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

by

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A Thesis

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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

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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.

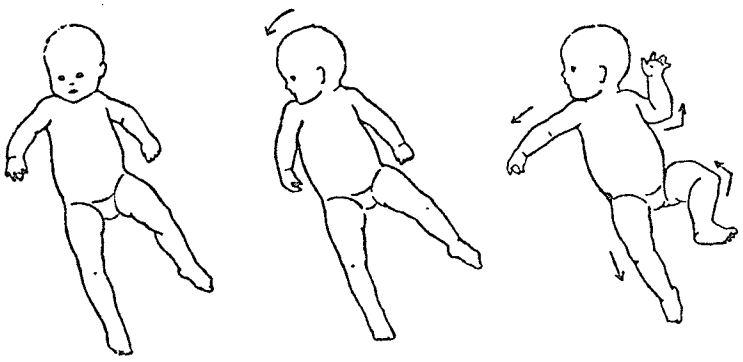
Reticular system - the functional system which utilizes the reticular formation. It appears to be responsible for the relative state of alertness of the organism (sleep-wake patterns) as well as having an inhibitory or facilitory effect on the motor systems.

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



a. supine, arms and legs extended

turn head to one side

extension of face limbs, flexion of skull limbs

Figure I A T N R

(Mysak 1969)

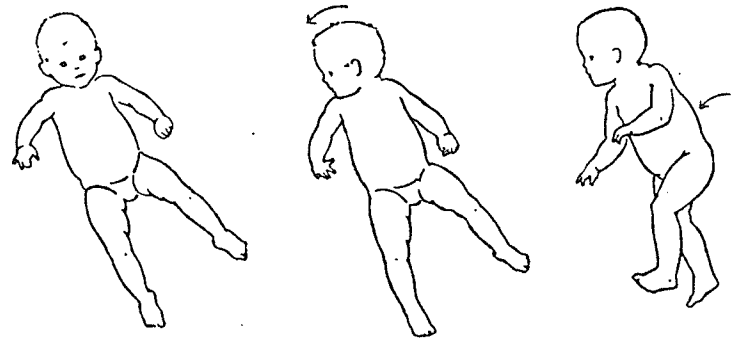
the child's face and mouth away from a flexed elbow, thereby making the use of both hands together in the midline impossible. This destroys one of the basic mechanisms for development of eye-hand coordination. It also interferes with skills of daily living, including self-feeding.

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



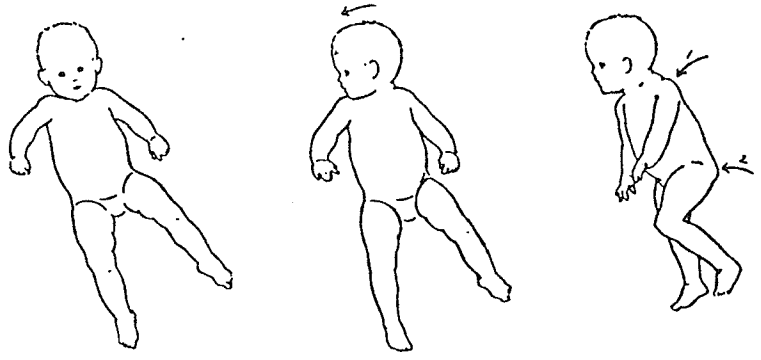
a. supine, arms and legs extended

rotate head to one side

body rotates as a whole in same direction as head

Figure 2 Head on body righting

(Mysak, 1969)



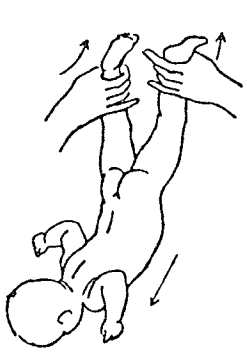
c. supine, arms and legs extended

turn head to one side

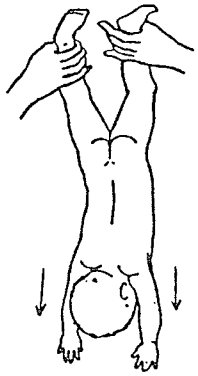
head turns, then (1) shoulders, (2) pelvis

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.

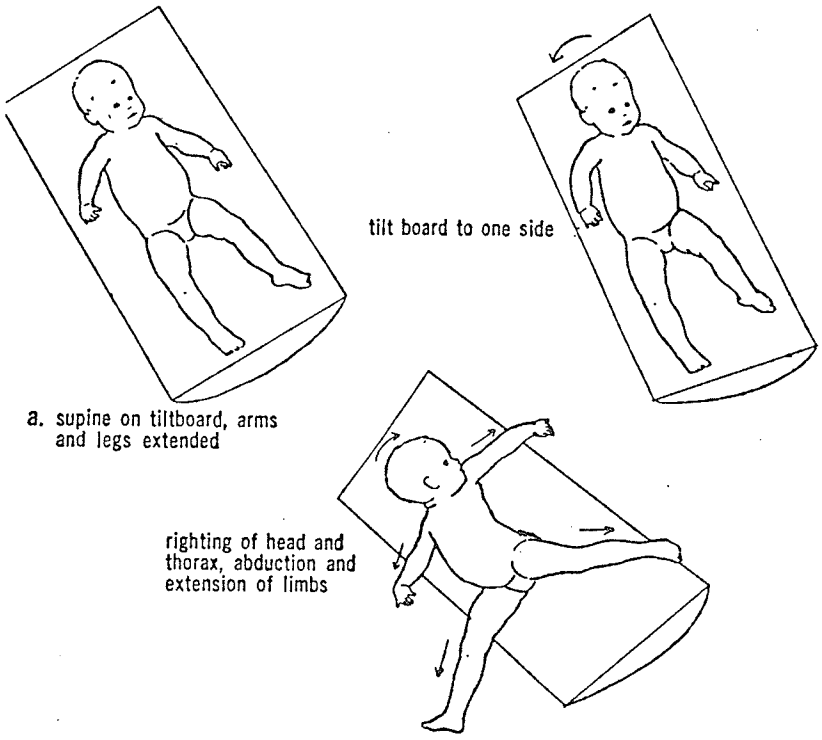


Figure 5 - Equilibrium Reactions

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