1 Identifying Signs of Neuromotor Immaturity in Children and Adults

If we ran a health service rather than a disease service it would focus on a physiological and evolutionary approach to health and education.

Paynter, A. (2011)¹

1.1 Introduction

Health and well-being are not simply the product of absence of disease. They are the sum total of a system and systems which function well together. Dys-ease as opposed to the pathological features associated with disease can result from lack of synergy within the functioning of systems. Dys-ease produces a variety of symptoms ranging from behavioural and specific learning difficulties in children to emotional and psychological problems in adults.

Problems arising from dys-ease or dysfunction can be compounded for social reasons by the operational restrictions imposed on the various professional disciplines responsible for identifying problems and prescribing effective remedies.

Parents are often caught in this professional no-man's-land, first seeking medical advice or reassurance when concerned about aspects of their child’s development. If no underlying medical condition can be found, the family tends to be passed on to the next service in the system allocated to take on responsibility for the child’s development. More often than not, this is education, but few educators are qualified to investigate or treat physical dysfunction, while health practitioners are not primarily concerned with educational difficulties. Spanning these two disciplines lies the domain of the educational psychologist, well qualified to assess and diagnose conditions in which physical dysfunction plays a part (e.g. developmental coordination disorder, attention deficit disorder, attention deficit hyperactivity disorder, ASD), but not in a position to provide a remedy for a range of physical symptoms. The result is that many of these children simply ‘fall through the net’ of services intended to identify children at risk and offer appropriate support or intervention – neither ‘bad enough’ for medical treatment nor ‘good enough’ – to realize their potential in the classroom.

This group of children is often subjected to numerous assessments, but go on to receive either inadequate or inappropriate intervention. Inappropriate intervention is the type that
focus on the symptoms of underlying dysfunction instead of tackling underlying causes. If, for example, teaching more of the same does not ameliorate the presenting problem, while it can provide ongoing support, it is not the solution.

Similarly, a specific group of adults who present with symptoms which formerly would have been described as ‘neuroses’ may have a history of a cluster of underlying physical factors which have combined over time to make the individual more vulnerable to stress.

The now redundant term ‘neurosis’ describes relatively mild forms of mental illness that is not caused by organic disease, involving symptoms of stress (depression and anxiety). Neurosis affects only part of the personality, is accompanied by a less distorted perception of reality than in a psychosis, does not result in disturbance of the use of language and is accompanied by various physical, physiological and mental disturbances (as visceral symptoms, anxieties or phobias). The term neurosis was coined by the Scottish doctor William Cullen in 1769 to refer to ‘disorders of sense and motion’ caused by a ‘general affection of the nervous system’. For him, it described various nervous disorders and symptoms that could not be explained physiologically. The term was re-defined by Carl Jung and Sigmund Freud over a century later, who used it to describe a variety of mental disorders in which emotional distress or unconscious conflict is expressed through various physical, physiological and mental disturbances, which may include physical symptoms (e.g. hysteria, hypochondria) or emotional symptoms (such as phobias, panic, anxiety and depression).

Today, many of these conditions do respond to medical and behavioural therapeutic interventions, others do not. In seeking to find a solution for those who do not respond to standard treatment or who are recidivists, further investigation for signs of neuromotor immaturity can help to identify additional underlying factors which may be involved in the continuation of symptoms and which might respond either to a physical intervention programme, combination of a physical programme and behavioural therapy or a different type of medical solution.

It is stressed that in all cases, this screening test should not be used to form a diagnosis but only as a basis for further investigations.

1.2 How to Use This Manual

The manual comprises four chapters.

Chapter 1 provides a general introduction for all readers. It includes a definition of Neuromotor Immaturity (NMI) and its implications and a literature review of links between NMI and specific learning difficulties followed by a description of the role of primitive reflexes in normal development.

The INPP method is described and compared with other well-known motor training programmes including Sensory Integration (SI), the Bobath therapy and the Vojta method.

Chapter 2 comprises the INPP screening test for use with children (4–16 years).
Chapter 3 explains the links between neuromotor immaturity and symptoms of anxiety, agoraphobia and panic disorder in adults.

Chapter 4 comprises the INPP screening test for use with adults.

Chapter 1 is recommended to all readers. Chapters 1 and 2 are relevant for professionals working with children; Chapters 1, 3 and 4 to professionals working specifically with adults. Professionals working with children and adults should read all chapters.

1.3 Overview

Neuromotor functioning provides one indication of maturity in the functioning of the central nervous system. It is also linked to functioning of the vestibular, proprioceptive and postural systems, which collectively provide a stable platform for centres involved in oculo-motor functioning and subsequently visual perception. Individuals with neuromotor immaturity frequently experience difficulties with related skills such as balance, coordination and visual perception, which can affect behaviour and educational performance in children and result in chronic anxiety and emotional sensitivity in adults.

Problems connected to neuromotor immaturity can be subtle and diffuse, failing to fit into any single diagnostic category but nevertheless undermining an individual’s ability to function with competence and confidence. Children may present in a physician’s consulting room as a behavioural problem or emerge in the classroom as a low achiever; adults seeking medical help may complain of a range of symptoms for which no abnormality is detected on clinical investigation.

One method of identifying signs of neuromotor immaturity is through the use of standard tests to assess retention of primitive reflexes and development of postural reactions and other tests for ‘soft signs’ of neurological dysfunction. Soft signs, which have previously been dismissed as being too generalized to be useful for diagnostic purposes, are minor neurological signs indicating non-specific cerebral dysfunction.

The presence or absence of primitive reflexes at key stages in development provides acknowledged signposts of maturity in the functioning of the central nervous system. Primitive reflexes emerge in utero, are present in the full-term neonate and are inhibited in the first six months of post-natal life as connections to higher cortical centres and frontal areas develop. Primitive reflexes are also suppressed in the course of normal development as postural reactions and muscle tone advance.

Primitive reflexes are retained under certain pathological conditions, such as cerebral palsy. In cerebral palsy, retention of the reflexes occurs as a result of damage to the brain or abnormal development which may have occurred pre-natally, at birth or post-natally (Bobath and Bobath, Illeingworth, Capute and Accardo, Fiorentino, Levitt, Brunstrom). Damage to the immature brain interferes with the normal process of maturation in a predictable, orderly, developmental sequence resulting in lack of inhibition, demonstrated by prolonged
retention of the primitive undifferentiated patterns of movement control characteristic of infancy, accompanied by abnormal muscle tone, development of postural control, impaired patterns of movement and delayed motor development. Primitive reflexes also re-emerge in degenerative conditions such as multiple sclerosis and Alzheimer’s disease, when demyelination results in deterioration of postural reactions and primitive reflexes are disinhibited. For many years, it was assumed that retention of primitive reflexes could not exist to a lesser degree in the absence of identified pathology, and therefore, primitive reflexes were not the subject of investigation in children with less severe motor delays or children who simply present with signs of a specific learning difficulty.

