still must be taken into consideration that at any given time a high percentage of these children were under the influence of medication.

Treatment method. Ayres has put forth a scientific rationale for this treatment method in her many publications. It is widely used with children with learning disabilities, both children and adults with recent traumatic brain damage or schizophrenic-type behavior, and the multiply-handicapped child. Clinical impression, as reflected in the literature, indicates that it is effective.

The literature also points out that early motor experience, active or passive, is a positive factor in C N S development. It also says that without normal tactile feedback and a normal response to this feedback, a child will not explore his environment. Ayres says that neither passive motor, nor tactile stimulation should be applied if the child strongly objects to it. This policy was followed in the study. As a result, no two children received exactly the same treatment.

The studies found which substantiate this treatment used very small samples. None of the subjects of these studies were mentally retarded.

Length of time over which treatment was applied. It has been pointed out that the group of children studied were slow developers. They were also resistive to changes in their routine and slow to adapt to new regimens. Twenty minutes, five days a week for six weeks, is a short treatment period from which to expect significant developmental change in any group of children. It is even less likely to produce significant change in the slow-maturing, multiply-handicapped child. The similar studies cited were either more intensive, covered a longer time span, or both.

Testing of Eye-follow and Eye-hand Coordination

The tests used. The method of testing for functional use of the eyes, which was used in this study, is that most commonly used (Ayres, 1973; Banus, 1971; Kephart, 1971 and Vulpé 1977.) The addition of sound increases the number of sensory channels stimulated and should increase the likelihood of a maximal response. Vulpe (1977) uses a rattle to test eye-follow.

The children were encouraged to reach for the rattle. This was done to give some indication of the part which sight played in the child's use of his hands and manipulation of his environment.

The way in which the tests were applied. No variations were made from the conventional methods mentioned above.

The population used in the study. Many of the medications which are given to these children have their primary effects on the R.A.S., particularly the alerting systems. This could affect the examiners' opportunity to gain the child's attention. This drug-effect would be true also for environmental visual cues.

The factors of slow development and seizures, discussed under reflex, probably also apply to functional use of the eyes and their ability to direct the hand. All of these children had passed the chronological age of six months after which time the eyes are believed to direct the hand in the normal child.

It must also be considered that with few exceptions none of these children had had normal amounts of gross motor experience, active or passive, which has been shown to be a major contributing factor in the development of an understanding of what one sees and in fine motor control of the hand.

Treatment method. No part of the treatment was specifically directed to eye control. However, as a vestibular cerebellar brain stem loop is known to influence, the use of the intrinsic eye muscles, any treatment which improved the processing of vestibular information would be expected to improve purposeful use of the eyes.

Length of time over which treatment was applied. The same time factors felt to mitigate against change in reflex status would be assumed to influence speed of change in ability to use the eyes functionally.

Problems of Interpretation of Tactile Responses

The test used for response to tactile stimulation gave inconclusive results. The inherent problems of testing response to tactile stimulation in the mentally retarded, non-verbal child have been discussed. For example, whether the stroking was tolerated because the child did not have functioning tactile receptors, or because his attention system was not processing this information, or because he found the stroking satisfying, is not known. Similar questions could be asked concerning the child unable to tolerate stroking. Reliable tests are greatly needed which could determine whether a mentally retarded, or any non-verbal child, has useful tactile sensation.

Equilibrium Reactions and Learning

The tests given to indicate the presence of prone and supine equilibrium reactions which normally appear at four to six months, were not included in the data because only two children displayed their presence on either the pre- or post-test. This is of interest, as fourteen of the children walked independently; five walked with assistance; and twenty-four sat independently. Paine (1964) found a similar phenomenon among multiply-handicapped children.

