

Introduction

The Gravitational Force and the Nervous System

“ The force of gravity prevails continuously everywhere on this planet and is of prime importance in permitting the nervous system to perform all aspects of its function”.¹

The influence of the gravitational force upon development and the importance of a well functioning vestibular system have been neglected thus far but are of interest in the research into a science of consciousness. Already Myrtle McGraw suggested that the challenge of overcoming gravity heightened consciousness.² Also the work of Paul Schilder is clearly pointing in that direction.³

The most common connection between the gravitational force and the human nervous system is the vestibular system. The vestibular apparatus is the organ that detects sensations of equilibrium. “As Stanley-Jones (1960)⁴ has pointed out, the sensory receptors of the vestibular apparatus in the inner ear responding to the force of gravity are non-adaptive and are the most important energy source for increased neuronal activity “.¹ The first parts are formed during the third week in utero and the system is functioning around the 8th week. This is also the time when the fetus´ first movements are detectable. Humprey (1965) pointed out a close correlation between structural and functional development in this part of the nervous system.⁵ However, Precht (1984) does not believe the fetus has the capacity to respond to vestibular stimulation⁶ while Odent´s (1986) opinion is “The vestibular system of the fetus is constantly being stimulated when the mother is walking , dancing, changing her position and so on”.⁷

“Each function develops while the nervous system and its executive mechanism grow. The functions that are fully matured , or nearly so, at birth, remain strictly localised in the organs and in the nervous system. The breathing function, all the vegetative functions, the reaction to gravity, the circulation, in short, all the elements of functions that need little or no apprenticeship, and no further growth of their material support or the nervous tissue concerned, continue to be localized. The localization of all the functions that need growth of the body, and in particular those that need growth of the nervous tissue and apprenticeship, becomes more and more diffuse at each successive level of maturity. At maturity, all these functions are practically a property of the whole organism, and the destruction of any nervous mass or organ, no matter how great the mutilation may be, cannot completely eliminate or abolish the function”.⁸

Another connection between the gravitational force and man was proposed when Mittelstaed (1992) found gravity receptors in the human trunk.⁹

A third connection comes from Prigogine (1984) “But recall the Bénard cell; from a mechanical perspective , its instability is the raising of its center of gravity as the result of thermal dilatation. In other words, gravitation plays an essential role here and leads to a new structure in spite of the fact that the Bénard cell may have a thickness of only a few millimetres. The effect of gravitation on such a thin layer would be negligible at equilibrium, but because

of the nonequilibrium induced by the difference in temperature, macroscopic effects due to gravitation become visible even in this thin layer. Nonequilibrium magnifies the effect of gravitation".¹⁰

A forth connection is offered by Pettigrew (2004): "I will conclude with a speculation on the role of neuronal mechanoreception in the detection of tiny gravitational forces that was first stimulated by observations on the gravity-anomalous mountain environments of Buddhist retreatist meditators, but which receives support from diverse directions, particularly the new evidence for extreme sensitivity of mechanoreceptors that could signal small gravitational changes. Gravity may provide a new arena for the interaction of the physics and biology of consciousness".¹¹

Primitive Reflexes or Fundamental Movement Patterns

We were born equipped with a set of fundamental movement patterns traditionally called primitive reflexes.^{12,13} According to Touwen,¹⁴ primitive because the infant's brain is considered underdeveloped compared to the adult brain and reflex because the infant's brain is considered working on a reflex basis. Touwen's conclusion is that the concept of primitive reflexes is wrong. The infant's brain is too complex to be explained in terms of primitive and reflexive. Instead of viewing the brain as a strictly hierarchical system we must understand it as a dynamic whole. He writes "How can the development of a complex system such as the central nervous system be conceptualized so that the entire system is involved in the developmental process? For an explanation, it is possible to borrow from the field of thermodynamics. The developing nervous system can be considered as an 'open system', that is, it exists and grows because of continuous influx of energy and information.¹⁵ An open system is not in equilibrium, but in a 'dynamic' state".¹⁴

As a consequence of Touwen's argument I find it more appropriate to use the concept of fundamental movement patterns instead of primitive reflexes.¹⁶

