

THE EFFECT OF UNINTEGRATED PRIMITIVE POSTURAL
REFLEXES ON CHILDREN WITH LEARNING PROBLEMS

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**THE EFFECT OF UNINTEGRATED PRIMITIVE POSTURAL REFLEXES
ON CHILDREN WITH LEARNING PROBLEMS**

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This dissertation studies the effect of unintegrated primitive postural reflexes on children with learning problems. The aims of the study were to establish whether there was a relationship between primitive postural reflexes such as the tonic labyrinthine, asymmetrical tonic neck and symmetrical tonic neck reflexes and academic performance at school as well as primitive postural reflexes and habitual postural patterns such as propping the head up when sitting at a desk, sitting on feet on a chair etc. The candidate also investigated whether there was a relationship between specific primitive postural reflex activity and specific academic skills such as reading, writing and arithmetic as well as specific habitual postural patterns. All the grade one, grade two and standard one pupils in the schools used for the study were evaluated for the presence of unintegrated primitive postural reflexes. The children with unintegrated primitive postural reflexes were identified and placed in the experimental group and matched to a control group according to age, IQ, sex and class teacher. Comparisons between the two groups with respect to academic performance and habitual postural patterns were made. In addition, the candidate investigated

whether any relationship existed between specific primitive postural reflexes and specific academic skills, as well as specific habitual postural patterns in the experimental group only. The study concluded that no significant difference existed between the two groups in respect of academic achievement, but that a significant difference existed between the two groups in terms of habitual postural patterns. No relationship was found between specific primitive postural reflexes and specific academic skills or specific habitual postural patterns.

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

Elna Jooste
3rd day of July, 1942

ACKNOWLEDGEMENTS

This study was undertaken to investigate whether unintegrated primitive postural reflexes were an important factor in the treatment of children with learning problems. Many children with learning problems are referred for occupational therapy. As occupational therapy deals with these children, utilising neurophysiological principles, the candidate felt that it was important to investigate the effect of unintegrated primitive postural reflexes on these children as one of the factors to be taken into consideration when evaluating these children and planning a treatment programme.

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LIST OF ABBREVIATIONS

IFMF	- intrafusal muscle fibres
EFMF	- extrafusal muscle fibres
PPR	- primitive postural reflex
TLR/R-TLR	- tonic labyrinthine reflex
TLRS/R-TLRS	- tonic labyrinthine reflex in supine
TLRP/R-TLRP	- tonic labyrinthine reflex in prone
NRR	- neck righting reaction
BRR	- body righting reaction
ATNR/R-ATNR	- asymmetrical tonic neck reflex
STNR/R-ATNR	- symmetrical tonic neck reflex
AR/R-AR	- associated reactions
PSR/R-PSR	- positive supporting reflex
HPP	- habitual postural pattern
P-TLRS	- HPP associated with the TLRS
P-TLRP	- HPP associated with the TLRP
P-ATNR	- HPP associated with the ATNR
P-STNR	- HPP associated with the STNR
P-AR	- HPP associated with the AR
P-PSR	- HPP associated with the PSR
IQ	- Intelligence Quotient
NBGT	- National Bureau group Test
NSAGT	- New South African Group Test
SD	- Standard Deviation
SAMRC	- South African Medical Research Council
PMDP	- Bio-Medical Data Package

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1. INTRODUCTION

1.1. Statement and Analysis of the Problem

In surveying the literature related to children with learning problems, it became apparent that many researchers have recognised the significance of adequate motor ability and the role that it plays in learning cognitively. These researchers include Kraus and Hirschland (1954), Kagerer (1958) Kephart (1960), Delacato (1963 and 1966), Bax and MacKeith (1963), Ayres (1972a), Rider (1972a and b), Norton (1972a and b), Finocchiaro (1974), Gordon (1976), Bender (1976), Towne (1979), Montgomery and Richter (1980), Walker and Boney (1981), Bundy and Fisher (1981), Harris (1981) and Dunn (1981).

Gordon wrote:

"The most important aspects of development are the child's gradual acquisition of the erect posture and subsequent ambulation, the increasing awareness of objects, individuals and activities in the surroundings; the development of hand function; and the acquisition of speech" (1976:12).

Delacato (1963 and 1966) theorised that if any aspect of neurological organization is not complete, then further neurological development will be adversely affected. This neurologic development is dependent on phylogenetic and ontogenetic neural development. He re-iterates that the ontogenetic development of the

nervous system recapitulates the phylogenetic neural development of man.

"This orderly development in humans progresses vertically through the spinal cord and all other areas of the central nervous system up to the level of the cortex, as it does with all mammals. Man's final and unique development progression takes place at the level of the cortex and it is lateral, (from left to right or from right to left) (Delacato 1966:6).

He points out further that man has developed a cortex through the evolutionary cycle, yet that neurological appendages which were needed during this developmental cycle and functions were retained at the lower level. Unique to man, though, is the ability to stand fully upright, having functional stereoscopic vision, having the ability to supinate and pronate the arm and hand, having the ability to oppose the thumb and forefinger, to operate unilaterally with the hand, foot and eye on the same side of the body (therefore has developed lateral dominance), and having the ability to speak and write a language or alternatively to have developed a symbolic language.

However, in the event of any obstruction or incomplete neurologic organization at any stage of this ontogenetic recapitulation, mobility, communication and language dysfunction will occur. In fact Delacato (1963 and 1966) says that problems with speech and reading are different manifestations of the same problem, amongst which he lists aphasia, delayed

speech, stuttering, retarded reading, poor spelling and writing as well as reading below the performance of mathematics.

In the event of evaluating the cause of the problem Delacato (1963 and 1966) suggests that the diagnostic procedure begins at the highest level of neurological organization, that of cortical dominance, and moves successively to the lower levels of cortex, midbrain and pons.

To summarise, Delacato (1966) believes that neurological organization based on normal phylogenetic and ontogenetic development. During this development, the child progresses through the stage of primitive postural reflexes which is superceded by the next stages enhancing crawling, creeping and walking which all add to man's unique neurological function which will enable him to talk, read and write.

Ayres (1972a, 1979) has added to the model which states that academic learning i.e. reading, writing and arithmetic, is based on intact postural mechanisms and that many children with learning problems have sensory integrative disorders and inadequate integration of impulses at subconscious levels of the Central Nervous System. She postulated that the more primitive systems play an important role in "sensory integration" and with subsequent output via the motor systems. Of

speech, stuttering, retarded reading, poor spelling and writing as well as reading below the performance of mathematics.

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these, the extrapyramidal system exerts an important influence in securing adequate unconscious postural background mechanisms. Postural background movements refer to:

"The subtle, spontaneous body adjustments that make overt movements of the hands, such as reaching for a distant object, easier. These postural adjustments depend upon good integration of vestibular and proprioceptive inputs" (Ayres 1979:183).

Postural background movements are dependent on an adequate postural reflex mechanism. The postural reflex mechanism is dependent on the utilization and inhibition of primitive postural reflexes and reactions, which is the process that helps the child to conquer gravity and assume the upright posture. This process is unique to man.

The ability to assume the upright posture frees the hands from a supporting function and enables the ability to develop eye hand co-ordination, the use of tools and to communicate. The development of the hearing and visual systems also becomes more sophisticated which plays an important role in the acquisition of communication skills. These communication skills are supported by the ability to be able to speak, read, write and do arithmetic. These are the very areas in which the child with learning problems struggles.

Norton (1972a and b) also recognised the disturbed

feedback mechanism of dysfunction and it's effects on central organization and learning. She pointed out that the sensory feedback accompanying movement plays a vital part in perceptual development and adaptations. This feedback also includes the integration of reflexes of proprioception from the muscles, tendons, ligaments and facia.

The American National Advisory Committee to the Bureau of Education for the Handicapped, Office of Education in 1968 devised the definition for children with learning problems as follows:

"Children with special learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written languages. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicap, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia etc. They do not include learning problems which are due primarily to visual, hearing or motor handicaps, to mental retardation, emotional disturbance or to environmental deprivation." (Rider 1972b:239).

Norton (1972a) pointed out that learning disorders may include difficulty in reading, spelling, arithmetic, writing, memory and conceptualisation. The children may be distractible, impulsive, hyperactive and unco-ordinated. Confused laterality is often evident as well as strabismus, speech deficits and short attention span. These symptoms all contribute to this

multihandicap. Balance, motor planning and fine skilled performance are frequently inadequate. She further points out that these characteristics are in accordance with soft neurological signs.

Ayres (1979) described children with learning problems as having

"a difficulty in learning to read, write, compute, or do schoolwork that cannot be attributed to impaired sight or hearing, or to mental retardation." (Ayres (1979:182)

The definitions for children with learning problems mainly describe the symptoms which they present and no reference is made to the actual causes responsible for these symptoms. As already stated, many researchers have recognised the importance of adequate motor ability to be able to learn cognitively, and this is best illustrated in looking at the suggested treatment programme postulated by Ayres (1972a).

The therapy programme, thus, suggested by Ayres (1972a:145) consists of the following steps:

- (1) Normalising the vestibular and tactile systems.
- (2) Inhibiting the primitive postural reflexes.
- (3) Developing equilibrium reactions.
- (4) Normalising eye movements.
- (5) Enhancing co-ordination of the two body halves.
- (6) Developing visual form and space perception.

This treatment technique is called "sensory integrative

therapy" which is defined as:

"Treatment involving sensory stimulation and adaptive responses to it, according to the child's neurologic needs. Therapy usually involves full body movements that provide vestibular, proprioceptive, and tactile stimulation. It usually does not involve activities at a desk, speech training, reading lessons, or training in specific perceptual or motor skills. The goal of therapy is to improve the way the brain processes and organizes sensations" (Ayres 1979:184).

It seems therefore that some authors (Rider 1972b, Finnochiaro 1974, Bender 1976, Ayres 1972 and 1979, Montgomery and Richter 1980, Walker and Boney 1980, Bundy and Fisher 1981, Harris 1981, Dunn 1981) feel primitive postural reflexes to be an important component of learning disabilities. Two studies were of particular importance i.e. that of Rider (1972b) and of Finnochiaro (1974) in formulating this study.

Rider (1972b) carried out a study on "The Relationship of Postural Reflexes to Learning Disabilities" to determine whether a relationship existed between postural reflex level and academic performance. The postural reflex levels studied were the spinal, brainstem, midbrain and cortical levels and she administered individual reflex testing as described mainly by Fiorentino in 1963 to each child in both the experimental (consisting of children enrolled in a perceptual-motor training programme) and control groups (consisting of normal second-grade children). She found that learning disabled children demonstrated

significantly more abnormal responses than normal second grade children. She also found that the learning disabled group had the most abnormal responses at midbrain level (twenty five per cent). The percentage of responses at the other levels were eleven per cent at cortical level, seven percent at brainstem level and three percent at spinal level. It should be recorded that there were twenty children in the learning disabled group and thirty eight children in the normal second grade group.

"The fact that the children with learning disorders had significantly more abnormal responses than the normal children lends empirical support to the theory of minimal neurological impairment as a factor in the etiology of learning disabilities" (Rider 1972b:242)

She also said that the sample was too small to draw universal generalizations, but the degree of significance in her study is high enough to warrant further research. According to her, she also found a significant relationship between the prevalence of abnormal reflexes and scores on the reading ($p < .10$) and spelling ($p < .01$) subtests of the Wide Range Achievement Test (WRAT) in the normal children.

Finocchiaro (1974) also investigated "Behaviour Characteristics in Learning-Disabled Children with postural Reflex Dysfunction". The postural reflexes used for her study were the asymmetrical tonic neck reflex to the left and to the right, as well as the

symmetrical tonic neck and tonic labyrinthine reflexes.

She conducted her study with eighteen learning disabled children of which twelve had postural reflex dysfunction (experimental group) and six without such dysfunction (control group). These two groups were compared.

She found that in only one behaviour factor out of eleven, namely "external reliance", a significant difference existed between the two groups. (External reliance is a factor reflecting passive and directionality confused behaviours.) Secondly, she found that learning disabled children with postural reflex dysfunction had increased problem behaviour with increased chronological age. She felt that this study emphasised the need for further investigation into children with postural reflex dysfunction.

1.2. Scope and Objectives of the Study

In view of the above, it was thought to be important to try to establish the possible effects of unintegrated primitive postural reflexes on children with learning problems.

In surveying the results of the studies conducted by Rider (1972b) and Finocchiaro (1974) which are related to this study, it became apparent that:

- a) The groups (experimental and control) in these studies were not homogenous as regards age, sex, IQ and with the same teacher. The candidate studied two homogenous groups which were selected from normal schools. One group evidenced primitive postural reflex activity and the other was without primitive postural reflex activity.
- b) The effect on writing was not investigated. Rider (1972b), in fact, pointed out that the highly significant relationship between spelling and the prevalence of abnormal reflexes might well be more of a function of the motor aspect of the spelling test, namely writing, than of the cognitive aspect. The candidate therefore included writing as one of the factors to be compared between the two groups in this study.
- c) The effect on habitual postural patterns was not investigated which is one of the aspects the candidate investigated.
- d) Rider (1972b) investigated reflex responses on spinal, brainstem, midbrain and cortical levels, whereas the candidate only considered some primitive postural reflexes at the brainstem level. In the candidate's opinion, the released tonic reflexes have a greater effect on abnormal movement patterns than the righting reactions at midbrain level and the balance and equilibrium reactions which occur at the cortical level.

e) Finnochiaro (1974) investigated teacher- and parent-observed behaviours in two groups of learning disabled boys, one group evidencing presence of residual early postural reflex responses and the other group lacking evidence of these responses. The postural reflex test used by Finocchiaro (1974) evaluated the presence of the asymmetrical tonic neck reflex to the right and to the left in the quadrupedal position, as well as the symmetrical tonic neck reflex and tonic labyrinthine reflex in the pivotal prone position.

The candidate studied the same primitive postural reflexes. Two groups of subjects will be selected from normal schools and compared in terms of academic performance and habitual postural reflexes.

f) Both Rider (1972a b) and Finnocchiaro (1974), emphasised the need for further investigation regarding the effects of postural reflex dysfunction.

The survey of the literature, in particular the findings of Rider (1972a) and Finocchiaro (1974) serve to re-inforce the impressicn gained by the candidate in clinical situations, that unintegrated primitive postural reflexes were frequently found in learning disabled children. This prompted the candidate to formulate the parameters for this study.

1.3. Method of Investigation

The present study was undertaken to study whether unintegrated primitive postural reflexes were more prevalent in children with learning problems and whether these reflexes had a relationship to particular academic skills, if the experimental and control groups were homogenous as regards to age, sex, IQ and having the same teacher. The influence of primitive postural reflexes on habitual postural patterns was also investigated. This necessitated:

1.3.1. The compilation of the following measuring instruments:

1.3.1.1. A procedure to evaluate primitive postural reflexes.

1.3.1.2. A questionnaire to identify habitual postural patterns.

1.3.2. The identification of two homogenous groups as regards age, sex, IQ and having the same teacher, (the experimental group having unintegrated primitive postural reflexes while the control group had integrated primitive postural reflexes).

1.3.3. Comparing the two groups in respect of:

1.3.3.1. Overall performance, reading, writing and arithmetic in academic achievement at school.

1.3.3.2. Habitual postural patterns.

1.3.4. The investigation of any relationship in the experimental group only between specific primitive postural reflex activity and

1.3.4.1. academic achievement (overall performance, reading, writing, arithmetic).

1.3.4.2. habitual postural patterns.

1.4. Definition of Terms used

Primitive postural reflexes are a group of static responses studied by Magnus (1926) on the brainstem animal. These reflexes are tonic in nature and produce increased tone of predictable distribution over the whole body musculature. These reflexes are normal in early infancy and are modified, inhibited and integrated as the central nervous system matures.

Habitual postural patterns refer to bad or poor postural attitudes that are assumed by a person habitually in normal everyday activities, such as habitually propping up the head when sitting at a desk or even slumping on the table, sitting on the feet when sitting on a chair etc. These habitual postural patterns are often referred to as poor or bad postural habits and are not recognised as good postural control or attitudes.

2. REVIEW OF LITERATURE

In reviewing the literature pertaining to primitive postural reflexes, the candidate felt that the reader should also be aware of the neurophysiological principles underlying the study of these reflexes. Summaries are therefore given of the physiology of the simple reflex arc, muscle tone, the effect of the various levels of integration in the central nervous system (CNS) on muscle tone and the postural reflex mechanism. Each primitive postural reflex will be reviewed as it pertains to its description, testing, integration in the course of motor development and the adverse effects if not adequately integrated.

Anatomy and physiology of the nervous system is described by McNaught and Callander (1967), Chusid and Mc Donald (1967), Guyton (1969), Ayres (1972a) and Farber (1982).

2.1. THE SIMPLE REFLEX ARC

Mc Naught and Callander (1967) pointed out that reflexes form the basis of all CNS activity and occur at all levels of the brain and spinal cord. The

simple reflex arc is the smallest functional unit and consists of a sensory or afferent neuron which synapses with the motor or efferent neuron in the CNS.

The sensory neuron consists of a receptor which receives a stimulus. The afferent sensory nerve transmits the impulse to the CNS where it synapses with either a single neuron or several successive neurons connected in series with each other, either with an intermediate neuron or in this case with a motor neuron. The efferent motor neuron or nerve fibre transmits the impulse to the effector (which could be striated muscle which will contract).

A connecting neuron sends impulses to and receives impulses from other parts of the brain and has multiple connections which could influence the effect on the effector organs.

2.2. NEUROPHYSIOLOGIC BASIS OF MUSCLE TONE

"Muscle tone is a state of continuous mild contraction of muscle dependent upon the integrity of nerves and their central connections and the complex properties of muscle such as contractibility, elasticity, ductility, and extensibility." (Chusid and McDonald 1976:162).

The stretch (Myotatic) reflex maintains muscle tone and is situated in the spinal cord. It represents a simple reflex arc. The impulses are initiated in the annulo spiral endings and flower spray endings situated

in the muscle spindle in the intrafusal muscle fibres (IFMF) as well as in the golgi organ in the tendon. The impulse is transmitted via the afferent sensory neuron to the spinal cord where it synapses with other neurons such as those going to various levels in the CNS, and an intermediate neuron which eventually synapses with the efferent motor neuron in the anterior horn cell, from where the impulse is transmitted to the extrafusal muscle fibres (EFMF) with contractile ability.

Guyton (1969) pointed out that this tone of skeletal muscle may increase or decrease depending on the physiological activity of the body.

Muscle tone is maintained, controlled and influenced by normal function at six levels in the CNS (Chusid and McDonald 1976):

- (1) The precentral motor cortex (Brodman areas four and six);
- (2) the basal ganglia;
- (3) the midbrain;
- (4) the vestibulum;
- (5) the spine;
- (6) the neuro muscular system.

Figure 2:1 illustrates the myotatic reflex with the various structures involved in muscle tone.

Muscle spindle contraction is also effected by impulses from supraspinal structures which cause discharge of the gamma efferent neurons. The gamma efferent motor neuron synapses with a motor neuron in the anterior horn cell which stimulates the annulo spiral ending and the flower spray ending (receptors) in the striated muscle portion of the IFMF.

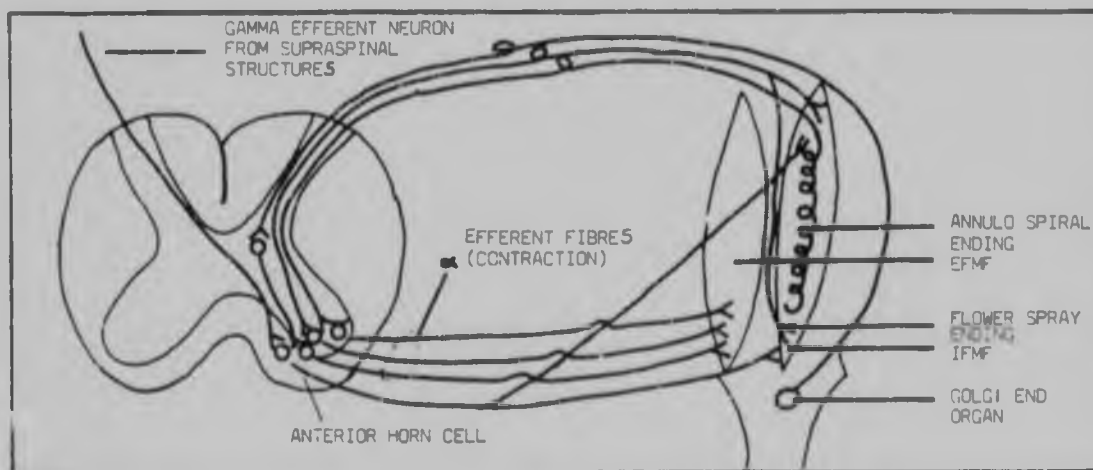


Figure 2.1: The Myotatic Reflex.

Various impulses from the CNS have an influence on muscle tone which balance the inhibition and excitation of alpha and gamma motor neurones. Impulses are transmitted from:

- (1) Sensori-motor and premotor cortex via the cortico spinal tract and the rubro spinal tract to override unconscious postural patterns and cause voluntary movement. Greatest effect is on

progravity motor neurons i.e. upper extremity extensors and lower extremity flexors. It also controls distal muscles in fine rapid movements (Chusid and McDonald 1967).

(2) Cortex, cerebellum and basal ganglia to the medullary reticular formation and the lateral reticular spinal tract with greatest effect on progravity muscles (motor neurons going to the upper extremity extensors and lower extremity flexors).

(3) Impulses via the vestibular system are transmitted to:

(a) the reticular formation, pons reticular formation and medial reticular spinal tract where they stimulate mainly the motor neurons the antigravity muscles (upper extremity flexors and lower extremity extensors),

(b) the lateral vestibular nucleus via the lateral vestibulo spinal tract also excites the motor neurons of the antigravity muscles.

In summary, co-activation of the interneuron pools is stimulated which in turn transmits impulses via the alpha motor neuron to the EFMF as well as transmits impulses via the gamma motor neuron to the IFMF which in turn contracts and stimulates the ending from which impulses are transmitted via the Ia afferent neuron to

the alpha efferent neuron to the EFMF.

2.3. THE POSTURAL REFLEX MECHANISM

Insight into the neurophysiological basis of muscle tone brings us to a better understanding of how the postural reflex mechanism develops.

Postural adaptation is brought about by the development of motor ability and maturation of the CNS. Input or stimulation is received via the vestibular, proprioceptive and tactile receptors which transmit impulses to the CNS. Various functions occur at the different levels of development in the CNS. The development of the postural reflex mechanism illustrates these functions and has been described by Fiorentino (1963) and Bobath (1965) as follows:

During the first two months of life, the spinal reflexes are predominantly present, after which they are inhibited by the brainstem reflexes. These reflexes are phasic in nature and occur in patterns of total extension or flexion in an apedal position (prone or supine lying). Muscle tone is thus influenced to change in short periods of contraction and then relaxation. Examples of reflexes on this level are the flexor withdrawal, extensor thrust and crossed extensor reflexes. It should however be pointed out that they are protective reactions in cases of

emergency and can be elicited at later stages such as in pulling the arm or leg away from a painful stimulus.

Brainstem reflexes are predominantly present during the first four months of life, after which they are modified by the righting reactions. At the brainstem level the infant is still apical, but muscle contraction is static or tonic in nature. These reflexes are referred to as primitive postural reflexes as muscle tone is prolonged and static and gives skeletal stabilization. They are elicited by stimulation of the labyrinths, neck proprioceptors, proprioceptors in the small muscles of the foot and pressure on the ball of the foot. Examples of reflexes at this level include the tonic labyrinthine-, asymmetrical- and symmetrical tonic neck reflexes, associated reactions and the positive supporting reflex.

The reflexes at midbrain level are called righting reactions. They are predominantly present from six months to five years of age and establish the normal head and body relationship in space and to each other.

They change muscle tone to enable the contraction and relaxation of muscles in combined flexion and extension patterns to bring about those movement patterns which will allow for head control and rotation around the body axis. These movement patterns are necessary to help the child to roll over, sit up, get in the

quadrupedal position and eventually to the standing position.

Equilibrium reactions occur at the cortical level. These reactions are present in prone and supine in order to help the child to maintain these positions when placed on an unstable or moveable surface. The same applies in both the sitting and quadruped positions. By the time the child is bipedal, he has mastered rotation and can move with stability. He has also overcome the force of gravity and can assume an upright posture in sitting, standing and walking.

Figure 2.2. illustrates the different levels of maturation in the CNS and how these reflexes and reactions affect the distribution of muscle tone and development of the postural reflex mechanism.

However, in the event of any lesion, incomplete or delayed neurological development, reflexes at the lower levels of maturation of the CNS will be released which will dominate motor patterns. This is especially seen in the severely neurologically damaged child or cerebral palsied who has a limited repertoire of movements and mainly moves in the stereotyped patterns of the tonic reflexes within the brainstem level.

It therefore seems to the candidate that postural background movements are dependent on an adequate

postural reflex mechanism. The postural reflex mechanism is dependent on the utilization and integration or inhibition of the primitive postural reflexes and reactions which is the process that helps the child to conquer gravity and assume the upright posture. Good postural control will enable the child to acquire gross and fine motor co-ordination with the subsequent acquisition of basic skills and achievement levels.

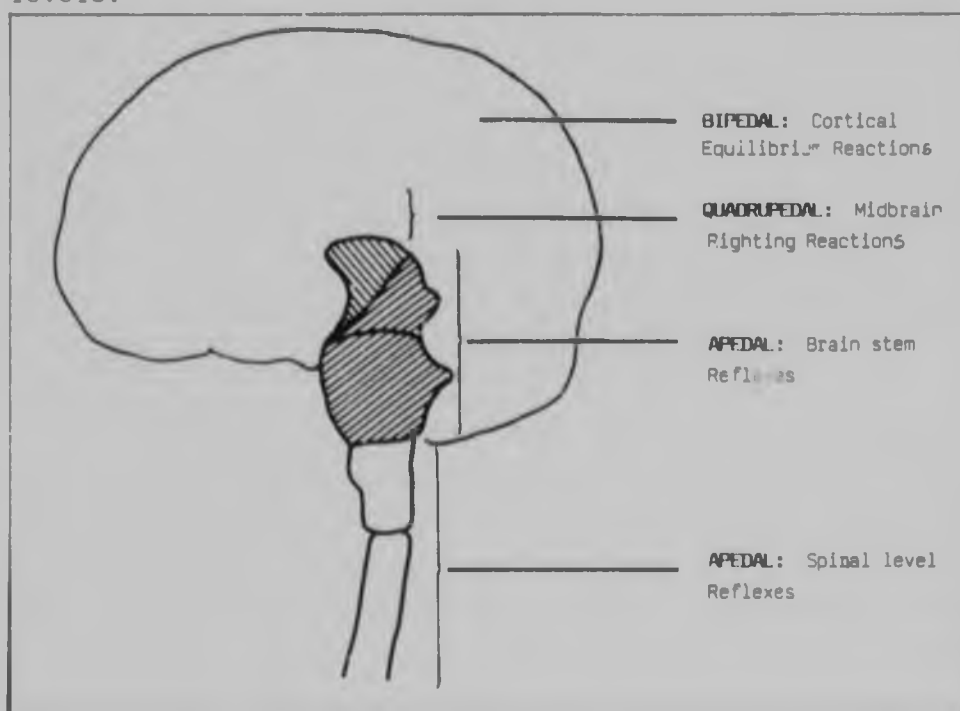


Figure 2.2: Levels of inhibition in the CNS (after Fiorentino 1963).

2.4. PRIMITIVE POSTURAL REFLEXES

According to Ayres (1972a), abnormal presence of the tonic neck- and the tonic labyrinthine reflexes in

particular may be diagnostic of perceptual motor dysfunction. These reflexes are tonic in nature and occur at the brainstem level. The candidate decided to study these reflexes as well as associated reactions together with the positive supporting reflex which also occurs at this level. The spinal reflexes, righting reactions, balance and equilibrium reactions were to be excluded from this study. For the purpose of this study, the following reflexes were taken into consideration:

- Tonic labyrinthine reflex (TLR)
- Asymmetrical tonic neck reflex (ATNR)
- Symmetrical tonic neck reflex (STNR)
- Associated reactions (AR)
- Positive supporting reflex (PSR)

2.4.1. The Tonic Labyrinthine Reflex (TLR)

2.4.1.1. Description of the TLR

The TLR influences tone depending on body posture in relation to gravity (Gordon 1976 and Norton 1972b). It is particularly the effects of gravity on the labyrinth (semi-circular canals) of the inner ears which form an important part of the proprioceptive sensory system which sends a continuous stream of sensory information to the CNS. This information concerns the orientation of the head and body to

gravity, and the direction and rate of their movement through space (Bender 1976).

Flexor tone is increased when an infant is placed in a prone position (prone flexion response) and extensor tone is increased when the infant is placed in a supine position (supine extension response). It should however be clarified that it is not the basic position which elicits the TLR, but more the relationship of the labyrinths to the force of gravity which receives stimulation (proprioceptive sense organ) that elicits the effect of the TLR in the supine or prone positions.

Bender (1976) describes the prone flexor response as:

"Characteristic of the reflex-dominated neonate - knees pulled up under his abdomen, buttock elevated, elbows bent tightly and clenched fists sometimes tucked under his chest" (Bender 1976:17).

The supine extension response on the other hand allows increased tone in the extensor muscles which results in little or no resistance when the infant's limbs are passively straightened, except for the hip joints (Bender 1976).

The characteristic posture of the newborn in supine is still with more flexion in all four limbs but a few weeks later the back will be straight, head turned to one side and tilted back. Flexion of the lower limbs is reduced and the upper limbs are usually affected by the ATNR with the skull side arm flexed at the elbow

and the face side arm extended. When the infant is startled, both arms will open wide therefore move into extension and abduction. The TLR has been described by Magnus and de Kleijn (1912), Fiorentino (1963) and Bobath (1965).

2.4.1.2. Testing of the TLR

To test for the presence of the TLR, clinically two positions are used. Classically the TLR is tested in both supine and prone positions but different workers test reflexes in different ways.

To test the TLR in supine (TLRS), the child is placed in a supine position with head in midposition and limbs extended. The test stimulus is the position of the labyrinths in relation to gravity. A positive reaction elicits an increase in extensor muscle tone which is felt as resistance when the limbs and head are passively flexed, while in a negative reaction this resistance will not be felt (Fiorentino 1963).

The test of the Institute for Neuro- Physiological Psychology (Blythe and McGrown, no date given) for this reflex requires that the patient be placed in a "supine position with packing under the shoulders and upper dorsal area" (Ibid:9) while the patient's head is supported by an assistant. The head is then dropped backwards quickly, "taking care that it does not touch

the floor" (Ibid:9). Visible extensor tonus in legs with flexor relaxation denotes a residual TLRS.

To test the TLR in prone (TLRP), the child is placed in a prone position with head in midposition, legs extended and arms extended above the head. The test stimulus is the same as described in TLRS. A positive reaction elicits an increase in flexor muscle tone, seen and felt in the upper limbs, knees, hips and neck muscles. A negative reactions does not elicit increased flexor tone as described.

Ayres (1972a) also describes testing the reflex by assuming and maintaining an opposite postural pattern to the response expected by the reflex (reflex inhibiting posture) in order to evaluate the effect of integrated TLR in children with learning problems. The Bobaths (1966) define "Reflex Inhibiting Patterns" as

"Postural patterns which change (break up) pathological patterns due to released tonic reflex activity" (Bobath 1966).

This method has been used by many workers who researched Ayres' theories, for example Montgomery and Richter (1980), Walker and Boney (1981), Bundy and Fisher (1981), Harris (1981), Dunn (1981) and Rider (1972a and b).

Using this method to evaluate the TLRP, the child is asked to assume a prone extension posture and to

maintain it for a certain period of time. Graded criteria have been used by these workers in evaluating this ability (this will be further discussed in the evaluation section of this study in Chapter I - p.9.).

In evaluating the TLRS, the child is asked to assume a supine flexion posture and to maintain it for a certain period of time (this will also be discussed in more detail in the section on evaluation in Chapter III: p.88).