This ability to perform on a higher level without the basic underlying subconscious controls is known as a splinter skill. Kephart (1971) and others feel that conscious attention is required to practise splinter skills. This does not leave the attention mechanisms free for observation and learning. It may be more advantageous for this group of children with their limited capabilities to be able to sit and walk independently than to give their full attention to the exploration of their environment. Criteria should be established to determine which children should be taught the splinter skills, probably to the exclusion of any but the most basic academic skills.

Conclusions

Implications for Therapists

This study has indicated that some of the common tools used to assess the level of physical development of the normal or near normal child may not be dependable for use with this and similar populations. It has raised a number of questions about these tools, the answers to which are not readily found in the current literature.

Reflex testing for large and/or uncooperative individuals

Because the presence of the tonic reflexes is considered to be abnormal in the child over one year, the general literature assumes a small child. The literature on reflex testing for the atypical child seems to imply early testing. Fiorentino in her well illustrated text shows a small boy (1973). No references were found to the difficulty of handling large individuals in the tests which require lifting and moving as in P.E.T. and the righting reflexes.

Change in muscle tone is often the criteria on which decisions are made in judging the presence of the A.T.N.R. Heightened tone could be either a reflex response or a reaction to unwanted handling.

The effects of various medications and/or seizures on reflex response

Medications commonly administered to this group of children may effect the C.N.S. to either facilitate or inhibit motor responses. Some medications used for children with seizures are often inhibiting to the ascending R.A.S. In any of these circumstances there will be changes from the motor responses expected from the same child in an unmedicated state.

Illingsworth (1975, p. 167) says that no child should be examined for reflex responses following a major seizure. Nothing was found in the literature concerning transcient epileptic episodes and examination for reflex response.

The use of single test results

This appears to be common practice. Paine et al in 1964 used the findings of Vassella and Karlsson and tested each child ten times. They considered six positive responses in ten trials as indicative of the presence of the reflex. No other studies found indicated the use of more than one trial. Nor were any studies found which attempted to replicate that of Varsella and Karlsson.

A possible substitute for reflex testing to indicate C.N.S. development levels

There are many developmental scales which provide criteria with which to estimate developmental age. Most of these assume control of the static reflexes. For example the normal baby at eight months sits independently and reaches for an article at his side. This assumes that both the A.T.N.R. and the symetric tonic neck reflex are under higher control.

Measurement of nystagmus might provide a more objective measure. McGraw (1941) describes nystagmus as a change in overt behavior which reflects reorganization of the neural mechanisms below a cortical level. In the same article she outlines the three phases of characteristic changes in this response with increasing age. She refers to her subjects as infants.

van der Laan and Oosterveld describe changes in nystagmus in age groups 0-1, 2-10, 11-20 - - - 80-90,>91. They show typical performance for each of these groups.

As nystagmus is dependent only on use of the extrinsic eye muscles and the changes McGraw describes appear to be easily observed, these might be useful for the very immature person. van der Laan and Oosterveld's observations were recorded by mechanical means and therefore objective. These tests might be useful for the more mature individual.

The treatment method

The treatment method, since it is widely used, expensive of therapists' time, and assumed by clinical impressions to be effective, should be further investigated.This investigation should cover a longer time span, include more children, and involve a greater consideration for the specific diagnosis of the children involved in the experimental and control groups.

Implications for the Classroom Teacher of the Mentally Retarded

Of all the variables in this study, the one dealing with the use of the eyes and eye-hand coordination is most clearly and directly linked with education. Four of these children were in school at the time of the study, and seven were in nursery school.

The implications for school readiness and the ability to profit from classroom experience are obvious. Banus

(1971) says that no child should attend kindergarten until he can use his eyes independently of his head. Ilg and Ames (1955) state clearly that a child should not enter school until he has good eye control.

In 108 trials (four with each child), no child crossed the mid-line with his eyes independent of head movement; only three crossed the mid-line with their hands. Each of these children crossed only once and with one hand. Eight children failed to reach for the rattle on half or more of the trials. All but one of these children were able to focus. Of the seventeen who reached consistently for the rattle, thirteen used their eyes to guide their hands. Fourteen changed hands at the mid-line. All the other children turned their bodies to avoid crossing it. This means that twelve of the children either did not reach or did not coordinate hand movements with what they saw, in the conventional way.