Physicians are familiar with the assessment of primitive reflexes as part of the paediatric neurological examination at birth and in the first six months of life, but if development is progressing normally at six months of age, these tests are rarely repeated in older children or adults, because it is assumed that primitive reflexes do not persist in the absence of pathology. This assumption has led to the development of a somewhat polarized view of how primitive reflexes are regarded within the medical professions; because there are no clear presenting symptoms of pathology, primitive reflex status in the older child is not assessed – a case of putting the telescope to the blind eye and saying, ‘I see nothing through it’.

Children and adults who have residual primitive reflexes and/or under-developed postural reactions tend to ‘slip through the net’ of clinical services. Symptoms in the form of behavioural disorders, specific learning difficulties, under-achievement and anxiety states appear within the family, at school, in higher education and in the physician’s consulting room, often in the form of ‘secondary neuroses’ or non-specific ailments, which have developed over several years and which are, in part, the result of increased levels of stress needed to recruit and maintain compensatory processes.

1.4 Relationship Between Neuromotor Immaturity and Learning Outcomes

Literature review

The concept that neurological dysfunction can underlie problems with learning is not new. Developmental disabilities were recognized in the nineteenth century chiefly as two forms of delay - cognitive delay in the case of mental retardation and motor delay in the case of cerebral palsy – but less severe symptoms involving discrepancy between intelligence and more specialized areas of language, learning, communication and social interaction including early infant autism only emerged in the twentieth century.

In the 1920s, the French were among the first to notice a link between ‘motor awkwardness’ and learning disabilities, which they sometimes described as ‘psychomotor syndromes’. In 1940, R.S. Paine described the presence of several isolated motor signs, such as awkwardness, tremor, hyper-reflexia or mild impairments in walking, in children with specific learning difficulties. He also pointed to problems in the perception of auditory or visual information, faulty concepts of space, diminished attention span, difficulty in abstract thinking and delays
in academic achievement being characteristic features of children with learning disabilities. Mild epileptic symptoms were also noted as sometimes being present.9

In other countries, the term Minimal Brain Dysfunction (MBD) started to be used. MBD was formally defined in 1966 by Samuel Clements as a combination of average or above-average intelligence with certain mild to severe learning or behavioural disabilities characterizing deviant functioning of the central nervous system which could involve impairments in visual or auditory perception, conceptualization, language and memory and difficulty controlling attention, impulses and motor function,10 but with more than 99 possible symptoms listed as diagnostic criteria for MBD by the 1970s, the term MBD was already being rejected as too broad.

Investigations into the presence of abnormal or immature reflexes in individuals with specific learning difficulties emerged from various schools of thought and disciplines in the 1970s.

In 1970, an Occupational Therapist (OT) at the University of Kansas carried out a study in which she compared the reflex levels of a group of neurologically impaired children with a group of children with no known neurological impairment. Every one of the group diagnosed with neurological impairment had abnormal reflexes. Eight out of nineteen subjects in the ‘normal’ or comparison group also showed some reflex abnormalities, and it was subsequently found that of these eight, one had behaviour problems and the remainder had either reading or writing difficulties.11

In 1972, Rider (OT), also at the University of Kansas, set out to assess the prevalence of abnormal reflex responses in normal second grade children comparing their results to a group of learning-disabled children. She found that the learning-disabled children had significantly more abnormal reflex responses than the normal children. Using the Wide Range Achievement Test (WRAT) scores as an independent measure, she compared WRAT scores on the basis of whether there were abnormal reflex responses or not. Children with integrated reflexes scored consistently higher on the achievement tests than those with abnormal reflexes.12

In 1976 at the University of Purdue, Miriam Bender examined the effect of just one reflex, the Symmetrical Tonic Neck Reflex (STNR) on education, and found that the STNR was present in 75% of a group of learning-disabled children but not present in any of a comparison group of children without a history of learning disabilities. She also developed a series of exercises designed to help inhibit the STNR and observed that as the STNR diminished many of the children’s presenting symptoms improved.13

In 1978, A. Jean Ayres, the originator of Sensory Integration (SI) therapy, observed that one of the major symptoms manifested by children in disorders of postural and bilateral integration was ‘poorly developed primitive postural reflexes, immature equilibrium reactions, poor ocular control and deficits in a variety of subtle parameters that are related to the fact that man is a bilateral and symmetrical being’.14 One of the aims of sensory integration therapy was ‘not to teach specific skills such as matching visual stimuli, learning to remember a sequence of sounds, differentiating one sound from another, drawing lines from one point to another, or even the basic academic material. Rather, the objective is to enhance the brain’s ability to learn how to do these things’.14 The objective was modification of the neurological dysfunction interfering with learning rather than attacking the symptoms of the dysfunction.
In 1994, Wilkinson carried out a replica study based on Rider’s (1972) research. She found not only a link between residual primitive reflexes and specific learning difficulties but also identified a connection between residual primitive reflexes and educational under-achievement. Her findings indicated that one reflex – the Tonic Labyrinthine Reflex (TLR) – underpinned many of the presenting educational difficulties and that there was a relationship between the continued presence of the Moro reflex and specific problems with mathematics.15

Goddard Blythe and Hyland16 investigated differences in the early development of 72 children diagnosed with specific learning difficulties compared to children with no evidence of specific learning difficulty using the INPP Developmental Screening Questionnaire.17–19 They found significant differences in the developmental histories of the two groups with children in the specific learning difficulty group having a markedly higher incidence of early life events or signs of delay in motor and language development and factors related to the functioning of the immune system. Delays in learning to walk and talk were particularly significant in the group with specific learning difficulties.16

Other studies that have investigated the persistence of abnormal reflexes in children with specific reading difficulties have found the Asymmetrical Tonic Reflex (ATNR) to be present in children with reading difficulties20–22 and a cluster of abnormal primitive and postural reflexes present in a sample of children diagnosed with dyslexia23 and in children with attention deficit disorder.24

Investigations into the incidence of abnormal primitive reflexes in a sample of 672 children in seven mainstream schools in Northern Ireland between 2003 and 2004 revealed that 48% of children aged 5–6 years (P2) and 35% of children aged 8–9 years (P5) still had traces of primitive reflexes. Fifteen per cent25 of P5 children had a reading age below their chronological age. Of these, 28 also had elevated levels of retained reflexes. Elevated levels of retained reflexes were correlated with poor educational achievement at baseline. In the younger group (P2), it was found that retained primitive reflexes correlated with poor cognitive development, poor balance and teacher assessment of poor concentration/coordination. Neurological scores and teacher assessment at baseline predicted poorer reading and literacy scores at the end of the study.26

Some research suggests that children growing up in areas of social disadvantage may also be at greater risk of educational under-achievement, not only as result of lack of appropriate stimulation in terms of opportunity for language development and reading, but also because of immature motor skills.27

Empirical findings also suggest that improvement in markers of neuromotor maturity (primitive reflex status) is associated with improvement in behavioural problems in some children.28