Kraus and Hirshland (1954) described the standardisation and use of the Kraus-Weber Test. Karger (1958) studied these test items extensively and found a high correlation between tasks four and five of the test and achievement at school among elementary school children. Roach and Kephart (1966) included the Kraus-Weber Test items in the Perceptual Motor Survey. Tasks four and five in the Kraus-Weber Test of physical fitness consist of performing an extended movement pattern from the prone position. In test four the child is asked to raise straight legs twenty five centimeters off the floor and hold the position for ten seconds while the examiner holds the child's chest down. After this the examiner holds the feet while the child is required to clasp hands behind the head, to lift the head, shoulders and chest off the floor and hold it for ten seconds.

In item two of the Kraus-Weber test, the child is asked

sit up from the supine position without the help of his hands, and then while lying on his back with hands behind the head, is asked to lift straight legs about twenty five centimeters from the floor, maintaining this position for ten seconds is what item three consists of. It was thus necessary to review these tests as well, in order to evaluate the presence of the TLR.

Norton (1972b) suggested an assessment chart based on the quality of movement and posture beyond the three-year chronological age and modified it from the one designed by the Bobath's neurodevelopmental technique. In supine the child is asked to pull knees close to the chest, bend elbows and cross arms, while hands are put on shoulders and then raise the elbows. In prone the child is asked to straighten arms beside the head, raise it and turn palms of hands to the ceiling while straightening the fingers.

The DeGangi-Berk Test of Sensory Integration (1983) describes a monkey-task to assess the ability to maintain an antigravity posture in flexion. The child is instructed to lie on his or her back on a mat. The child is asked to hold onto a dowel held lengthwise along the midline by grasping the dowel and crossing legs at the knees over the dowel. The examiner then lifts the child up in the air, grasping the endpoints of the dowel. The child is asked to keep his or her

nose close to the pole while the action is timed. The other task involves an aeroplane action and assesses the ability to assume and maintain an antigravity posture of extension. In this instance, the child's legs are straddled on each side of the examiner's body.

The child is grasped on each side of the thorax so that the trunk is in an arched position and is asked to spread the arms and abducted as if flying. Maintenance of this posture is timed.

2.4.1.3. Integration of the TLR in the course of motor development.

The TLR is usually present in an infant from two to six months of age. It is however modified with the development of the labyrinthine righting reaction (LRR) which gradually enables the child to raise the head to a normal position in relation to gravity, with the face vertical and the mouth horizontal. This applies to both supine and prone positions and is also applicable in the sidelying position.

In the prone position, extension patterns develop in a cephalo-caudal fashion throughout the body. At one month the baby is just able to lift the chin off the supporting surface and at two months the head can be lifted to forty five degrees. Extension spreads to thorax and shoulders with the ability to bear weight on the elbows and forearms at three months; spreads to

lumbar spine and hips at four months of age and to knees at five months of age. At six months the child has a strong Landau Reaction.

"The prone extension posture is possibly related to the Landau reaction in which the five or six-month-old child holds his body, especially the trunk and legs, in extension when supported at the abdomen by the examiner" (Ayres 1972a:18).

Ayres (1972a) proposes that assuming the prone extension posture probably helps the sensori-motor system to inhibit or integrate the TLR.

Complete hip extension is only achieved at two years of age. This is unique to man and enables him to obtain the erect posture.

The LRR develops at a later stage in the supine position. The child starts to lift the head at five months. In sitting, head control and arm support is good at six months and perfect at eight months.

"The infant's 'startle reaction' disappears at the same time as the Landau Reaction and protective extension of the arms appear, which is at about six months of age" (Ayres 1972a:8).

With good head control, the child can now start to change his position by rotating around the body axis and equilibrium reactions start to develop.

During this process of development, the infant integrates the TLR and gains control over the prone flexion and supine extension responses (Fiorentino

1981).

2.4.1.4. Functional Significance of the TLR in Normal Development.

Fiorentino (1981) discussed the contribution of the TLR in normal development as follows: The TLR develops extensor tone throughout the body to create a balance between flexors and extensors. The development of extensor tone enhances the ability to reach, bring the limbs to the midline of the body and eventually allows for crossing of the midline of the body by moving or reaching further than the midline. The ability to reach frees the limbs away from the body and allows exploration of spatial orientation and direction. Once crossing of the midline of the body is possible, rotation is initiated within the body axis, thus allowing rolling over.

On the other hand, the TLRP (Fiorentino 1981) stimulates flexor tone of the total body, acting as a counterbalance to the development of extensor tone in the supine position. If the balance between the development of extensor tone and flexor tone is maintained, it will give stability in the prone position which is necessary if the child is to proceed to the next stages in motor development and the eventual erect posture.

Development of the LRR in the prone position allows for dorsiflexion of the head and spread of extensor tone until the Landau reaction is developed.

It is important to note that extension of the head will elicit the symmetrical tonic neck reflex which then enables the child to get enough extensor tone in the upper trunk and eventual extension of the upper limbs while sitting on the heels. From this position the child moves into a four point quadruped position which is the starting position for crawling and in part inhibits the TLR.

In the same context of functional significance of the TLR, Kephart (1960) pointed out that to sit up is the first of these gross motor abilities to develop. The child has to learn to make certain postural adjustments and to manipulate tensions in various muscle groups in order to maintain a sitting posture. This is a function of the posturing mechanism. He further points out that the child must be able to hold his head erect.

Another researcher Bender (1976) pointed out that the TLR also contributes to a child's orientation in space by saying that:

"This early orientation to the direction 'with gravity/against gravity' lays the foundation for the child's later perception of the vertical dimension of space. At the same time, from associated sensations of touch and pressure, the infant gains his

earliest sensory experiences relating to 'belly side' and 'back side'. These will later project as a second dimension of space - 'infront of / in back of' (Bender 1976:18).

Kraus (1927) pointed out that the effect of the TLR is utilized in adult activities such as in diving, in swimming and in gymnastics. The effects of the TLR is the ability to utilize extensor and flexor patterns and to control the body in patterns where these are balancing each other. It is thus not completely reflexive any more but has a strong voluntary component.

2.4.1.5. Adverse Effects of the TLR if not Adequately Integrated.

Persistence of the TLR will prevent development of normal motor ability as enumerated by Fiorentino (1981) and others. Bobath (1956) identified certain effects of unintegrated TLR in children with severe neurological dysfunction. An inability to lift the head against the force of gravity, therefore prevents head control. These children are usually stuck in the supine or prone positions and do not acquire sitting or quadruped positions. Because the upper limb cannot reach away from the body, contractures of flexion and adduction will develop. The spine and lower limbs go into spastic extension and adduction. Spasticity in pectoral and abdominal muscles will cause a dorsal kyphosis. Rotation around the body axis is prevented

and the child will not be able to change from one posture to another or even take weight on upper limbs or sit up.

Very little reference to the possible adverse effect that an unintegrated TLR could have on the child with learning problems could be found in the literature. DeGangi and Berk (1983) pointed out that the persistence of TLR and its influence affects postural stability and movements against gravity. Norton (1972b) recorded that children having difficulty in assuming the flexed posture in supine with clawing of the fingers and difficulty in raising the elbows seem to have trouble with writing. In addition she also recorded that cursive writing is affected by the effect of the TLR in prone. That is if the child cannot straighten arms beside head, raise it, turn palms of hands upwards and straighten fingers. The candidate therefore decided to investigate any relationship between unintegrated TLR and habitual postural patterns. Researchers like Delacato (1963 and 1966), Rider (1972b) and Ayres (1972a) mainly refer to the development of adequate motor ability to be able to learn cognitively.

2.4.2. The Asymmetrical Tonic Neck Reflex (ATNR).

2.4.2.1. Description of the ATNR.

The ATNR has been described by Magnus and De Kleijn (1912), as observed in decorticate animals and they classified it as a statotonic reflex. Gesell^{and Ilg} (1949) observed a fencing posture with an extended arm on the face side when the head is turned and a crooking of the other arm. The legs often assume a similar postural pattern but this is usually less obvious. This postural attitude is most marked during one to three months of age in all babies during normal development.

Many researchers have observed, tested and described the AINR in: normal infants (Gesell^{and Ilg} 1949, Fiorentino 1963, Paine et al 1964 and Paine and Oppe 1966, Millani-Comparelli and Gidoni 1967, Gordon 1976, Capute et al 1978,); normal children (Ayres 1972a, George 1972, Johnston 1973, Car at al 1974); normal adults (Ikai 1950, Tokizane et al 1951, Hellebrandt et al 1962, Ayres 1972a); infants and children with severe neurological dysfunction (Fiorentino 1963, Bobath (1965), Paine et al 1964 and Paine and Oppe 1966); children with learning and emotional problems (Silver 1952, Rider 1972a, Ayres 1972a, Bender 1976, and adults with brain lesions (Bobath 1970, Brunstrom 1970).

In summary, the ATNR is described as a tonic reflex at

the brainstem level, elicited by lateral rotation of the head with subsequent extension of the face side limbs and flexion of the skull side limbs. Sometimes only a change in the tone of the appropriate muscles can be detected. In normal adults the effect of the ATNR can be detected by changes in muscle tone of the appropriate muscle groups (Tokizane^{et al}, 1951).

Ayres (1972a) pointed out that there was some evidence that just looking to the side could elicit an ATNR. This is supported by Parmenter (1975) who said:

"Postural reaction and extraocular muscle control are closely related on a reflex level, each affecting the other" (Parmenter 1975:465).

Magnus (1926) observed the reflex in decerebrate animals without labyrinths and thus theorised that the ATNR originated from receptors in the joints and ligaments of the first three cervical vertebrae. McCouch et al (1951) confirmed this theory.

2.4.2.2. Testing the ATNR.

The ATNR is usually tested with the person in the supine position with head in midposition, arms and legs extended. Testing procedures are described by Bobath (1945) and Fiorentino (1963).

The head is turned to one side. A positive reaction elicits extension of the arm and leg on the face side

or an increase in extensor tone while flexion is elicited in the arm and leg on the skull side, or increase in flexor tone.

Tokizane et al (1951) seated the subject in a chair and rotated the head of the subject to one side and then the other. Electromyographic studies indicated more electrical activity in those muscle groups which are involved in the ATNR.

The Institute for Neuro-Psychological Psychiatry (Blythe and McGrown, no date given) distinguishes between a retained and a residual ATNR in adult patients. Retained ATNR implies a visible flexion or extension of limbs, whereas in a residual ATNR the examiner would only detect changes in muscle tone appropriate to the effect of the ATNR. They evaluated the ATNR in patients with neurotic conditions and also assessed whether the effect of the ATNR was present in both sides of the body, limited to one side of the body or either in one arm or leg.

Futhermore the presence or absence of the Transformed (Adults) Tonic Neck Reflex (TTNR) is examined by Blythe and McGrown (no date given). This is done by placing the patient in a prone position with the face pointing towards the dominant hand and arm which is flexed while the skull limbs are extended. The patient is asked if he is comfortable and instructed to make slight

movements to ensure comfort. The patient's head is then rotated to the other side while the body is kept in exactly the same postural attitude. If discomfort is experienced and the patient changes the postural attitude to the exact, but reverse position, then the TNR is fully present (Blythe and McGrown, no date given).

Delacato (1963) pointed out that in children who have considerable mobility, it is difficult to evaluate the existence of the tonic neck reflex as neurological organization has superseded the function at the lower level (brainstem). He suggests that the child be asked to crawl on the floor with the stomach in constant contact with the floor. Once again he says it is difficult to elicit pure response as the effect of function at higher levels tend to interfere with it.

Finally, he suggests that the most reliable and valid ascertainment of the presence of neurological organization at the level of the pons (brainstem) is when the child is asleep. The parent is therefore asked to observe the child while asleep. If the child is well organised at the level of the pons, he will sleep in a homolateral position on his stomach i.e. for a right hand child the left arm and leg will be flexed to the side the face is turned with the thumb pointing to the face. The opposite arm and leg will be extended. The position is reversed for a left handed child.

If the child does not sleep in one of these positions, the parent has to turn the child's head to the opposite direction from which the child is facing while asleep.

If the child is well organised at this level of neurological development, one of the following should take place: (1) The body configuration should reverse itself as the head is turned while the child remains asleep. (2) The child should resist the turning of the head and return to its original sleeping position while remaining asleep. (3) The child will wake up.

Norton (1972b) assesses the effect of the ATNR in prone by checking freedom of head movement and the influence of head position on tone of extremities, when the child is asked to bring arms straight beside body with palms on floor. She also checks for extension of the arm when the head turns towards that arm in kneeling and crawling positions.

Ayres (1972a) feels that the ATNR should be tested in a variety of ways and describes placing the child in a quadruped position (with instructions to keep the arms straight). The head is then laterally rotated. The examiner observes whether there is any indication of elbow flexion on the skull side of the head. She also describes the reversed ATNR posture, which requires the child to assume a reflex inhibiting posture. The child is asked to place the one hand in the side on the hip, to extend the contralateral leg and then to rotate the head to the side of the flexed arm. It is

observed whether the child can assume this posture and maintain this position with adequate balance.

The effect of the ATNR in the standing position, with the feet together, arms stretched forward, fingers spread open, eyes closed and head rotated from side to side has also been described and used by Ayres (1972a).

She termed this test "Schilder's arm extension test". The same test has also been used by Towne (1979) Walker and Boney (1981) and Dunn (1981).

Other researchers have also used the quadruped position and described it together with various criteria for eliciting the reflex and observing the effect in different degrees or intensities using a variety of parameters (Rider 1972a and b, Finocchiaro 1974, Parmenter 1975, Montgomery and Richter 1980, Walker and Boney 1981, Dunn 1981).

Zemke and Zemke (1982) developed electrogoniometers for research in studying the ATNR. According to them the stimulus of the ATNR has not been accurately measured in the traditional way of testing the ATNR. They propose that both the elbow flexion (response) and degrees of head rotation (stimulus) be measured while testing for the ATNR in the quadruped position.

Zemke (1980) used a rating scale to evaluate forty normal three and five year old children. This rating scale was described by Parmenter (1983) and consisted of a four point rating scale. The rating scale is as follows:

- 1 = Obvious loss of balance, elbow flexion more than sixty degrees, forearms may touch surface, contralateral leg may leave surface, collapsing of body.
- 2 = elbow flexion more than sixty degrees. depression of shoulders and trunk movement, no balance loss.
- 3 = Elbow flexes thirty one to sixty degrees, little shoulder depression.
- 4 = Elbow flexion more than thirty degrees or no elbow flexion, slight visible muscle tone changes or no visible muscle changes.

General criteria that have been described to test the ATNR are as follows:

- The child should be placed in a quadruped position, head in midline, face parallel to floor, knees and hips flexed to ninety degrees. The child should not lock the elbows in extension.
- The child's head should be rotated only ninety degrees to the side with chin on shoulder.
- Elbow flexion in the arm on the skull side of the head in children between three and nine years of age

over forty nine degrees "or an obligatory one over 25 degrees may be regarded as suggestive of some abnormality" (Carr et al 1974:333).

It is generally accepted that the examiner should not only be aware of movement and change in postural attitude or pattern, but that tone changes in the limbs should also be assessed (Fiorentino 1963, Bobath 1965, Capute et al 1978).

Sieg and Shuster (1979) compared the methods of three positions to evaluating the ATNR for effectiveness and reliability. The three test positions included quadruped with passive head rotation; standing with eyes closed, arms outstretched and passive head rotation; quadruped reflex inhibiting posture (RIP) with active head rotation, including pre positioning of face side arm on hip and skull side leg stretched and lifted backwards off the floor.

Statistical analysis of the scores indicated that the therapist could use any of these three test positions, although some clinical judgement would still be necessary in each instance.

2.4.2.3. Integration of the ATNR in the Course of Motor Development

Gordon (1976) states that it is accepted that the ATNR is easily observed in normal babies between the age of

one and three months of age. The normal baby is not dominated by the ATNR and will move in and out of the position with ease.

"The reflex is believed to be integrated as the central nervous system matures" (Zemke 1980:32).

which is usually when the neck righting reflex (NRR) is utilised. The NRR is present at birth. This is a midbrain reflex for turning from supine to sidelying to prone. The body righting reaction on the body (BRR) develops at about six months of age and utilizes the rotary components of movement around the body axis and prepares the child for assuming the sitting and quadruped positions. This rotation around the body axis to get to the upright posture is used until four and a half to five years of age, after which time adequate equilibrium reactions will allow the child to get up to sitting in a symmetrical manner (Gesell, ^{and his} 1949 and Fiorentino 1981).

"However research suggests that the ATNR continues to influence movement in children and normal adults under certain conditions including relaxation and exercise (Zemke 1980:32).

2.4.2.4. Functional Significance of the ATNR in Normal Development

Delacato (1963) pointed out that the first use of the tonic neck reflex takes place intra-uterinely, and in fact, that an intact tonic neck reflex pattern is a prerequisite for non-traumatic and normal birth. Even

obstetrical procedures utilise the use of the tonic neck reflex via the rotation of the baby's head during the birth process.

He further elaborates on the functional use of the tonic neck reflex by the infant for propulsion while the body is dragged along. This he terms crawling. This crawling motion is with the body in contact with the floor while the propulsion movements are made in a homolateral fashion typical of that of the amphibian movements with the arm and leg on the same side flexed while those on the opposite side are extended. This early crawling is the first mobility function where mobility from one point to another is brought about.

^{2nd Ilg}
Gesell_A (1949) wrote that the ATNR at four weeks of age is

"a natural form of asymmetry which serves to bring the eyes and hand in co-ordination..."
(Gesell, 1949:94 and 46).
^{2nd Ilg}

The ATNR is activated from time to time as a developmental exercise. It also prepares for the ability to reach for an object and look at a target. Rider (1972b) recorded that Gesell observed an interesting relationship between the ATNR and hand dominance in foetal and post foetal subjects. He found that in fourteen out of nineteen subjects, the dominant face direction was predictive of later handedness.

and Hy
Gesell (1949) also said that in later years for example the eight year old at school would raise his hand to communicate with the teacher in a modified and agitated ATNR attitude. In fact he wrote that in general the activity of the ATNR resembles the stances assumed in fencing, boxing, creeping, walking, throwing, golfing and playing the violin.

"In all these motor skills the action system must strike asymmetric as well as symmetric attitudes in order to maintain poise and to make progressive movements" (Gesell and Hy 1949:226).

Fiorentino (1981) elaborates on the contribution of the ATNR in the development of motor ability. It breaks up the symmetrical extension and flexion patterns of movement which is elicited by the TLR as well as helping in the development of alternating movement patterns. It enables unilateral use of the body halves, prepares the child for the development of integrating the effect of neck rotation, visual fixation and reaching, thus being fundamental to the establishment of visually directed reaching and eye-hand co-ordination. It initiates flexion of the skull limb which will eventually flex over the body to the midline and cross the midline of the body. In co-ordination with the LRR, it will initiate rotation around the body axis.

In addition, Bender (1976) explained how the ATNR evokes a lateralized response of the infant's body by the proprioceptive experience of increased extensor

tone in the face side limbs while the skull side limbs experience increased flexor tone.

"This is the infant's earliest experience with simultaneous reception of different proprioceptive information from the two sides of his body. From discrimination of the differences in this information, the infant develops his earliest awareness of himself as bilateral, with the two sides of his body capable of different but simultaneous movement" (Bender 1976:18).

2.4.2.5. Adverse effects of the ATNR if not Adequately Integrated

Bobath (1965) studied the adverse effects of the ATNR in children with severe neurological dysfunction and concluded that the ATNR causes a greater degree of asymmetry towards the more severely affected side. It thus prevents bringing the hand and or arm to the midline of the body and getting the hand to the mouth for eating, grasping an object while looking at it, limiting visual field and following an object past the midline of the body. Such children cannot acquire eye-hand co-ordination or develop adequate dominance. They cannot support themselves in crawling, sitting, walking or using both hands together for grasp and support (Parmenter 1975).

Capute et al (1978) reported that Pacella and Barrera (1940) documented that the ATNR influences the grasp reflex with a reinforcement on the skull side and a weakening on the face side.

It would thus seem that if the ATNR is not adequately integrated, it in fact results in a rigid posture with very little flexibility which hampers the easy adjustment of postural background movements. This fact has also been of concern to Kephart (1960) who places a lot of emphasis on postural flexibility during walking on a balance beam. Ayres (1972a) places emphasis on resistance or discomfort to passive movements during Schilder's arm extension test which

"differentiates among lack of flexibility, strength and inadequate reflex integration" (Montgomery and Richter 1980:3).

Norton (1972b) suggested that the influence of tone in extremities due to the ATNR in prone affect the ability in fine skill and possibly figure-ground perception.

DeGangi and Berk (1983) recorded that if the ATNR is not adequately integrated, the child frequently has difficulties with midline activities and tasks requiring rotation of the neck and trunk muscles.

2.4.3. Symmetrical Tonic Neck Reflex (STNR)

2.4.3.1. Description of the STNR

The STNR is described as a reflex flexion of the arms and extension of the legs when the neck is flexed (ventroflexion) and extension of the arms and flexion of the legs when the neck is extended (dorsiflexion). It thus means that the muscle tone increases in those

muscle groups which are responsible for the said movement patterns (Bobath 1965 and Fiorentino 1963).

Gordon (1976) pointed out that

"It is most easily elicited between the ages of six to eight months, and its absence at this time, or exaggeration and persistence to an older age, are signs of developmental disorder" (Gordon 1976:4).

According to Bender (1976), the name implies that the STNR produces symmetrical changes in the distribution of muscle tone in reflex response to the symmetrical change of the head with relation to the trunk.

It is believed that the stimulation to the proprioceptors in the neck muscles causes this particular distribution of tone. However, Bender (1976) also points out that passive positioning of the lower limbs (for example bending the knees under a child's belly and keeping firm pressure on the buttocks) will elicit a head-extension response and pushing up on straight arms for support. Likewise, as a child pulls himself to a standing position by using his arms, flexion of the elbows result and the head pulls forward and down while the hips and knees strongly extend to push him up into an erect position.

2.4.3.2. Testing the STNR

The position most commonly described for eliciting the STNR is that of the quadruped position or prone over

the tester's knees.

Fiorentino (1963) illustrates the testing method with a child over the tester's knees. If the head is ventroflexed, a positive reaction will elicit predominantly flexor tone in the upper limbs and extensor tone in the lower limbs. If the reaction is negative, then there is no change in tone of arms or legs. If the head is dorsiflexed, a positive reaction will elicit dominant extensor tone in the upper limbs and dominant flexor tone in the lower limbs. If the reaction is negative, then there is no change in tone of arms or legs.

Ayres (1972a), Montgomery and Richter (1980), Walker and Boney (1980), Dunn (1981) place the child in the quadruped position while the head is dorsiflexed and ventroflexed. The tester observes any joint flexion, especially in the elbows, which might occur.

DeGangi and Berk (1983) also observed the effect in the hips and mid-trunk upon extension of the head.

The Institute for Neuro-Psychological Psychology (Blythe and McGrown, no date given) examines the reflex in two ways, apart from the fact that they distinguish between a retained STNR and a residual STNR (Retained implying visible postural changes whereas residual would only cause changes in muscle tone). In the "all-four" position more emphasis is placed on the

buttocks being pulled towards the heels or visa versa by the change in tone within the hamstrings (either increased or decreased depending on the effect of the STNR). They also suggest sitting upon the examiner's knees if the patient is younger than ten years of age.

The neck is flexed or extended. A retained STNR will show visibly the appropriate movement patterns while a residual STNR will show changes in muscle tone.

Bender (1976) devised the Bender-Purdue Reflex Test which is wholly dependent on signs of STNR immaturity.

She uses a set of six criteria to describe the postures and behaviour characteristics of reflex performance and levels of STNR influence on creeping tasks. These criteria include descriptions and illustrations of:

- A. The child's overall creeping posture during performance of the task.
- B. Position of the head.
- C. Position and use of the arms and hands.
- D. Position and use of the hips and knees as related to each other and to the trunk.
- E. Degree of tension in ankles and feet; their position in relation to the floor.
- F. Creeping patterns and rhythm.

She established subclinical levels for each of the above sections of postural attitudes and designated

them as Zero, Mild, Moderate, Marked and Strong.

"For the purpose of scoring this scale was expanded to include numerical values of 0 through 8" (Bender 1976:29).

The reflex itself is not specifically elicited, but the effect of the STNR on resisted forward- and backward creeping is observed.

Norton (1972b) observed the effect of the STNR in prone when the child was asked to support weight on extended arms, while the child was asked to bend and raise the head. In kneeling and crawling the effect was observed when the child was asked to rock forwards and backwards as well as bending and raising the head. In the latter position the examiner observed lordosis, flexion of elbows and thrust of legs with flexion of the head. Alternatively the examiner observed extension of the elbows and raising of knees off supporting surface with inversion of feet when the neck extended.

2.4.3.3. Integration of the STNR in the Course of Motor Development

The process of integrating or inhibiting the STNR is initiated by transferring weight forwards and backwards. As the child gradually increases his voluntary control, he achieves a smooth reciprocal creeping gait (Bender 1976).

In order to creep, the child has to move his arms and legs rhythmically and alternatively, with head well up to see where he is going. The limbs must function independently from the position of the head and Bender (1976) pointed out that to become an efficient creeper, the child suppresses the tonic neck reflex. However, he only overcomes the reflex completely once he has become an efficient and flexible walker.

Montgomery and Richter (1980) supported the theory of how the STNR is integrated and recorded:

"The normal child begins to crawl on his stomach around six to seven months of age. Although other patterns of movements (such as 'homologous') are sometimes observed, the child usually crawls in a reciprocal pattern. The left arm and right leg move together, followed by simultaneous movement of the right arm and left leg. Head righting in a prone position would be present and the child's face should be perpendicular to the floor" (Montgomery and Richter 1980:72).

To summarise the integration of the STNR in the course of motor development, it appears that the ability to maintain a quadruped position against the force of gravity and utilising equilibrium reactions while rocking backwards and forwards are the most important components. Crawling becomes possible before walking.

2.4.3.4. Functional Significance of the STNR in Normal Development

Fiorentino (1981) wrote that the STNR and labyrinth system interact with each other, in order to prevent

disequilibrium and to detect any movement as well as the orientation of the head in space.

As the TLR is integrated, the STNR starts to develop. It is initiated by the effects of the labyrinthine and optical righting reactions in neck extension which again causes the spread of extensor tone down the spine. True to the STNR, the flexor tone in lower limbs and extensor tone in the upper limbs will increase with dorsiflexion of the head. During this process of utilizing the STNR, the child will first be able to get into a prone position on elbows, which will develop the ability to extend the elbows until the four point quadruped position can be achieved. From this position reciprocal creeping will progress.

Ridler (1972a) also pointed out that the STNR permits bilateral activity and the ability to bring the hand to the mouth.

Gordon (1976) supports Fiorentino and wrote:

"The reflex is thought to aid normal children to get onto hands and knees with the head up before they crawl and use their limbs independently" (Gordon 1976:4).

Bender (1976) elaborated on the functional use of the STNR by pointing out that it does not only help the child to get into the quadruped position in preparation for creeping, but also acts when the child pulls himself to standing from which walking will emerge.

She stresses the importance of suppression of the STNR when the child begins to creep, especially when moving the legs and arms alternately and rhythmically while the head is well up to enable him to see where he is going. By looking around he explores the world around him.

This again provides invaluable experience to the child in exploring space and organising information into basic temporal concepts such as rhythm, synchrony and duration.

"The co-ordinated movements of creeping promote better differentiation of movement. This ability to move one part of the body independently but in synchrony with other body parts is essential to flexible and efficient use of the body for exploration, for learning" (Bender 1976:22).

2.4.3.5. Adverse Effects of the STNR if not Adequately Integrated.

In severe neurological impairment, such as in cerebral palsy, the presence of the STNR will prevent the acquisition of equilibrium and balance reactions in the quadruped or standing positions. Subsequently the child will try to utilize the STNR by sitting between the outwardly flexed legs like a 'frog', or sitting on the sacrum with adducted and extended legs while the head is flexed forward and the upper limbs flexed.

In milder cases, such as children with learning problems, the effects are much more subtle and they can

influence their development and ability to learn effectively.

According to Bender (1976), the creeping stage is an important one as it promotes the adequate suppression of the STNR. If this does not occur, the reflex remains active and its response modifies a child's voluntary movements, which in turn will interfere with optimal development in motor and intellectual ability. The posture and balance will be inflexible and rigid, the locomotor patterns will be clumsy and somewhat limited. Proprioceptive feedback will be distorted, which in turn will interfere with the normal process of sensory-motor integration. Co-ordinated movement will be difficult without continuous proprioceptive input with subsequent difficulty to develop automatic patterns and to make satisfactory perceptual-motor match.

DeGangi and Berk (1983) pointed out that when the STNR is poorly integrated, postural control is usually poor.

The example given is that the trunk may sag when in the quadruped position which may affect reciprocal bilateral movements of the extremities.

2.4.4. Associated Reactions (AR)

2.4.4.1. Description of AR

Conolly and Stratton (1968) said

"Associated, or synkinetic movements are movements accompanying a motor or intended motor function but not necessary for its performance. Indeed, from the point of view of effective adaptation they are often superfluous. They are usually contralateral and symmetrical to that limb or part of the body which is voluntarily active" (Conolly and Stratton 1968:49).

Vuckovich (1968) pointed out that associated reactions show instability in multiple postural actions. He describes a spooning of one or both hands with increased associated movements.

Walsche (1923), in a study undertaken in 1912 - 1914 of the so-called "associated movements" of hemiplegia, reached the conclusion that these reactions should be regarded as postural reactions as they are variations in muscle tone and attitude and not movements in the strict physiological sense.

Associated reactions usually mirror the movement on the opposite limb of the one which executes a forceful movement. These mirrored movements are accompanied by an increase in muscle tone in total synergic involuntary movement patterns. Identical associated movements are described as a homologous reaction and simultaneous extension as a heterologous reaction (Fog

and Fog 1963).

The stimuli to elicit AR could also include clenching teeth, yawning, sneezing, coughing etc. Apart from forceful movements, AR could also be elicited by purposeful voluntary movements such as writing, rapid alternative movements (e.g. pro- and supination of the forearm) and thumb-finger touching. The effort in overcoming a positive supporting reaction in a hemiplegic patient while walking will cause AR in the arm and hand on the same side (Bobath 1970).

2.4.4.2. Testing of AR

Fiorentino (1963) places the patient in a supine position and asks the patient to squeeze an object. AR are observed as mirroring in the opposite limbs and or an increase of tone in other parts of the body.

Fog and Fog (1963) described the following tests for eliciting AR's:

1. Feet-hand test:

The child is asked to invert his feet. In most cases AR will present in flexion and supination of the forearms, but in some cases as pronation or extension.

2. Hand-hand test:

The child is asked to exert a certain degree of

pressure between the thumb and first finger. AH presents as a similar movement in the opposite hand. Sometimes a reverse reaction will be observed with the fingers being extended.

Different degrees of pressure can be tested such as in using a spring clothes peg and a bulldog paper clip.

Conolly and Stratton (1968) also listed the feet-hand and clip pinching test to ascertain associated movements. In addition they listed the finger spreading test (Ashton 1973 personally communicated with Conolly to ascertain that the diagram illustrating the scoring procedure was incorrect in their paper "the figure legends should be reversed") and the finger lifting test.

Towen (1979) describes specific tests for co-ordination, associated movements and walking. Those tests which will elicit associated movements are:

1. Mouth-opening and finger-spreading phenomenon:

"A spreading and extension of the fingers and thumb is observed, sometimes accompanied by an extension of the joints of the wrist" (Towen 1979:56).

This reaction is elicited when the child is asked to open his mouth as wide as possible, to close his eyes tightly and to stick out the tongue as far as possible while the examiner holds the child's wrists between thumb and index finger.

2. Diadochokinesis and associated movements:

Mirror movements of the non-active arm on request to perform quick alternating pronating and supinating movements of the other arm.

3. Finger opposition test:

Touching the tips of the fingers sequentially with the thumb e.g. 2,3,4,5,4,3,2,3,4,5,etc. Mirror or associated movements are observed in the other hand.