The Gravitational Force and Fundamental Movement Patterns

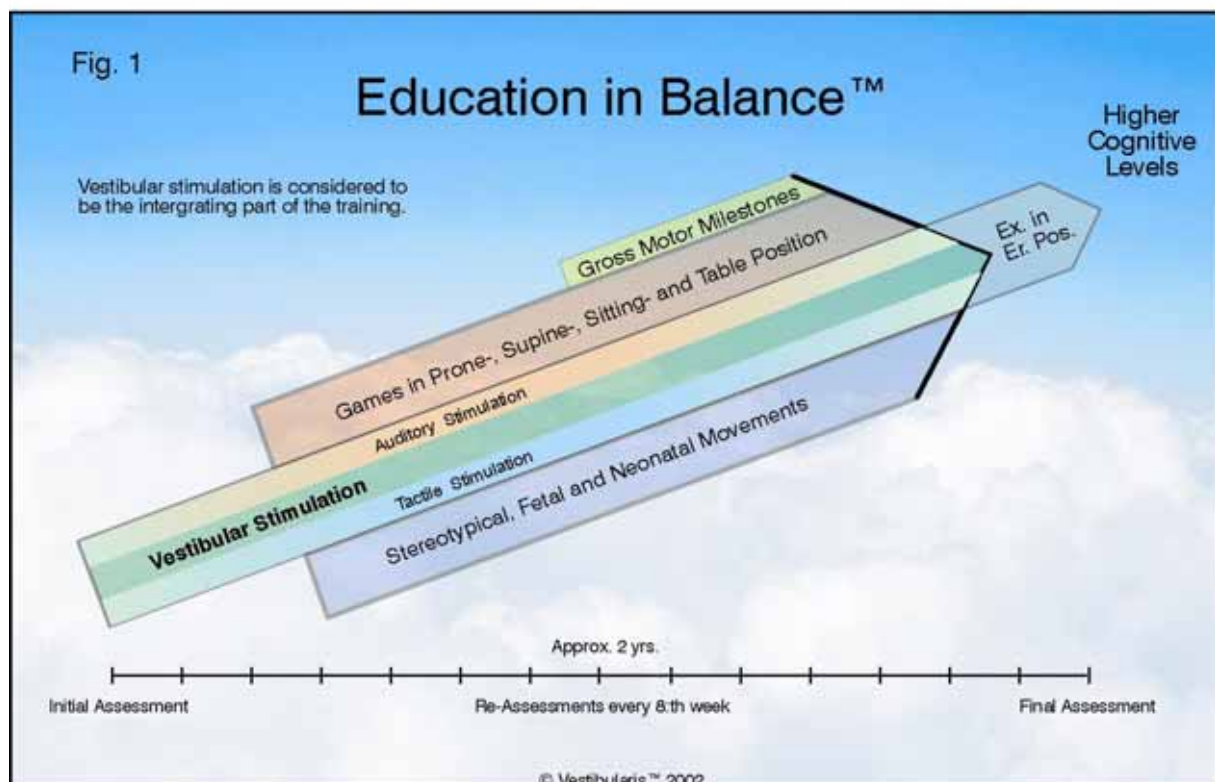
During the first years of life the subcortical activity is gradually followed by an increase of cortical influence.¹⁷ The fundamental movement patterns (fmp) are supposed to be inhibited.¹⁸ Vestibular stimulation and stereotypical movements, both of which are brain stem functions,^{16,19} seem to be of great importance in this process.²⁰ The vestibular system is most sensitive to stimulation between 6 and 12 months.²¹ This is the time when crawling, creeping and walking occurs. Fmp in their crudest form will be laid to rest, only to show up again in emergency situations. If the process of inhibition is incomplete and one or more of 'the reflexes' remain, partly or totally, uninhibited there will likely be problems.^{22,23,24} Fmp acting from the subcortical level will continue to influence the person's movement behaviour. Through lack of vestibular response the psychological behaviour will also be affected.^{16,25} Instead of being an open system the nervous system will act as being partly a closed system.

Higher Cognitive Levels

At Vestibularis™, a school of fundamental movement education, in Mönsterås, Sweden, more than 600 children and youngsters with sensory motor problems have been trained according to the method Education in Balance™.¹⁶ Most of our clients are healthy individuals with normal intelligence. As the training moves along there is always improvement when it comes to movement behaviour. Also, as the nervous system is becoming more integrated, we find in our clients an increased awareness and a better ability to use higher cognitive levels. Our clients are gaining more insight and they are becoming more aware.²⁵

To help or to help not

Working from the hypothesis that vestibular stimulation as well as fundamental movement training matters, we have trained a couple of brain injured clients. These clients, one child and one adult, are doing almost the same programme as the uninjured clients. The child was born with his handicap while the adult was affected by a 'strokelike' attack five years ago. In both cases traditional medicine couldn't provide sufficient help when it came to rehabilitation. The adult, A.B, did motor progress as well as mental progress to a certain level when trained at the hospital. Then he 'lost' these abilities and that is when he came to see us. Contrary to main stream medicine we train our clients below functional level. That is, we start with exercises in prone and supine positions (Fig 1).