1.5 Neuromotor Immaturity in Adolescents

Adolescents and young adults can also be caught in the transition from compulsory education to establishing an independent adult life. Dr Lawrence Beuret, an MD practicing in Chicago, specialized in treating this age group, who start to experience problems for the first time in the final stages of secondary education or when they move into higher education:
Multiple factors converge in adolescents and adults with neurological dysfunction to create elusive and diffuse symptomology. Early reading and learning difficulties are generally absent; fine motor and writing problems are minimal; gross motor coordination is little affected; athletic ability may be above average and early behaviour is within age-appropriate norms. Academically ‘not working up to potential’ and emotionally or behaviorally not responding to accepted therapeutic or pharmacological interventions are the hallmarks of neuromotor immaturity in this population. This differs substantially from younger children whose symptoms closely correlate with the continued presence of primitive reflexes. The under-development or absence of postural reflexes (reactions) has a much greater influence on symptom development in this older population.29

Postural reactions and their role in supporting perceptual stability are described more fully in Chapter 3.*

Beuret went on to describe how the under-development of postural reactions has a much greater influence on symptom development and functional limitations in this older population, quoting De Quirós and Schrager9 as providing one of the most detailed insights into the pathology created by incomplete development of this reflex system. In summary, he states:

Any deficiency in the critical systems of postural control must be compensated for by the intervention of the highest (most recently evolved) areas of the CNS. This follows the dictates of Jackson’s Law – the most highly developed, most complex functions – will be sacrificed to maintain functions earlier evolved, more primitive, and more critical to survival. In humans these encompass high level and complex cortical activities such as comprehension, executive function, analytical, and synthetic abilities, as well as cognitive and processing competence.

In this older population vestibular-proprioceptive mismatch becomes the common thread throughout an individual’s history, testing and treatment response. A history of motion sickness which continues beyond puberty or some abnormal responses to motion is present in all cases, although intensity and frequency is reported to be highly correlated with certain personality factors. Motion sickness – nausea, vertigo, headache and fatigue – being the most frequently reported symptoms, occurs uniformly in response to attempting to read or engage in some form of visual fixation (reading a map or using a screen) while riding in a moving vehicle. Other abnormal motion responses may be present concurrently with, or independently from, motion sickness. These can involve adverse reactions to lateral, vertical, interrupted and rotational forces such as those encountered on winding roads, hilly terrain, amusement rides, elevators and high speed trains.29

The hallmark of this group is that they have usually achieved high educational standards in the early stages of education through diligence and hard work, but either start to fail educationally or to develop emotional problems when the quantity of required reading increases, the academic environment requires a less teacher-directed approach, the demands to multi-task increase and, if entering higher education, both social and educational adaptations are required to achieve and integrate socially.

The INPP screening test is not sufficient to identify neuromotor immaturity as an underlying factor in this age group unless detailed attention is paid to tests for balance, soft signs of

*A more detailed description of neuro-motor immaturity in adolescents may be found in the chapter co-authored by Beuret in Attention, Balance and Coordination – The A,B,C of Learning Success.
neurological dysfunction and the developmental history of the individual. More detailed assessment for the presence of under-development postural reactions is usually needed with this age group.

1.6 Relevance of the INPP Screening Test to Health Practitioners

Family doctors and clinicians are in the front line of services available to identify signs of neuromotor immaturity in children, adolescents and adults and to make appropriate referral for further investigations and appropriate treatment.

1.7 What is the INPP Method?

The Institute for Neuro-physiological Psychology (INPP) was established in 1975 by psychologist Peter Blythe, PhD, with several aims in mind:

1. To research into the effects of immaturity in the functioning of the Central Nervous System (CNS) in children with specific learning difficulties or academic underachievement and adults suffering from anxiety states, agoraphobia and panic disorder.
2. To develop reliable methods of assessing CNS maturity
3. To devise effective remedial intervention programmes

Children seen at INPP screening are examined on an individual basis using a series of standard medical tests to assess physical abilities:

- Gross muscle coordination and balance
- Patterns of motor development
- Cerebellar involvement
- Dysdiadochokinesia
- Aberrant primitive and postural reflexes
- Oculo-motor functioning (control of eye movements)
- Visual perception
- Visual Motor Integration (VMI)
- Audiometric examination and dichotic listening

The diagnostic assessment findings provide the basis for prescribing an individual regime of physical exercises which the patient carries out every day at home. Parents are responsible for supervising children’s exercises each day. The exercises take between 5 and 10 minutes a day and are practised over a period of approximately 12 months. The patient’s progress is reviewed at six to eight weekly intervals and the exercise programme adjusted accordingly.

INPP practitioners are professionals who already have the relevant professional qualifications to work in a field allied either to education, medicine or psychology and who have undertaken
additional training in the use of the INPP diagnostic assessment and remedial intervention programme(s).

The INPP method is not intended to replace standard neurological examinations and psychological or educational assessments usually carried out by trained psychologists, remedial specialists and medical and other non-medical professionals. It does, however, provide a unique system with which to assess and remediate signs of neuromotor immaturity in children and adults for which no other cause has been found.

The following screening tests have been compiled to enable health practitioners to identify signs of neuromotor immaturity and provide the basis for appropriate referral. The screening tests should not be used in isolation to form a diagnosis.

**Why assess posture and balance?**

Posture is defined as the reflex anti-gravitational adaptation of a living body to the environment in which he lives. Posture depends on reflex acts which occur as a result of the integration of several sensory inputs and rapid adaptive motor reactions chiefly involving the visual, proprioceptive and vestibular systems. ‘Posture means unconscious, inattentive, anti-gravitational adaptation to the environment’. When reflex actions are functioning efficiently and at a developmentally appropriate level, they free ‘higher’ cognitive systems in the brain from conscious involvement in the maintenance of postural control. Conversely, if reflexes are not functioning in an age-appropriate fashion, conscious attention must be diverted to the adaptation and maintenance of postural control at the expense of attention to other cognitive tasks. Posture is also essential to support static balance, to provide a frame of reference for coordination and a stable platform for centres involved in the control of eye movements (oculo-motor functioning).

**Why carry out assessments for balance?**

Balance is a continuous dynamic process that describes the interplay between various forces, particularly gravity acting with the motor power of the skeletal muscles. A person has achieved equilibrium when it can maintain and control postures, positions and attitudes. Balance is the end product of cooperation between proprioception, vestibular functioning, mechanoreceptors and vision, mediated by the cerebellum. Posture and balance together provide the bases for motor activities on which all physical aspects of learning depend:

To have a sense of balance one has to know where one is in space at any particular moment. In vertebrates the point of reference for the balance mechanism is the head. The vestibular system (balance mechanism) informs the brain where the head is in relationship to the external environment. The proprioceptive system informs the brain where the head is in relation to the rest of the body thus informing it where the head is in relation to its supporting base. Any movement of any part of the body is made with reference to the brain’s understanding of where it is in relationship to its structural support (base). With these three inputs the brain can instruct a model of the head and body in relationship to itself and the external world.