4. Walking on tiptoe:

The child is asked to walk for approximately twenty paces on tiptoe. Any body, arm or head movements which are not present during ordinary walking must be recorded as AR (Towen 1979). Associated movements can be seen in extended arm and hands, lip and tongue movements or even clenched fists with extended arms.

5. Walking on heels:

The child is asked to walk on his heels for approximately twenty paces forwards and back. Any body, arm or head movements observed during walking, which are out of the ordinary, must be recorded as AR. Associated movements are seen in flexion of the elbow, hyperextension of wrists, flexion or extension of fingers, abduction of

shoulder joint and lip and/or tongue movements.

The latter two tests differ from the feet-hand test described by Fog and Fog (1963), in that the child is asked to walk on the toes and then on the heels instead of inverting the feet and walking on the lateral part of the soles.

2.4.4.3. Integration of AR in the Course of Motor Development

In the course of normal development of neurological repertoire, postural reactions are more generalised and more reflexive in motor output at the initial stages of development. As development progresses, changes occur in the motor output. Some neurological phenomena will merely change with age (e.g. diadochokinesis), while others disappear altogether (e.g. many associated movements).

Associated movements are more prominent in the presence of other tonic reflex activity and emphasises abnormal patterns of movement in total synergies. As muscle tone becomes more adaptive with the development of equilibrium reactions and the child starts to conquer gravity, associative movements will diminish.

The phenomena of associated reactions is recognised by many researchers and Gordon (1976) wrote that

associated movements tend to be suppressed as the child grows older. Few fourteen to sixteen year old children will still show slight associated movements.

In fact asymmetry of the movements is a more helpful finding in their persistence, which usually indicates immaturity of postural control in older children" (Gordon 1976:19)

It is however recognised that associated movements are inhibited or integrated when movement patterns are practised and these movement patterns become automatic as in activities executed in daily life. Inhibition of associated reactions is also necessary for the acquisition of detailed discriminative motor activity (Conolly and Stratton 1968).

"In the mature and uninjured brain, no associated movements occur when daily life activities or well-trained motor performances are executed." (Bax and McKeith 1963:52)

Paine and Oppe (1966) wrote that it should be recognised that associated movements may persist into adult life, especially when unfamiliar movement patterns are learned or practised.

Conolly and Stratton supported this fact and said:

"the normal and mature adult can present associated movements when attempting a new and intriguing performance" (Conolly and Stratton 1968:56)

Taking all the above facts into consideration, it is thus normal that some movements will be mirrored in pre-school children and in some instances in school-going children especially, when a task or

movement requires effort or when new movement patterns are executed.

2.4.4.4. Functional Significance of AR in Normal Development.

No confirmation can be obtained in the literature on the functional significance of AR, but it can be assumed that neurological overflow from the effort on the performing body part which causes AR, to the opposite side for example, will again, by the same neurological means, reinforce the act on the performing side. AR will aid in the accomplishment of a task requiring effort.

Generally O'Connell and Gardiner (1972) pointed out that a motor skill is a group of simple, natural movements combined in an unusual or new manner. To execute a skill, precise integrative function is needed. This integrative function depends on automatic mechanisms of which proprioceptive reflexes at different levels of the CNS is part. It should however be remembered that these reflexes require interregulation from supraspinal and cortical levels in the CNS.

2.4.4.5. Adverse Effects of AR if not Adequately Integrated

Prominent AR in the severely damaged CNS will cause the development of deformities in synergic postural patterns especially common in hemiplegic and diplegic clinical types.

Montgomery and Richter (1980) noted that

"Associated reactions may be excessive in both gross and fine motor activities. Inco-ordination is evident when the child is unable to isolate movements such as single leg raising (supine) or to perform upper-extremity movements such as alternately patting the floor with one hand and then the other" (Montgomery and Richter 1980:5).

Conolly and Stratton (1968) noted that part of a sample of children studied by them, who had been separated into different classes on their learning capacity, appeared to have some relationship between being in the upper stream, and success on the battery of test on associated reactions.

2.4.5. Positive Supporting Reflex (PSR)

2.4.5.1. Description of the PSR

The PSR is described as being normal up to four months of age. If the child is held in the standing position, the exteroceptive stimulation on the ball of the foot as well as the proprioceptive stimulation on

the stretched intrinsic muscles of the foot will cause simultaneous contraction of flexors and extensors of the lower limb. The leg thus becomes a stiff pillar in an effort to support the body in an upright posture (Bobath 1965:34).

Gordon (1976) said

"A true positive supporting reaction appears at about 6 months of age, but often earlier among children with cerebral diplegia. However, in the first four weeks of life, suspending a baby upright with the feet against a flat surface will produce stiffening of the legs but the knees do not extend" (Gordon 1976:15).

2.4.5.2. Testing of the PSR

The PSR is tested in the standing position and the response elicited when the child is bounced on the soles of the feet (Fiorentino 1963:20). When the reflex is present, it will cause an increase of extensor tone in the legs and with plantar flexion of the feet, genu recurvatum may occur. If the reflex is not present, there will be no increase of tone and the legs will flex volitionally if the child is held in space..

Vuckovich (1968) pointed out that one should note whether the whole foot is placed on the floor when walking, or whether walking is on the toes. Walking on the toes indicates minimal brain damage or immaturity of the CNS.

Norton (1972b) assessed the control or effect of

hypertonicity in the squatting position with heels on floor while weight was shifted sideways. In addition she also assessed the distribution of tone in standing and components of walking. She specifically checked for inability to put heels on the floor, constant clawing of toes, tendency to topple backwards or sideways in squatting, inability to extend hips adequately, excessive lordosis, genu recurvatum, unequal weight distribution, internal rotation, inverted feet and balance problems in standing and components of walking.

Montgomery and Richter (1980) also observed gait and suggested that the child walk back and forth at varying speeds on a ten foot long path. Heel-toe pattern and tip-toe gaits are checked for any primitive patterns. Balance will also be affected if there are any traces of a PSR.

2.4.5.3. Integration of the PSR in the Course of Motor Development

Neuro-developmentally, the phasic type of reflexes functioning on a spinal level precedes other primitive postural reflexes (Worth and Chavasse 1959).

The flexor withdrawal, extensor thrust and crossed extensor reflexes phase out by two months of age when the stepping response occurs, if the child is suspended

in an upright position. The flexor withdrawal reflex is a protective reaction and helps to develop balance between flexor and extensor tone. (Fiorentino 1981) The crossed extension reflex comprises the withdrawal of one leg which causes the extension and adduction of the other leg. This reflex helps to develop alternating extensor tone in the lower limbs, breaks up symmetrical flexion and extension movements (seen in STNR) and is a precursor to amphibian movements. Amphibian movements prepare the child for crawling, creeping and walking patterns and combines with the extensor thrust reflex and the PSR in early stages to supply sufficient extensor tone to stand on one leg while the other limb flexes (Fiorentino 1981).

The Magnet response (Primary Standing) precedes the PSR. It contributes to the initial development of extensor tone of the muscles supporting the knee and hip joints, bilaterally or unilaterally. It also helps in the development of the foot musculature such as the invertors, evertors, dorsiflexors and plantar flexors (Fiorentino 1981).

Primary stepping (Spinal level) again indicates the potential for automatic reciprocal walking. It helps in the development of balance in flexor and extensor tone for future standing and walking including dorsiflexion of the feet and extension of the toes (Fiorentino 1981).

The PSR thus does exactly what its name implies, namely supporting the body on an extended lower limb in the upright position. Arrest at this stage of development will cause a stiff unfunctional pillar of support. Worth and Chavasse (1959) wrote that integration of the PSR occurs with the development of supporting weight in the standing position at twenty four weeks, standing on the whole foot at thirty six weeks, the ability to stand and lift one foot off the ground at forty four weeks. The child must now be able to take weight on the whole foot and place the heel down on the floor. At forty eight weeks the child can cruise along furniture, walk at fifty two weeks holding with one hand and walk independently at eighteen months.

Successful integration of the positive supporting reflex is the ability to put the heel of the foot down first on the floor and thus walk with a heel-toe gait.

2.4.5.4. Functional Significance of the PSR in Normal Development

Combined with the Landau reflex, the PSR helps with extension of the trunk, balance between flexors and extensors of the hips and trunk which is important in the development of a straight back in sitting and standing. The PSR is also the precursor to standing

and walking.

It stimulates both flexor and extensor tone to create the cocontraction necessary for the pillar-like limb of the supporting reaction in the tonic phase of neuro-development with subsequent support of lower limbs in the upright standing and walking postures (Fiorentino 1981).

2.4.5.5. Adverse Effects of the PSR if not Adequately Integrated.

In the severely neurologically affected child, the PSR is not checked and is thus inhibited by higher neurological functions. The effect of the reflex becomes exaggerated with a subsequent stiff pillar of support without any muscle tone modifications which would occur in equilibrium reactions, thus bringing about a dynamic and adjustable pillar of support.

The patient will not be able to put the heel to the ground, the limb will be rigidly extended with internal rotation and adduction of the lower limb. This phenomenon creates a narrow base of support which affects the ability to balance, prevents weight transference from one leg to the other and prevents the ability to stand or walk. Combined with the effect of the extensor thrust reflex, a person will be pushed off balance.

Adequate dorsiflexion of the foot will be prevented, clawing of the toes will occur and contractures and deformities will develop. (Fiorentino 1981) Functionally a patient will have difficulty standing up from a chair as the PSR will push him back in the chair. Difficulty will also be experienced in descending stairs as the patient will collapse in an effort to bend the supporting leg to move to the step below (Bobath 1965).

2.5. HABITUAL POSTURAL PATTERNS

The candidate defined habitual postural patterns as bad or poor postures which a child habitually assumes during normal everyday activities. The literature does not refer to this occurrence although the candidate became aware of it in the population seen in clinical situations. In reviewing the literature, Delacato (1963) was the only other person who recorded a similar observation by writing

"Poor writers have two significant characteristics. Their handwriting is disorganized, i.e. there is great variation in the size of the letters and in the spacing between letters and words. They also tend to tilt their heads strangely when writing, tend to assume strange sitting positions or move their heads constantly while writing" (Delacato 1963:11).

Kephart (1960) possibly also refers to the negative effects of poor or rigid posture by elaborating on the need for a flexible posture, meaning that postural adjustments must be flexible and operative over a

range. He reasons that all movement patterns and consequently all behaviour, must develop out of the posturing mechanism. The posturing mechanism refers to the lower levels in the central nervous system responsible for the maintenance of appropriate postural adjustments during the acquisition of basic skills and achievement levels.

Norton (1972b) pointed out that children with minimal cerebral dysfunction appear normal at school age. They are however clumsy, performs poorly in physical education and writes poorly.

2.6. LEARNING DISABILITIES

A learning disability was defined in chapter one. This problem area has been of particular interest to many disciplines including neurologists, paediatricians, psychiatrists, educationalists, psychologists, occupational therapists, speech therapists, optometrists and even physiotherapists. Extensive literature in special journals, books, conference proceedings and articles is available on this subject. The candidate limited herself to review some of the literature pertaining to learning problems as it possibly relates to postural reflex dysfunction.

Kephart (1960) pointed out that many different skills must be learned before a child can read and write. He

places a lot of emphasis on the motor bases of achievement of which posture plays an important role. From this basis the child will develop laterality, directionality, body image followed by the development of the perceptual process and eventual conceptualization. The basic skills in the learning process such as writing, reading and arithmetic is dependent on the development of perception and conceptualization.

Delacato (1963) also recognised the fact that reading is a perceptual act which is a function of the human nervous system. This perception depends on the organization of sensations which happens within the central nervous system. A perceiving brain must be an organized brain.

"To recapitulate: The organization of sensations to the point of recognition results in perception; the organization of perception to the point of seeing relationships results in conception. This is the order in which the processes take place" (Delacato 1966:46).

Vuckovich (1968) reported that it was the psychologists and educators who emphasized that an organic brain dysfunction was present in children with learning problems. With a more refined neurological examination, subtle deviations could be observed in these children. He admitted though, that these symptoms were difficult to interpret as they occurred in an organism that is not yet fully neurologically matured and that many of the parameters for normal children

need to be established clearly.

Ayres (1972a) in fact pointed out that if the child's nervous system does not develop in a normal manner, it makes him unable to organize a response to a stimulus, thus making him learning disabled. She also says that many symptoms seen in children with learning disabilities suggest dysfunction in the brainstem. The brainstem is particularly concerned with gross or total body sensorimotor function, such as that involved in simple space perception or riding a scooterboard. The cortex is better prepared to handle specialised and complex actions such as reading and the use of tools, including a pencil, but cannot do it adequately without integrated function at the brain stem level. Accordingly, therapy emphasises the gross abilities before fine motor skills and specific academic learning.

Norton (1972a and b) suggested that children with learning problems often have soft neurological signs which is medically identified as minimal cerebral palsy. She discussed sensorimotor feedback deficits and learning problems in two articles headed: Minimal Cerebral Dysfunction. In these articles she claimed that a year or less of modified neurodevelopmental approach prior to perceptual training twice weekly and a home programme for the child with minimal cerebral dysfunction frequently produced behavioural changes. The modified neurodevelopmental approach recognised

that primitive postural reflexes and reactions have a specific time of onset and disappearance related to the maturational process. They underlie spontaneous behaviour and the development of advanced movement behaviour which differentiates in fine and skilled responses.

Peters et al (1975) pointed out in their special neurological examination of children with learning disabilities, that the physician, at the very least, should observe the child in the act of writing and in the act of reading to analyse the execution of these school skills in relation to the findings of the neurological examination.

Two studies were reviewed for their particular relevance in formulating the research design for this study. These were the research carried out by Rider (1972b) and Finocchiaro (1974).

Rider (1972b) carried out studies on "The Relationship of Postural Reflexes to Learning Disabilities." She used two groups of children; the first group consisted of thirty eight normal second-grade children and the second group were children who were enrolled in a perceptual-motor training program because of under-achievement and characteristics in accordance with the definition of learning disabilities. The

procedures used were the Wide Range Achievement Test (WRAT) and reflex testing and teacher evaluations on all the children selected for the study. She then analyzed the results for:

(1) differences between the two groups in prevalence of abnormal reflex responses. (2) Differences in the normal second grade children group (Group 1) between boys and girls in prevalence of abnormal reflex responses. (3) Relationship between prevalence of abnormal reflex responses in Group 1 and teacher evaluation. (4) Relationship between prevalence of abnormal reflex responses in Group 1 and in reading, spelling and arithmetic abilities, as measured by the WRAT. She found that:

- a) Learning disabled children demonstrated significantly more abnormal reflex responses than normal second grade children.
- b) Boys exhibited significantly more abnormal reflex responses than did girls in the same group.
- c) There was no significant correlation between prevalence of abnormal reflex responses of normal second grade children and the teacher's evaluation. This was in the expected direction.
- d) Normal second grade children who demonstrated abnormal reflex responses had lower mean scores on each subtest of the WRAT (reading, spelling and arithmetic) than had those children who had no abnormal responses.

"Correlation between prevalence of abnormal reflex responses and scores on the spelling test of the WRAT were significant. Correlations between prevalence of abnormal reflexes and arithmetic and reading subtests of the WRAT were in the expected direction but not of significant magnitude" (Rider 1972b:242).

In addition, she grouped the reflexes tested according to levels of Central Nervous System maturation and corresponding levels of reflex development. Analysis of results showed that the children in the perceptual motor programme presented with the following percentages of abnormal reflexes at the different levels: twenty five per cent of the total responses at midbrain level, eleven per cent at cortical level, seven per cent at brainstem level and three per cent at spinal level.

"The normal second-grade children showed a gradually progressive increase in the number of abnormal responses from spinal and brainstem reflexes (2.1%) to midbrain reflexes (3%) to cortical responses (3.5%)" (Rider 1972b:242)

Finocchiaro (1974) investigated "Behaviour Characteristics in Learning-Disabled Children with Postural Reflex Dysfunction". She found that:

- a) "External Reliance, a factor reflecting passive and directionality confused behaviours, was significantly more prevalent in the children with reflex dysfunction." (Finocchiaro 1974:32).

The other behaviour factors were not significant and included classroom disturbance, impatience,

disrespect-defiance, external blame, achievement anxiety, comprehension, inattentive-withdrawn, irrelevant-responsiveness, creative initiative and need-closeness-to-teacher. These behaviour factors are identified on the Devereaux Elementary School Behaviour Rating Scale (DESBRS.) (Spivack and Swift 1967).

- b) Classroom disturbance and disrespect-defiance significantly increased in older children with postural reflex dysfunction, while need-closeness-to-teacher significantly decreased (DESBRS). Inadequacy-immaturity and personality disorders on the "Behaviour Problem Checklist" which correlated with age in the postural reflex dysfunction group were significant. Short attention span and laziness in school was measured by inadequacy-immaturity, while personality disorders measured variables such as feelings of inferiority, anxiety and social withdrawal.

2.7. SUMMARY

This chapter dealt with the various opinions of those persons who studied the different primitive postural reflexes considered in this study. The literature on primitive postural reflexes was dealt with under headings of description of the reflex, testing of the reflex, integration of the reflex in the course of motor

development, functional significance of the reflex in everyday activities and adverse effects if the reflex was not adequately integrated. The latter aspect mainly dealt with the severely neurologically impaired and not with the person minimally affected. The information gained by the candidate in surveying the literature aided in compiling an evaluation profile to detect any unintegrated primitive postural reflexes in the population used for this study.

Literature on habitual postural patterns was also scrutinized, but very little was found on this subject.

A vast resource of literature exists on the subject of learning disabilities. In this instance the candidate was selective and recorded only the literature that pertains to children with learning problems that made reference to possible postural reflex dysfunction.

3. RESEARCH DESIGN AND METHODOLOGY

3.1. INTRODUCTION

The review of literature showed that some researchers have found that the presence of primitive postural reflexes, such as the asymmetrical tonic neck reflex, has an effect on the learning ability of a child (Rider 1972b, Norton 1972a and b, Ayres 1972 and 1979 and Zemke 1980). The purpose of this study was to evaluate whether primitive postural reflexes were present in children attending normal schools and where present, the relationship of these reflexes to academic performance and poor habitual postural patterns in the classroom situation.

This research was executed on white primary school children in grade one, grade two and standard one at two schools in Krugersdorp on the West Rand, Transvaal, Republic of South Africa.

3.2. THE AIMS OF THE STUDY

The aims of the study were

3.2.1. To establish whether there was a relationship between the presence of primitive postural reflexes and

3.2.1.1. overall academic performance and the

individual skills of reading, writing and arithmetic

3.2.1.2. habitual postural patterns.

3.2.2. To investigate any relationship between the presence of specific primitive postural reflex activity and

3.2.2.1. academic achievement (overall performance, reading, writing and arithmetic) as well as

3.2.2.2. habitual postural patterns.

3.3. HYPOTHESES

The following nul (H0) and alternate (H1) hypotheses were formulated to investigate the aims of the study.

3.3.1. Hypothesis 1

Ho

Unintegrated primitive postural reflexes do not have a relationship to the child's performance at school.

H1

Unintegrated primitive postural reflexes do have a relationship to the child's performance at school.

3.3.2. Hypothesis 2

Ho

Unintegrated primitive postural reflexes do not have a relationship to habitual postural

patterns of the child.

H1

Unintegrated primitive postural reflexes do have a relationship to the habitual postural patterns of the child.

3.3.3. No hypothesis was formulated on the relationship between individual primitive postural reflexes and academic achievement (e.g. reading) or for the matching of habitual postural patterns to certain primitive postural reflexes as these were exploratory aims.

3.4. VARIABLES

The following independent and dependent variables were identified:

Independent variable Hypothesis 1:

Primitive postural reflexes.

Dependent variable Hypothesis 1:

Performance at school.

Independent variable Hypothesis 2:

Primitive postural reflexes.

Dependent variable Hypothesis 2:

Habitual postural patterns.

Controlled variables refer to the criteria set by the

candidate for selecting the groups of children. These were

- a) the age which ranged from six years to nine years eleven months;
- b) the race i.e. white South African children;
- c) the Intelligence Quotient (IQ) which had to be within the normal to superior range to exclude the effects of inferior intellectual ability. The IQ's ranged from ninety to 146.

3.5. THE PILOT STUDY

3.5.1. Aims of the pilot study:

The aims of the pilot study were

- 3.5.1.1. To examine the feasibility of administering and scoring the tasks used during the evaluation of primitive postural reflexes and any problems which might occur in this administration.
- 3.5.1.2. To improve the practical application of the various evaluation and questionnaire procedures to be used.
- 3.5.1.3. To provide an opportunity for the candidate to become skilled in the administration of the procedures to be used.
- 3.5.1.4. To experiment with the possibility of evaluating more than one child at the same time.

3.5.1.5. To investigate the possibility of teacher participation in administering group IQ tests.

3.5.2. Venue for the pilot study

A pilot study was undertaken in October/November 1983 at a country school named Rodora situated between Carletonville and Krugersdorp.

Rodora School was selected as it did not have an aid class. Therefore the children with learning problems were accommodated in the same class as children who had no specific learning problems. The school principal, who was very interested in any measures that could be taken to help children with learning problems, offered his school as the venue for the study.

Permission and co-operation was obtained from the Transvaal Education Department and Educational Aid Centres to conduct the study in schools, provided that a school principal was agreeable to the study being conducted at his school.

3.5.3. Measuring Instruments

This section describes the evaluation of primitive postural reflexes, the habitual postural patterns as defined by the candidate, the evaluation procedures used for academic achievement and IQ.

3.5.3.1. Evaluation of Primitive Postural Reflexes

(See Appendix A p.203) for administration procedures)

3.5.3.1.1. Rating Scale.

In searching the literature and studying the various testing methods for each reflex, the candidate concluded that a special evaluation of Primitive Postural Reflexes should be compiled for the purpose of the study. This was also done to obtain uniformity in the rating scale for the various reflexes that were evaluated. In some instances the candidate used a variety of ways to evaluate a specific reflex e.g. in the evaluation of associated reactions seven tests were used, whereas in others (such as the symmetrical tonic neck reflex) only one suitable task could be found. Where possible a variety of tests were used to evaluate the same reflex so that unintegrated reflexes could be identified with more certainty.

Towen (1979) used a rating scale ranging from zero to three or four, Montgomery and Richter (1980) and Walker and Boney (1981) used a rating scale ranging from zero to two. This method of rating seemed appropriate as it only allowed three choices, namely present, absent or doubtful. The candidate used a rating scale which was defined as follows:

) = The reflex was absent and none of the signs of the reflex could be observed.

1 = There was a possibility that the reflex was present or the therapist was unsure whether the signs observed were related to the presence of the reflex.

2 = Positive signs indicated a presence of the reflex which was interfering with the task the child was asked to do.

Evaluation of the following reflexes was considered for the purpose of this study. These are listed according to the order in which the evaluation was administered

- Tonic Labyrinthine Reflex (TLR).
- Symmetrical Tonic Neck Reflex (STNR).
- Asymmetrical Tonic Neck Reflex (ATNR).
- Associated Reactions (AR).
- Positive supporting Reflex (PSR).

The following guideline was used to identify the presence of unintegrated primitive postural reflexes (PPR) in each child. Each task used to evaluate the various PPR was rated zero, one or two according to the rating scale above (on previous page). The sum of the scores obtained for the different tests pertaining to a specific primitive postural reflex was examined by the candidate and a cut-off point for each reflex

established. The median score was used as the cut-off point. A score higher than the cut-off point indicated unintegrated primitive postural reflexes (PPR) (See table 3.1).

TABLE 3.1: Scoring analysis for identifying unintegrated PPR

PPR	Maximum Points	Integrated PPR	Unintegrated PPR
TLRS	6	0- 3	4- 6
TLRP	4	0- 2	3- 4
STNR	4	0- 2	3- 4
ATNR	12	0- 6	7-12
AR	32	0-16	17-32
PSR	16	0- 8	9-16

The following cut-off scores were necessary to indicate the presence of a PPR in a child:

Tonic Labyrinthine Reflex in supine	= > 4
Tonic Labyrinthine Reflex in Prone	= > 3
Symmetrical Tonic Neck Reflex	= > 3
Asymmetrical Tonic Neck Reflex	= > 7
Associated Reactions	= >17
Positive Supporting Reflex	= > 9

The rating of each reflex will be discussed in more detail when dealing with the reflex individually.

3.5.3.1.2. Method of evaluation

The data sheet used to record information on each child (see appendix B) contained the identifying information on the child (name, date of birth, date of evaluation, age of the child and the name of the examiner) as well

as the tests for the evaluation of each PPR. The reflexes were evaluated and recorded in a sequential pattern and started in the supine position, then in the prone position, getting onto hands and knees in the quadruped position, standing and walking. Each child was evaluated in a room on a mat. The procedure was executed exactly as described in appendix A and lasted ten to fifteen minutes.

3.5.3.1.3. Materials Used

The materials required to administer the evaluation of primitive postural reflexes were:



MAT: 1a



CLOSE-UP showing the
stop watch (1b)
template (1c)
spring clip (1d)
cardboard (1e)

FIGURE 3:1

(a) A mat, one and a half meters by one meter for the child to lie on (Figure 3.1a).

- (b) A stop watch to record the time that the child could maintain certain postures. (For the purpose of this study a Toshiba LC-584WA was used. The measurements could be recorded an accuracy of 1/10 second) (Figure 3.1b).
- (c) A template measuring twenty five degrees of elbow flexion on one side and fifty five degrees of elbow flexion on the other side (See figure 1c). This was used to measure the degree of elbow flexion in the quadruped position and to ensure an accurate rating when the number of degrees of flexion determined the score.
- (d) A spring clip with three kilograms resistance (as measured by placing sufficient weights on the handle to open it) was used in the Hand-hand test for eliciting associated reactions (See figure 3.1d).
- (e) A piece of cardboard size fifteen cm by ten cm was used for the child to hold between the chin and shoulder during the reverse ATNR task (See figure 3.1e).
- (f) A set of instruction cards was compiled to ensure that the examiner administered the evaluation in a consistent way.

3.5.3.1.4. Test Methods.

The evaluation of primitive postural reflexes was conducted as follows:

3.5.3.1.4.1. Tonic Labyrinthine Reflex in the Supine Position(TLRS):

Three methods were used to assess the TLRS. These were:

- a) Assuming the supine flexed pattern.
- b) Sitting up from supine.
- c) Lifting straight legs while lying supine.

a) Assuming the supine flexed pattern.

As the population to be tested did not have severe neurological dysfunction, the presence of this reflex was difficult to detect. Therefore a method was used in which the child was required to maintain a posture which was the reverse of the posture normally found in the presence of a TLRS.

This method of evaluation was described by Ayres (1972a) and others who have researched her theories (Montgomery and Richter 1980, Walker and Boney 1981, Bundy and Fisher 1981, Harris 1981, Dunn 1981, Rider 1972a & b).

In order to test for the presence of the reflex, the child was asked to assume the supine position on a mat on the floor. The child was then asked to

cross the arms over the chest and hold the elbows; to cross the ankles, bend the knees, lift the head and to curl up in a little ball while trying to put the nose between the knees (See figure 3.2). The child was to maintain this posture for as long as possible while counting out aloud. The length of time that the child held this position was timed with a stopwatch. If the position could be held for twenty seconds or more it was assumed that the TLRS was adequately integrated as the child could overcome the effect of increased muscle tone in the extensors of the trunk normally elicited by the TLR in supine. This time period was selected as research conducted by Dunn (1981) revealed that a normal child of six years old and older was able to maintain the supine flexed posture for at least twenty seconds.



FIGURE 3.2



FIGURE 3.3

Once it could be ascertained that the child could maintain the posture, resistance was applied to the forehead and knees. Both aspects of the procedure were necessary to achieve a full score for the performance.

The rating was allocated as follows:

- 0 = If the child could maintain a supine flexed posture for twenty seconds and maintain it against resistance. The reflex was regarded as being adequately integrated (Figure 3.2).
- 1 = If the child could maintain the posture for only ten to nineteen seconds, could not tolerate any resistance, and/or held the arms around the legs to assist. It was felt that presence of the reflex may be inhibiting his ability.
- 2 = If the child could not achieve the required flexed posture, could not lift the head off the floor or was unable to maintain a supine flexed posture for nought to nine seconds, it was assumed that the TLS was not integrated (Figure 3.3) and its presence prevented the child from holding the supine flexed position. It was assumed that increased muscle tone in the extensors of the trunk was the cause.

b) Sitting up from Supine

The second method of evaluating the TLRS was by asking the child to sit up from supine without the help of his hands. This method was described in the Perceptual Motor Survey (Kephart 1960) and is

part of the group of tests described as Kraus-Weber tests (see p.27 in Chapter 2). The movement of sitting up from lying requires action in the trunk flexors with inhibition of the extensors. This movement will be difficult if excess tone is present in the trunk and hip extensors.



FIGURE 3.4



FIGURE 3.5

The rating of the child's ability was allocated as follows:

- 0 = The child performed the sitting up task easily while the hands were clasped behind the head (Figure 3.4).
- 1 = The legs were lifted off the ground or the arms were brought forward to assist the movement.
- 2 = The child could not sit up (Figure 3.5) or needed support of the hands and placed them behind him on the floor to give assistance to the movement.

c) Lifting straight legs.

The third method used to evaluate the presence or absence of the TLRS was one in which the child was required to lift straight legs twenty five centimeters off the floor and maintain the position for ten seconds. This task was described in test three of the Kraus-Weber test (Kephart 1960). This task was felt by the candidate to make a contribution to the evaluation of unintegrated TLRS as failure of the task was thought to be caused by the factors that prevented the child sitting up from lying i.e. increased muscle tone in the extensors of the trunk and hip muscles preventing easy hip flexion.



FIGURE 3.6



FIGURE 3.7

The rating of the ability to perform the movement was allocated as follows:

- 0 = The child could lift straight legs twenty five centimeters off the floor i.e. could raise the legs without bending the knees

and could maintain the position for ten seconds (Figure 3.6).

- 1 = The legs were raised but the knees were bent and the position was maintained for less than 10 seconds.
- 2 = The child could not lift the legs off the floor even with bent knees (Figure 3.7).

3.5.3.1.4.2. Tonic Labyrinthine Reflex in the Prone Position (TLRP)

The child was now asked to lie in the prone position. From this position the examiner tested the TLRP. Two methods were used to evaluate the TLRP.

- a) Assuming a prone extended pattern.
- b) Lifting the chest off the floor and then lifting straight legs off the floor.

a) Assuming a prone extended pattern.

As in the TLRS, the child is asked to assume a pattern which is the reverse of that which is brought about through the presence of the reflex. In this instance the child was asked to raise the head and shoulders with arms in a "hands-up" position while at the same time the legs were lifted off the floor, knees straight. In other words the child was asked to hyperextend the whole body while lying on the abdomen and at the same time to count out aloud while maintaining this posture for twenty seconds.



FIGURE 3.8



FIGURE 3.9

The rating was allocated as follows:

- 0 = The TLRP was integrated (Figure 3.8).
i.e. the child could maintain the extended position for twenty seconds.
- 1 = The child could not maintain the posture for twenty seconds but held it for at least ten seconds or had difficulty assuming a hyperextended posture.
- 2 = If the child could not assume the posture or could only maintain it for nine seconds or less (Figure 3.9).

b) Lifting the chest followed by lifting straight legs.

The second test to evaluate the presence of the TLRP was taken from tasks four and five of the Kraus-Weber Test (Kephart 1960). Although this test was originally designed to measure muscular fitness (Krauss and Hirschland 1954), the candidate believes that an unintegrated TLRP could prevent the development of adequate muscular strength in those muscles responsible for maintaining the posture

described below, which enhances a position opposite to that brought about by a positive TLRP.

In the test the child was asked to clasp the hands behind the head, to lift the chest off the floor and to hold the position for ten seconds while the examiner held the child's feet on the floor (see fig.3.10). The second part of the test involved lifting straight legs while the child's head rested on his hands and the examiner held the child down between the shoulder blades. Once again the child lifted straight legs and held the position for ten seconds (see fig 3.12).