This appears to be a vision problem, but the possibility of a deficiency in the alerting system should not go unconsidered. Tactile and gross motor input are known to be closely associated with the alerting system and the vestibular system, and the muscles of the eye used in tracking are indisputably linked with the vestibular system. The vestibular system is also closely linked with the cerebellum which is largely responsible for fine motor control of the hand. It seems highly probable that high potency, time-intensive, gross motor and tactile input are the forerunners of attention, mature functional use of the eyes, and eye-hand coordination, in that order. These abilities are vital to human learning at any but the most primitive level and indispensable to any academic achievement.

At a time when more and more handicapped children are being placed in conventional or semi-conventional classrooms, we should be asking what constitutes school readiness for this group, particularly as it applies to the use of the eyes and hands. This suggests the need for a more definitive study of the input factors which influence development of mature control of fine hand and eye movements. We have no standards to tell us how important eye control and eye-hand coordination are for readiness in a modified school program.

Implications for further studies

The basis for this study was the assumption, supported by the literature, that reflex status is a reliable indicator of C.N.S. development and maturity, and that conventional methods of assessment would be reliable with this group of children. This appears not to be the case. As no other tests which show a close correlation with integration of the C.N.S. at the automatic level were found, further investigation of the factors which influence the results of this type of testing should be undertaken.

The major factors which appear to indicate the areas of need for further investigation to assess the validity of reflex testing as it is used with this group of children are; (1) a diagnosis of mental retardation (slow development) (2) larger and less cooperative children than those usually described by the reflex tester (3) seizure prone children and (4) children under medication.

Any such study should take into consideration the findings of Vassella and Karlsson (1962).

General Problems of Reflex Testing

The possibility of finding a true control group in this population is difficult. Such a group would be made up of children confined to bed, or left to their own devices for long periods of time. Fortunately care in most accommodation for this type of child has improved greatly in the last few years so that such groups are rare. The differential in development between a control group, which experienced the normal active life seen in most institutions and a group given extra stimulation has been narrowed. This factor also contributes to the need for treatment of greater concentration and longer duration.

The problems of procuring a homogeneous or near homogeneous group of children from this population are very nearly insurmountable. It is generally accepted that no two brain damaged children have similar problems. Congenital anomolies rarely appear singly, and while there are a few commonly occurring combinations of anomolies, these in no way exclude the presentation of other accompanying disabilities. These factors are compounded by developmental and chronological age differences and differences in capability in, and speed of, learning. This points up a need to record complete diagnostic material on each child. Factorial analysis of results might then indicate the specific disabilities which respond most favourably to this treatment.

Specific Problems

Retardation or slow development

Once some of the foregoing criteria have been dealt with, a study which made allowances for the slow or retarded development rate shown by these children could be planned. Such a study ideally would be carried out over a much longer period of time -- at least a year. It should also be more concentrated -- twice a day for six or seven days a week.

Size and cooperation

Large size and unwillingness to cooperate should probably rule any child out of a study which included reflex responses among the measured variables. It is almost impossible to judge whether muscle contraction is the result of the child's struggle or the result of reflex activity.

Seizures

Daily reflex testing of a group of children known to have regular uncontrolled seizures of any kind,and a careful record of time of and severity of seizures might prove useful in indicating whether reflex responses are in any way correlated with pre or post seizure changes in C.N.S.function. This information would be useful in evaluating the validity of a given test for any individual child.

Medication

It could be anticipated that it would prove difficult if not impossible to find a control group of similarly diagnosed children who were not on medication. However the need for a separate study to evaluate the effects of medication on reflex response seems to be indicated as most children in this group are under medication. Children on identical medication might be divided into three groups. Using Vassela and Karlsson's method, one of these groups could be tested one-half hour after medications to the administering of medication and one group tested mid way between.