Abnormal primitive reflexes in the school-aged child and adult provide evidence of lack of integration in the functioning of these three systems, which are fundamental to the
sense of position and stability in space. Problems in control of balance can be manifested in a number of ways:

- Postural control
- Coordination
- Control of eye movements (affecting visual perception)
- Perception – for example, vertigo, sense of direction and disorientation
- Vegetative symptoms – for example, nausea, dizziness, palpitations and hyperventilation
- Psychological – anxiety and fear

Control of balance provides not only physical stability for moving in space but also acts as one of the main reference points for cognitive operations in space, including orientation (knowing your place in space, necessary to navigate through space), directional awareness (needed for way finding; understanding the orientation of symbols – for example, b and d, p and q and 2 and 5; being able to read an analogue clock or a compass) and mental operations in space involved in mathematics and the ability to visualize the motor actions needed for the ideation (motor planning) and execution of well-controlled movement.

**What is the significance of static balance and dynamic balance to learning?**

Static balance describes postural fixation, which consists of stabilized body attitudes. Static balance is necessary to be able to remain still in fixed positions. Children who have poor control of static balance often find it difficult to sit or remain still tending to be restless when engaged in pursuits which need to be performed from a fixed position, such as sitting at mealtimes, passive listening in class and writing. These children have a need to be ‘in motion’ in order to concentrate, and this restlessness can be seen as fidgeting and inattention. Paradoxically, the same children may have relatively good coordination when engaged in activities which involve action, such as on the sports field or in the playground.

Some research has pointed to a link between the ability to maintain balance while standing on one leg and specific language disorders.32

Dynamic balance describes the various translations and re-adaptations of postural role in performing efficient movements. Children with poorly developed control of dynamic balance will tend to shy away from robust physical activities, which involve translation of position in space – for example, carrying out forward rolls and vaulting over an object – consequently, they lack confidence in situations that require rapid adaptive reactions.

Adults tend to experience generalized feelings of insecurity which are thought to stem from lack of gravitational security; these include difficulties with orientation and way finding (particularly in unfamiliar environments) resulting in increased anxiety, which may later lead to avoidance. ‘Secondary’ psychological symptoms such as dislike or fear of new environments and desire to remain in familiar situations can be linked to problems with static or dynamic balance.

**What is the significance of postural control to learning?**

Posture is not only a neuro-*physiological* function that ensures physical stability and mobility against the pull of gravity, but it is also ‘primarily a central neuro-*psychological* system which
embraces a wide range of functional levels from spinal reflexes to higher mental processes. Postural control is linked to at least three perceptual systems – vestibular (balance), proprioceptive and visual – dysfunction in any one of these systems or how they operate together can affect the processes of perception on which all higher academic skills depend. Posture both supports and reflects the functional relationship between the brain and the body, to the extent that it has been said that ‘there is nothing in the mind that cannot be seen in the posture’.

**What is the link between primitive reflexes, balance and postural control?**

The Asymmetrical Tonic Neck Reflex (ATNR), Symmetrical Tonic Neck Reflex (STNR) and Tonic Labyrinthine Reflex (TLR), hereafter referred to collectively as primitive tonic neck and labyrinthine reflexes, both influence and reflect the functioning of the vestibular system and its interaction with other position and motion sensors.

### 1.8 How Does the Vestibular System Work?

The vestibular system or labyrinth comprises the non-acoustic elements of the inner ear and consists of three semi-circular canals and one utricle and one saccule located in each ear. The planes of the semi-circular canals lie approximately at right angles to each other. Each canal is filled with fluid (endolymph), which, as a result of its inertia, flows through the canal whenever the head experiences angular acceleration in the plane of that canal. Movement of the endolymph deflects the cupula, a structure which behaves like a critically damped pendulum to seal an expanded portion of each canal called the ampulla. Information concerning the extent of deflection of the cupula is sent to vestibular receiving areas of the brain via sensory cells lying at its base. In addition to sending information about the rate of head movement, these signals also generate compensatory eye movements (nystagmus), whose main function is to maintain the stability of the visual world by stabilizing the visual image on the retina, despite movement of the head. The otolithic receptors in the utricle and the saccule act as multidirectional accelerometers. The main function of the otoliths is to indicate the head’s orientation in relation to gravity, detecting information about tilt as well as linear displacement.

The vestibular system differs from the other five senses of touch, taste, hearing, smell and vision in that it has no special sensation of its own. We only become consciously aware of the vestibular system if its functioning becomes impaired or there is a disturbance in cooperation with other sensors involved in motion and position. This normally ‘secretive’ system then ‘speaks’ through the other senses, either heightening or dampening sensitivity, affecting levels of arousal and eliciting physical and mental symptoms of dizziness, disorientation and sometimes motion sickness.

Motion sickness has been described as the ‘vestibular system’s special form of sickness’, because motion sickness only occurs in the presence of a healthy and intact vestibular system, but motion sickness is in fact the product of conflict between information received by the vestibular system and other sensors involved in postural adaptation in response to different types of motion. Judging speed of motion provides one example of this – because speed is evaluated through two systems, by the vestibular system and the visual system. For the brain to accept the result, the two estimations must be coherent.
Balance is the art of not falling; walking is a continuous sequential process of moving from stability through instability (while transferring weight from one foot to the other) and regaining stability; the ability to remain ‘poised’ between one phase of action and another depends on balance.

Berthoz described control of motor actions and thinking as a dual process in which posture and motor control are a preparation for action so that even our thoughts and dreams are an internalized simulation of action. Our executive functions give us the capacity to inhibit cognitive strategies or innate reflexes that kick in too quickly. One might say to think is to inhibit and disinhibit; to create is to inhibit automatic or learned solutions; to act is to inhibit all the actions we do not take.

Individuals still under the influence of primitive reflexes do not lack strength or power, rather they lack voluntary control over release of power and choice of actions. This can affect not only control of volitional movement and discrepancy between intended movement and performance but also cognitive processes. Berthoz goes on to say that ‘inhibition enables competition, facilitating decision making, plasticity (flexibility) and consequently decision making and stability’.

### 1.9 Primitive Reflexes

The symmetrical tonic neck reflex, symmetrical tonic neck reflex, tonic labyrinthine reflex and Moro reflex.

**Why have these four reflexes been selected for evaluation?**

Reflexes that are connected to the functioning of the vestibular system have consistently been shown to act as barriers to learning and to play a part in the development of anxiety states:

1. The Asymmetrical Tonic Neck Reflex (ATNR)
2. The Symmetrical Tonic Neck Reflex (STNR)
3. The Tonic Labyrinthine Reflex (TLR)
4. The Moro reflex

**The Asymmetrical Tonic Neck Reflex (ATNR)**

The Asymmetrical Tonic Neck Reflex (ATNR) emerges in normal development at circa 18 weeks’ gestation, at about the same time as the mother becomes aware of her baby’s movements. Rotation of the head to one side elicits extension of the arm and leg on the side to which the head is turned and retraction of the opposite arm and leg. The ATNR increases in strength as pregnancy progresses and should be fully developed at birth in the full-term neonate.