This procedure differs from assuming a prone extended pattern as the pattern is broken down in two sections namely extension of the head and chest followed by extension of straight legs, whereas the first requires simultaneous extension of both chest and legs.



FIGURE 3.10



FIGURE 3.11



FIGURE 3.12



FIGURE 3.13

The performance rating was allocated as follows:

- 0 = The child could meet the requirements for both parts i.e. head and feet as described above for ten seconds each (Figures 3.10 and 3.12).
- 1 = The child could only perform part i.e. only lift the head or the feet.
- 2 = The child could not meet the requirements for both parts of the test (Figures 3.11 and 3.13).

3.5.3.1.4.3. Symmetrical Tonic Neck Reflex (STNR)

From the prone lying position the child was asked to get onto all fours i.e. kneeling on hands and knees like a dog or a baby crawling. The examiner instructed the child to keep the arms straight in slight internal rotation and the elbows in an unlocked position. The examiner ensured that the fingers of the hands pointed forward and that the knees were slightly apart. While in this position the child's neck was flexed and then extended by the examiner. This testing procedure was designed, described and used by Ayres (1972a), Montgomery and Richter (1980), Dunn (1981), Walker and Boney (1981).



FIGURE 3.14



FIGURE 3.15



FIGURE 3.16

The rating was allocated as follows:

- 0 = The child could maintain extended arms during flexion and extension of the head (Figure 3.14 and 3.15).
- 1 = One or both arms flexed slightly, the flexion being less than twenty five degrees from the extended zero degrees position.
- 2 = Either one or both elbows flexed more than twenty five degrees, thus implying inadequate integration of the STNR (Figure 3.16).

3.5.3.1.4.4. Asymmetrical Tonic Neck Reflex (ATNR)

Three methods were used to evaluate the ATNR:

- a) Turning of head in quadruped position.
- b) The reversed ATNR posture.
- c) Turning of head in standing position.

a) Turning of head in quadruped position.

While the child remained in the same quadruped position as used for the STNR, the head was turned ninety degrees to both left and right sides to test for the presence of the asymmetrical tonic neck reflex. This method was described by Ayres (1972a), Montgomery and Richter (1980) Walker and Boney (1981) and Dunn (1981). It was assumed that when the ATNR was present, the resultant shunt of tone caused by turning the head would bring about flexion in the arm on the skull side of the head.



FIGURE 3.17



FIGURE 3.18

The rating for the presence or absence of the ATNR was allocated as follows:

- 0 = The child's arms remained extended during turning of the head (Figure 3.17).
- 1 = The arm on the skull side of the head flexes slightly. The degree of flexion was less than fifty five degrees from the zero extended position as measured by the

template.

- 2 = The arm on the skull side of the head flexed more than fifty five degrees and more, indicating an unintegrated ATNR (Figure 3.18).

b) The reversed ATNR posture.

While still in the quadruped position, the child was asked to place one elbow in a flexed position with the hand on the hip. At the same time he was asked to extend and raise the contralateral leg and then to turn the head in the direction of the flexed arm while holding a piece of cardboard between the shoulder and the chin. The posture had to be maintained for twenty seconds. This method of evaluating the ATNR was designed, described and implemented by Ayres (1972a), Dunn (1981), Walker and Boney (1981). It was assumed that the presence of the ATNR which would shunt extra tone into the extensors of the arm on the jaw side and into the flexors of the arm on the skull side, would make it impossible for the child to maintain the position.

The rating was allocated as follows:

- 0 = The child could assume the posture and maintain it for twenty seconds (Figure 3.19).
- 1 = The child could only assume it with great

difficulty or hold it for less than twenty seconds.

2 = The child could not assume the posture (Figure 3.20).



FIGURE 3.19



FIGURE 3.20

c) Turning the head in upright standing position.

The third method of evaluating the presence of the ATNR was by asking the child to stand with both feet together, arms stretched forward, fingers spread apart and eyes closed. This test is called Schilder's Arm Extension Test and is described by Ayres (1972a). This testing procedure has also been described by Townen (1979), Dunn (1981) and Walker and Boney (1981). The presence of the ATNR would cause the skull arm to flex.

The rating was allocated as follows:

0 = The arms remained stretched out in front with little or no deviation while the head was turned by the examiner. The deviation should be less than twenty five degrees

(Figure 3.21).

- 1 = When slight changes in the posture of the arms occurred during head turning and there was slight trunk rotation and slight resistance to head turning. The changes in the posture of the arms are observed as vertical or lateral deviations from the median line (between twenty five and forty five degrees) or even slight flexion and extension of the elbow.
- 2 = Definite postural changes occurred in the arms with definite resistance to head turning and or more than forty five degrees trunk rotation (Figure 3.22).

- a) Mouth opening and finger spreading phenomenon.
- b) Use of diadochokinesis.
- c) Finger opposition test.
- d) Hand-hand test.
- e) Feet-hand test.
- f) Walking on tiptoe.
- g) Walking on heels.

The candidate endeavoured to use more than one test to evaluate a specific reflex. Sound methods to evaluate this reflex were observed in the literature (Bax 1963 and Townen 1979), and the candidate used them all in the evaluation. The reason for this was that the candidate wanted to use more than one testing procedure

(Figure 3.21).



FIGURE 3.21



FIGURE 3 22

3.5.3.1.4.5. Associated Reactions (AR)

Seven methods were used to evaluate AR.

- a) Mouth opening and finger spreading phenomenon.
- b) Use of diadochokinesis.
- c) Finger opposition test.
- d) Hand-hand test.
- e) Feet-hand test.
- f) Walking on tiptoe.
- g) Walking on heels.

The candidate endeavoured to use more than one test to evaluate a specific reflex. Scund methods to evaluate this reflex were observed in the literature (Bax 1963 and Townen 1979), and the candidate used them all in the evaluation. The reason for this was that the candidate wanted to use more than one testing procedure

- 1 = When slight changes in the posture of the arms occurred during head turning and there was slight trunk rotation and slight resistance to head turning. The changes in the posture of the arms are observed as vertical or lateral deviations from the median line (between twenty five and forty five degrees) or even slight flexion and extension of the elbow.
- 2 = Definite postural changes occurred in the arms with definite resistance to head turning and or more than forty five degrees trunk rotation (Figure 3.22).

where possible to be able to identify the presence of a reflex with more confidence. These methods were all used in the standing position and were compiled from tests described by Bax (1963) and Townen (1979).

a) The mouth-opening and finger-spreading phenomenon

While standing facing the examiner, the child's wrists were grasped between the thumb and index finger of the examiner. The arms were then extended passively by the examiner ensuring that the child's wrists and fingers hung loosely. The child was asked to open the mouth as wide as possible (phase one) and then to close the eyes tightly (phase two) and finally to stick the tongue out as far as possible (phase three). Phases two and three served to reinforce phase one. This method was described by Townen (1979). It was assumed that the muscular effort needed for the above movements would cause an overflow into the wrist and fingers.



FIGURE 3.23



FIGURE 3 24

Scoring the presence of associated movements was as

follows:

- 0 = No movement occurred and the wrists and fingers remained relaxed (Figure 3.23).
- 1 = Slight spreading of the fingers occurred.
- 2 = A marked spreading of the fingers with some extension of the wrists occurred. Maximal spreading and marked extension of the fingers was often accompanied by extension of the wrists (Figure 3.24).

b) Diadochokinesis (Towen 1979).

The child was required to stand with one arm relaxed at the side of the body while the other arm was flexed at ninety degrees at the elbow with the hand pointing forward in the midposition. The child's head was centered and the arm and shoulder relaxed. The child was then asked to pronate and supinate the forearm quickly while trying to keep the elbow still and away from the body. The presence of associated movements was observed in the opposite arm.



FIGURE 3.25



FIGURE 3.26

Scoring was allocated as follows:

- 0 = No visible mirror movements or flexion of the elbow occurred. (Figure 3.25 shows no mirror movements although the child was asked to keep the elbow in flexion).
- 1 = Marked mirror movements without flexion of the elbow or barely discernable mirror movements or slight flexion of the elbow without mirror movements.
- 2 = Marked mirror movements with flexion of the elbow (Figure 3.26).

c) The finger opposition test (Towen 1979).

The child was asked to place the fingers of one hand consecutively on the thumb of the same hand e.g. 2-3-4-5-4-3-2. The child was requested to perform these movements, completing five sequences to and fro. Each hand was tested in turn.

Scoring was allocated as:

- 0 = No associated movements in the opposite hand occurred (Figure 3.27).
- 1 = Barely discernable associated movements in the opposite hand.
- 2 = Marked associated movements in the opposite hand (Figure 3.28). These associated movements resembled the movements performed by the other hand.



FIGURE 3.27



FIGURE 3.28

d) The hand-hand test (Bax 1963)

The child was asked to exert pressure with thumb and index finger in opening a clothespeg or spring paper clip (bulldog clip).



FIGURE 3.29



FIGURE 3.30

The scoring was allocated as:

- 0 = No associated movements were observed in the opposite hand (Figure 3.29).
- 1 = A reverse reaction with fingers extending (heterologous reaction) in the opposite hand.
- 2 = Similar movements i.e. flexion of the fingers (homologous reaction) in the opposite hand (Figure 3.30).

e) The feet-hand test.

This test was originally designed by Fog and Fog (1963) and was also described by Eax (1963) and requires the child to invert the feet and walk on the outer border of the feet. Associated movements of the hands were observed. Fog and Fog (1963) stated that this usually presents as supination of the forearm and sometimes pronation of the forearm or extension of the elbow.



FIGURE 3.31



FIGURE 3.32

The scoring was allocated as:

- 0 = No supination or associated reaction of the hand (Figure 3.31).
- 1 = Slight supination of the forearms.
- 2 = Excessive supination or pronation of the forearms (Figure 3.32).

f) Walking on tiptoe

The child was asked to walk on tiptoe for approximately twenty paces and back again. Associated reactions in the upper limbs occurring during walking on tiptoe was described by Towne (1979). These AR's were extension or flexion of the elbow, with pro- or supination of the forearm, flexion or extension of the wrists and even clenching of the hands.



FIGURE 3.33



FIGURE 3.34

The scoring was allocated as:

- 0 = No visible associated movements (Figure 3.33).
- 1 = Barely discernable movements into extension at elbow with clenching of hands.
- 2 = The above movement was marked and in addition, abduction of the upper limbs was

accompanied by movements of the lips and tongue (Figure 3.34).

g) Walking on heels.

Associated reaction occurring during walking on heels as described by Townen (1979) was also evaluated. The child was asked to walk on his heels over a distance of approximately twenty paces and then back again. These AR were described as flexion of the elbows and hyperextension of the wrists.



FIGURE 3.35



FIGURE 3.36

The scoring was allocated as:

0 = No visible associated movements (Figure 3.35).

1 = Barely discernable movements occurred in the arms into flexion of elbows and

and hyperextension of the wrists.

2 = The above movement was marked. In addition, adduction of the upper limbs and movements of the lips and tongue occurred (Figure 3.36).

3.5.3.1.4.6. Positive Supporting Reflex (PSR)

The PSR was evaluated in standing and walking positions with bare feet. Four methods were used to evaluate PSR:

- a) Walking on tiptoe.
- b) Walking on heels.
- c) Standing on one leg.
- d) Hopping on one leg.

Walking on tiptoe and walking on heels was also used in the evaluation of associated reactions. These methods were described by Townen (1979).

a) Walking on tiptoe.

The child was asked to walk on tiptoe for approximately twenty paces, turn around and walk back again. It was presumed that the presence of this reflex and the extra tone in the extensors of the leg would cause the legs to be extended rigidly and make it difficult for the child to lift the foot off the ground.

The scoring was allocated as follows:

- 0 = The child walked well on tiptoe with adequate flexibility in legs. (Fig. 3.37)
- 1 = The child managed with difficulty and had problems with his balance.
- 2 = The child walked on the balls of his feet with rigidly extended knees and his balance was poor. (Fig. 3.38)



FIGURE 3.37



FIGURE 3.38

b) Walking on the heels.

The child was asked to walk on the heels over a distance of approximately twenty paces, turn around and walk and back again. It was presumed that the child would find it difficult to dorsiflex the feet and walk on the heels if there was a residual positive supporting reflex with increased tone in the extensors throughout the leg.



FIGURE 3.39



FIGURE 3.40

The scoring was allocated as:

- 0 = The toes remained of the ground and the child walked well on the heels. (Fig. 3.39)
- 1 = The toes did not remain raised.
- 2 = The child was unable to walk on the heels or to dorsiflex the feet adequately. (Fig 40).

c) Standing on one leg.

The child was asked to stand on one leg for at least twenty seconds while holding the elbows with the palms of the hands (Towen 1979, Ayres:SCSIT 1972b).

Each leg was tested in turn. Once again it was presumed that a positive supporting reflex would cause a rigid pillar of support with little or no flexibility in the leg to maintain standing balance on one leg.

The scoring was allocated as:

- 0 = The child could maintain the position for twenty seconds without losing balance for

seven year olds and older, and for thirteen seconds for six year olds (Towen 1979) (Fig. 3.41).

- 1 = The child could stand on one leg but not meet the required length of time or the toes tended to claw.
- 2 = The child was unable to stand on one leg, the leg stiffened thus causing a rigid pillar of support with a tendency to raise the heel. The toes clawed and there was no flexibility in the leg for the maintenance of balance. (Fig. 3.42).



FIGURE 3.41



FIGURE 3.42

d) Hopping on one leg.

Lastly, the child was asked to hop on one leg in one spot on each foot at least twenty times (Towen 1979). The child was asked to hop on the ball of the foot and not on the whole flat foot. It was

presumed that the additional pressure that this places on the ball of the foot would elicit a PSR which would not be seen when the child was asked just to stand on one leg.



FIGURE 3.43



FIGURE 3.44

The scoring was allocated as:

- 0 = The seven year old and older child managed twenty hops and the six year old managed thirteen hops with ease and flexibility, maintaining balance (Towen 1979). (Fig. 3.43).
- 1 = The child could not maint in hopping on the ball of the foot thus was jumping on the whole foot or could not meet the required number of hops.
- 2 = The child was unable to hop on one leg due to the leg being rigid and with poor balance. (Fig. 3.44)

3.5.3.2. Compiling the Habitual Postural Pattern Questionnaire (See Appendix C p.216)

The candidate investigated whether there was any relationship between PPR and certain habitual postural patterns (HPP) which children often display in the classroom situation. The candidate grouped these patterns according to their apparent relationship to the patterns seen in PPR. The HPP noted were those that occurred habitually in the classroom situation. The class teachers were asked to note the presence or absence of HPP in the children in their class (see appendix C).

3.5.3.2.1. Recording

The candidate compiled a questionnaire to record the presence or absence of HPP. Teachers had to complete a questionnaire for each child in their class on which they had to tick the appropriate block which evaluated whether a certain habitual postural pattern was present or not. A YES/NO method of recording was therefore used to identify any HPP. A positive response denoted the presence of a particular HPP.

3.5.4.2.2. Method used to evaluate HPP.

The following habitual postural patterns and their apparent relationship to specific primitive postural reflex activity were described by the candidate.

Patterns associated with the tonic labyrinthine reflex
(PTLR):

The released TLR in the decerebrate animal prevents extension patterns in the prone or more ventral orientated postures, as well as preventing flexion patterns in the supine or more dorsal orientated postures. The following HPP's were thus identified as having some similarities to the patterns seen in the TLR:

- a) Propping the head with the hand at the desk when writing. The sitting posture while writing tends to be a more ventral orientated posture with more flexion patterns as seen in the lower and upper limbs. This enhances the effect of the TLR in prone with the result that the antigravity or back extensor muscles and neck muscles are inhibited.



Figure 3.45



Figure 3.46

The result is that the child slumps forward without having adequate head control. In order to help him

to maintain an upright posture, the child supports his head with his hand when sitting at a desk (See fig 3.45 and item 1 in Appendix C).

b) Having a slumped posture sprawling over the desk or leaning against furniture. The same rationale as described under point a) would apply in this instance. Because the child has not integrated adequately the TLR in prone, it would prevent the adequate development and strengthening of the antigravity muscles, with the result that the child would find it tiresome to maintain himself against the force of gravity. It is thus much easier to lean on or against furniture and walls or even sprawl over the desk (See Fig. 3.46 and item 2 in Appendix C).

c) Inability to assume a prone extension or supine flexed posture, especially during the physical education programme. These would include difficulties in activities requiring sit-ups, raising straight legs off the floor while lying on the back and arching the back while lying on the tummy. Muscle weakness could well be the reason for difficulties in performing such tasks. The candidate however believes that the effect of the TLR which is not adequately integrated could be one of the reasons why muscle weakness occurs (See fig. 3.5, fig 3.7, fig 3.9 and items 12, 13 and 14 in

Appendix C).

Patterns associated with the asymmetrical tonic neck reflex (PATNR):

The released ATNR in decerebrate animals elicits extension patterns on the face side of the body when the head is turned to the side and flexion patterns on the skull side of the body. It thus prevents the arms from coming forward, and meeting in the midline and even crossing the midline to the contralateral space. The following HPP's were thus identified as having a possible relationship to the ATNR.



FIGURE 3.47



FIGURE 3.48



FIGURE 3.49

d) Moving or twisting the book or paper to one side of the working surface in an effort to avoid crossing the body midline (See fig. 3.47 and item 3 in Appendix C).

e) Moving or twisting the body when the book or paper is fixed in an effort to avoid crossing the body

midline and thus crossing the body midline (See Fig. 3.48 and item 4 in Appendix C).

f) Twisting the arm and hand around in different postural attitudes while writing or tracing in an effort to prevent use of contralateral space and thus crossing the body midline (See fig. 3.49 and item 4 in Appendix C).

g) Gesell^{and Ilg}, (1949) pointed out that the ATNR's presence in normal development in the first few months of life focuses vision on the outstretched hand. It does not relate to co-ordination at such a young age. The candidate thus believes that if the ATNR is not adequately integrated, it affects the child's flexibility of movement and muscle tone adaptations which in turn will affect effective eye-hand co-ordination (See item 6 in Appendix C).

Patterns associated with associated reactions (PAR):

In neurologically normal persons, AR are utilised to re-inforce a specific movement in another part of the body when more effort is required to perform a specific action, such as opening a jar. When AR are excessive and not adequately integrated, there can be a disabling effect on the execution of certain everyday activities such as writing or tying shoe laces. The following HPP's were identified as having a similarity with associated reactions:

- h) Mirror or associated movements in the Non-dominant hand while involved in activity with the dominant hand. This phenomenon indicates that AR are present while the dominant hand is busy in activity (See fig. 3.50 and item 7 in Appendix C).



FIGURE 3.50



FIGURE 3.51.

- i) Inadequate use of the dominant hand. Effort needed to move could cause AR in the non-dominant hand. This AR could in turn cause excess tone in the dominant hand thus setting up a continuous cycle.
- j) Fisting of fingers of the non-dominant hand while writing. Although similar to the effects stated in point h), the candidate decided to list it specifically for teachers to observe (See item 7 in Appendix C).
- k) Involuntary movements of any body parts while executing a task e.g. tongue movements (See fig. 3.51 and item 8 in Appendix C).

Patterns associated with symmetrical tonic neck reflex
(STNR):

The STNR elicits flexion patterns in the upper limbs and shoulder girdle and extension patterns in the lower limbs and pelvic girdle when the head is ventrally flexed. On the other hand, it elicits extension patterns in the arms and shoulder girdle and flexion patterns in the lower limbs and pelvic girdle when the head is dorsally flexed or extended. The following HPP's were thus identified as having a possible relationship to the STNR.

- 1) Sitting on the heels with feet on chair. The child probably assumes this posture in an effort to maintain the body upright with extension of the trunk in the region of the thorax and head. Excessive flexion of the lower limbs enhances this posture which is typical of the STNR (See fig.3.52 and item 9 in Appendix C).



FIGURE 3.52



FIGURE 3.53

m) Reclining on chair with legs stretched out under the desk. This again is the opposite posture which is described under point (l). It results in more flexion of the upper trunk and extension of the lower limbs. It could also be the reason why the child writes in a cramped writing style near the body which is the observation listed under point (n) (See fig. 3.53 and item 10 in Appendix C).

n) Cramped writing style with hand held against the body (See fig. 3.54 and item 11 in Appendix C).



FIGURE 3.54



FIGURE 3.55

o) Sitting between flexed legs on a flat surface (frog sitting). The same rationale as enumerated upon under point (l) applies (see fig. 3.55).

Patterns associated with positive supporting reflex (PPSR):

The PSR elicits cocontraction in the muscles of the lower limb. This is necessary to help the person to

maintain the upright posture and support himself on his legs. When the PSR becomes too strong, the cocontraction in the leg muscles becomes exaggerated, with the result that the muscles in the leg lose their flexibility and muscle tone adjustments, while he balances on the leg. The tasks or situations described below were all used in structured situations when the PSR was evaluated. They are enumerated upon below, to point out the functional situations at school where the child will encounter problems. The following HPP's were thus identified as having a relationship to the unintegrated PSR.

- p) Difficulty in maintaining balance on one leg. The rigidity in the leg caused by a PSR could have an effect on muscle tone adjustments in the maintenance of balance (See fig. 3.42 and item 16 in Appendix C).
- q) Difficulty in walking on a straight line with heels touching toes of the back foot. In this task, the base of support is narrowed or reduced, with the result that more muscle tone adjustments in the legs are required. In other words, a flexible supporting pillar is needed. A PSR would prevent the necessary flexibility and muscle tone adjustments in the leg (See item 17 in Appendix C).
- r) Difficulty in hopping on toes or ball of foot, loses

balance. The stimulation on the ball of the foot is one of the known effects which elicits the PSR. If the child can perform this task without losing his balance, it would be a sure sign that the PSR is adequately integrated (See fig. 3.44 and item 18 in Appendix C).

s) Difficulty in walking on tiptoe. Another task which could elicit the PSR by the stimulation on the ball of the foot (See fig 3.44 and item 19 in Appendix C).

t) Difficulty in walking on heels. An unintegrated PSR would have enhanced plantar flexion of the ankle and foot with possible shortening of the achillis tendon. This will prevent easy dorsiflexion of the ankle with the resultant difficulty in walking on the heels (See fig. 3.40 and item 20 in Appendix C).

In addition, teachers were requested to specify any other observations which might influence the child's functioning such as pencil grip and pressure in writing.

This questionnaire also requested other identifying information pertaining to the child such as the name, date of birth, date of recording observations, age of child, class, name of teacher, name of school, IQ of the child, average level of performance at the end of the second term of the year in which the child was seen for this study, average levels of reading, writing, arithmetic, and whether the child was left- or

right-handed.

3.5.3.3. The rating scale in academic performance.

The rating scale given to academic performance ranged from one to five. This was the method used by the Transvaal Education Department for rating academic performance in grade one, grade two and standard one. Unfortunately it is a very subjective method of rating a child and different teachers adhere to different norms. It was therefore very important to ensure that matched pairs in the study had the same teacher. The ratings were as follows:

- 1 = indicates very good performance
- 2 = indicates good performance
- 3 = indicates average performance
- 4 = indicates below average performance
- 5 = indicates poor performance.

3.5.3.4. Assessing the Child's Intellectual Ability

Group tests to determine the IQ were administered with the assistance of the Educational Aid Centres in Randfontein and Krugersdorp.

Three different tests were used namely:

- 3.5.3.4.1. N.B.(National Bureau) Group Test for five- and six-year-olds (NBGT 6/6 1967)

3.5.3.4.2. N.B. Group Test for seven- and eight-year-olds (NBGT 7/8 1967).

The NBGT tests were designed after research by the National Bureau of Educational and Social Research of the Department of Education, Arts and Science.

"The tests for Afrikaans- and English speaking children are identical. Provision was made for two age series, namely, one test for five- and six-year-olds and another for seven- and eight-year-olds, there being only one form for each age series." (Manual for the NBGT 1967:1)

3.5.3.4.3. The New South African Group Test (NSAGT)

The subtests of the NSAGT measure reasoning, relationships, visualization, insight and comprehension and were used with the nine-year to nine-year-eleven-month age group.

The NSAGT consists of the following sub-tests:

a) Non verbal subtests:

1. Number sequences.
2. Figure analogies.
3. Completion of patterns.

b) Verbal subtests:

1. Classification of word pairs.
2. Verbal reasoning.
3. Word analogies.

3.5.3.5. Inter Rater Reliability on Assessment of Reflexes

All evaluations regarding the Primitive Postural Reflexes was administered by the candidate according to a standard procedure compiled by her (see Appendix A).

The supervisor checked the method of administering and scoring the evaluation by observing the candidate evaluating eight children. The scores obtained by the two raters on this occasion were identical. The test procedure was therefore felt to have inter rater reliability.

3.5.4. Sample selection

During the pilot study, all the children in grade one, grade two and standard one at Rodora School were evaluated (eighty two children consisting of twenty eight in grade one, twenty seven in grade two and twenty seven in standard one). The measuring instruments as described under point 3.5.3. were used.

Within this group, sixteen children were identified as having unintegrated primitive postural reflexes, according to the scoring criteria described under point 3.5.3.1.1. It was possible to match these children to a child in a control group. The control group had integrated primitive postural reflexes according to the criteria formulated by the candidate and matched the experimental group in age and IQ.

The three teachers completed the questionnaires on the

Postural Pattern Profile on all of the children in their respective classes (eighty two in total). The teachers were not aware of the results obtained by the candidate i.e. they did not know which children were in the study.

The Educational Aid Centre in Randfontein gave guidance and took responsibility for obtaining the IQ of each child by means of group IQ tests. The persons involved in these procedures were the orthodidactitian for the nine-year-olds in standard one and grade two; the candidate for the seven- to eight-year-olds in standard one, grade two and grade one, as well as the five- to six-year-olds in grade one; while the grade one teacher administered the test for all six- to seven-year-olds in grade one and grade two.

3.5.5. Results of the pilot study

The data was not analysed because the candidate identified changes to be made to the protocol sheets as well as the administration of the evaluation and questionnaire before entering the next step in the study. However, the candidate was able to streamline the procedures and extract certain principles for use in the actual study. Comments on the procedure, scoring criteria and method of administration follow:

3.5.5.1. Evaluating Primitive Postural Reflexes

The suggested protocol form and administration

procedures proved adequate. The candidate experimented with the possibility of evaluating two children simultaneously in the pilot study. This proved unsatisfactory as some children started competing with each other which affected their respective scores. It was also difficult to evaluate certain items simultaneously on two children. The possibility of having the next child for evaluation present in the room was also tried in order to speed up the procedure and use time more effectively. This resulted in prior knowledge of the evaluation and influenced the child's performance on the evaluation. Therefore it was decided to test only one child at a time.

3.5.5.2. Using the Habitual Postural Pattern Profile

Some teachers had difficulty in completing the questionnaire giving adequate consideration to each point as they did not quite understand what was expected of them. The candidate realised that more time needed to be allocated to detailed briefing of the teachers prior to completing the questionnaire.

To simplify the completion of the questionnaire, columns were added indicating specifically NO or YES; and RIGHT or LEFT side and only asking for more detail if the answer was YES. This was added to each question phrased, so that teachers had only to tick the

appropriate answer and elaborate only if the answer was yes.

3.5.5.3. Obtaining the IQ

Permission was obtained from the Transvaal Education Department to execute the study at schools on the West Rand and to use the services of the Educational Aid Centres. The IQ of each child was obtained by using group IQ tests. Although permissible for teachers to administer these tests under the supervision of the school psychologist or orthodidactitian, this proved unsatisfactory and unreliable. The teacher tended to give the children appropriate clues, with the result that most children in that class scored IQ's well above normal. The candidate thus decided not to use teachers in this procedure.

3.6. THE STUDY

3.6.1 Selecting the venue for the study

The study was carried out in Krugersdorp, Transvaal, Republic of South Africa. As children with learning problems were used in the study and comparisons had to be made with a control group, schools without aid classes had to be identified on the West Rand.

There were eleven primary schools in Krugersdorp. At the time of the study, two of these schools had special aid classes for children with learning problems and had

to be eliminated from the study. These were Ebenaeser Skool and Paardekraal Skool. All the other schools could be used for the study and the candidate intended to test all the children in grade one, grade two and standard one until sufficient children were found for the sample size in each group i.e. experimental and control groups. All eleven schools were to be used, alternating between Afrikaans and English medium schools to provide enough children for an adequate sample size as suggested by the statistician. Thus Protearifse Laerskool and Monument Primary School were the first two schools that were used for the practical execution of the study.

The statistician (Dr G. Reinach) from the Institute for Biostatistics, considered two variables to determine the sample size. These variables were the average mark a child could get over subjects and the rating for specific academic skills such as reading, writing or arithmetic. Accepting a type I error of five per cent and a type II error of ten per cent it was decided by the statistician that forty two children in the experimental group and forty two children in the control group were needed for the study.

3.6.2. Evaluation procedures used

This was described in detail under section 3.5.3. and was the same as that used in the pilot study.

3.6.2.1. Assessment of Primitive Postural Reflexes (See section 3.5.3.1.)

A similar format to that of the pilot study was used. The administration of the evaluation is described in appendix A and the protocol sheet can be seen in appendix B. The candidate evaluated all the children in grade one, grade two and standard one at the two schools used for this study. Thus a total of 403 children were evaluated for primitive postural reflexes by the candidate.

3.6.2.2. Completion of the Habitual Postural Pattern Questionnaire (See section 3.5.3.2.)

The questionnaire on each child was completed by all the grade one, grade two and standard one teachers at the schools used for the study. The questionnaire can be seen in appendix . This questionnaire was modified after using it in the pilot study as described in section 3.5.3.2.

3.6.2.3. Assessing the Child's Intellectual Ability (See section 3.5.3.4.)

Group IQ tests were administered with the assistance of the Educational Aid Centres in Randfontein and Krugersdorp. The candidate assisted the orthodidactitians by administering the test to some groups under supervision of the orthodidactitians at these centres.

3.6.3. Sample selection

It was the aim to obtain two groups of children, namely "normal" and "affected". The latter group was the experimental group and was defined as children with at least one unintegrated primitive postural reflex.

The children were obtained from schools where both normal and affected children were present in the same class. Each affected child, was matched with a normal child of similar age, sex and IQ and was in the same class at school. It was important for a pair to be in the same class to ensure that the same teacher evaluated the pair's academic achievements and HPP's. This was done to eliminate the effect of the different evaluations on academic performance and HPP's on both the child in the experimental group and in the control group, thus ensuring that the difference which may be obtained between the two groups may not be ascribed to the teachers.

Once all the data was available, it was possible to select the experimental (affected) and control groups.

This was done manually and by the candidate. There were approximately thirty children in each class and matching had to be done within such a group.

A total of 403 children were assessed in grade one,

grade two and standard one at two schools in Krugersdorp. Eighty eight children were assessed from Protearifse Laerskool, an Afrikaans medium school. Thirty two children were in grade one, twenty eight children in grade two and twenty eight children in standard one. Three hundred and fifteen children were assessed at Monument Primary School which is an English medium school. The latter group consisted of four grade one classes totalling ninety seven children, four grade two classes totalling one hundred and fourteen children and three standard one classes totalling one hundred and four children (See Table 3.2).

TABLE 3.2: Distribution of Children Assessed

	<u>Grade I</u>	<u>Grade II</u>	<u>Std I</u>	<u>Total</u>
Protearifse Skool	32	28	28	88
Monume t Primary	97	114	104	315
TOTAL	129	142	132	403

The candidate had no knowledge of academic or habitual postural patterns of any children prior to the testing of primitive postural reflex activity or allocation to the experimental or control groups.

3.6 3.1. The Experimental Group

Fifty nine children were selected from the population used for this study. These children were selected as

they:

- a) were thought to have one or more unintegrated primitive postural reflex i.e. (obtaining at least the median of the possible score for each reflex tested), as evaluated on the previously described evaluation, i.e. it was doubtful that each reflex was integrated
 - b) fell within the age group i.e. the ages ranged from six years three months to nine years and five months.
 - c) Fell within the normal IQ range.i.e. had an IQ of ninety or above. The range was ninety to 146.
- Each child in the experimental group was matched to a child in the control group.