Interpretation of responses

As the nature of this treatment method is dependent on tactile and vestibular input and the child's response to tactile input. Responses to vestibular input are more overt and appear to be more accurately evaluated.

No references were found concerning response to specific tactile inputs as it correlates with the level of general response or attention in the child. Currently research is being directed to the investigation of identification of attention levels, and the factors which influence both the level and duration of attention.This may provide the much needed basis upon which to evaluate the non-verbal child's subjective response to tactile input. Further understanding of, and methods of evaluating attention and response levels may also provide an alternate method by which to evaluate change in the C.N.S. development and its ability to integrate incoming stimulae.

The heterogeneous nature of the group

The implications of the difficulty of obtaining statistically matched groups with regard to specific disability has been discussed, as has the problem of lack of mutual exclusiveness of these disabilities. Overcoming this problem seems unsurmountable.

Use of the Eyes

An avenue for research which seems, on the surface at least, to promise more specific information is the possibility of change in ability to use the eyes effectively. Fixation, eye follow, recognition and convergence (which was not evaluated in this study) all appear to be objectively measurable. Some problems might arise in distinguishing them from attention. As the use of the extrinsic muscles of the eye have been shown to be dependent upon integrity of a vestibular, cerebellar, cervical mid-brain loop, high intensity long duration vestibular input could be expected to improve the ability to use the eyes.

If such were the case, some of these children could be given better tools with which to explore and manipulate their environment. They would also be more likely to be able to take greater advantage of the opportunities for more formal education, job training and employment opportunity.

Conclusion

In the past fifteen years, social pressures have promoted the integration of the mentally retarded into the community: social gatherings, recreational activities, schools, places of work and worship.

This has put a new onus on the individuals and agencies that work with these people to reconsider their aims and objectives. It is not enough to physically place the mentally retarded in the community. Consideration must be given to the factors which make for successful integration, acceptance and a measure of success in school, and in closed or open employment. Thought must be given also to the other factors which make for success in our social structure. We must understand the basic abilities upon which these skills are built. We must provide an environment rich in the factors which facilitate these abilities in order to enable each individual to achieve the highest social, perceptual and life skills of which he is capable. Without these skills, survival is difficult in our society.

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APPENDIX A

Description of treatment of two widely differing children

Appendix A

Treatment Program for Two Widely Differing Children

T, five and a half years old, has no seizures, is not self-abusive but does eat her clothes, walks smoothly, is just beginning to use words meangfully so can express approval and disapproval. She attends school.

The tactile part of her treatment program began by rubbing her hands and arms, feet and legs, with a terry cloth mitt and a sponge which was soft on one side and rough on the other. She preferred the rough side of the sponge and drew away from fur and soft brushes. After the second week she was encouraged to walk on a sisal runner. For the first few days she firmly refused to take more than two steps. Coincidental with this she was beginning to tolerate having the soles of her feet rubbed by a close-clipped piece of soft fur. This experience immediately preceded the opportunity to walk on the runner. The day she first tolerated the fur on the soles of her feet for thirty seconds, she also walked the length of the runner. Gradually, by the end of six weeks, she built this up to three lengths of the runner without complaint. She preferred the runner to ribbed rubber matting.

The vestibular part of the program consisted largely of the use of the exercise ball and the hammock. She was placed face down on the ball and rocked forward and back. At first, merely being placed on the ball upset her and she struggled against it. Even at the end of treatment she was happy on the ball for only a few seconds. She sat upright in the hammock and expressed verbal delight when twirled, usually singing a recognizable tune. However, when the hammock was pushed back and forward as a swing, T was not content.