In the first months of life, the ATNR plays a part in spontaneous movements, developing ipsilateral movements and acting as one of the earliest pre-conscious mechanisms for training hand–eye coordination (Figure 1.1). It is normally inhibited between four and six months of post-natal life (Figure 1.2).
Retention of the ATNR beyond six months of age can interfere with the development of subsequent motor abilities such as rolling over, commando-style crawling, control of upright balance when the head is turned to one side, the ability to cross the midline of the body when the head is turned to the affected side (potentially affecting bilateral integration), lateral eye movements and hand-eye coordination. Some observations have indicated a link between retention of the ATNR and failure to develop a preferred side of functioning.38,39

In the school-aged child, a residual ATNR can interfere with activities which involve crossing the midline especially writing position (Figure 1.3a), writing grip (Figure 1.3b) and control of the hand when writing. If it is present in combination with other reflexes connected to the control of the eye movements involved in reading, it can act as a barrier to reading. Prevalence of the ATNR has been found to be greater in some children with reading difficulties.51 In adults, it can either affect control of balance and dependent functions when the head is turned to one side or be elicited as a result of postural or vestibular dysfunction.

Figure 1.1 ATNR neonate.

Figure 1.2 ATNR inhibited by the action of sucking in an infant at four months.

Figure 1.3a ATNR influencing writing position.

Figure 1.3b ATNR influencing writing grip.
The Symmetrical Tonic Neck Reflex (STNR)

The Symmetrical Tonic Neck Reflex (STNR) is present for a few days at birth, recedes and then re-emerges between five and eight months at the time when the infant is learning to push up on to hands and knees from prone in preparation for crawling. The STNR should only remain active for a few weeks or retention can interfere with the next developmental stages of crawling on hands and knees, sitting and standing posture and hand–eye coordination.

The STNR is elicited in a four-point kneeling (quadruped) position when head extension elicits an increase in extensor muscle tone in the arms and flexor tone in the hips and knees (Figure 1.4 and Figure 1.5).

Conversely, flexion of the head elicits increase in flexor tone in the arms, causing the arms to bend, and increases extensor tone in the muscles of the hips and knees (Figure 1.6).

While the STNR has an important function in helping the infant to defy gravity, firstly in getting up on to hands and knees and secondly in helping him to pull to standing at the side of the cot, playpen or an item of furniture, it should not persist in the quadruped position after he becomes secure in the quadruped position or in the upright position once he has learned to stand unaided. If it fails to be suppressed by the time independent walking is established, distribution of muscle tone in the upper and lower halves the body can continue to be affected by head position or movement of the head through the mid-plane.

*Crawling on hands and knees is sometimes referred to as creeping, particularly in American literature on child development.*
In the school-aged child, this can be most readily observed in sitting posture when writing. When the child looks down at the writing surface, the arms want to be bend (and the legs extend), making the child lean further towards the writing surface, so that in some cases she may end up almost lying on the desk to write (Figure 1.7).

When the head is raised, the child is able sit up, but each time he or she looks down, the arms bend. If she extends her head, the opposite reaction occurs – the arms straighten and the legs bend. Children will try to find all sorts of different ways to get comfortable when sitting to write, including wrapping their feet around the legs of the chair or partially squatting on the chair (Figure 1.8, Figure 1.9, Figure 1.10 and Figure 1.11).

Figure 1.7  Sitting posture typical of an STNR in flexion.

Figure 1.8  STNR influencing sitting posture.

Figure 1.9  STNR influencing sitting posture.

Figure 1.10  STNR influencing sitting posture.

Figure 1.11  STNR influencing sitting posture.
In adults, the STNR can affect sitting posture (Figure 1.9, Figure 1.10 and Figure 1.11), upper and lower body integration, hand–eye coordination (particularly in the elderly) and visual perception.

In addition to making sitting awkward and uncomfortable, retention of the STNR in the school-aged child can affect specific hand–eye coordination skills including control involved in bringing the hand to the mouth when eating. Children with a residual STNR often have a history of being messy eaters finding it difficult to bring a fork, spoon or cup to the mouth without spilling some of the contents on the way. It can also interfere with the development of specific oculo–motor skills such as speed of accommodation needed to copy from the board or track an object approaching at speed (e.g. catching a ball) and the vertical tracking skills needed to align columns correctly in maths and for judging heights.

**The Tonic Labyrinthine Reflex (TLR)**

The Tonic Labyrinthine Reflex (TLR) is present at birth and is a primitive reaction to gravity which recedes as head control, muscle tone and postural control develop. When the newborn is held in the supine position, if the head is lowered below the level of the spine, the arms and legs will extend (Figure 1.12).

![Figure 1.12 Tonic labyrinthine reflex in extension. Reproduced with permission from Goddard SA (2002). Reflexes, Learning and Behavior. Fern Ridge Press, Eugene, OR. © Fern Ridge Press.](image)

If the head is elevated and flexed above the level of the spine, the arms and legs will flex (Figure 1.13).

![Figure 1.13 Tonic labyrinthine reflex in flexion. Reproduced with permission from Goddard SA (2002). Reflexes, Learning and Behavior. Fern Ridge Press, Eugene, OR. © Fern Ridge Press.](image)
As head righting reflexes (postural reactions) develop in the first weeks and months after birth, the TLR is inhibited by higher brain centres and is replaced by a series of more advanced postural reactions, which facilitate adjustment of head position in response to movement of the body or the environment. These automatic head righting reactions provide the basis not only for control of balance and general coordination but also a stable postural platform for centres involved in the control of eye movements (fixation, convergence, accommodation and tracking) on which visual perception depends.

Retention of the TLR beyond three and a half years of age is associated with problems with balance, muscle tone and control of the eye movements needed for reading, writing, copying and mathematics and can also affect spatial skills. This is because spatial awareness and the ability to manoeuvre and carry out cognitive operations in space depend first on having a secure physical reference point in space.

Adults with evidence of a TLR usually experience generalized symptoms of insecurity linked to poor gravitational security and visual–perceptual problems.

**The Moro reflex**

The Moro reflex is present in the healthy full-term neonate and forms part of the routine paediatric assessment carried out shortly after birth. A weak or absent Moro reflex is seen in cases of upper motor neuron lesions; an asymmetrical Moro reflex at birth may indicate a fractured clavicle or Erb’s palsy. It is inhibited at circa four months of post-natal life when it is gradually replaced by the adult startle or Strauss reflex.

The Moro reflex is usually tested by placing the palm of the hand under the baby’s head and lowering the head below the level of the spine. Unexpected vestibular stimulation such as rapidly lowering the whole body or striking the supporting surface will also activate the reflex. When the head is lowered, the arms abduct, the legs to a lesser degree; there is a rapid intake of breath; the neonate ‘freezes’ momentarily in the abducted position before the arms adduct; and the baby will usually start to cry (Figure 1.14).