3.6.3.2. The Control Group

Fifty nine children with integrated primitive postural reflexes were selected to match those children in the experimental group. Children were matched according to:

- a) sex,
- b) age (within six months), the ages of the control group ranged from six years to nine years eight months in this group.
- c) IQ (within ten points). This ranged from ninety two to 146,
- d) class i.e. they were in the same class and had the same teacher.

3.7. DATA ANALYSIS

All identifying information (name, age, sex, IQ), ratings for performance at school, scores obtained for PPR and YES/NO answers on postural patterns were computed and analysed. The means and SD of all sets of scores were calculated as a measure of dispersion of the data.

Academic performance was scored on a scale from one to five. Children were placed in one of two categories.

The two categories of scoring consisted of the scores which ranged from one to three and those that ranged from four to five. All the other variables were observed in two categories of being present or absent.

According to Bonferoni (Nether and Wasserman 1974), if more than one test is performed on the same data, the significance level for each test should be adapted according to the number of tests performed. The statistician recommended that as research was looking for trends, that a $p\text{-value} < 0,05$ was indicative of the trend therefore Bonferoni's correction was not applied.

However, the exact probability obtained will be quoted.

All calculations were done on the IBM computer of the Institute for Biostatistics of the South African Medical Research Council (SAMRC), utilizing the BMDP (Bio-Medical Data Package) (Dixon 1981).

The results were analysed as follows:

3.7.1. Comparisons were made between the two groups in respect of:

3.7.1.1. Overall academic performance, reading, writing and arithmetic. Since the sample is fifty nine, the t-test could be applied when comparing the means because of the central limit theorem. (If the sample is large enough the means will be normally distributed, irrespective of the population distribution.)

3.7.1.2. The presence of habitual postural patterns.

The children were paired and arranged in 2x2 tables i.e. one table for each set of HPP's. Because of the small numbers in the specific variable of HPP's, non parametric statistics had to be used and McNemar's test was used to compare the presence or absence of HPP in the experimental and control groups.

3.7.2. The effect of unintegrated PPR's on academic achievement and HPP's was investigated in the experimental group. The data was unpaired and because of the small numbers of a specific variable, non parametric statistics were used.

3.7.2.1. To investigate the effect of unintegrated PPR on academic achievement, 2x2 tables were constructed. This was done as follows:

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3.7.1.1. Overall academic performance, reading, writing and arithmetic. Since the sample is fifty nine, the t-test could be applied when comparing the means because of the central limit theorem. (If the sample is large enough the means will be normally distributed, irrespective of the population distribution.)

3.7.1.2. The presence of habitual postural patterns. The children were paired and arranged in 2x2 tables i.e. one table for each set of HPP's. Because of the small numbers in the specific variable of HPP's, non parametric statistics had to be used and McNemar's test was used to compare the presence or absence of HPP in the experimental and control groups.

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3.7.2.1. To investigate the effect of unintegrated PPR on academic achievement, 2x2 tables were constructed. This was done as follows:

	ACADEMIC ABILITY		TOTAL
	LE3	GT3	
PPR	ABSENT		
	PRESENT		
	TOTAL		

Fisher's exact test as applied to test for significant differences in the scores obtained by those children in whom a specific PPR was found and those who did not have that specific PPR. If a statistical difference existed between the two sets of data, a relationship between the reflex and failure to achieve a good academic rating was proved.

3.7.2.2. To investigate the effect of unintegrated PPR's on HPP, 2x2 tables were constructed and Fisher's exact test was used to determine any differences between the two sets of data. The 2X2 tables were constructed as follows:

	SPECIFIC HHP		TOTAL
	ABSENT	PRESENT	
<u>SPECIFIC PPR</u>	ABSENT		
	PRESENT		
	TOTAL		

If a statistical difference was found between the two sets of data, a relationship existed between the specific PPR and the specific HPP.

3.8. Summary

This chapter dealt with the research design and methodology used in the research. The pilot study was discussed and the measuring instruments enumerated upon. The actual study was discussed, as well as how the data was analysed. In this way it was hoped to establish whether a difference existed between the two groups in respect of academic achievement and habitual postural patterns. In addition, the candidate investigated whether a relationship existed between specific primitive postural reflexes and specific academic skills as well as specific primitive postural reflexes and specific habitual postural patterns.

4. RESULTS OF THE STUDY

4.1. INTRODUCTION

The results were studied and analysed in terms of the following:

- a) Selection of the experimental group.
- b) Matching of the experimental group with a control group.
- c) Comparing the performance at school between the experimental (affected) and control groups.
- d) Comparing the presence of habitual postural patterns (HPP) between the experimental (affected) and control groups.
- e) Comparing the presence of individual primitive postural reflexes (PPR) and performance at school in the experimental group.
- f) Investigating the possible correspondence between individual PPR and HHP in the experimental group.

4.2. SELECTION OF THE EXPERIMENTAL GROUP

If one or more primitive postural reflexes were present in a specific child, the child qualified for placement in the experimental group.

Out of 403 (100%) children tested at two schools in Krugersdorp (Protearifse Laerskool and Monument Primary

School), 156 (40.9%) children were identified as having one or more unintegrated PPR, according to the scores obtained. Out of this group only fifty nine (14.6%) children were selected for the experimental group. They were selected because they adhered to the criteria formulated (i.e. having one or more of the unintegrated primitive postural reflex, falling within the age group and within the IQ group stipulated) for this study as well as having a child to whom they could be matched within a control group. None of the children in the control group were found to have any remnants of primitive postural reflexes.

An analysis of the number and type of reflexes found in the fifty nine children are as follows:

Out of the fifty nine children (100%) in the experimental group, thirty three children (55.9%) had only one unintegrated PPR which was distributed as seen in Table 4.1.

TABLE 4.1: No of children who had only one unintegrated PPR in the experimental group

PPR	No Children	Group %
TLRS	2 children	(3.4%)
TLRP	1 child	(1.7%)
STNR	6 children	(10.2%)
ATNR	17 children	(28.8%)
AR	7 children	(11.9%)
PSR	0 children	(0%)

It was interesting to note that the ATNR had the

highest incidence. Of the remaining twenty six children (44.1%), twenty five children had an ATNR in conjunction with one or more of the other reflexes, while one child had a combination of STNR and AR. This showed that the ATNR was the reflex which most frequently occurred, twice as many times as the AR. Table 4.2 indicates the number of children with combinations of PPR.

TABLE 4.2: Number of children who have more than one

PPR.

PPR	No Children	Percentage
ATNR & AR	12 children	(20.3%)
ATNR & TLRP	6 children	(10.2%)
ATNR & TLRS	2 children	(3.4%)
ATNR & TLRP&S	1 child	(1.7%)
ATNR & STNR	1 child	(1.7%)
ATNR & PSR	1 child	(1.7%)
ATNR & AR & TLRP	1 child	(1.7%)
ATNR & AR & STNR	1 child	(1.7%)
STNR & AR	1 child	(1.7%)

The number of times that each reflex was observed in the total experimental sample of fifty nine children is seen in Table 4.3 and Figure 4.

TABLE 4.3: Frequency of unintegrated PPR

Reflexes	No of times	% of Children
TLRS	5	(8.5%)
TLRP	9	(15.3%)
STNR	9	(15.3%)
ATNR	42	(71.2%)
AR	21	(35.6%)
PSR	1	(1.7%)

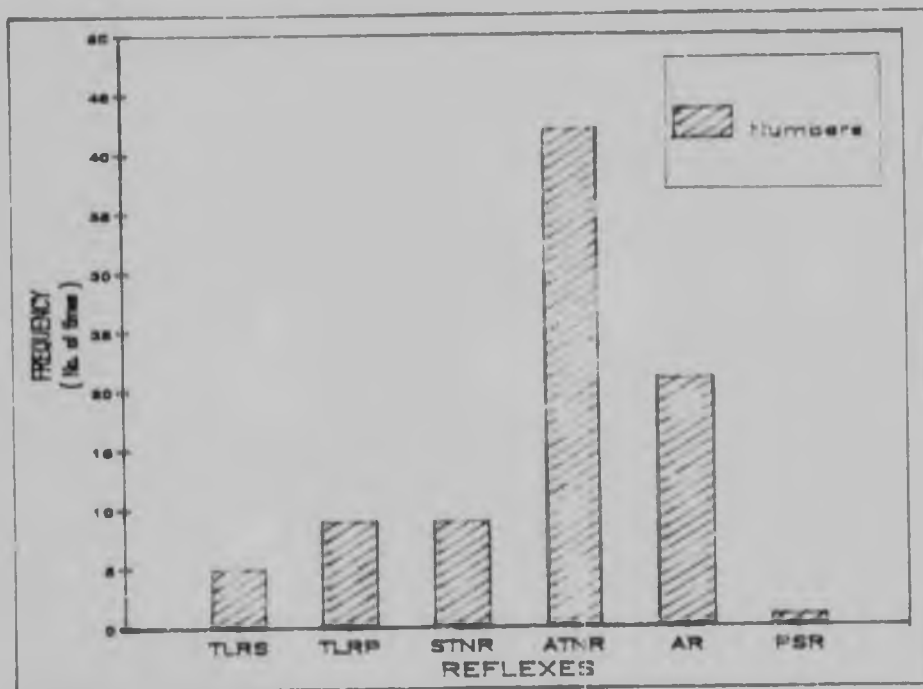


FIGURE 4:1: Histogram indicating frequency of unintegrated PPR in the affected group (n=59)

Some comment needs to be made about the inclusion of the PSR. Once again, the candidate could not identify PSR with certainty, except in one case. This child happened to be a hemiplegic, thus having a specific neurological impairment.

4.3. MATCHING OF THE EXPERIMENTAL GROUP WITH THE CONTROL GROUP

Matching was done according to the criteria previously defined, i.e. each pair had the same class teacher, were of the same sex, had the same age and fell within

the same IQ range. Each of the fifty nine children placed in the experimental group had one or more unintegrated PPR, and was matched to a child in the control group, whose PPR's were integrated. Table 4.4 provides the mean, SD and range of values for age and IQ in each group. As can be seen from this table, the age and IQ of each group is similar.

TABLE 4.4: Mean and SD of experimental and control groups for matching in terms of age and IQ (n=59 in each group)

<u>Variable</u>	<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>Range of values</u>
Age	Affected	7.78	0.88	6.34 - 9.59
	Control	7.78	0.88	6.00 - 9.84
IQ	Affected	109.34	11.73	92 - 146
	Control	109.29	12.56	90 - 146

4.4. COMPARING PERFORMANCE AT SCHOOL BETWEEN THE EXPERIMENTAL (AFFECTED) GROUP AND THE CONTROL GROUP

The two groups were compared for overall performance at school as well as for specific abilities in reading, writing and arithmetic in order to determine whether there were any significant differences between the two groups, thus whether a link could be established between the presence of PPR's and academic performance.

The paired t-test was used for this purpose.

It must be remembered that academic performance was

scored on a scale which ranged from one to five, one indicating a very good performance whereas five indicates poor performance. Two-by-two tables were constructed using three as the cutpoint.

4.4.1. Overall Performance.

A summary of the mean, SD, range of scores and p-value obtained through the paired t-test is recorded in table 4.5. The frequency figures are recorded in table 4.6.

TABLE 4.5: Mean, SD, range of scores and p-value based on the paired t-test in Experimental and Control Groups for Overall Performance

<u>Variable</u>	<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>	<u>p-value</u>
Overall	Affected	2.65	0.7	1 - 5	0.1330
Performance	Control	2.49	0.89		

TABLE 4.6: Observed frequency table for comparing performance between the experimental (X) and control (Y) groups:

		<u>Y-Perform</u>			<u>TOTAL</u>
		<u>1 to 3</u>	<u>4 to 5</u>		
<u>X-Perform</u>	<u>1 to 3</u>	36	5	:	41
	<u>4 to 5</u>	10	8	:	18
	<u>TOTAL</u>	46	13	:	59

On analysing the results obtained by each pair, it was found that in forty four pairs of children both the experimental and control groups obtained similar scores i.e. thirty six pairs a score of one to three and eight

pairs a score of four to five. Of the pairs that did not obtain similar scores i.e. fifteen pairs, ten children in the experimental group obtained low scores i.e. four to five while five obtained high scores i.e. one to three. Thus it can be seen that a high proportion of pairs of children i.e. 74.6 per cent received similar scores while only 25.4 per cent received different scores. The paired t-test showed that there was therefore no statistically significant difference between the overall academic performance scores obtained by the experimental and control groups ($p = 0.1330$).

4.4.2. Reading Ability.

In comparing the two groups in their reading performance, using the paired t-test, a similar result was obtained i.e. there was no significant difference between the two groups ($p = 0.2889$). Table 4.7 gives the mean, SD, range and p-value for the scores obtained in reading ability for the experimental and control groups and table 4.8 gives the observed frequency in a 2x2 table of reading scores.

**TABLE 4.7: Difference between Experimental and Control
usGroup for Reading**

<u>Variable</u>	<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>	<u>p-value</u>
Reading	Affected	2.54	1.06	1 - 5	0.2889
	Control	2.41	1.00		

TABLE 4.8: Observed frequency table for comparing reading between the experimental (X) and control (Y) groups:

<u>X-Read</u>	<u>Y-Read</u>			<u>TOTAL</u>
	<u>1 to 3</u>	<u>4 to 5</u>		
<u>1 to 3</u>	42	6	:	48
<u>4 to 5</u>	7	4	:	11
<u>TOTAL</u>	49	10	:	59

In comparing reading ability in the fifty nine pairs (100 per cent), it was found that in forty six pairs of children, both the experimental and control groups obtained similar scores i.e. forty two pairs one to three and four pairs four to five. Of the pairs that did not obtain similar scores i.e. thirteen pairs, seven children in the experimental group obtained low scores i.e. four to five while six children obtained high scores i.e. one to three. Thus it can be seen that a high percentage of pairs of children i.e. 78 per cent, received similar scores while only 22 per cent differed in their scores. The paired t-test showed that this difference in reading scores, between the experimental and control groups was not statistically significant ($p = 0.2289$).

2.4.3. Writing Ability

In comparing writing ability between the two groups, the difference between the two groups was again not

significant when using the paired t-test ($p = 0.2360$).

The difference between the means of the two groups, SD, the range and the p-value is summarised in Table 4.9. Table 4.10 gives the observed frequency in a two-by-two table between the two groups in writing scores.

TABLE 4.9: Difference between Experimental and Control Groups for Writing

<u>Variable</u>	<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>	<u>p-value</u>
Writing	Affected	2.76	1.06	1 - 5	0.3173
	Control	2.58	1.07		

TABLE 4.10: Observed frequency table for comparing writing between the two groups.

<u>X-Write</u>	<u>Y-Write</u>		<u>TOTAL</u>
	<u>1 to 3</u>	<u>4 to 5</u>	
1 to 3	39	6	45
4 to 5	10	4	14
<u>TOTAL</u>	<u>49</u>	<u>10</u>	<u>59</u>

When comparing the writing ability in fifty nine pairs (100 per cent) of children, it was found that in forty three pairs of children, both the experimental and control groups obtained similar ratings i.e. thirty nine pairs one to three and four pairs four to five. Of the pairs that did not obtain similar scores i.e. sixteen pairs, ten children in the experimental group obtained low scores i.e. four to five, while six children obtained high scores i.e. one to three. Thus it can be seen that a high percentage of pairs of children i.e. 72.9 per cent received similar scores

while only 27.1 per cent received different scores. The paired t-test showed that this difference was not statistically significant ($p = 0.3173$).

4.4.4. Arithmetic ability.

The paired t-test was again used to compare the two groups in terms of arithmetic ability. Table 4.11 gives the means, SD, range of scores and p-value obtained for arithmetic ability and Table 4.12 gives the observed frequency.

TABLE 4.11: Difference between means, SD, range of scores and p-value for Arithmetic in the two groups

<u>Variable</u>	<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>	<u>p-value</u>
Arithmetic	Affected	2.54	0.88	1 - 5	0.4054
	Control	2.32	1.67		

TABLE 4.12: Observed frequency table for arithmetic ability between the two groups.

<u>X-Arith</u>	<u>Y-Arith</u>		<u>TOTAL</u>
	<u>1 to 3</u>	<u>4 to 5</u>	
1 to 3	44	8	52
4 to 5	5	2	7
TOTAL	49	10	59

When analysing the results obtained by each pair, it was found that in forty six pairs of children, both the experimental and control groups obtained similar scores i.e. forty four pairs one to three and two pairs four

to five. Of the pairs that did not obtain similar scores, i.e. thirteen pairs, five children in the experimental group obtained low scores i.e. four to five while eight obtained high scores i.e. one to three. Thus it can be seen that a high percentage of pairs of children i.e. 78 per cent received similar scores while only 22 per cent received different scores. The paired t-test showed that again there was no statistically significant difference between the arithmetic scores obtained by the experimental and control groups ($p = 0.4054$).

4.4.5 Summary

Thus the Null (H_0) hypothesis which states that unintegrated PPR do not have a significant relationship to the child's performance at school is accepted. No statistically significant differences were found between the two groups of children when overall academic ability, reading, writing and arithmetic scores were analysed.

4.5. COMPARING THE PRESENCE OF HABITUAL POSTURAL PATTERNS (HPP) BETWEEN THE EXPERIMENTAL AND THE CONTROL GROUPS

Certain HPP were identified and studied in relation to a specific PPR. These HPP were grouped by the candidate and classified according to their similarity in pattern to that described in PPR's and therefore

their possible link to the PPR's (See Section 3.5.3.2. p 119).

A YES/NO method of recording was used to identify a. / HPP. Any positive answer denoted the presence of a particular variable in HPP's. Therefore a cutpoint of >0 was used for the calculation of statistical differences between experimental and control groups.

The presence or absence of HPP in the experimental and control groups were compared by using McNemar's test for paired data. It became evident that there was a definite difference in the prevalence of HPP between the experimental and control groups. The experimental group had more abnormal postural patterns than had the control group.

The p-value using McNemar's test for paired data in each group of HPP's is given in table 4.13.

TABLE 4.13: P-value according to McNemar's test
for paired data in comparing HPP in the
experimental and control groups (n=59).

<u>Variable</u>	<u>P-value</u>	<u>*Significance</u>
P-TLRS	0.02*	<0.05
P-TLRP	0.6	>0.05
P-STNR	0.02*	<0.05
P-ATNR	0.03*	<0.05
P-AR	0.0029**	<0.01
P-PSR	0.0027**	<0.01

* $p < 0,05$, ** $p < 0,01$

A p-value <0.05 indicates a probably significant difference between the two groups in respect of the variable HPP, whereas a p-value of <0.01 indicates an almost certainly significant difference between the scores obtained by the two groups and thus it seems that the experimental group had HPP's which could be related to unintegrated PPR's.

A difference in HPP existed between the two groups in HPP's which were classified according to P-TLRS, P-STNR, P-ATNR, P-AR and P-PSR (See table 4.13). The relationship of each HPP to its similar PPR is discussed in the following paragraphs:

4.5.1. HPP classified according to TLRS (P-TLRS)

Table 4.14 gives the frequency table for P-TLRS in the experimental (X) and control (Y) groups.

TABLE 4.14: Observed frequency table for HPP classified according to the TLRS.

		Y-P-TLRS		TOTAL
		ABSENT	PRESENT	
X-P-TLRS	ABSENT	31	4	35
	PRESENT	14	10	24
	TOTAL	45	14	59

When analysing the results obtained by each pair, it was found that in forty one pairs of children, both the experimental and control groups obtained similar ratings i.e. thirty one pairs did not have P-TLRS and ten pairs did have P-TLRS. Of the pairs that did not have similar ratings i.e. eighteen pairs, fourteen

children (23.7 per cent) in the experimental group did have a P-TLRS while four children (6.8 per cent) did not have a P-TLRS. Thus it can be seen that 69.5 per cent of children had similar ratings while 30.5 per cent were different. According to McNemar's test, a p-value = 0.0184 was calculated. This difference is probably significant at the 5 per cent probability level (See table 4.13).

4.5.2. HPP classified according to TLRP (P-TLRP)

Table 4.15 gives the frequency table for HPP, classified according to the TLRP between the experimental and control groups.

TABLE 4.15: Observed frequency table for HPP classified according to the TLRP.

		Y- P-TLRP			
		ABSENT	PRESENT		
X-P-TLRP	ABSENT	29	6	:	35
	PRESENT	8	16	:	24
	TOTAL	37	22	:	59

When analysing the results obtained by each pair, it was found that in forty five pairs of children, both the experimental and control groups obtained similar ratings i.e. in twenty nine pairs, both children did not have P-TLRP and in sixteen pairs, both children did have P-TLRP. The other fourteen pairs differed in their ratings. Eight children (13.6 per cent) in the experimental group had P-TLRP while the other six children (10.1 per cent) did not have P-TLR. McNemar's test calculated a p-value = 0.06 ($p > 0.05$)

which is not a significant difference between the two groups (See table 4.13).

4.5.3. HPP classified according to STNR (P-STNR)

According to McNemar's test a probably significant difference was found at the 5 per cent level in P-STNR between the two groups ($P = 0.0218$). Table 4.16 is the two-by-two table, constructed to compare the findings between the experimental (X) and control (Y) groups.

TABLE 4.16: Observed frequency table for HPP classified according to the STNR.

		Y-P-STNR			TOTAL
		ABSENT	PRESENT		
X-P-STNR	ABSENT	26	6	:	32
	PRESENT	17	10	:	27
	TOTAL	43	16	:	59

* $p = 0.02$ $p < 0.05$

In analysing the presence of P-STNR, thirty six (61 per cent) pairs of children out of fifty nine (100 per cent) pairs showed similar postural patterns i.e. twenty six pairs of children did not have P-STNR and ten pairs did have P-STNR. The other twenty three (39 per cent) pairs differed in the presence of the P-STNR.

In seventeen pairs (29 per cent), the children in the experimental group presented with the identified postural patterns while the children in the control group did not. Six (10 per cent) children in the control group presented with the identified postural

patterns while their counterparts in the experimental group did not. This difference was probably significant at the 5 per cent level (See table 4.13).

4.5.4. HPP classified according to ATNR (P-ATNR)

A p-value = 0.0330 (See table 4.13) was calculated between the experimental and control groups for P-ATNR by using McNemar's test. This is at the 5 per cent significance level.

Table 4.17 gives the two-by-two table constructed to compare the results between the experimental and control groups for the presence or absence of the P-ATNR.

TABLE 4.17: Observed frequency table for HPP classified according to the ATNR.

<u>Y-P-ATNR</u>		<u>ABSENT</u>	<u>PRESENT</u>	<u>TOTAL</u>
<u>X-P-ATNR</u>	<u>ABSENT</u>	23	6	: 29
	<u>PRESENT</u>	16	14	: 30
	<u>TOTAL</u>	39	20	: 59

Thirty seven pairs of children (62.7 per cent) had similar postural patterns i.e. in twenty three pairs, both did not have P-ATNR and in fourteen pairs both children did have P-ATNR. Twenty two pairs (37.3 per cent) differed in their postural patterns. Of these twenty two pairs, sixteen children (27.2 per cent) in the experimental group showed the presence of P-ATNR while those in the control group did not, and six children (10.1 per cent) in the control group showed P-ATNR while their counterparts did not. This is an

indication that the two groups differed respect of P-ATNR.

4.5.5. HPP classified according to AR (P-AR)

Table 4.18 represents the two-by-two table constructed to compare the presence or absence of P-AR in the experimental and control groups.

TABLE 4.18: Observed frequency table for HPP classified according to AR.

		Y-P-AR		TOTAL
		ABSENT	PRESENT	
-AR	ABSENT	37	3	40
	PRESENT	16	3	19
	TOTAL	53	6	59

From this table it is evident that forty pairs (68 per cent) had similar postural patterns, i.e. a pair either presented with P-AR or did not. Nineteen pairs (32 per cent) differed in their postural patterns. Of these sixteen (27 per cent) children in the experimental group presented P-AR while their counterparts did not, while only three (5 per cent) children in the control group presented with P-AR while their counterparts did not. $P = 0.0029$ is considered significant at the one per cent level as calculated on McNemars' test for paired data, therefore the presence of these patterns was found to be significantly more prevalent in the experimental group.

4.5.6. HPP classified according to PSR (P-PSR)

A p-value = 0.0027 showed a significant difference at the one per cent level of significance within the experimental and control groups for P-PSR.

Table 4.19 presents the two-by-two table constructed to compare the experimental group with the control group in terms of P-PSR.

TABLE 4.19: Observed frequency table for P-PSR.

	Y-P-PSR			TOTAL
	ABSENT	PRESENT		
X-P-PSR	ABSENT	33	2	: 35
	PRESENT	14	10	: 24
	TOTAL	47	12	: 59

From this table, it is evident that forty three pairs of children (72.9 per cent) had similar postural patterns and sixteen pairs (27.1 per cent) differed in their postural patterns. Of the sixteen pairs, fourteen children (23.7 per cent) in the affect group showed the identified patterns, while two children (3.4 per cent) in the control group did. Their counterparts did not. $P = 0.0027$ is considered a significant difference at the $P < 0.01$ level of significance(see table 4.13).

4.5.7. In summary

From the above analysis, it can be seen that there is a

significant difference in five out of the six groups of HPP's (see Table 4.13). A probably significant difference ($p < 0,05$) was found in P-TLRS, P-STNR, P-ATNR and a certainly significant difference with regard to P-AR and P-PSF ($0,01$). P-TLRP was the only group of HPP, i.e. linked to the TLRP, which did not show a significant difference between the two groups.

The nul hypothesis (H_0) two states that unintegrated PPR do not have a significant relationship to the habitual postural patterns of the child. This hypothesis is rejected and the alternative hypothesis (H_1) accepted. It states that unintegrated PPR do have a significant relationship to the habitual postural patterns of the child. This conclusion is supported by the fact that in five out of six instances, a significant difference was found in the HPP which were grouped according to their similarities to the PPR's.

4.6. COMPARISON BETWEEN INDIVIDUAL PPR'S AND PERFORMANCE AT SCHOOL IN THE EXPERIMENTAL GROUP ONLY

The differences between good (i.e. one to three) and bad i.e. (four to five) academic ratings in the presence or absence of each PPR were compared in the experimental group only, as it will be remembered that PPR's are not present in the control group. Table 4.20 gives the frequency of each reflex observed in the

experimental group, and the p-values obtained for academic skills when these were compared in terms of good or bad when a reflex was present. Fisher's exact test was used for this purpose. The data was unpaired and the frequency of the specific reflexes was low, therefore non-parametric statistics were used.

TABLE 4.2): Number of specific PPR (n) and p-values when specific academic skills were compared with specific PPR's in the experimental group only

<u>Variable</u>	<u>n</u>	<u>Overall Performance</u>	<u>Reading</u>	<u>Writing</u>	<u>Arithmetic</u>
TLRS	5	0.16	0.04*	0.58	0.48
TLRP	9	1.00	0.67	0.43	0.29
STNR	9	0.11	0.35	0.43	0.29
ATNR	42	1.00	0.28	0.31	0.66
AR	21	0.73	0.73	0.75	0.69
PSR	1	1.00	1.00	1.00	1.00

(*p<0.05)

In most cases there was no difference between the academic rating of children who had a specific reflex and those who did not have that reflex, therefore a link between the reflex and poor performance could not be established. In only one instance (i.e. reading) was there a significant difference between the scores of children who had a TLRS and those who did not (p =

0.04). It was possible, therefore to link the existence of a TLRS with poor scores in reading. Table 4.21 illustrates the two-by-two table constructed to compare reading ability with the presence of TLRS.

TABLE 4.21: Observed frequency table when comparing reading and the presence of TLRS.

		READ			
		LE3	GT3		
TLRS	ABSENT	46	8	:	54
	PRESENT	2	3	:	5
	TOTAL	48	11	:	59

If one analyses the performance of those children (in the experimental group), who had a TLRS, and those who did not, with reading ability, only five children (8.5 per cent) were identified as having an unintegrated TLRS while fifty four children (91.5 per cent) had integrated the reflex. Forty eight children performed well in reading, of which two (4.2 per cent) had not integrated the reflex. Eleven children performed poorly in reading, of which three (27.3 per cent) had not integrated the reflex. It was found that those who had positive signs of the TLRS had lower reading scores ($p < 0.05$) than those who did not have positive signs of the TLRS.

4.7. HABITUAL POSTURAL PATTERNS AND THEIR
RELATIONSHIP TO PPR ACTIVITY IN THE EXPERIMENTAL
GROUP ONLY

The candidate also examined the relationship between specific PPR activity and those HPP with similar patterns to a specific PPR within the experimental group.

TABLE 4.22: Mean, SD and range of scores for each group of HPP as studied in relation to each PPR. The p-value is calculated by Fishers exact Test and n denotes the frequency of each PPR in 59 subjects in the experimental group only.

<u>n</u>	<u>Variable</u>	<u>Mean</u>	<u>SD</u>	<u>Range</u>	<u>p-value</u>
5	P-TLRS	0.66	0.96	0 - 3	1.00
	R-TLRS	1.66	1.15	0 - 4	
9	P-TLRP	0.76	1.12	0 - 4	0.73
	R-TLRP	1.15	1.17	0 - 4	
9	P-STNR	0.53	0.65	0 - 3	1.00
	R-STNR	0.76	1.48	0 - 4	
42	P-ATNR	0.81	0.96	0 - 3	0.25
	R-ATNR	7.20	1.84	4 -12	
21	P-AR	0.37	0.58	0 - 2	1.00
	R-AR	14.53	3.68	2 -21	
1	P-PSR	0.75	1.18	0 - 4	0.41
	R-PSR	1.24	1.56	0 - 9	

Table 4.22 gives the mean, SD and range of scores for each PPR and for each HPP, as well as the p-value in the experimental group. Fisher's exact test was used to determine whether there was a statistical difference between those children who had both a HPP and its

related reflex and those who had a HPP but no related reflex. As no difference could be found between the two groups, it cannot be said that a relationship of HPP to a particular PPR exists (See table 4.22). For the purpose of clarity, the variables will be indicated by "P" denoting the HPP and "R" denoting the PPR.

The two-by-two tables constructed to study the relationship between PPR and HPP in the classroom situation are presented in tables 4.23 - 4.28. If one examines the number of children who showed positive HPP's (i.e. in the middle column), and compared this to the children who did not show HPP's (i.e. in the left column), then it can be seen that the percentages between those who show HPP's and those who do not, do not differ.

Table 4.23: Observed frequency table for R-TLRS and

		P-TLRS		TOTAL
		ABSENT	PRESENT	
usR-TLRS	ABSENT	32	22	: 54
	PRESENT	3	2	: 5
	TOTAL	35	24	: 59

TABLE 4.24: Observed frequency table for R-TLRP and

		P-TLRP		TOTAL
		ABSENT	PRESENT	
R-TLRP	ABSENT	29	21	: 50
	PRESENT	6	3	: 9
	TOTAL	35	24	: 59

TABLE 4.25: Observed frequency table for R-STNR and

		P-STNR			
		ABSENT	PRESENT		
R-STNR	ABSENT	27	23	:	50
	PRESENT	5	4	:	9
	TOTAL	32	27	:	59

TABLE 4.26: Observed frequency table of R-ATNR and

		P-ATNR			
		ABSENT	PRESENT		
R-ATNR	ABSENT	6	11	:	17
	PRESENT	23	19	:	42
	TOTAL	29	30	:	59

TABLE 4.27: Observed frequency table for R-AR and P-AR

		P-AR			
		ABSENT	PRESENT		
R-AR	ABSENT	26	12	:	38
	PRESENT	14	7	:	21
	TOTAL	40	19	:	59

TABLE 4.28: Frequency observed table of R-PSR and P-PSR

		P-PSR			
		ABSENT	PRESENT		
R-PSR	ABSENT	35	23	:	58
	PRESENT	0	1	:	1
	TOTAL	35	24	:	59

4.7. Summary

This chapter dealt with the results of the study.

No significant difference was found in the performance at school between the experimental and control groups.

The hypothesis which states that unintegrated PPR do not have a significant relationship to the child's performance at school, was thus accepted. Neither

could any meaningful relationship or difference be found between any of the individual PPR and the different academic skills.