E, 7 years old, on medication for seizures, is not self-abusive, but is aggressive and abusive towards other children and staff. No obvious explanation for her not walking alone is known, but she demands some contact with a person's hand or a wall. She has no speech, does not even babble. Because she appears to have reached plateaus, she is not presently on any type of formal program off the ward. E displays what is known as "postural insecurity". She is terrified by any change in position. This is not a matter of new experiences only, as she is frightened by the elevator in which she rides several times a day, every day.

She enjoyed any and all tactile stimulation given, from a scrub brush to a fuzzy mop. It appeared to relax her and she was less irritable and sensitive to position change following stimulation than prior to it.

Vestibular input was quite another matter, however. She never tolerated anything in this domain except gentle rocking (while being held firmly by the therapist). Sideways rocking on the floor, rocking on a small rocking horse and in another rocking toy, and reaching over the bolster for a toy all produced fear. The ball and the hammock produced stark terror. At the end of the study, E seemed a little less frightened by the rocking toy.

APPENDIX B

Raw Data

Raw Scores

Table 2.

	Post-test 1							Post-test 2						
	ATN		PET	E	F	tact.		ATN		PET	E	F	tact.	
Treatment	L	R		L-R	R-L	L	R	L	R	PET	L-R	R L	L	R
1	4	4	0	0	0	2	4	1	1	0	0	0	4	4
2	4	4	4	2	2	2	1	4	4	0	3	3	4	4
3	4	4	4	1	1	4	4	4	4	0	0	0	4	4
4	1	1	4	0	0	4	4	2	4	0	0	3	4	1
5	4	3	0	3	3	2	1	4	4	0	0	0	4	4
6	4	4	0	3	3	4	4	1	4	0	0	0	4	4
7	4	4	0	2	2	4	4	4	4	0	3	3	4	4
8	4	4	0	3	3	3	3	4	4	4	3	3	4	3
Placebo														
9	1	2	4	2	2	2	1	1	1	4	1	1	1	2
10	2	2	0	3	3	4	4	4	4	4	3	3	4	4
11	4	4	0	2	2	3	4							
12	4	4	0	3	3	1	1	2	2	4	3	3	4	4
13	4	1	0	3	3	1	1	4	1	0	3	3	4	1
14	4	4	4	0	0	4	4	4	4	4	0	0	4	4
15	4	4	0	3	3	4	4	4	4	4	3	2	4	4
16	4	4	0	3	3	4	4	4	4	0	3	3	4	4
Control														
17	4	4	4	3	3	1	1	4	4	4	3	3	1	1
18	1	1	4	0	2	3	3	1	1	0	0	2	3	3
19	4	4	0	3	3	4	1	4	4	0	1	1	3	3
20	4	4	0	0	0	1	1	4	4	0	0	0	1	1
21	1	1	0	3	3	4	4	1	1	0	3	3	4	3
22	4	4	4	2	2	2	1	4	4	0	3	3	1	1
23	4	4	0	-	-*	4	4	4	4	4	-	-*	1	1
24	4	4	0	3	3	1	1	4	4	4	1	2	3	3
25	4	4	0	0	0	4	4	4	4	0	0	0	4	4
26	4	4	4	1	1	1	1	4	4	0	0	0	1	1
27	4	1	4	0	0	4	1	1	4	0	3	3	1	1

*blind

Recording Form

Table 3

Name
Age

Pre-test 1. 2.
Post-test 1. 2.

ATN		L	R
Overt movement	1		
Tone change	2		
Tone change with resistance	3		
No change	4		

PET	Yes	No
Present		

Righting	Yes	No
Head on body		
Body on body		

SER	Yes	No
Present		

Eye follow		L-R	R-L
Doesn't focus	0		
Doesn't follow	1		
Jerks to follow	2		
Follows Head and Eye	3		
Follows Eyes Alone	4		
Crosses mid line (check)			

Reaches		Yes	No
Pulls arm away	1		
Becomes very restless	2		
Tolerates 30 sec.with comfort	3		
Tolerates 60 sec.with comfort	4		