Although the Moro reflex is most sensitive to vestibular stimulation in the first days of life, it can also be elicited by any sudden change of position or unexpected sensory event and is the only one of the primitive reflexes to have multisensory receptors.

Retention of the Moro reflex in an older individual is associated with a tendency to over-react and to be hypersensitive to specific stimuli. Although the accepted method for assessing the Moro reflex is rapid alteration of head position, the Moro reflex can continue to be elicited by other sensory
stimuli at an older age if the specific sensory system involved is unable to filter or process sensory stimuli adequately. The reflex can also be elicited by destabilizing postural control if postural reactions are under-developed. Retention of the Moro reflex in older children and adults is associated with an over-reactive startle response and increased propensity to anxiety.‡

1.10 What evidence is there that intervention in the form of movement programmes aimed at the level of primitive reflexes improves reflex status and educational outcomes?

Traditionally, remediation of educational difficulties tends to be primarily aimed at treating the symptom, that is, focusing resources on teaching and practice of more reading, more writing, more spelling and more maths as is considered necessary. While this can be beneficial if the problem is a direct result of deficit in teaching or the learning of foundation skills, it will not ameliorate difficulties that arise as a result of defects in underlying physical skills that support higher aspects of learning.

The concept of using motor training programmes to improve learning is not new either. Kephart,41 Frostig and Horne,42 Getman et al.,43 Cratty,44 Barsch,45 Ayres,14 Belgau,46 Kiphard and Schilling47 and others all advocated and developed perceptual and developmental screening and training programmes to improve the perceptual–motor skills of young children to enhance learning outcomes. In 1975, Blythe and McGlown48 developed the INPP programme for use with individual children aimed specifically at inhibiting primitive reflexes and stimulating the development of more mature postural reactions. A body of research into the effects of intervention programmes aimed at integrating primitive and postural reactions has gradually accumulated over the last 30 years beginning with small-scale independent studies, which have indicated, firstly, that primitive reflexes can and do respond to specific physical interventions and, secondly, that maturation in reflex status is accompanied by improvements in coordination and educational measures.20,25,40,48–49

In 1996, the INPP clinical programme was adapted for use in schools.50 Research carried out on this programme has consistently shown that:

1. There is a significant decrease in active primitive reflexes and improvement in measures of balance and coordination in children who followed the programme compared to control and comparison groups.

There are improvements in drawing and reading in children who had both abnormal reflexes and who were performing below chronological age in these skills before introduction of the programme.51–54

Empirical evidence provided by reports from teachers and head teachers has indicated that there are improvements in behaviour, particularly playground behaviour; children are quicker to settle at lessons following the exercises; and there are noticeable differences in children’s poise and posture.

In one study carried out in Northumberland, five children had been referred to the Behavioural Support Service in the area. At the end of the first term on the programme, all of the children were removed from the support service’s list despite the fact that no specific behavioural intervention had been given in the intervening time.55

A follow-up study carried out in Germany two years after a cohort of children had completed the school programme found that the participants had maintained the gains they had made two years after they had completed the programme.56

A study involving 139 children in four primary schools in Germany carried out between 2008 and 2011 indicated that children who took part in the INPP school programme showed greater improvement in measures of abnormal reflexes, learning outcomes and social behaviour compared to control groups who did not participate in the exercise programme. Children in a class receiving speech therapy made the most significant progress.57

1.11 What was Known About Exercises to Inhibit Primitive Reflexes? When was the INPP Method Developed? What has been Your Personal Experience Since then?

In 1969, when Peter Blythe, PhD, first became interested in the effect of aberrant reflexes on children with average to above average intelligence who had specific learning difficulties, there were no exercises available to directly inhibit the aberrant reflexes. Others, Berta and Karel Bobath, for example, had recognized the significance of aberrant reflexes when working with cerebral palsy but tried to teach children with cerebral palsy higher cortical movements in the hope the cortex could be trained to ‘contain’ the effect of the continued primitive reflexes.

Initially, Blythe and one of his students, David J. McGlown, developed specific movements designed to teach the CNS to inhibit the aberrant reflexes and stimulate the appropriate postural reflexes. Later, Blythe recognized that primitive and postural reflexes have a purpose – a genesis, a period of maturation and, in the case of the primitive reflexes, a limited period of function. When a reflex has fulfilled its purpose, it diminishes until entirely inhibited by the developing CNS. It was this realization which led to INPP’s unique approach to reflex inhibition and integration.
The INPP clinical programme integrates reflexes in a number of different ways depending on the presenting profile of the patient. Some reflexes are stimulated; others are integrated by stimulating associated sensory systems; normal infant movements are replicated to help integrate reflexes; and in some cases, ‘higher’ postural reflexes are stimulated to assist in the inhibition and integration of developmentally earlier primitive reflexes. The INPP remedial programme is based on the results of the INPP neuro-developmental assessment and the developmental profile of the individual patient. In other words, the reflex status of the patient provides the basis for the type and developmental level of remedial movements or sensory stimulation recommended.

In 1996, the INPP developmental assessment and clinical programme was adapted by Goddard Blythe for use in schools. This involved the selection of a small number of tests taken from the full INPP diagnostic assessment and adapted for use by teachers to identify children who have underlying difficulties with balance and coordination, evidence of three primitive reflexes and visual–perceptual problems, who would benefit from a daily exercise regime.

Goddard Blythe devised a general developmental movement programme to be used with whole classes of children or smaller selected groups. The programme was designed to be used under the supervision of a teacher who had attended one to two days’ training in the use of the test battery and movement programme. The movements are carried out every school day for a minimum of one academic year, key elements of the programme being regularity (every day), repetition (using the same movements daily for several weeks) and duration (minimum of one year to complete the programme).

The exercises are based on movements made by normal developing infants in the first year of life. All children participating in the programme progress through the programme at the same pace, and teachers do not select specific exercises for individual children. The INPP programme for schools has been the subject of a number of studies.

1.12 What is the Difference Between the INPP Method, Sensory Integration (SI), Vojta Therapy, Bobath Therapy and Others Working with Primitive Reflexes? What are the Criteria for Referral to a Particular Therapy?

The INPP method

The INPP method uses standard tests developed for use by medical practitioners to assess areas of functioning listed under Section 1.7. While the tests for gross muscle coordination and balance, dysdiadochokinesis, oculo-motor functioning, visual perception and laterality provide indications of the degree and specific areas of dysfunction, it is the reflex profile viewed in a developmental and hierarchical sequence which will provide the basis for remediation using a developmental movement programme tailored to the results of the individual assessment.
Exercises may be viewed in five functional categories:

1. Stimulation (primitive reflex) exercises.
2. Stimulation or training of the sensory system(s) that elicit the reflex, for example, vestibular training (other systems of intervention may also work in this way. For example, auditory training can help to reduce reactivity of a Moro reflex elicited primarily by auditory stimuli).
3. Use of normal developmental movement patterns which occur at the time that one or several reflexes are being integrated.
4. Stimulation of a developmentally later reflex to inhibit an earlier one.
5. Stimulation of postural reflexes.
6. Use of exercises devised to integrate on a particular reflex (constructed movements).