A significant difference ($p < 0,05$) was found between the HPP in the experimental and control groups. The Hypothesis that unintegrated primitive postural reflexes do have a relationship to the habitual postural patterns of the child was therefore accepted.

No relationship could be found between specific PPR and HHP similar to PPR.

5. DISCUSSION

During clinical practice prior to this study, clinical observations used to evaluate a child's functioning and establish a baseline on which to plan therapy, indicated that there was a high incidence of unintegrated PPR's in learning disabled children referred for occupational therapy. This stimulated the candidate to investigate unintegrated PPR's in children attending normal school and whether unintegrated PPR's had a relationship to poor academic performance. In surveying all the qualitative and quantitative information collected during the course of the study, the following aspects are considered for discussion:

5.1. REVIEW OF THE LITERATURE

The literature was reviewed to find support for the candidate's observations of the possible relationship between unintegrated PPR's and learning problems. Simultaneously, the literature was reviewed to collect information that could form a basis for compiling a PPR profile for evaluation purposes to be used in this study. At the same time, HPP were described with the subsequent compilation of a suitable questionnaire for use with teachers. The candidate proceeded to study literature pertaining to the neuro-physiological aspects underlying PPR to gain a better understanding

of these PPR. A summary of the functions of the central nervous system is outlined in Chapter Two: pages 14 - 22. Ayres (1972a) and Farber (1982) also described the neuro-physiological basis related to PPR and especially those aspects related to sensory integration treatment and a multisensory approach in neuro rehabilitation. They stated that the integration of PPR is important. Historically, the treatment of unintegrated PPR's is relevant as it's importance is recognised in the subconscious control of posture which forms the background for movement skills.

Movement skills are the product of sensory stimulation and integration of the stimuli.

Once the background information was compiled, the candidate studied literature related to those PPR relevant to this study. The literature was analysed in terms of the description of the reflex, methods of testing, significance of the reflex to motor development and the adverse effects on motor ability if not adequately integrated. The Bobaths (1965) and Fiorentino (1963) particularly elaborated on the effect of unintegrated PPR's in children with severe neurological dysfunction.

Researchers such as Ayres (1972a), Rider (1972a & b), Montgomery and Richter (1980), Walker and Bony (1981), Bundy and Fisher (1982), Harris (1981), Dunn (1981) etc. all described testing methods for PPR in children with learning difficulties and it was possible to compile a PPR testing profile from methods found in the literature. Very little reference was made in the

literature regarding the particular effects of unintegrated PPR's on habitual postural patterns (HPP's). The candidate made the assumption that there could be links between the two in children with learning problems. The candidate thus endeavoured to identify and record HPP's which could be studied in relation to unintegrated PPR. These are enumerated upon in Chapter III point 3.5.3.2.2. (p.114).

5.2. COMPILING THE MEASURING INSTRUMENTS

5.2.1. ASSESSMENT OF PPR

As already stipulated in Chapter III point 3.5.3.1.: p.83, the principles applied in compiling the assessment protocol for PPR were, firstly, the use of a standard rating scale for all tasks chosen for the evaluation, and secondly, the use of a variety of tasks to evaluate each PPR.

In analysing the different tests used to evaluate each PPR, there was found to be an imbalance in the number of tests assigned to each reflex See table 5.1.

From table 5.1, it can be seen that the number of tests varied from two to fourteen for the different PPR's evaluated. This could have influenced the identification of the PPR.

Table 5.1: Number of tests assigned to each PPR

<u>PPR</u>	<u>Number of tests</u>
TLRS	3 tests
TLRP	2 tests
STNR	2 tests (head dorsiflexed and head ventroflexed)
ATNR	6 tests (three with head to left and three with head to right)
AR	14 tests (seven on each side)
PSR	10 tests (five on each leg)

It is interesting to note that Sieg and Shuster (1979) who compared three different methods of evaluating the ATNR, came to the conclusion that any of the three methods they used could be used with the same results.

At the same time, they commented that some clinical judgement in rating each method would be necessary.

The candidate felt that the use of more than one task was necessary to evaluate the presence of each PPR and that a similar number of tests be selected for each PPR to obtain parity in the evaluation of the different PPR's. On the other hand, one should identify the one specific test most appropriate for evaluation of each PPR as did Sieg and Shuster (1979). They compared three different testing methods for evaluating the ATNR for effectiveness and reliability.

The rating scale for each task was easy to follow and few problems were experienced. The method of rating applied to all tests was based on the rating scale used by Towne (1979) in his Examination of the Child with

Minor Neurological Dysfunction. It should, however, be recorded that Zemke (1982) when she studied the ATNR used specially designed apparatus to measure the effects of the ATNR. Zemke's method could be more scientific, as the child was positioned more accurately. The candidate could have given more consideration to similar scientific methods such as the use of electrodes on those muscles involved or even apparatus in which to position each child specifically, for example, the quadruped position with the head in the midposition.

Another aspect worth discussing is the cutoff point used in the identification of PPR's. As a variety of tests was used to evaluate the presence of unintegrated PPR's, the candidate decided to use as a cutoff point the median of the total values possible for each PPR. This cutoff point has not been scientifically established or proven. Computing a distribution curve and aligning it to a normal gaussian curve would possibly help to get a more realistic cutoff point. This cutoff point could have been one SD to the left on the normal distribution curve and would have given a higher cutpoint. This gaussian or distribution curve could have been compiled from the data obtained from all the 403 children evaluated for the study.

In a retrospective analysis of the use of the cutoff points, the candidate realised that the percentage of children found with unintegrated PPR (namely 156 out of 403 which amounted to 38.7%) is too high when compared to the 20% expectancy percentage of children with learning disabilities in a normal population group (Smith 1986).

In analysing the different tests used for the evaluation of PPR, the candidate feels that some tests were administered with more confidence. These were those tests described by other researchers and used specifically for the purpose of identifying unintegrated PPR's. These tests included those using opposite postural patterns in the TLRS/P and the ATNR as well as those stimuli specifically applied to elicit a PPR as in the case of STNR, ATNR and AR. Other tests which the candidate included were obtained from tests with similar actions as those required for the evaluation of PPR's but were actually described for different reasons such as evaluating muscular fitness, hyper- or hypotonia, co-ordination and balance (Kephart 1960 and Townen 1979).

The candidate included those tests described by Kephart (1960) and Townen (1979) as the distribution of muscle tone brought about by a PPR could have an effect on the strength or fitness of a muscle, on muscle tone adjustments for equilibrium and on balance reactions, as well as co-ordination skills.

There was a specific question regarding the link

between strength and PPR'S in those tests requiring situps, straight leg raising (either in supine or prone) and lifting the head and thorax in prone as either adequate muscle strength or PPR's could prevent the adequate performance of these tests. The candidate realises that muscle strength is an important prerequisite for performing these tests. On the other hand, if muscle strength is diminished, the effect of the PPR's on strength should be considered. These tests described by Kephart (1960) and Towne (1979) used in this dissertation were not used in isolation to identify unintegrated PPR's, but aided in identifying an unintegrated PPR with more certainty.

Another aspect needing more discussion is the reason for evaluating the upper limbs in rating the presence of the STNR and the ATNR and not the lower limbs. The candidate did not negate the effect of these PPR's on the trunk, hips, knees and feet, but these reflexes have a greater effect on the upper limbs according to the literature (Ayres 1972a, Dunn 1981, Montgomery and Richter 1981, Zemke 1980). As these reflexes seem to have a greater influence on the upper limbs, it is easier to identify the presence of the reflex in the upper limb. It also simplifies the evaluation procedure and makes it less complicated than evaluating the trunk, hips, knees and feet at the same time. It should however be recorded that Bender (1976) has designed an evaluation procedure for the STNR taking

every part of the body into consideration (head, upper limbs, hands, hips, knees, feet etc.). This is a very comprehensive evaluation of only one reflex and the candidate did not want to overemphasise one reflex. In addition, special video equipment was needed in order to administer this evaluation. The candidate attempted to compile an evaluation procedure which could be used easily in clinical situations.

Some comment needs to be made about the inclusion of the PSR. Once again, the candidate could not identify PSR with certainty, except in one case. This child happened to be a hemiplegic and therefore had a specific neurological impairment. It was interesting to note that despite the fact that the PSR could not be identified, many children in fact had problems with the HPP classified according to PSR terminology. The reason for this could be attributed to other factors, such as poor balance or poor gross co-ordination. It should, however, be remembered that the reasoning pertaining to the effect of the PPR on muscle tone, muscle tone adjustments in equilibrium and balance reactions, muscle strength and co-ordination should not be ignored. The same reasoning would apply to the inclusion of those tests pertaining to balance, such as standing on one leg. The other task, namely walking on the heels, also needs some comment. The candidate thought that if the PSR enhanced plantar flexion, it would thus prevent the easy acquisition of dorsiflexion

or even the maintenance of the dorsiflexion needed to walk on the heels. That is the reason why this task was included in the evaluation of the PSR, but was found not to be good for eliciting the PSR (possibly because the stimulus that commonly elicits a PSR was eliminated i.e. pressure on the ball of the foot).

The evaluation of AR refers to both mirror movements and associated movements. For the purpose of clarity, the candidate would define mirror movements as those movements occurring on the opposite side of the body, mirroring or copying the exact movements on the other side. Associated reactions/movements are more intense and present in patterns of the strongest muscle synergies (i.e. flexor pattern muscles in the upper limb and extensor pattern muscles in the lower limb). Therefore, effort on one side of the body would elicit patterns of excessive flexion in the upper limbs on the opposite side. Associated tongue movements can also occur as a result of intense effort in performing a task. Townen (1979) described most of these tests and he used the terms mirror/ associated movements as synonyms.

The reader also becomes aware of the same task being used for evaluating both AR and PSR as seen in walking on toes and walking on heels. These tests were described by Townen (1979), who in fact evaluates both AR and walking ability at the same time. According to

Towen (1979), the significance of high scores usually indicates hypotonia, hypertonia, hemisyndromes and possible manifestations of slow neurological development.

Different rating scales were used for the different variables compared in this study. The rating scale used for the evaluation of PPR's consisted of a score nought, one and two. The recording system used for identifying HPP consisted of yes/no answers. "Yes" was given a rating of one whereas "no" got a rating of zero. Academic performance was rated on a scale which ranged from one to five. These different rating scales did not really cause any problems. The candidate, however, feels that the rating for academic skills (which ranged from one to five) allowed for a very wide range of ability within each rating which could affect the accurate analysis of good or poor ability in these skills.

5.2.2. THE HABITUAL POSTURAL PATTERN (HPP) QUESTIONNAIRE

Although the teachers were specially briefed and the HPP questionnaire was explained in a meticulous way by means of a lecture illustrated with transparencies, it was found that all the teachers did not complete the questionnaire with the same amount of insight and accuracy. This was noticed by the candidate when a particular child portrayed a specific HPP in the test situation and this was not noted by the teacher. Teachers are not trained in the observation skills

needed to detect postural patterns as is an experienced therapist. They are not aware of the abnormal postural patterns and are therefore not fully familiar with them. A solution to this problem could have been to utilise the observation skills of another therapist to observe the children's habitual postural patterns in the classroom situation.

In comparing the method of the evaluation of PPR and those HPP occurring in the classroom situation, the reader becomes aware of the similarity between certain tests in the PPR profile and certain activities in the school. Special reference is made to those tests pertaining to prone extension, doing sit-ups, straight leg raising, standing on one leg, walking on toes, walking on heels and jumping on one leg.

Specific instructions are given in a standardised method to evaluate PPR activity. They are often timed with a stopwatch and executed in a specific way. Similar actions occur in the school situation, such as in normal functional movement activities, especially during physical education classes. It is in these situations that the teacher has the opportunity to observe inadequate performance of these movement skills which are then linked to the concept of habitual postural patterns as outlined in the questionnaire.

The candidate does not deny that other causes such as

low tone, fatigue, weak muscles and other problems could be responsible for the presence of these identified HPP, but once again, if these patterns are habitually present, it was felt that the possibility of the effect of PPR's should be investigated.

The academic rating of each child was also subjective and allocated by each individual teacher according to her own norm. Some teachers were very strict and would seldom rate a child at one, whereas other teachers again would seldom rate a child at five. For this reason, the candidate chose the cutpoint between four and three, three to one denoting good performance and four or five denoting poor performance.

5.2.3. OBTAINING THE IQ

For the purpose of this study, group IQ tests were applied. Two different types of IQ tests were used, one for the six to eight year old age group and the other for the nine year old age group. These were the only tests available. All the children to be matched with each other were subjected to the same IQ test which was an important factor in pairing the children.

Out of 403 children, thirty children presented with an IQ below ninety using the respective group IQ tests. These children were automatically omitted from the study.

5.3. SELECTING THE GROUPS AND PAIRING THE SUBJECTS

The candidate intended using all the schools in Krugersdorp which did not have an aid class. There were nine of these schools. The names of the schools were listed alternating English with Afrikaans. After evaluating the children at the first two schools, the candidate had collected a big enough sample to make the comparative studies as set out in the aims. The groups were large enough according to the statistician.

Retrospective analysis showed that the type of population group seen at the selected schools, was representative of different socio-economic groups namely wealthy, middle class and poor. The children also came from urban and more rural (plots) environments. However, the schools should have been randomly selected by making and using a set of random tables.

Once all the data on the children evaluated was available, it was possible to select the experimental (affected) and control groups. This was done manually and by the candidate. There were approximately thirty children in each class and matching had to be done within such a group.

5.4. DATA ANALYSIS

An aspect which was affected by inadequate insight and an inability to convey exactly what the study should investigate, was the small numbers obtained for some of the PPR's namely the TLRS (5), TLRP (9), STNR (9) and PSR (1). These small numbers possibly do not allow for accurate deductions concerning the individual reflexes in relation to academic performance and HPP's.

A factor analysis was considered to investigate the variables which have a strong relationship to each other. However, the Bio-statistical department could not execute an appropriate programme on the data. This resulted in the fact that this aspect could not be studied as the candidate did not plan this to take place when the study began.

5.5. COMPARATIVE STUDY BETWEEN THE TWO GROUPS IN RESPECT OF ACADEMIC ACHIEVEMENTS (AIM 1)

5.5.1. Overall Performance

The results obtained did not indicate any significant difference ($p = 0.1330$) in the average percentage of the two groups in overall performance at school. This was not in accordance with the findings by Rider (1972b) who carried out studies on "The Relationship of Postural Reflexes to Learning Disabilities". She pointed out that normal grade two children without any abnormal reflex responses had higher mean scores on the subtests of the Wide Range Achievement Test (WRAT)

(reading, spelling and arithmetic) than those children with abnormal responses. See table 5.2 as presented by Rider (1972b)

Table 5.2: "Mean scores of normal second grade children on WRAT subtests"					
WRAT subtests	Children who exhibited all normal reflexes n = 21	Children who exhibited abnormal reflexes n = 17	SD	Correlation	Significance
Reading	70.1	64.67	8.5	.29	<.10
Spelling	40.8	37.94	4.2	.68	<.01
Arithmetic	31.1	28.41	5.1	.23	NS"

Rider (1972b) felt that the significance was high enough to warrant further research. In my opinion, only one correlation has an adequate level of significance namely .68 for spelling, and one a low degree of correlation namely .29 for reading. Allan (1982) stated in general that "a co-efficient of 0,5 to 0,74 indicates a moderate degree of correlation and a co-efficient of 0,25 to 0,49 indicates a low degree of correlation". According to Rider (1972b), Kerlinger states that even correlations of around .30 should be considered as valuable leads for theory and subsequent research. In her study, she recorded that the prevalence of abnormal reflex responses correlated highly with spelling achievement ($r=.68$; $p.<.01$), moderately with reading ($r=.29$; $p.<.10$), and did not reach significance in arithmetic achievement ($r=.23$). In fact, she found a significant relationship between prevalence of abnormal reflexes and scores on reading

and spelling subtests of the WRAT in normal children when the data was analysed by Point Biserial Correlation. (In this group of thirty eight children, twenty one exhibited normal reflexes whereas seventeen exhibited abnormal reflexes). Rider's (1972b) learning disabled group consisted of twenty children of which only two did not have abnormal reflexes. These two children performed academically at a higher level (as measured on the WRAT) although all the learning disabled children performed on a low level. Rider (1972b) studied two groups of children that differed markedly and which were not matched to each other. The candidate studied two matched groups which did not differ markedly but only in the presence or absence of PPR's.

The study carried out for this dissertation had similar findings in that the mean scores on reading, writing and arithmetic were poorer in the experimental group than in the control group. It should, however, be pointed out that the respective p-values for these specific academic skills were not significant in this study. See tables 4.5, 4.7, 4.9 and 4.11. They were, however, based on more relevant statistical procedures.

The results obtained warranted acceptance of the Null Hypothesis 1, which stated that unintegrated PPR do not have a significant effect on the child's performance at

school. Although no significant difference was found in specific academic skills such as reading, writing and arithmetic, there was a definite trend in that poorer mean scores in the experimental group denoted that the group did not perform as well as did the control group.

5.5.2. Reading Ability

It is interesting to record that according to Ayres (1972a) and Kephart (1960), one of the aspects important in reading ability is good eye control or eye movements. If eye control is adequate, then the child will be able to move the eyes over a sentence without losing his place, causing stammering or having difficulty finding his place again (quick localisation). Smooth eye movements will ensure good pursuits and crossing the midline of the body. Good eye movements are dependent on adequate head control, which means that the head can move independently from the rest of the body and maintain itself in the upright posture against gravity (Bobath 1956). This is only possible if the basic postural reflex mechanism has developed adequately and allows the person to conquer gravity. Development of an adequate postural reflex mechanism is dependent on the integration of PPR's which will allow free and independent combinations of movement patterns and a wide variety of complex movement patterns (Bobath 1965, Fiorentino 1981, Ayres

1972a, Montgomery and Richter 1980).

Taking all this background information into consideration, it is interesting to note that no significant difference could be found in reading skills of the affected and control groups. The reasons could be: 1) identification of PPR is not accurate; 2) unintegrated PPR in the minor neurologically impaired do not necessarily influence eye movements to such an extent that reading ability is affected.

5.5.3. Writing Ability

In analysing the technical aspect of writing ability, the candidate came to the conclusion that it is dependent on good pencil grip and control which is dependent on good postural control. Good postural control is only possible if the person has a variety of complex movement patterns which could be utilised voluntarily against a normal adaptable postural reflex mechanism. A normal adaptable postural reflex mechanism is only possible once PPR's have been adequately integrated.

This statement is supported by what Rider (1972b) recorded in her findings, namely that she found a relationship that was particularly evident in reading and written spelling in a learning disabled group who had abnormal reflexes. She said that the highly significant relationship between spelling and prevalence of abnormal reflexes might be more a function of the motor aspect of the spelling test

(writing) than a cognitive function.

Once again, taking this background information into consideration, it is interesting to note that no significant difference between the two groups as regard handwriting could be detected. The reasons could be: 1) Identification of PPR were not accurate; 2) Unintegration of these reflexes do not necessarily influence the physical ability to writ. 3) The norms that teachers apply differ, even if the matched pairs had the same teacher, which does not give an accurate overall rating of handwriting; 4) Rider's (1972b) group was selected because they had learning problems, whereas the experimental group in this dissertation was chosen because they had unintegrated PPR's.

5.5.4. Arithmetic Ability

The candidate feels that arithmetic is mainly a mental ability and thus a child should be able to manipulate the concepts independently of physical movements.

It is, however, believed that arithmetic concepts are based on spatial awareness (Kephart 1960, Bender 1976) which is only possible if a child has experienced movement, propulsion and moved around to learn about space. This moving about is also dependent on adequate movement patterns which are only possible if PPR have been adequately integrated. This academic

skill also did not show any statistically significant difference between arithmetic scores obtained by the experimental and control groups ($p = 0.4054$).

5.5.5. Summary

In summary, all the discussion pertaining to the effect of unintegrated PPR's on academic achievement reveals that unintegrated PPR's do not appear to have an influence on reading, writing and arithmetic skills. This study certainly did not prove that it had any significant effect on any of these skills which are necessary for academic learning.

In the candidate's opinion, not all children who have unintegrated PPR's have learning problems. In fact, the presence of unintegrated primitive postural reflexes is not a diagnostic feature of children with learning problems, but all children with learning problems should be evaluated for unintegrated PPR as it could be one of the contributing factors to their difficulties in the learning situation.

To support this opinion, reference is made to Rider's (1972b) statement:

"The fact that children with learning disorders had significantly more abnormal reflexes than did the normal children, lends empirical support to the theory of minimal neurological impairment as a factor in the etiology of learning disabilities" (Rider 1972).

5.6. COMPARATIVE STUDY BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS IN RESPECT OF HPP (AIM 2)

The results obtained (See Table 4.1) indicated a probably significant ($p < 0.05$) difference between the two groups in five out of six variables compared in HPP's. The variables showing probably significant differences are those HPP classified according to TLRS, STNR, ATNR, AR and PSP. There is very little literature available on or applicable to this aspect of the study, and findings are purely those observed by the candidate.

The two groups were selected according to the presence or absence of PPR's. Therefore, no PPR's occurred in the control group. Both groups displayed HPP, but the occurrence in the experimental group was statistically significantly higher than the same HPP's displayed within the control group. Table 5.3 gives the number of occurrences in both PPR's and HPP's

TABLE 5.3: Prevalence of PPR and HPP in the experimental and control groups.

Variable	Primitive Postural		Habitual Postural	
	Reflexes		Patterns	
	Affected	Control	Affected	Control
TLRS	5	0	24	14
TLRP	9	0	24	22
STNR	9	0	27	16
ATNR	42	0	30	20
AR	21	0	19	6
PSP	1	0	24	12

As the groups were selected according to the presence or absence of PPR's, it is self-evident that none of the children in the control group would have a PPR. The high incidence of HPP's in the control group could be ascribed to the fact that any one occurrence of any suggested HPP was positive and was thus recorded as being present.

It should be pointed out that a certain number of tasks were allocated to each variable in PPR's and HPP's. The number of tasks for each variable is summarised in table 5.4.

Table 5.4: Number of tasks allocated to each variable

	in PPR'S and HPP's	
	HPP	PPR
TLRS:	2	3
TLRP:	3	2
STNR:	4	1 (2)
ATNR:	3	3 (6)
AR :	2	7 (14)
PSR :	5	5 (10)

(The value in brackets indicates that the task pertained to left and right side which doubled the number of tasks for that particular variable)

It is also interesting to note that HPP's occurred more frequently than PPR's (see Table 5.3.) in variables classified according to TLRS, TLRP, STNR and PSR, whereas the variables ATNR and AR appeared more frequently in the PPR than HPP. It is difficult to analyse these findings, but the following should be borne in mind when streamlining the study for future

investigations:

1. A similar number of tasks should be allocated to each aspect being investigated.
2. The YES/NO method for recording HPP's was used to simplify scoring for the teachers. A positive "Yes" denoted the presence of a particular variable in HPP's. Therefore, the cutpoint was >0 . A similar rating scale than that used for identifying PPR's namely 0, 1, 2 could have been considered and a cutpoint established by means of constructing a distribution curve with the cutpoint at -1.0 SD.
3. Even greater care should be taken to guide the teachers in the completion of the HPP by making sure that they understand how to identify HPP's, or alternatively to use another therapist in filling out the questionnaire on HPP's.

It was interesting to note how many more children presented with specific HPP's than had difficulty performing those tasks related to the PPR (See Table 5.3). Inevitably, the question was raised whether the criteria used in evaluating performance on PPR's and HPP's tasks were realistic or not. On the other hand, Townen (1979) described some of these testing methods very specifically, especially those pertaining to AR and difficulties seen in standing and walking tasks. He did not specifically ascribe any difficulties to a PPR in those tests executed in standing and walking,

but often referred to poor performance due to hypo- or hyper-tonicity and mild hemi-syndrome. According to the candidate, this could indirectly refer to the presence of a PSR.

The comparison of PPR's and HPP's indicates that the Null Hypothesis (H_0) (i.e. unintegrated PPR) does not have a significant effect on HPP of the child which may not be rejected out of hand or accepted as it stands, as the significance level is only $p < 0.05$. Five of the six variables proved to be almost certainly significant at $p < 0.05$. These were the HPP's related to the TLRS, STNR, ATNR, AR and PSR. Only one of the variables supported this hypothesis and this was the HPP related to TLRP.

5.7. INVESTIGATING ANY RELATIONSHIP BETWEEN SPECIFIC PPR AND SPECIFIC ACADEMIC SKILLS IN THE EXPERIMENTAL GROUP ONLY

Comparisons were made between the presence of absence of a particular reflex and the achievement of a good or poor score in the various aspects of academic performance (see Table 4.20 p. 156). Only one variable, i.e. TLRS showed an almost certainly significant difference in the reading scores between those children who had a TLRS and those who did not ($p = 0.04$, $p < 0.05$).

Super (1979), in his investigations of movement patterns relevant to perceptual testing, found that the Kraus-Weber sit-up test loaded heavily as a factor in

reading ability ($r = .86$). The candidate also used the Kraus-Weber test as a means of evaluating the presence of the TLRS. It seems that the link between reading and the TLRS was also confirmed by Super (1979).

There were no differences other (that that of reading) between academic performance and the presence or absence of a specific reflex found by the candidate. One could reason that the samples available were not representative enough e.g. only 5 x TLRS, 9 x TLRP, 9 x STNR, 21 x AR and 1 x PSR. On the other hand, the only variable having an adequate sample, namely 42 x ATNR proved no relationship with any of the specific academic skills.

It could be reasoned that too much splintering of variables was affected by the breakdown of PPR, and that PPR should be investigated as a unit. Alternatively, one should study the relationship of only one PPR (i.e. TLRP) as the classifying variable for placement in the experimental group in a study.

5.8. INVESTIGATING ANY RELATIONSHIP BETWEEN SPECIFIC PPR AND SPECIFIC HPP IN THE EXPERIMENTAL GROUP ONLY

This relationship could only be studied in the experimental group as the control group had no PPR

activity. As enumerated in Chapter III and Chapter IV, the candidate drew up her own criteria to select tasks representative of those HPP that could be related to the PPR. The aim of the study was thus to investigate whether or not any relationship existed between a specific PPR and the corresponding HPP as suggested by the candidate.

The sample size should be taken into consideration as it related to the number of different PPR. It could be argued that the sample size for each PPR was too small (e.g. 5 x TLRS, 9 x TLRP, 9 x STNR, 21 x AR and 1 x PSR) to conduct a meaningful comparison. On the other hand, 42 x ATNR was an acceptable sample size, according to the statistician. The p-values for these variables were $p = 0.25$ which did not prove any relationship at all (See table 4.26 p.160).

A correlation matrix may have shown some relationship between all the factors. However, this is not a good statistical tool and was not used in this study.

5.9. IMPLICATIONS OF THIS STUDY FOR OCCUPATIONAL THERAPISTS

This study proved that enough literature pertains to PPR. The effect of unintegrated PPR can not be totally ignored when dealing with children, especially those having problems at school. It did, however, prove that

unintegrated PPR in a normal school going-population have no effect on the ability to learn i.e. PPR's by themselves do not result in poor learning ability. DeGangi and Berk (1983), in their studies while compiling the DeGangi-Berk Test for Sensory Integration, (which consists of subtests evaluating postural control, bilateral integration and reflex integration), found that the reflex integration subtests do not have the same diagnostic potential as do those subtests evaluating postural control and bilateral integration in diagnosing sensory integration difficulties. However the significance of unintegrated PPR as it relates to children with learning problems could not be proved either way and further studies asking more probing questions should be designed.

The following examples are given:

1. Establishing possible reasons for the abnormal habitual postural patterns observed in the school situation, such as muscle weakness, balance problems etc.
2. Establishing a scientific cutpoint for identifying unintegrated primitive postural reflexes.
3. The effect of unintegrated PPR's on behaviour.

4. Whether the ATNR has any effect on left and right sides of the body.
5. Comparing numbers of IPR in normal and learning disabled populations.

It is also difficult to isolate specific aspects, as all aspects contribute and influence one another in the total functioning of a child. Giving weighting to a single aspect of function, so that it alone can be used as a diagnostic or measuring tool, is a very dangerous practice or principle to apply in evaluation and treatment. Degangi and Berk (1983) also express concern in the use of reflex integration subtests alone in diagnosis, and therefore discourage it. The therapist should never lose sight of the totality of the individual and his specific unique situation. The evaluation of PPR's possibly contributes to establishing a base' for the treatment of a child who has certain problems hampering him in the learning situation.

6. CONCLUSION

It was the purpose of this study to investigate the effect of primitive postural reflexes on children with learning problems. The children with learning problems were those in the normal school situation with a normal IQ but not actualising their potential. These children are often referred for special evaluations and therapeutic procedures. The study was thus designed (1) to establish whether there was a relationship between primitive postural reflexes and overall academic performance, as well as (2) whether there was a relationship between primitive postural reflexes and habitual postural patterns. In addition, the candidate also investigated whether there was a relationship between specific primitive postural reflex activity and (a) specific academic skills such as reading, writing and arithmetic as well as (b) specific habitual postural patterns.

Hypotheses were formulated to the effect that unintegrated primitive postural reflexes do not have a relationship with academic performance and do not have a relationship to habitual postural patterns.

In order to conduct the study, the candidate had to review the literature that pertained to primitive postural reflex activity as well as compile measuring tools to evaluate the presence of primitive postural

reflexes and habitual postural patterns.

The study was then designed as follows:

1. All grade one, grade two and standard one children in two schools were tested by the candidate in a standardised way to detect any unintegrated primitive postural reflexes. The schools selected to be used for the study did not have an aid class, as it was hoped that any children with learning problems would thus be included in the main stream and not grouped together in a specific aid class. The candidate would thus not be aware of those children who were performing poorly at school.
2. The teachers of these children were asked to complete a questionnaire which gave information on the child's age, sex, an average rating for overall academic performance, and specific ratings for reading, writing and arithmetic. In addition, they had to mark a questionnaire which posed specific questions on habitual postural patterns for each child in the classroom situation. These were yes/no answers.
3. All the children were tested on group IQ tests with the assistance of the School Psychological services.

The candidate then proceeded to select the experimental and the control groups. The experimental group consisted of those children with one or more unintegrated primitive postural reflex. In addition, they had to be within the age group six years to nine years eleven months, and to be within the IQ range of ninety to 146.

Each child in the experimental group was then matched to a child in the control group. Matching had to adhere to the following criteria:

- a) the same sex;
- b) similar age (within six months of each other),
- c) similar IQ (within ten points) and
- d) the same class teacher.

Once all the data was available, statistical measures were used to compare the two groups with each other in order to determine whether differences occurred between them. This was done to fulfil the aims of the study.

The candidate found that no significant difference existed between the two groups in respect of their academic performance. It was, however, interesting to note that throughout, the experimental group obtained higher mean scores for overall performance, reading, writing and arithmetic than did the control group. This indicated that the experimental group did not do as well academically as the control group. Thus it

could be assumed that the presence of primitive postural reflexes does influence postural patterns but other factors (variables) which were not taken into account in this study e.g. family background (socio-economic) could have played a part here.

A significant difference existed between the two groups in respect of habitual postural patterns. In fact, those children with unintegrated primitive postural reflexes had significantly more habitual postural patterns than those children who had integrated their primitive postural reflexes.

Generally, no relationship could be found between specific primitive postural reflexes and the specific skills in academic achievement, except for one which indicated a relationship between the tonic labyrinthine reflex in supine and reading ability and no reasons can be found for this possible relationship. Neither could any relationship be found between specific primitive postural reflexes and specific habitual postural patterns.

The candidate feels that it was certainly worthwhile to conduct research on the presence of primitive postural reflexes, as these are often included in the evaluation and treatment of patients with learning problems attending occupational therapy. It helps to bring the role of PPR in children with learning problems into

perspective and therapists must thus be careful that they do not overemphasise the effect of these reflexes when planning treatment of patients.

Thus the aims of the study were fulfilled, the hypothesis was not disproved. No relationship was found between the presence of primitive postural reflexes and academic achievement, but a definite relationship was found between the presence of primitive postural reflexes and habitual postural patterns. However, it must be born in mind that, as Rider (1972b) pointed out, it is possible for a learning disabled population to have a high incidence of unintegrated primitive postural reflexes. This incidence, however, does not affect the learning disability per se.

The study, however, emphasises the fact that assumptions made concerning the causes of a child's learning problem cannot be made. Ayers (1972a) very aptly pointed out

"Intermodality association occurs at all levels of the brain, that at higher levels being part dependent upon that which occurs at lower levels. At higher levels, additional non-sensory processes such as memory and reasoning are involved. Because higher more cognitive processes are more easily evaluated, they are most frequently the object of studies of intermodality association in human beings. The dependence of cortical function on brain stem function, however, requires focusing attention on intermodality association at brain stem and other subcortical levels" (Ayers 1972a:28)

REFERENCE LIST

- ABERCROMBIE, M.L.J., LYNDON R.L. and TYSON, M.C. (1964). Associated Movements in Normal and Physically Handicapped Children. Devel. Med. Child Neurol. 6:573-580.
- ALLAN, J.C. (1982). Learning About Statistics. Johannesburg: MacMillan South Africa (Publishers) (Pty) Ltd.
- AMES, L.B., GILLE E, C., HAINES, J. and ILG, F.L. (1979). The Gesell Institutes' The Child from one to six. Evaluating the Behaviour of the Preschool Child. London: Hamish Hamilton.
- ASHTON, R. (1973) Associated Movements in Yoruba School-children. Devel. Med. Child Neurol., 15:3-7.
- AYRES, A.J. (1972a). Sensory Integration and Learning Disorders. Los Angeles, California: Western Psychological Services.
- AYRES, A.J. (1972b). Southern California Sensory Integration Tests Manual. Los Angeles, California: Western Psychological Services.
- AYRES, A.J. (1979). Sensory Integration and the Child. Los Angeles, California: Western Psychological Services.
- BAX, M. and Mac Keith, R. (1963) Minimal Cerebral Dysfunction. Clinics in Devel. Med. No 10. London: SIMP/Heinemann.
- BENDER, M.L. (1976). The Bender-Purdue Reflex Test and Training Manual. San Rafael, California: Academic Therapy Publication.
- BIGSBY, R. (1983). Reaching and Asymmetrical Tonic Neck Reflex in Pre-Term and Full-term Infants. Physical and Occupational Therapy in Pediatrics, 3(4):25-41. The Haworth Press, Inc.
- BLYTHE, P. and Mc Grown, D.J. (no date given) The Clinicians Handbook for the Detection and Remediation of Organic Brain Dysfunction. Chester, England: Insight Publications. (The Institute for Neuro-Physiological Psychology).
- BOBATH, B. (1965). Abnormal Postural Reflex Activity Caused by Brain Lesions. London: The Chartered Society of Physiotherapy in association with William Heinemann Medical Books Ltd.
- BOBATH, B. (1970). Adult Hemiplegia: Evaluation and Treatment. William Heinemann Medical Books Ltd.
- BOBATH, B. and BOBATH, K. (1966) Lecture Notes Course on Neuro Developmental Therapy.

- BOBATH, K. (1966). The Motor Deficit in Patients with Cerebral Palsy. Clinics in Devel Med., No 23.
- BRUNSTROM, S. (1970). Movement Therapy in Hemiplegia. Harper and Row, New York.
- BUNDY, A.C. and FISHER, A.G. (1981). The Relationship of Prone Extension to other Vestibular Functions. Am. J. Occup. Ther., 35(12):782-787.
- CAPUTE, A.J., ACCARDO, P.J., VINING, E.P.G., RUBENSTEIN, J.E. and HARRYMAN, S. (1978). Primitive Reflex Profile. Monographs in Devel. Ped., Vol. 1. Baltimore, London, Tokyo: University Press.
- CARR, C., ROUTH, D.K., BYARD, M.T. et al. (1974). A Developmental Study of the Asymmetrical Tonic Neck Reflex. Devel Med. and Child Neurol., 16:329-335.
- CHUSID, J.G. and McDONALD, J.J. (1967). Correlative Neuroanatomy and Functional Neurology. Lange Medical Publications.
- CONOLLY, K. and STRATTON, P. (1968). Developmental Changes in Associated Movements. Devel Med. and Child Neurol., 10:49-59.
- CORYELL, J., HENDERSON, A., LIEDERMAN, J. (1982). Factors Influencing Tonic Neck Reflex in Normal Infants. Physical and Occupational Therapy in Pediatrics, 2(2/3):51-65. The Haworth Press, Inc.
- DEGANCI, G.A., BERK, R.A. and LARSEN, L.A. (1980). The Measurement of Vestibular-based Functions in Pre-School Children. Am. J. Occup. Ther., 34(7):452-459.
- DEGANCI, G.A. and BERK, R.A. (1983). DeGangi-Berk Test of Sensory Integration. Los Angeles, California: Western Psychological Services.
- DELACATO, C.H. (1963). The Diagnosis and Treatment of Speech and Reading Problems. Springfield, Illinois: Charles C. Thomas.
- DELACATO, C.H. (1966). Neurological Organization and Reading. Springfield, Illinois: Charles C. Thomas.
- DENCKLA, M.B. (1974). Development of Motor Co-ordination in Normal Children. Devel. Med. Child Neurol., 16:729-241.
- DIXON, W.J. (1981). BMDP Statistical Software. Berkeley: University of California Press.
- DUNN, W. (1981). A Guide to Testing Clinical Observations in Kindergartners. Sponsored by AOTA Sensory Integration Speciality Section. Am. OT Ass.

- FAKUDA, T. (1961). Studies on Human Dynamic Postures from the Viewpoint of Postural Reflexes. Acta Otolaryng. 151 (Suppl).
- FARBER, S.D. (1982). Neurorehabilitation a Multisensory Approach. W.B. Saunders Company.
- FINOCCHIARO, A.C.J. (1974). Behaviour Characteristics in learning Disabled children. Am. J. Occup. Ther., 28:30-35.
- FIORENTINO, M.R. (1963). Reflex Testing Methods for Evaluating Central Nervous System Development, 2nd Ed. Springfield, Illinois: Charles C. Thomas.
- FIORENTINO, M.R. (1981). A Basis for Sensorimotor Development. Normal and Abnormal. Springfield, Illinois: Charles C. Thomas.
- FOG, E. and FOG, M. (1963). Cerebral Inhibition Examined by Associated Movements. Clinics in Devel. Med., No 10. London: SIMP/Heinemann.
- GESELL, A. and AMES, L.B. (1942-1943) Ontogenetic Correspondences in the Supine and Prone Postures of the Human Infant., Yale Journal of Biology and Medicine. Vol 15:565-573.
- GESELL, A. and ILG, F.L. (1949) Child Development. An Introduction to the Study of Human Growth. New York and Evanston: Harper and Row Publishers.
- GEORGE, C.O. (1972). Effects of the Asymmetrical Tonic Neck Reflex Upon Grip Strength of Normal Children. Res Quart. Am. Ass. Health Phys. Educ., 41:361-364.
- GORDON, N. (1976). Pediatric Neurology for the Clinician. Clinics in Devel. Med., Nos 59/60. London: SIMP/Heinemann.
- GUYTON, A.C. (1969). Function of the Human Body. W. B. Saunders Company.
- HARRIS, N. (1981). Duration and Quality of the Prone Extension Position in Four-, Six-, and Eight Year Old Normal Children. Am. J. Occup. Ther., 35(1):26-30.
- HELLEBRANDT, F.A., SHADE, M., CARNS, M.L. (1962). Methods of Examining the Tonic Neck Reflexes in Normal Human Subjects. Am. J. Phys. Med., 41:91-139.
- IKAI, M. (1950). Tonic Neck Reflexes in Normal Persons. Jap. J. Psychol., 1:118-124.
- JOHNSON, D.W. (1973). Neural Basis for Reading: The Relationship in Sensorimotor Integration. Ed.D. Dissertation. Temple University, Philadelphia.

- KALVERBOER, A.F. (1975). A Neurobehavioural Study in Pre-School Children. Clinics in Devel. Med., No.54. London: SIMP/Heinemann.
- KAGERER, R.L. (1958). The Relationship between the Kraus-Weber Test for Minimum Muscular Fitness and School Achievement. Unpublished Masters Thesis, Purdue University.
- KEPHART, N.C. (1960). The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill Publishing Company.
- KNOBLOCH, H. and PASAMANICK, B. (1974). Gesell and Amatruda's Developmental Diagnosis. 3rd ed. Hagerstown, Maryland, New York, San Francisco, London: Harper and Row Publishers.
- KRAUS, H. and HIRSCHLAND, R.P. (1954) Minimum Muscular Fitness Tests in Schoolchildren. Res Quart. XXV:178-88.
- KRAUS, W.M. (1927). Erectness in Man. Archives of Neurology and Psychiatry. 17(1):1-11.
- LUHAN, J.A. (1932). Some Postural Reflexes in Man. Archives of Neurology and Psychiatry. 28:649-660.
- MAC NEELA, J.C. (1984). A Review of the Primitive Reflex Literature 1978-1982. Physical and Occupational Therapy in Pediatrics, 4(2):79-99. The Haworth Press, Inc.
- MAGNUS, R.L. (1926). Some Results of Studies on the Physiology of Posture. Lancet. 2:531-536.
- MAGNUS, R. and DE KLEIJN, A. (1912) The Influence of the Position of the Head on the Tone of the Muscles of the Extremities. Abstract 16 in S Brunstrom (1970) Movement Therapy in Hemiplegia. Harper and Row, New York.
- MATTIS, S., FRENCH, J.H. and RAPIN, I. (1975). Dyslexia in Children and Young Adults. Three Independent Neuropsychological Syndromes. Devel. Med. Child Neurol. 17:150-163.
- MCCLEARY, R. and MOORE, R. (1965). Subcortical Mechanisms of Behaviour. New York: Basic books.
- MCCOUCH, G.P., DEERING, J.D., LING, T.H. (1951). Location of Receptors for Tonic Neck Reflex. J. Neurophysiol. 14:191-195.
- MCCAUGHT, A.B. and C'LLANDER, R. (1967). Illustrated Physiology. E. and S. Livingstone Ltd.

- MILANI-COMPARELLI, A., GEDONI, E. (1967). Routine Development Examination in Normal and Retarded Children. Dev. Med. Child Neurol., 9:631-638.
- MONTGOMERY, P. and RICHTER, E. (1980). Sensorimotor Integration for Developmentally Disabled Children. A Handbook. California: Western Psychological Services.
- MYKLEBUST, H.R. (1986). Learning Disabilities: Definition and Overview. Progress in Learning Disabilities, 1:1-15. New York and London: Greene and Stratton.
- NETER, J. and WASSERMAN, W. (1974). Applied Linear Statistical Models. p. 730 Homewood, Illinois: Richard D. Irvin Inc.
- NORTON, M.A. (1972a). Part I: Sensorimotor - Feedback Deficits and Learning Problems. Minimal Cerebral Dysfunction. Am. J. Occup. 26(3):135-146.
- NORTON, M.A. (1972b). Part II: Modified Treatment and Evaluation of Movement. Minimal Cerebral Dysfunction. Am. J. Occup. 26(4):186-199.
- O'CONNELL, A.L. and GARDNER, E.B. (1972). Understanding The Scientific Bases of Human Movement. The Williams and Wilkins Co.
- PACELLA, B.L. and BARRERA, S.E. (1940). Postural Reflexes and Grasp Phenomena in Infants. J. Neurophysiol. 3:213-218.
- PAINE, R.S., BRAZELTON, T.B., DONOVAN, E. et.al. (1964). Evolution of Postural Reflexes in Normal Infants and in the Presence of Chronic Brain Syndromes. Neurology, 14(11):1036-1048.
- PAINE, R.S. and OPPE, T.E. (1966). Neurological Examination of Children. Clinics in Devel. Med., 20/21. Medical Evaluation and Information Unit. London: SIMP/Heinemann.
- PARMENTER, C.L. (1975). The Asymmetrical Tonic Neck Reflex in Normal First and Third Grade Children. Am. J. Occup. Ther., 29:463-468.
- PARMENTER, C.L. (1983). An Asymmetrical Tonic Neck Reflex Rating Scale. Am. J. Occup. Ther., 37:462-465.
- PETERS, J.E., ROMINE, J.S. and DYKMAN, R.A. (1975). A Special Neurological Examination of Children with Learning Disabilities. Devel. Med. Child. Neurol., 17:63-78.
- PARR, C., ROUTH D.K., BYRD, M.T. et. al. (1974). A Developmental Study of the Symmetrical Tonic Neck Reflex. Develop. Med. Child Neurol., 16:329-335.
- PRUDDEN, B. (1956). Is Your Child Really Fit. New York: Harper Bros.
- RIDER, A.R. (1972a). Tonic Neck Reflexes. Am. J. Occup. Ther., 26(3):132-134.

- RIDER, A.R. (1972b). Relationship of Postural Reflexes to Learning Disabilities. Am. J. Occup. Ther... 26(5):239-243.
- ROACH, E.G. and KEPHART, N.C. (1966). The Purdue Perceptual Motor Survey. Columbus, Ohio: Charles E. Merrill Books Inc.
- SIEG, K.W. and SHUSTER, J.J. (1979). Comparison of Three Positions for Evaluating the Asymmetrical Tonic Neck Reflex. Am. J. Occup. Ther... 33(5):311-316.
- SIEGEL, S. (1956). Nonparametric Statistics for the Behavioural Sciences. New York: McGraw Hill: 68-75.
- SILVER, A.A. (1952). Postural and Righting Responses in Children. Pediatr., 41:493-498.
- SMITH, A. (1986). Neurophysiologic Aspects of Learning Disorders. Learning Disorders 3:61-64.
- SPIVACK, G., SWIFT, M. (1967). Devereux Elementary School Behaviour Rating Scale Manual. Devon, The Devereux Foundation.
- THE NATIONAL ADVISORY COMMITTEE ON HANDICAPPED CHILDREN (1968). First Annual Report, Special Education for Handicapped Children, Washington, US Department Health Education and Welfare, Office of Education.
- TOKIZANE, T., MURAO, M., OGATA, T. et. al. (1951). Electromyographic Studies on Tonic Neck, Tonic Lumbar and Labyrinthine Reflexes in Normal Persons. Jap. J. Physiol., 2:131-146.
- TOWEN, B.C.L. (1979). Examination of the Child with Minor Neurological Dysfunction. 2nd ed. Clinics of Devel. Med., No 71. London: SIMP/Heinemann.
- VUCKOVICH, D.M. (1968). Pediatric Neurology and Learning Disabilities. Progress in Learning Disabilities., 1:16-38. New York and London: Greene and Stratton.
- WALKER, C. and BONEY, S. (1981) Directions and Comments for Clinical Observations. Based on Ideas of Pat Buetner, Cary Siegner and Linda Daniels. Lecture notes Theory Course on Sensory Integration.
- WALSHE, F.M.R. (1923). On Certain Tonic or Postural Reflexes in Hemiplegia, with Special Reference to the so-called "Associated Movements". Brain, Part 1, 46:1-37.
- WATERLAND, J.C., DOUDLAH, A.M., SHAMBIES, G. (1966). The Influence of Tonic Neck Reflex on Vertical Writing. Acta Otolaryng., 61:383-392.

WELLS, H.S. (1944). The Demonstration of the Tonic Neck and Labyrinthine Reflexes and Positive Heliotropic Response in Normal Human Subjects. Science, 99:36-37.

WORTH, C and CHAVASSE, B. (1959). The Reflex Development in the Child. In T Lyle and G Bridgeman Squint. London: Bailliere, Tindall and Cox. p. 41.

ZEMKE, R. (1980). Incidence of ATNR Response in Normal Preschool Children. Physical and Occupational Therapy in Pediatrics., 1(2). The Haworth Press inc.

ZEMKE, R. and ZEMKE, W.P. (1982). Electrogoniometry. A proposed tool for measurement of the Asymmetric Tonic Neck Reflex. Physical and Occupational Therapy in Pediatrics, 2(1). The Haworth Press Inc.

ZEMKE, R. (1985). Application of an ATNR Rating Scale to Normal Preschool Children. Am. J. Occup. Ther.., 39(3):178-180.

WELLS, H.S. (1944). The Demonstration of the Tonic Neck and Labyrinthine Reflexes and Positive Heliotropic Response in Normal Human Subjects. Science, 99:36-37.

WORTH, C and CHAVASSE, B. (1959). The Reflex Development in the Child. In T Lyle and G Bridgeman Squint. London: P. Illere, Tindall and Cox. p. 41.

ZEMKE, R. (1980). Incidence of ATNR Response in Normal Preschool Children. Physical and Occupational Therapy in Pediatrics, 1(2). The Haworth Press Inc.

ZEMKE, R. and ZEMKE, W.P. (1982). Electrogoniometry. A proposed tool for measurement of the Asymmetrical Tonic Neck Reflex. Physical and Occupational Therapy in Pediatrics, 2(1). The Haworth Press Inc.

ZEMKE, R. (1985). Application of an ATNR Rating Scale to Normal Preschool Children. Am. J. Occup. Ther., 39(3):178-180.

ADMINISTRATION AND SCORING OF THE ASSESSMENT OF PRIMITIVE POSTURAL REFLEXES (6-9 years 11 months)

The child is asked to assume the SUPINE position on the floor:

TONIC LABYRINTHINE REFLEX IN SUPINE (TLRS)

a) Assuming the supine flexed pattern:

ADMINISTRATION:

Equipment: Stopwatch.

Procedure:

Examiner asks child to fold arms across chest, cross ankles, bend knees, hips and head thus curling up in a ball.

PLEASE LIE ON YOUR BACK. FOLD YOUR ARMS ON YOUR CHEST. CROSS YOUR ANKLES AND PULL YOUR LEGS UP SO THAT YOUR KNEES TOUCH YOUR TUMMY. NOW CURL YOUR HEAD UP AND YOUR LEGS UP SO THAT YOU GO INTO A BALL AND STAY THAT WAY AS LONG AS YOU CAN.

Let the child rest and then ask the child to resume the position. Examiner then applies resistance to the forehead and knees to see if child can maintain the position.

CURL YOUR HEAD UP TO YOUR CHEST. DON'T LET ME PUSH YOU. (Examiner gives resistance to forehead). CURL YOUR LEGS UP. DON'T LET ME PUSH YOU. (Examiner gives resistance to knees). NOW CURL YOUR LEGS UP AND YOUR HEAD UP SO YOU CAN GO INTO A BALL AND STAY THAT WAY AS LONG AS YOU CAN. DON'T LET ME PUSH YOU. (Examiner gives resistance to forehead and knees).

SCORING:

The examiner should take the following into consideration when allocating the rating:

- The number of seconds should be recorded of how well and how long the child can maintain the posture.
- Whether the child can maintain the posture with some resistance.
- Asymmetry at any stage with or without resistance.
- Difficulty in keeping the head flexed, nape of neck touching the floor.
- Whether the feet touch the floor.
- Presence of head retraction rather than flexion of the head.

2 = Present

1 = Doubtful

0 = Absent

1. If the child cannot achieve the required flexed position.
2. If the head cannot be lifted off the floor.
3. If the child is unable to hold the required flexed position for 2 - 9 sec.

1. The child has difficulty in maintaining the required flexed position while holding his hands around legs to assist.
2. Child can hold the position but is unable to take resistance.
3. Child can only maintain the position for 10-19 sec.

The child can achieve and maintain the position for 20 seconds with moderate exertion as well as be able to hold it against gravity and resistance.

b) Sitting up without the help of hands

ADMINISTRATION:

Procedure:

Still in the supine position, the child is asked to place his hands behind the head and to sit up without the support of hands.

FOLD YOUR HANDS BEHIND YOUR HEAD. CAN YOU SIT UP WITHOUT LIFTING YOUR LEGS?

SCORING:

The examiner should observe any asymmetry.

2 = Present

1 = Doubtful

0 = Absent

If the child can not sit up without the help of the hands.

- | | |
|---|---|
| 1. Can sit up without the help or support of the hands but lifts the legs off the ground. | The child can sit up without the support of hands and without lifting the legs off the floor. |
| 2. Examiner has to hold legs to floor before child can sit up. | |

c) Raising straight legs 25 cm

ADMINISTRATION:

Procedure:

Still lying in the supine position, with hands behind head, the child is asked to lift his straight legs twenty five centimeters from the floor and hold this position for ten seconds.

CAN YOU LIFT YOUR LEGS WITHOUT BENDING YOUR KNEES? STAY THAT WAY AS LONG AS YOU CAN.

SCORING:

The examiner should record the number of seconds and observe how long and how well the child can maintain the posture.

2 = Present

1 = Doubtful

0 = Absent

If the child cannot lift legs off the floor, even when knees are bent.

- | | |
|--|--|
| 1. Child can only lift legs off floor when knees are bent. | The child can raise legs with straight knees and maintain this position for 10 - 20 sec. |
| 2. Can only hold this position for less than 10 seconds. | |

The child now assumes the PRONE position on the floor.

TONIC LABYRINTHINE REFLEX IN PRONE

a) Assuming prone extended pattern.

ADMINISTRATION:

Equipment: Stopwatch

Procedure:

EXAMINER asks child to extend hips with extended knees (knees and thighs are not to touch the surface). At the same time chest and head should be lifted off the floor with the arms abducted at shoulders and flexed to about 90 deg. at the elbows. If positioning or demonstration is needed, the child should be allowed to rest and then asked to reassume the position. Ask him to count out aloud so that he does not hold his breath.

NOW LIFT YOUR HEAD, ARMS, CHEST AND STRAIGHT LEGS OFF THE FLOOR AND HOLD IT FOR AS LONG AS YOU CAN. COUNT OUT ALOUD.

SCORING:

The examiner should take the following into consideration when allocating the rating:

- Ability to assume the appropriate posture and maintain it for a period of time.
- Asymmetry.
- Presence of head protraction rather than extension.
- Record the number of seconds the child can maintain the prone extension posture for later comparison after treatment.

2 = Present

1 = Doubtful

0 = Absent

1. Unable to assume the prone-extension posture. Observe for:
- decreased hip extension even with facilitation
- knees touching surface even with knees flexed
- decreased trunk extension
- elbows touching the surface most of the time
- not able to count while maintaining the posture.

2. Decreased extension with decreased hip extension. Observe for:
- decreased hip extension even with facilitation
- knees on the mat
- slightly decreased hyperextension
- Elbows off the mat most of the time

3. Unable to maintain the prone-extension

1. Obtaining prone extension with excessive knee flexion. Observe for:

- decreased hip extension
- excessive knee flexion but ability to maintain knees off surface
- trunk minimally arched
- elbows off the surface or extended but forward off shoulders.
- able to count or talk while maintaining the position.

2. Prone extension with excessive effort. Holds 10 - 20 seconds. Observe for:

- decreased hip extension
- knees off surface most of the time either in flexion or extension
- can count or talk

1. Achieves total prone extension and can hold with moderate effort for 20+ seconds. Observe for:

- hyper-extended hips with distal part of thighs off the surface
- knees off the surface extended or flexed less than 45 degrees
- hyperextended trunk with shoulders and upper trunk off the surface (face vertical >45deg. and holding the head steady)
- elbows off the surface either flexed or extended. Arms in line with or behind shoulders even when flexed or extended. Arms even or behind shoulders
- can count or talk easily while maintaining the posture.

posture for 0 - 9 seconds.

- with effort
- slight facial grimacing
- obvious bobbing in and out of posture
- 3. Assuming the posture segmentally.

2. Assumes the posture easily, smoothly, quickly and simultaneously.

b) Kraus Weber Test 4 and 5

ADMINISTRATION:

Equipment: Stopwatch and a small pillow (A small pillow is placed under the child's hips in the prone position)

Procedure for 4:

Examiner asks the child to clasp his hands behind his neck. The examiner holds the child's feet and the child is asked to raise his head, shoulders and chest off the floor and to maintain the position for 10 seconds.

CLASP YOUR HANDS TOGETHER BEHIND YOUR NECK. LIFT YOUR HEAD, ARMS AND CHEST OFF THE FLOOR AND HOLD IT FOR AS LONG AS YOU CAN.

Procedure for 5:

Examiner asks the child to rest with head on hands. The examiner holds the child's chest down by placing the hand between the child's shoulder blades. The child is asked to raise the extended legs about 25 cm off the surface and to maintain the position for 10 sec.

REST WITH YOUR HEAD ON YOUR HANDS ON THE FLOOR. NOW LIFT YOUR STRAIGHT LEGS UP OFF THE FLOOR AND HOLD IT FOR AS LONG AS YOU CAN.

SCORING:

2 = Present

1 = Doubtful

0 = Absent

Cannot raise upper trunk or raise legs with extended knees off the surface

1. Raises upper trunk and arms and maintains the position for less than 10 seconds.

2. Can raise legs with flexed knees off the surface

3. Can perform one position and not the other.

Can maintain both positions for 10 sec.

SYMMETRICAL TONIC NECK REFLEX

ADMINISTRATION:

Equipment: Template representing goniometer.

Procedure:

The examiner instructs the child to keep his arms straight with fingers pointing forwards and weight on the palms of the hands. Elbows should not be locked. Be sure that hips are flexed at about 90 deg. and shoulders are flexed to 90 deg. Examiner first extends then flexes the child's head.

YOUR FINGERS SHOULD POINT FORWARD AND SLIGHTLY TO THE INSIDE. TRY TO KEEP YOUR ARMS STRAIGHT BUT NOT LOCKED AT THE ELBOWS. NOW LET ME BEND YOUR HEAD. HOLD THIS POSITION SO I CAN MEASURE. Examiner measures degree of elbow flexion on both sides by placing the template quickly against the arm.

SCORING:

The examiner should take the following into consideration when allocating the rating:

- Upon extension of the head, there will be a strong tendency for accompanying shoulder and elbow extension with some hip and knee flexion and a tendency to sit back on the heels.
- Upon flexion of the head, there will be a strong tendency for accompanying shoulder and elbow flexion with some hip and knee extension.
- Record elbow joint flexion when the head is flexed (normal extension designated as 0 deg. in the neutral zero method.)

2 = Present

1 = Doubtful

0 = Absent

- | | | |
|---|--|---|
| 1. One or both arms flexes in a pronounced manner when the head is ventro-flexed. Elbow flexion is more than 25 deg. (25+). | One or both arms flex slightly, elbow flexes less than 25 deg., (0-24). The child tend to lock the elbows. Observe the child's posture as the child assumes the position: | Elbow extension with unlocked elbows is maintained. |
| 2. The hips start to extend when the head is ventro-flexed and to flex when the head is dorsi-flexed. (Extended). | - flexion in hips and knees more than 90 deg.
- feet lifted off the floor
- feet dorsiflexed
- hands fisted, hands and fingers pointing outwards.
- head dorsiflexed | |

ASYMMETRICAL TONIC NECK REFLEX

a) Rotating head in quadruped position

ADMINISTRATION:

Equipment: Template representing goniometer.

Procedure: The examiner instructs the child to keep his arms straight with fingers pointing forwards and weight on the palms of the hands. Elbows should not be locked. Be sure that hips are flexed at about 90 deg. and shoulders are flexed to 90 deg. LET ME TURN YOUR HEAD. Examiner then rotates child's head 90 deg. starting in the neutral position. The chin should be lined up with the shoulder. HOLD THIS POSITION, SO THAT I CAN MEASURE. Examiner measures degree of elbow flexion in the opposite arm. The head is then rotated back to the centre. Pause before the head is rotated in the same way to the other side. HOLD THIS POSITION SO THAT I CAN MEASURE. Examiner measures the degree of elbow flexion in the arm on the skull side.

SCORING:

The examiner should take the following into consideration when allocating the score:

- The amount of flexion at the elbow in the contralateral arm as the head is turned and chin lined up with the shoulder.
- It is normal to have slight flexion in the elbow of the contralateral arm.
- Right and left differences.
- Hyperextension of the opposite arm.
- Degree of elbow flexion in contralateral arm should be recorded.

2 = Present

1 = Doubtful

0 = Absent

Arm on skull side flexes more than 55 deg. in a pronounced manner. The child may collapse on the floor.

The arm on the skull side flexes less than 55 deg. (0-54)

Arm extension is maintained on the skull side.

b) Assuming the reverse ATNR posture

ADMINISTRATION:

Equipment: Piece of cardboard and stopwatch.

Procedure: Examiner asks the child to assume the reverse ATNR posture while in the quadruped position. Hands on hip with fingers pointing down or forward or ventral opposite leg raised in an extended posture, head turned to the side of the flexed arm on hip. The child actively turns own head. The examiner places the piece of cardboard between shoulder and chin and asks child to hold it there. PUT THIS HAND (touch) HERE (touch hip) NOW LIFT THIS STRAIGHT LEG, HOLD IT (touch) TURN YOUR HEAD TO THIS SIDE AND HOLD THIS CARDBOARD HERE. HOLD THIS POSITION FOR AS LONG AS YOU CAN. Repeat instructions with head turned to the other side.

SCORING:

The examiner should take the following into consideration when allocating the rating:

- The effect of the ATNR on equilibrium reactions noting if the child

- can assume and maintain the posture.
- The extra effort or stress this posture may elicit.
- The effect of the ATNR which may not have been evident during the foregoing procedure.

2 = Present	1 = Doubtful	0 = Absent
Cannot assume the required position	Can assume the posture only with great difficulty and holds it for less than 20 sec. with great exertion (0-19)	Can assume and maintain the posture with adequate balance for more than 20 sec. and with moderate effort.

The child is asked to assume the STANDING position.
PLEASE STAND UP STRAIGHT

c) Schilder's arm extension test observing the effect of the ATNR

ADMINISTRATION:

Procedure: Examiner stands behind child and asks child PUT YOUR FEET TOGETHER, ARMS IN FRONT WITH PALMS TURNED DOWN (pronation). The examiner moves the child's head 90 deg. to each side (chin to shoulder). LET ME TURN YOUR HEAD. DID THAT BOTHER YOU? Repeat with arms turned upwards.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
Definite postural changes in arms (flexion or hyperextension in elbows). Resistance on head turning and trunk rotation.	Slight changes in posture of arms.	Arms remain stretched out in front, both in pronation and supination.

ASSOCIATED REACTIONS

a) Mouth opening and finger spreading phenomena

ADMINISTRATION:

Procedure: The examiner grasps the child's wrists between his thumb and index finger. The child's arms are passively extended, ensuring that the wrists and finger joints are relaxed and the hands hang down loosely. The examiner then asks the child to OPEN YOUR MOUTH AS WIDE AS YOU CAN. (phase 1) CLOSE YOUR EYES TIGHTLY (phase 2) STICK OUT YOUR TONGUE AS FAR AS YOU CAN (phase 3).

SCORING:

2 = Present	1 = Doubtful	0 = Absent
1. Marked spreading of the fingers with some extension during any of the phases.	Barely discernible spreading of the fingers. Could become more obvious during the latter phases.	No movements in the relaxed fingers and joints during any of the phases.
2. Marked spreading and marked extension of the fingers often accompanied by extension of the wrists.		

b) Diadochokinesis

ADMINISTRATION:

Procedure: The examiner asks the child to stand with one arm hanging relaxed at his side while the other arm is flexed at the elbow 90 deg. with the hand pointing forward. The child looks ahead of him. Examiner demonstrates four complete pro- and supination movements per sec. while keeping the elbow still and away from the body. WATCH ME. NOW YOU DO IT AT THE SAME SPEED WHILE TRYING TO KEEP YOUR ELBOW AWAY FROM YOUR BODY.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
Marked mirror movements with flexion of the elbow in the opposite arm.	1. Marked mirror movements with or without flexion of the elbow. 2. Barely discernable mirror movements or slight flexion of the elbow without mirror movements.	No visible mirror movements of flexion of the elbow.

c) Finger opposition test (Thumb-finger touching)

ADMINISTRATION:

Procedure: The examiner demonstrates to the child how to place the fingers of one hand consecutively on the thumb of the same hand. The distal phalanges should touch down to the first crease

ASSOCIATED REACTIONS

a) Mouth opening and finger spreading phenomena

ADMINISTRATION:

Procedure: The examiner grasps the child's wrists between his thumb and index finger. The child's arms are passively extended, ensuring that the wrists and finger joints are relaxed and the hands hang down loosely. The examiner then asks the child to OPEN YOUR MOUTH AS WIDE AS YOU CAN. (phase 1) CLOSE YOUR EYES TIGHTLY (phase 2) STICK OUT YOUR TONGUE AS FAR AS YOU CAN (phase 3).