Remediation starts from the point of the earliest aberrant reflex and/or sensory system involved and works developmentally from the brainstem up towards the cortex. This approach led one student of the INPP method to describe it as ‘Peter Blythe’s “bottom up” approach to resolving specific learning difficulties’. While there are similarities in underlying theory with other diagnostic and remedial systems such as Sensory Integration (SI), the INPP method differs in its developmental approach to stimulation–integration–inhibition, using primitive and postural reflexes as markers of immaturity, indicators of level and type of remediation required and measures of progress during and after intervention.

Although the INPP method can be applied to children from as young as six years of age and in exceptional circumstances (brain injury or a history of severe neglect in infancy) to younger children, the INPP individual programme is most effective when used with children from seven years of age and upwards.

The screening test for use in schools is suitable for use with children from four years of age to identify signs of neuromotor immaturity, but children under six can find it difficult to perform the exercises slowly and precisely. For this reason, less specific movement programmes are more suitable for use with this younger age group.

**Sensory Integration (SI) therapy**

Sensory integration was developed by A. Jean Ayres, an occupational therapist who had originally studied at the Institutes for the Achievement of Human Potential in Philadelphia, an organization dedicated to the development of rehabilitation programmes following brain injury. SI is a therapeutic method primarily for treating individuals with learning and motor organization problems. The SI approach to learning disorders:

- does not teach specific skills such as matching visual stimuli, learning to remember a sequence of sounds, differentiating one sound from another, drawing lines from one point to another, or even the basic academic material. Rather the objective is to enhance the brain’s ability to learn how to do these things.\(^{14}\)

Although SI also involves the assessment of some primitive and postural reflexes, remedial intervention is provided through stimulation, training and controlling the input of different
senses with the aim of eliciting more appropriate adaptive responses to sensory stimuli and improved organization in brain function. Therapy usually involves activities that provide tactile, proprioceptive and vestibular stimulation. The practice of SI as a therapy has evolved since A. Jean Ayres first developed it and presented it in her doctoral thesis. Some of the key principles and features of modern SI include:

- The assessment of the child’s difficulties is vital in order to find out where the child’s problems lie and how to plan treatment effectively.
- Child/therapist interaction (intensive).
- Child guided (often the child seeks out the sensory input he/she needs).
- Therapist aims to help the child to find this out for him-/herself and guides in the right direction so that he/she gets maximum benefit.
- Aims to raise the child’s self-confidence.
- Does not aim to teach the child how to perform/carry out specific tasks but ‘helps the child to learn’, that is, by using the sensory systems to help the brain to organize itself.
- Uses play and different types of equipment.
- Helps the child to work out how to interact appropriately with their environment.

In recent years, there has been a dichotomy among different branches of practitioners of SI. While one school of thought now places primary emphasis on sensory factors with less focus on motor skills (a deviation from A. Jean Ayres’ original ideas in which motor experience was an intrinsic part of sensory integration), another branch – Ayres Sensory Integration (ASI) – is at lengths to differentiate itself from the other SI therapies (brushing, weighted vests, weighted blankets, therapy ball chairs, etc.). ASI referred to the latter as sensory-based intervention in contrast to ASI where there is a strong emphasis on motor skills. The Ayres people refer to this in terms of praxis, action-projected sequences, bilateral coordination, and so on, as well as the tactile processing/sensitivities recognized by both groups as being a hallmark of sensory integration disorders. In this part of the dichotomy, there is great focus on the improvement of motor skills which would be in line with Ayres’ original writing. The current trends are polarizing strongly in both the sensory-based intervention and ASI, each remaining steadfast to prove their validity in treatment.59

**Vojta therapy**

The Vojta method is well known in Germany and other European countries but is not used extensively in the United Kingdom. Whereas the Vojta method shares the assessment of reflexes, posture and movement capabilities with the INPP method, the Vojta method tends to be directed at rehabilitation of brain injury, for example, cerebral palsy, spina bifida, etc., and can be started almost immediately after birth if indications for therapy are present. Assessment and therapy are used primarily with infants and young children. Therapy concentrates on:

- Modifying abnormal reflex activity through the induction of a different neurological activity supplying to the patient a new corporal perception. Proprioception plays a key role in the process.
- Improved control of breathing.
Identifying Signs of Neuromotor Immaturity in Children and Adults

- Fifteen to twenty minute sessions three to four times a day usually carried out by parents under the direction of the therapist

Therapy involves manipulation in addition to practising a range of developmental movements.

**Theoretical basis to the Vojta method**

The development of human movements from birth follows a hereditary and evolutionary plan starting from prone to the achievement of the erect posture and locomotion. Vojta described this as the principle of locomotion of postural ontogeny. Others have described this as ontogeny replicating phylogeny. Normally, motor activity is innate, and all children pass through similar milestones of motor development. The most important impulse for movement development is contact and interaction with the environment. The ability to react with posture is consistent with regular reactions of the body on voluntary and involuntary changes of position in space. Disturbance or impairment in the ability to react appropriately with posture affects the whole psycho-motoric development of the child, especially if it occurs during the first year of life.

The Vojta assessment uses a standard neurological test with additional tests.

The following criteria are assessed in relation to age (gestational age):

- Tone of the trunk and extremities.
- Holding and posture of the head.
- Antiflexion, retraction and opisthotonus of the head.
- Asymmetries.
- Quality of movement when flexing and extending the extremities.
- Supination and pronation of the hands and legs.
- Reaction of approach towards the surface.
- Primary reflexes including the crossed extensor reflex and the suprapubic reflex (pressing the symphysis, which is followed by stretching of the feet and legs). These two reflexes should be inhibited by the fourth month of life. Persistence will result in abnormal fixed movement patterns.
- Primary movements during the first year are also assessed, particularly rolling (supine to prone) and crawling, which are reflexive movement sequences controlled by the interaction of subcortical brain centres with the spinal level (cord).
- There are 10 different zones on the trunk, arms and legs from which the movement patterns are elicited. By applying varying degrees of pressure to different combinations of these areas, it is possible to initiate reflexive rolling and reflexive crawling.

Vojta states that in a persisting motor coordination disorder, it is not the automatic control of the postural reactions which is impaired but the central coordination of the different muscle groups (muscle flexing) which are crucial for motor development.