SCORING:

2 = Present	1 = Doubtful	0 = Absent
1. Marked spreading of the fingers with some extension during any of the phases.	Barely discernible spreading of the fingers. Could become more obvious during the latter phases.	No movements in the relaxed fingers and joints during any of the phases.
2. Marked spreading and marked extension of the fingers often accompanied by extension of the wrists.		

b) Diadochokinesis

ADMINISTRATION:

Procedure: The examiner asks the child to stand with one arm hanging relaxed at his side while the other arm is flexed at the elbow 90 deg. with the hand pointing forward. The child looks ahead of him. Examiner demonstrates four complete pro- and supination movements per sec. while keeping the elbow still and away from the body. WATCH ME. NOW YOU DO IT AT THE SAME SPEED WHILE TRYING TO KEEP YOUR ELBOW AWAY FROM YOUR BODY.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
Marked mirror movements with flexion of the elbow in the opposite arm.	1. Marked mirror movements with or without flexion of the elbow. 2. Barely discernable mirror movements or slight flexion of the elbow without mirror movements.	No visible mirror movements of flexion of the elbow.

c) Finger opposition test (Thumb-finger touching)

ADMINISTRATION:

Procedure: The examiner demonstrate to the child how to place the fingers of one hand consecutively on the thumb of the same hand. The distal phalanges should touch down to the first crease

eg. 2,3,4,5,4,3,2,3,4,5 etc. The child is requested to imitate these movements, completing five sequences to and fro. Each hand is tested in turn. The test should be carried out at a rate of 3-4 sec. for one complete sequence. WATCH ME. NOW YOU DO IT.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
Marked associated movements in opposite hand.	Barely discernible associated movements in opposite hand.	No associated movements in opposite hand

d) Hand-hand test

ADMINISTRATION:

Procedure: The examiner asks the child to exert a certain degree of pressure with thumb and first finger by using a clothes peg or spring paper clip exerting three kilograms resistance (bulldog). CAN YOU OPEN THIS PEG WITH YOUR THUMB AND FIRST FINGER, LIKE THIS. Repeat with the other hand.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
A similar movement is observed in the opposite hand (homologous reaction).	A reverse reaction with extension of fingers is observed in the opposite hand (heterologous reaction).	No associated movements observed in the opposite hand.

e) Feet-hand test (Fog Test)

ADMINISTRATION:

Procedure: The child is required to invert his feet and to walk on the outer side of the feet. PLEASE WALK ON THE OUTSIDE OF YOUR FEET LIKE THIS.

SCORING:

2 = Present	1 = Doubtful	0 = Absent
Associated movements of the hands with supination of the forearms. Sometimes accompanied by pronation	Slight supination of forearms.	No supination or associated movements of hands.

ASSOCIATED MOVEMENTS AND POSITIVE SUPPORTING REFLEX DURING WALKING

f)/a) Walking on tiptoe

ADMINISTRATION:

Procedure: Examiner asks the child to walk on tiptoe for 20 paces forwards, turn around and walk back again. PLEASE WALK ON TIPTOE FOR 20 STEPS FORWARD AND BACK AGAIN.

SCORING:

2 = Present

1 = Doubtful

0 = Absent

- | | | |
|--|--|---|
| f) Marked extension of hands or extension of arms with clenched hands. | Barely discernable movements in the arms and hands only. | No associated movements visible |
| a) Walking on balls of feet with rigidly extended legs. Balance is poor. | Walks with difficulty and had problems with balance. | Walks well on tiptoe with adequate flexibility in legs. |

g)/b) Walking on heels

ADMINISTRATION:

Procedure: Examiner asks child to walk on his heels for 20 steps forwards, turn around and back again. PLEASE WALK ON YOUR HEELS FOR 20 STEPS FORWARDS AND BACK AGAIN.

SCORING:

2 = Present

1 = Doubtful

0 = Absent

- | | | |
|---|--|---|
| g) 1. Marked flexion of the elbow 60 deg hyperextension. | Barely discernable flexion of the elbows and hyperextension of the wrists. | No associated movements visible. |
| 2. Marked flexion of the elbow >60 deg with abduction of the shoulder and or movements in the lips and tongue | | |
| b) Unable to walk on heels or dorsiflex feet. | Toes only raised for a few moments. | Toes remain off the ground and child walks well on heels. |

POSITIVE SUPPORTING REFLEX DURING STANDING

c) Standing on one leg

ADMINISTRATION:

Equipment: Stopwatch

Procedure: Examiner asks the child to stand on one leg, barefoot, for at least 20 sec. Each leg is tested in turn. Examiner asks child to PLEASE STAND WITH FOLDED ARMS, ELBOWS FLEXED AND HANDS TUCKED IN AND HELD AGAINST THE CHEST. Touching the left leg examiner says: LIFT THIS FOOT. STAY THAT WAY AS LONG AS YOU CAN. NOW LIFT THE OTHER FOOT.

SCORING:

The examiner should take the following into consideration when allocating the rating:

- Lifting the heel of the ground.
- Clawing of toes.
- Loss of balance.

2 = Present

1 = Doubtful

0 = Absent

Unable to stand on one leg due to a rigid pillar of support with a tendency to raise the heel and clawing of the toes.

Loss of balance within 13 sec. for six year olds and within 20 sec. for eight year olds.

Can maintain adequate balance on a flexible supporting leg for 14-16 sec for six year olds and 20 sec. for 7-9 year olds.

d) Hopping on ball of foot on one leg

ADMINISTRATION

Procedure: Examiner asks child to hop on the toes of each bare foot at least 20 times, starting with whichever leg the child prefers. PLEASE HOP 20 TIMES WHILE ON THE TOES OF ONE LEG. NOW HOP 20 TIMES ON THE TOES OF THE OTHER LEG.

SCORING:

2 = Present

1 = Doubtful

0 = Absent

Unable to hop due to a rigid pillar and absence of the PSR as well as an inability to maintain balance.

Starting to hop on the ball of the foot but gradually using the whole foot. Difficulty in maintaining balance while hopping. Less than 13-16 hops for six year olds and less than 20 hops for seven to eight year olds.

Maintaining balance on a flexible leg for 13-16 hops for six year olds and 20 hops for seven to eight year olds.

EVALUATION OF PRIMITIVE POSTURAL REFLEXES

NAME OF CHILD: _____

DATE OF BIRTH: _____ AGE OF TEST: _____

AGE OF CHILD: _____ MONTHS: _____

LEFT SIDESUPINERIGHT SIDE

Tonic Labyrinthine: Supine _____ 0 1 2 No sec: _____

Sitting up without help of hands _____ 0 1 2

Straight legs raised 10" _____ 0 1 2 No sec: _____

PRONE

Tonic Labyrinthine: Prone _____ 0 1 2

Kraus Weber Test 4 & 5 _____ 0 1 2

HANDS AND KNEES

2 1 0 Symmetrical Tonic Neck Reflex _____ 0 1 2

2 1 0 Asymmetrical Tonic Neck Reflex _____ 0 1 2

2 1 0 Reverse ATNR _____ 0 1 2

2 1 0 Schilder's Arm extension Posture _____ 0 1 2

STANDING

Associated movements during:

2 1 0 Mouth opening and finger spreading _____ 0 1 2

2 1 0 Diadochokinesis _____ 0 1 2

2 1 0 Finger Opposition test _____ 0 1 2

2 1 0 Hand-hand Test _____ 0 1 2

2 1 0 Feet-hand test (Fog) _____ 0 1 2

WALKING

Walking on tiptoe:

2 1 0 Associated movements _____ 0 1 2

2 1 0 Positive Supporting Reflex _____ 0 1 2

Walking on heels:

2 1 0 Associated movements _____ 0 1 2

2 1 0 Positive Supporting Reflex _____ 0 1 2

Positive Supporting Reflex:

Standing on one leg:

2 1 0 No sec L _____ No sec R _____ 0 1 2

2 1 0 Hopping on one leg _____ 0 1 2

SUMMARY OF SCORES OBTAINED

LEFT RIGHT TOTAL

4+ Tonic Labyrinthine Supine

3+ Tonic Labyrinthine Prone

3+ STNR

7+ ATNR

17+ Associated Reactions

9+ Positive Supporting Reflex

APPENDIX C

HABITUAL POSTURAL PATTERN QUESTIONNAIRE

NAME OF CHILD: _____ CLASS: _____
 DATE OF BIRTH: _____ TEACHER: _____
 DATE OF RECORDING OBSERVATIONS: _____ SCHOOL: _____
 AGE OF CHILD: _____ IQ: _____
 AVERAGE LEVEL OF PERFORMANCE (2nd TERM): _____
 IS CHILD LEFT HANDED: _____ OR RIGHT HANDED: _____
 READING LEVEL: _____ HANDWRITING LEVEL: _____
 ARITHMETIC LEVEL: _____

The teacher is requested to record any of the following habitual postural patterns in the classroom situation.

HABITUAL BEHAVIOUR

COMMENTS

If the answer is YES please give more detail

1. Propping the head on the hands at the desk when eg. writing.	YES NO	YES LEFT RIGHT
2. Having a slumped posture, sprawling over desk or lean-against furniture	NO	YES
3. Moving or twisting book or paper to one side of the working surface	NO	YES to YES to LEFT RIGHT
4. Moving or twisting the body when book or paper is fixed.	NO	YES to YES to LEFT RIGHT
5. Changing postural attitude of arm or hand while writing.	NO	YES
6. Eye-hand inco-ordination.	NO	YES
7. Fisting of fingers of non-dominant hand while writing	NO	YES
8. Involuntary movements of any body parts while executing a task e.g. tongue movements.	NO	YES

9. Sitting on heels with feet on chair.	NO	YES
10. Reclining on chair with legs stretched out under desk.	NO	YES
11. Cramped writing style near body.	NO	YES
12. Difficulty in doing situps.	NO	YES
13. Difficulty in raising straight legs off the floor while lying on back.	NO	YES
14. Difficulty in arching the back while lying on tummy.	NO	YES
15. Sitting between flexed legs on a flat surface (frog-like sitting).	NO	YES
16. Difficulty maintaining balance on one leg.	YES NO	YES LEFT RIGHT
17. Difficulty in walking on a straight line with heel touching toes of Hind foot.	NO	YES
18. Difficulty in hopping on toes/ball of foot. Loses balance.	YES NO	YES LEFT RIGHT
19. Difficulty in walking on tiptoe.	YES NO	YES LEFT RIGHT
20. Difficulty in walking on heels.	YES NO	YES LEFT RIGHT

Please specify any other observations which might influence the child's functioning such as pencil grip, pressure in writing etc.

APPENDIX D

RAW DATA EXPERIMENTAL GROUP

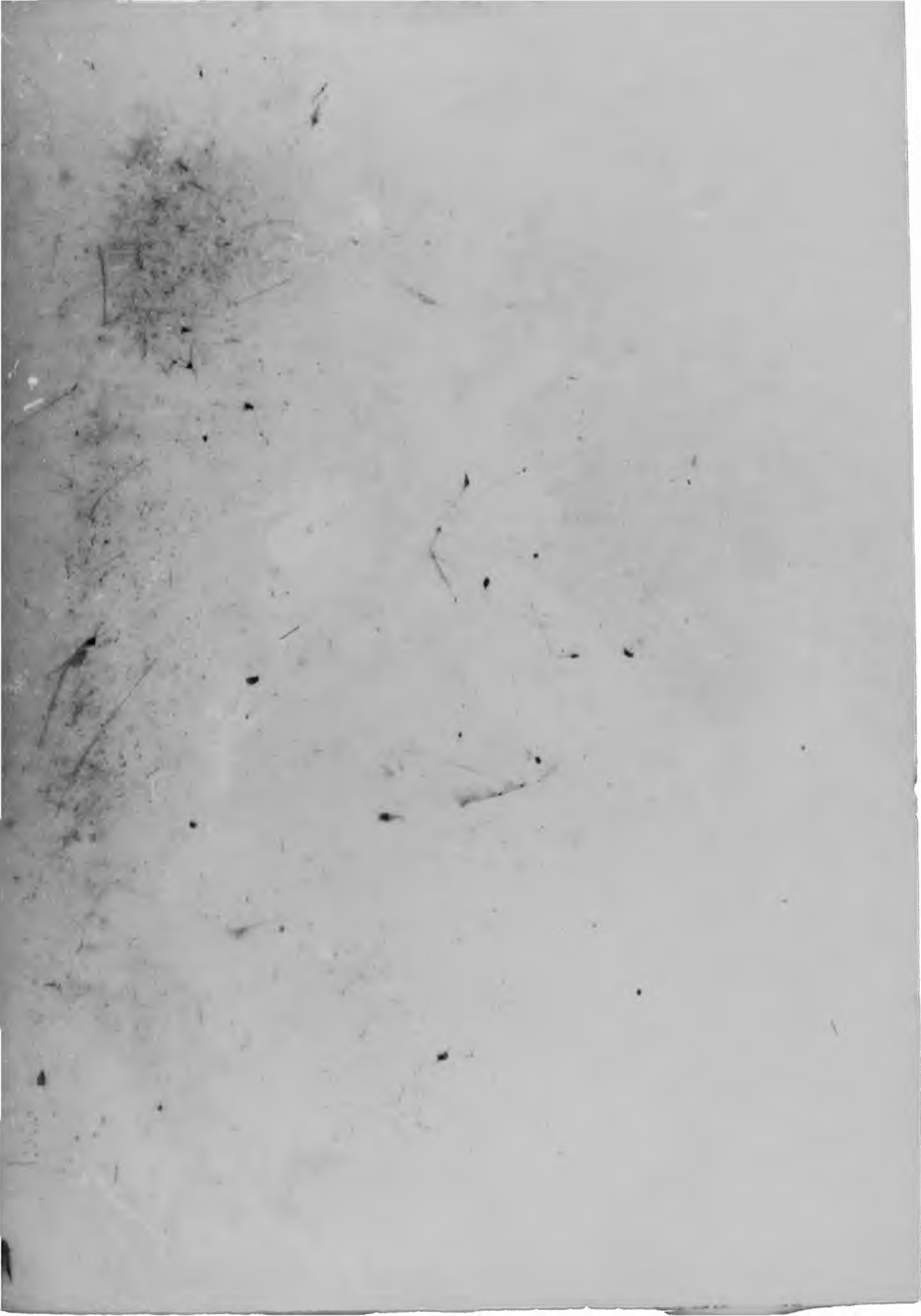
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1	902	128	1.00	1	1	1	1	0	0	2	4	2	4	2	5	1	0	0
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3	806	104	1.00	1	1	1	0	0	1	0	0	0	4	0	21	0	0	0
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5	808	100	3.00	3	4	2	3	2	3	4	0	1	7	1	16	1	3	4
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7	810	110	3.00	3	3	3	3	2	2	3	0	1	8	1	15	2	9	4
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9	810	104	3.66	4	4	3	1	1	0	2	4	0	5	1	17	0	1	0
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11	810	102	3.33	2	4	4	0	3	2	2	4	1	7	1	20	1	2	1
12	810	102	3.33	4	3	3	1	1	1	3	4	1	6	2	16	1	1	1
13	808	114	3.00	3	3	3	4	3	2	3	0	1	6	1	15	1	0	1
14	905	102	2.66	2	3	3	1	1	2	1	0	1	8	1	13	1	4	1
15	808	128	3.33	3	4	3	1	0	2	0	4	0	4	1	16	0	0	0
16	810	120	1.66	2	1	2	2	0	0	0	0	0	8	0	15	0	2	1
17	702	98	4.00	4	3	4	1	1	0	1	0	0	8	0	2	0	0	0
18	711	110	3.00	3	2	3	0	0	2	0	0	0	10	0	18	0	1	0
19	801	118	2.00	2	2	2	0	0	0	0	0	0	8	0	17	0	0	0
20	710	108	2.00	2	1	2	2	0	0	0	0	0	9	0	11	0	2	0
21	710	122	1.60	1	3	1	1	0	2	0	0	1	9	0	20	0	2	0
22	711	140	2.30	2	3	2	2	0	0	0	2	1	9	0	13	0	1	0
23	706	110	2.00	1	3	2	0	0	2	0	0	1	8	0	12	0	0	0
24	804	104	3.00	4	2	3	1	1	3	1	0	1	4	1	12	0	2	2
25	709	104	4.00	4	4	3	4	0	4	0	0	0	8	0	13	0	1	3
26	710	100	3.00	3	3	3	2	1	0	1	4	2	5	1	14	2	0	4
27	805	96	3.33	3	4	3	1	1	0	1	0	1	7	2	17	1	1	1
28	704	106	3.33	2	5	3	3	2	1	1	0	1	10	2	15	0	5	2
29	709	100	3.66	5	3	3	4	1	1	0	0	0	6	0	9	0	2	1
30	800	118	3.00	3	3	2	1	0	0	0	0	0	6	1	20	0	1	0
31	708	146	4.00	3	5	2	2	1	0	3	0	3	7	3	11	1	0	1
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35	800	96	3.00	3	3	3	3	1	1	1	0	1	11	2	13	1	1	1
36	802	104	3.27	4	3	4	1	0	1	0	4	0	5	0	12	0	1	1
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42	605	98	3.00	3	3	3	1	0	0	0	0	0	8	0	17	0	2	0
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45	610	118	2.00	2	3	2	1	0	0	0	0	1	6	0	17	1	2	0
46	607	120	1.00	1	2	2	1	0	0	0	0	0	8	0	18	0	1	0
47	609	99	2.00	2	3	3	2	0	2	0	0	0	8	1	18	0	0	0
48	609	94	1.20	2	2	2	3	1	0	0	0	0	7	0	15	0	1	0
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51	702	110	1.00	1	1	1	3	0	0	0	0	0	7	0	17	0	0	0
52	702	102	3.21	4	2	4	0	0	1	0	0	0	9	0	17	0	2	1
53	701	92	3.41	3	4	2	1	1	3	0	0	1	9	0	13	0	0	0
54	611	108	2.32	3	3	1	3	2	3	1	2	1	10	1	17	1	2	1
55	607	112	3.00	3	3	2	1	0	3	0	2	0	7	0	16	0	0	0
56	604	106	4.00	4	4	4	4	0	2	2	1	1	8	1	15	0	0	0
57	608	106	3.67	3	2	3	2	0	3	0	0	0	7	0	15	0	2	0
58	606	108	3.00	3	3	3	1	0	1	0	0	0	7	0	11	0	0	0
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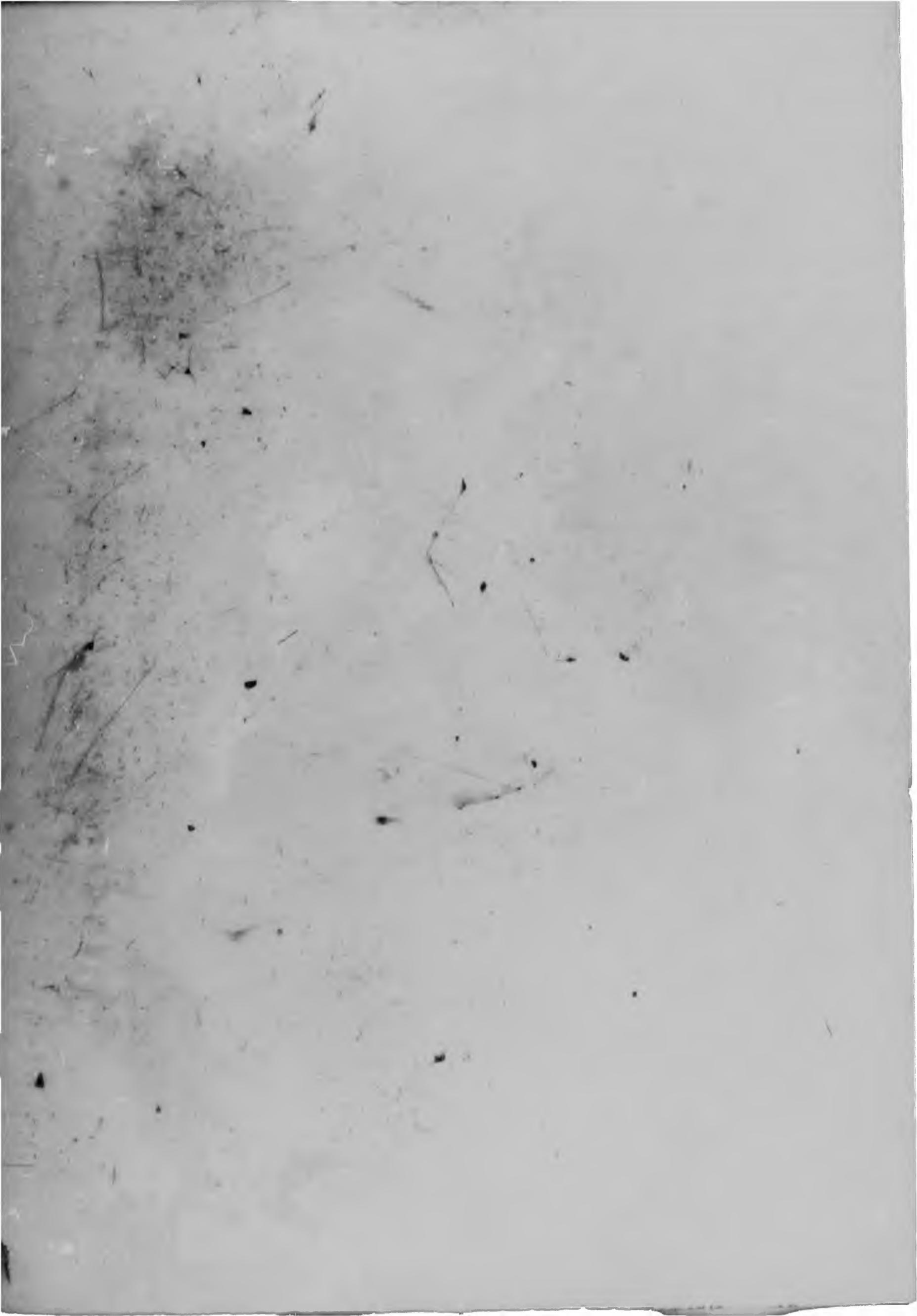
APPENDIX E

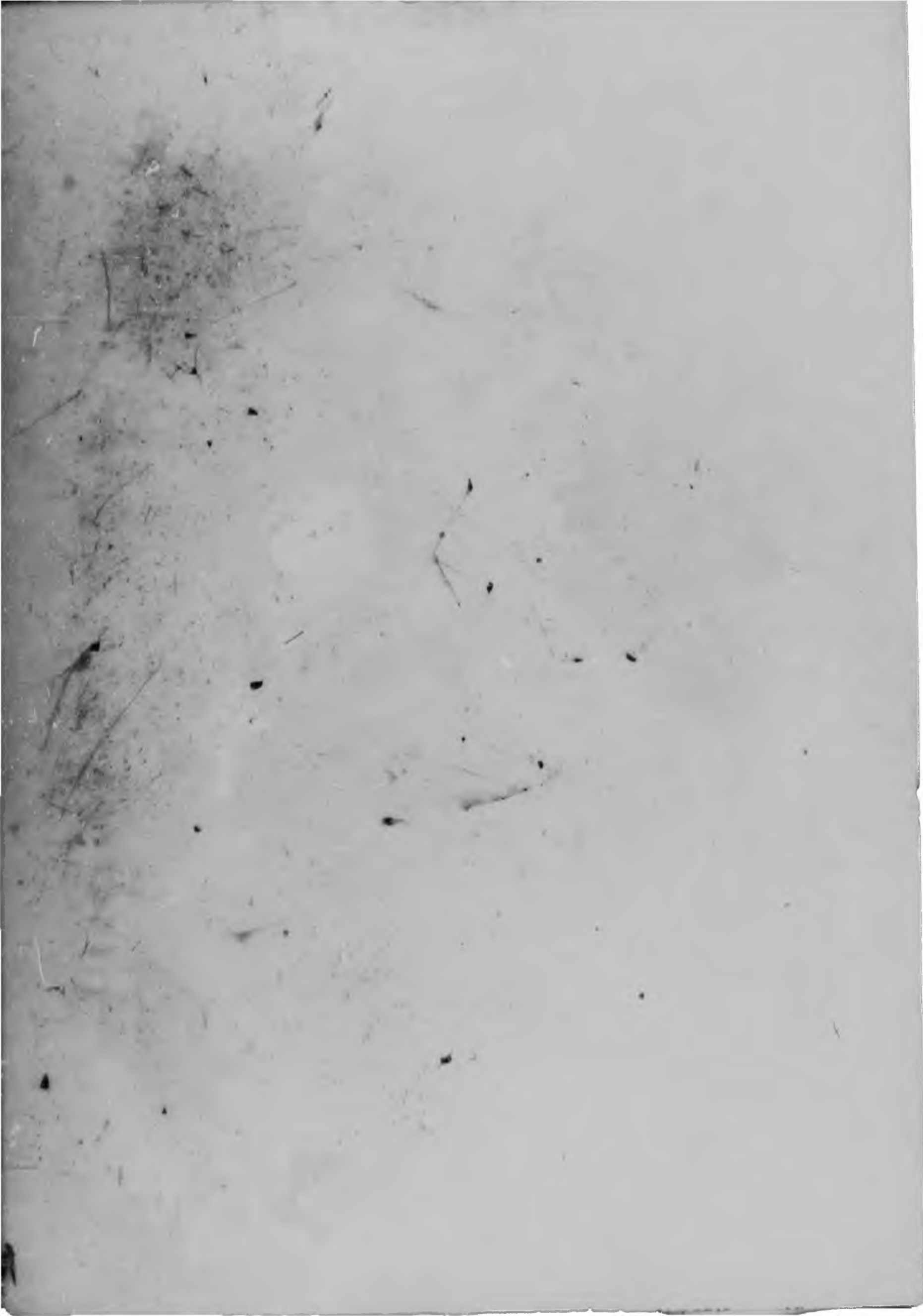
RAW DATA CONTROL GROUP

CHILD	AGE	IO	OVERALL	READ	WRITE	ARITH	TLRS		TLRP		STNR		ATNR		AR		PSR	
			PERFORM				R	P	R	P	R	P	R	P	R	P	R	P
1	903	121	2.50	1	2	1	0	0	0	2	0	1	3	1	5	0	0	0
2	805	112	2.00	2	3	3	0	0	2	2	0	1	0	2	3	2	0	0
3	807	96	2.25	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0
4	905	109	2.66	3	2	3	0	0	2	2	0	1	6	0	6	1	1	0
5	810	102	2.33	2	2	3	2	0	2	1	2	0	4	0	13	0	1	1
6	811	118	3.00	2	3	4	1	1	2	2	0	2	6	0	13	0	0	1
7	811	114	3.33	4	3	3	2	1	0	1	0	0	3	1	11	0	0	1
8	910	102	2.66	4	2	2	1	1	0	1	0	0	4	0	9	0	0	1
9	810	102	3.00	4	2	3	2	0	2	1	0	0	0	1	2	0	2	0
10	903	103	3.00	3	3	3	1	0	0	2	0	0	5	0	14	0	0	0
11	809	100	3.33	2	5	3	0	0	1	0	0	0	2	2	10	0	0	0
12	809	96	3.00	3	3	3	1	1	0	2	0	1	4	1	13	1	0	1
13	805	122	3.33	3	4	3	2	2	0	2	0	2	0	3	16	1	0	1
14	901	103	2.00	2	2	2	0	0	0	0	0	0	1	0	9	0	0	0
15	803	130	2.00	2	3	1	0	0	1	0	0	1	2	0	11	0	0	0
16	811	118	2.00	2	2	2	1	0	0	0	0	0	6	0	13	0	1	0
17	702	90	3.00	3	4	3	0	0	0	2	0	0	6	0	7	0	0	0
18	801	114	2.00	3	2	2	1	0	0	0	0	0	4	0	6	0	0	0
19	807	114	1.00	1	1	1	1	0	0	0	0	0	0	0	3	0	0	0
20	710	102	1.00	1	1	1	1	0	0	0	0	0	0	0	9	0	0	0
21	705	124	1.60	3	1	1	2	0	0	0	0	1	6	1	10	0	2	0
22	710	146	1.30	1	2	1	3	0	1	0	0	0	6	1	11	0	2	0
23	708	110	2.00	1	3	2	1	0	2	0	0	1	1	1	9	0	0	0
24	806	100	4.00	4	4	4	0	0	0	2	0	0	2	0	11	0	1	2
25	704	114	3.33	3	3	4	1	0	1	0	0	0	6	1	9	0	0	0
26	709	98	4.33	4	5	4	3	0	1	2	0	1	4	2	8	0	2	1
27	801	94	4.00	4	4	4	2	1	0	1	0	1	1	0	14	0	4	4
28	708	108	4.00	3	5	4	3	1	1	1	0	2	4	2	15	0	2	3
29	705	102	3.30	3	3	4	1	1	0	1	0	0	1	0	14	0	0	0
30	707	114	2.00	2	2	2	1	1	0	2	0	1	2	1	10	1	0	1
31	706	146	3.00	4	3	2	0	1	0	1	0	1	3	2	11	1	0	1
32	802	104	2.00	2	2	2	0	0	0	0	0	0	2	0	7	0	0	0
33	711	120	3.00	4	2	1	1	2	0	1	0	1	2	0	11	0	0	0
34	804	114	3.00	2	3	3	2	1	0	0	0	0	0	0	14	0	0	0
35	801	98	2.00	2	1	2	0	0	0	0	0	0	5	0	14	0	0	0
36	801	104	4.00	4	4	4	1	0	0	1	0	0	6	0	16	0	1	0
37	708	100	3.45	3	4	4	1	0	1	0	0	0	4	0	10	0	0	0
38	708	134	2.55	3	3	3	1	0	0	0	0	0	2	0	9	0	0	0
39	609	108	2.00	2	3	2	2	0	1	0	0	0	6	2	13	0	1	0
40	700	104	2.00	2	2	2	1	0	0	0	0	0	6	0	15	0	1	0
41	702	96	2.00	2	3	2	0	0	0	0	0	0	3	0	13	0	1	0
42	600	96	3.00	2	3	3	2	1	0	0	0	0	5	0	11	0	0	0
43	701	94	3.00	3	3	3	1	0	0	0	0	0	5	0	9	1	3	0
44	611	96	3.00	3	3	3	0	0	0	0	0	0	5	1	14	0	1	0
45	610	112	1.00	1	1	1	1	0	0	0	0	0	6	0	9	0	0	0
46	608	118	1.00	1	1	1	1	0	0	0	0	0	1	0	16	0	0	0
47	611	95	2.00	2	1	1	2	0	0	0	0	0	6	1	16	0	0	0
48	610	96	1.30	2	2	2	1	0	0	0	0	0	4	1	15	0	0	0
49	610	130	1.50	1	1	1	0	0	0	0	0	0	0	1	14	0	0	0
50	703	122	1.00	1	1	1	2	0	0	0	0	0	2	0	6	0	0	0
51	706	120	1.00	1	1	1	1	0	1	0	0	0	2	0	11	0	0	0
52	700	102	3.10	3	3	2	1	0	0	0	0	2	4	0	16	0	1	0
53	700	94	1.72	2	2	1	2	0	0	0	0	0	4	0	12	0	0	0
54	702	112	2.33	3	2	2	2	0	0	0	0	0	4	0	10	0	1	0
55	606	110	2.33	2	3	1	1	0	0	0	0	0	6	0	13	0	2	0
56	606	102	4.00	4	4	4	3	1	1	0	0	0	5	0	12	0	2	0
57	608	105	3.00	1	2	3	2	0	0	1	0	0	6	0	14	0	0	0
58	608	112	2.00	2	3	1	0	0	0	0	0	0	2	0	11	0	0	0
59	609	126	2.33	2	3	1	1	0	0	0	0	0	2	0	11	0	0	0









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