Indications for Vojta therapy:

- Irregularities of movement in infants
- Asymmetry of the chest
- Torsion of the neck
<table>
<thead>
<tr>
<th>Differences</th>
<th>Sensory integration</th>
<th>INPP method</th>
<th>Vojta method</th>
<th>Bobath method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapy suitable for:</td>
<td>Children with learning and motor organization problems</td>
<td>Children with specific learning difficulties, neuromotor immaturity, under-achievement; adults with agoraphobia and panic disorder where visual–perceptual and vestibular dysfunctions are also present</td>
<td>Assessment of infants at birth, treatment of acquired neurological conditions and neuro-developmental problems</td>
<td>Acquired neurological conditions, children with neuro-developmental problems</td>
</tr>
<tr>
<td>Investigations:</td>
<td>Assessment</td>
<td>Assessment</td>
<td>Assessment</td>
<td>Assessment</td>
</tr>
<tr>
<td>Therapist involvement:</td>
<td>Child/therapist intensive</td>
<td>Daily programme, 5–10 minutes per day, average duration 12 months</td>
<td>Therapist guided but carried out by parents under instruction from therapist</td>
<td>Therapy sessions vary according to the needs of the patient</td>
</tr>
<tr>
<td>Type of therapy:</td>
<td>Child guided</td>
<td>Therapist-led programme carried out under parental supervision</td>
<td>Therapist led but also carried out by parents at home under therapist’s direction</td>
<td>Therapist’s active involvement in carrying out therapy sessions</td>
</tr>
<tr>
<td>Method of treatment:</td>
<td>Does not teach specific skills, entrains sensory systems and improved organization in functioning of the brain</td>
<td>Therapy aimed specifically at inhibiting and integrating primitive and postural reflexes to stabilize the foundations for balance, postural control, coordination, oculo-motor functioning and visual perception</td>
<td>Uses a combination of manipulation and pressure (deep proprioceptive stimulation) and movement to improve function</td>
<td>Treatment is tailored to clients’ individual needs and is based upon an assessment of their abilities and analysis of their movement disorder. This is achieved through the use of specialized handling techniques that help to reduce spasticity and facilitate more normal movement</td>
</tr>
<tr>
<td>Brain level:</td>
<td>Remediation tends to work from the cortex downwards</td>
<td>Remedial intervention uses movements that start from the brainstem and works up to the cortex</td>
<td>Remedial intervention may involve different levels of the brain but is aimed primarily at improving the ability of the motor cortex to control movement</td>
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<tr>
<td>Equipment:</td>
<td>Uses play and different types of equipment</td>
<td>Minimal equipment required</td>
<td>Uses specific handling techniques to help children to relax and mobilize their muscles and joints. This improves the child's quality of posture and movement, enabling them to move more freely and be more stable and comfortable</td>
<td></td>
</tr>
<tr>
<td>Professional qualification of therapist:</td>
<td>Occupational therapists with additional SI training</td>
<td>Therapists with professional qualifications in a field allied to medicine, education or psychology who have trained in the INPP method</td>
<td>Parent under direction of Vojta therapist guidance and instruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physiotherapists with additional training in the Bobath method</td>
<td></td>
</tr>
</tbody>
</table>
Vojta therapy is recommended following manual therapy for the treatment of Kinematic Imbalance due to Sub-occipital Strain (KISS) and should be continued until the child crawls:

- Palsy of the plexus: M. Erb
- Spina bifida
- Dysplasia of the hip joint
- Poor erection, low truncal tone, inversion or eversion of the feet, scoliosis, kyphosis, paraplegia, neuralgia of the lumbar region and the sciatic nerve and myopathy

**Advantages of Vojta therapy**

Its advantage includes a clear concept of assessment and therapy which can start from early in development (immediately after birth if applicable).

**Disadvantages of Vojta therapy**

The disadvantages include babies cry during treatment, mothers can find this distressing and fail to carry out therapy correctly and therapy becomes more difficult to administer between two and four years of age as the child resists being held in the required positions.

The therapy aims:

- Achievement of fluent bipedal locomotion
- Improvement of strength, coordination, muscle tone and function
- Improvement of several autonomic functions including breathing, swallowing, digestion, circulation, blood pressure, urination and bowel movement

There are seven indicators for Vojta therapy. If there are more than four abnormal indicators in relation to age/gestational age, therapy should be used; if there are more than five indicators, therapy should start immediately.

Even infants who appear to be normal can be affected and benefit from therapy. Examples of infants at risk are those who have undergone a difficult birth or required intervention at birth (CS, ventouse, forceps, Kristeller movement) or infants born with low tone and asymmetry of posture.

The best time to apply the method is the first year.

**Bobath therapy**

Bobath therapy was developed in the 1940s by Dr Karel and Mrs Berta Bobath. It specializes in the treatment of acquired neurological conditions such as strokes, head injury, multiple sclerosis, incomplete spinal cord injury and Parkinson’s disease. It is also used to treat neuro-developmental conditions such as cerebral palsy and other allied conditions. It aims to
improve the quality of life and optimize ability by encouraging and increasing movement capabilities and function.

It is primarily a way of observing, analysing and interpreting task performance using assessment of the patient’s potential, which the Bobaths considered to be that task or those activities which could be performed by the person with a little help and therefore possible for that person to achieve independently where possible. The method also involves the use of various techniques. Bobath always advocated that the therapist should ‘do what works the best’ (Bobath, 1978). In the present day, this means that while therapy is based on sound evidence when it is available, much of what therapists do has not been formally evaluated (Table 1.1).

1.13 What are the Top Five Medical Diagnoses Where Referral to INPP Should Routinely be Considered After Checking the Reflexes by Clinicians?

The INPP method does not claim to offer a ‘cure’ for any specific disorder. Rather, it aims to improve functioning and can be applied to a range of disorders. While the INPP programme has been used to assist in rehabilitation after brain injury, it was primarily designed for use with children and adults in whom dysfunction is evident, but no pathology has been identified. The diagnostic categories in which symptoms have consistently shown improvement following use of the INPP method include:

- Neuromotor immaturity
- Development Coordination Disorder (DCD)/dyspraxia
- Educational under-achievement
- Specific motor–perceptual symptoms associated with dyslexia
- Motor aspects of Attention Deficit Hyperactivity Disorder (ADHD)
- Motor–perceptual aspects of Asperger’s disorder
- School phobia and selective mutism
- Agoraphobia and panic disorder when visual–perceptual and vestibular dysfunction are features of the presenting symptoms (Rehabilitation after acquired brain injury)

1.14 Screening Tests

The next section, which explains how to use the screening tests with children, has been compiled based upon evidence that has consistently shown that:

1. Maturity in the functioning of the central nervous system may be inferred from children’s neuromotor skills.
2. There is a relationship between children’s neuromotor skills and performance on motor dependent tasks.
3. Residual primitive reflexes respond to the INPP developmental exercise programme.
4. Improvement in neuromotor skills can have a positive influence on learning outcomes, emotional regulation and behaviour.

Factors assessed in the INPP screening test for health practitioners

- Balance
- Proprioception
- Primitive reflexes: ATNR, STNR, TLR and Moro reflex
- Dysdiadochokinesis

How to use the screening test

This test is for screening purposes only and should not be used to form a diagnosis.

It may be used to:

1. Identify children and adults with signs of neuromotor immaturity and related difficulties
2. Identify children and adults likely to benefit from the INPP reflex stimulation and inhibition programmes
3. Identify children who have issues related to neuromotor immaturity, visual–perceptual problems or auditory processing deficits who should be referred on for more specialized assessment, diagnosis and intervention

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