This presentation is focused on A.B and his training.

“There is no fundamental difference of kind whatsoever between psychic and physical activity. Both disappear with the destruction of the nervous system, both are the outcome of its functioning. The immediately observable physical world is governed by definite laws. The permanency and constancy of these laws, and in particular of the law of gravity, have moulded the human mind and body to expect cause and effect relationship between all phenomena”.⁸

During the last decades research has shown plasticity in the developing nervous system^{26,27} as well as in the adult brain.²⁸ ”It is also clear that plasticity depends on activity in the remaining pathways and synapses, therefore passive treatment of patients with pathology or trauma, whether accidental or elective, should be avoided”.²⁹ It is necessary to train and it seems probable that stimulation can make a difference but could our training help? If it could what results should we expect?

“The adult brain is morphologically different from the brain of an infant, so it functions differently. If the adult brain is damaged, the remaining parts which are responsible for the remaining functional display, are still biologically quite different from the healthy infant’s brain. It would be remarkable, therefore, if the functional display of the adult’s damaged brain and the healthy infant’s brain were similar, since it is impossible that the displays have identical mechanisms”.¹⁴ On the other hand: “It has been pointed out that the fetal reflex sequences tend to be repeated in the maturation of post-natal motor behaviour. The fact that the patterns of reflex activity of fetal life (and early infancy) lay the foundations for voluntary activity suggests the utilization of the principles of normal motor development as a basis for the restoration of motor function in the disabled”.³⁰ As always, there are two sides of the coin but following Capute’s answer in a discussion on the matter gave confidence. “Netsell wanted to know whether or not the primitive and postural reflexes might reappear in adult patients with head trauma. Capute answered that many of the reflexes were protective in nature. Some people believed that these reflexes found expression in the postures assumed by athletes. That might or might not be the case, but certainly the reflexes were under inhibitory control in a normal adult. They did reappear in cases of head trauma and acquired neurological diseases. Netsell asked if the character of these reflexes was the same in the adult with head trauma and in the normally developing infant. Capute answered that that was essentially true. The cerebrum was largely an inhibitory organ controlling the brainstem where many of the reflexes he had discussed were mediated. It was believed that, in cases of injury to the cerebrum, the brainstem might be released from inhibitory control and that primitive reflexes would then reappear. These reflexes might also disappear again as the individual recovered from head trauma. They were the same reflexes as were found in very young infants”.¹³

Method

Over view and Initial Assessment

Clients at Vestibularis are mostly children and youngsters with concentration problems and / or learning difficulties. Presently the average age for starting the program is 9.4 years and for completing the program 12.1 years. Approximately 20 % are girls and 80 % are boys. The main hypothesis behind the training is that uninhibited fundamental movement patterns are a hindrance to further physiological and psychological development.

A set of fundamental movement patterns and postural reactions are tested as well as the client's ability to roll, creep, crawl and move in an erect position. The ability to cope with rotation is also tested. Each test is scored from 0 to 4. '0' stands for no difficulties while '4' stands for severe difficulties.³¹

Criticism and Support

Touwen argued whether or not the reactions should be called reflexes.¹⁴ There has also been discussed whether or not they have a clinical value and if so, when?^{32,33,34,35}

Capute's opinion that the reactions are the same in both infants and adults find support in different studies.^{36,37,38,39,40} Burra et al (1980) also reported of reversible primitive reflexes in a case of adult psychosis.⁴⁰

"Teitelbaum and his coworkers have pointed out tellingly, that recovery often parallels the sequential development of the behaviour in infants".^{41a}

Education in Balance™

Training at Vestibularis follows the method Education in Balance^{16,25} with the special aim of giving the nervous system a second chance to 're-connect' and to mature. The training is divided in into five integrated parts and follows the sequence of neural development.

1. Stereotypical,^{42,43} fetal and neonatal movements. Devised by Blythe, Goddard Blythe,²³ Niklasson and Niklasson,³¹ following the patterns of the 'Primitive Reflex' system (fmp). "The early movements of the fetus and neonate, which were previously viewed as passive byproducts of rapid neural wiring are now viewed as interactive, that is, having a reciprocal effect on the underlying structure and function of the central nervous system".²²

2. Vestibular stimulation, we have found to be of importance for the integration of the stereotypical movements into the nervous system.^{19,31}

"Stimulation of the vestibular nuclei generates muscle tone and liberates the nervous system from these infantile reflex patterns".²⁰

3. Games with the special aim of enhancing muscle strength and body awareness.

4. Tactile stimulation.

5. Gross motor milestones. The unfolding⁴⁴ of rolling, creeping, crawling, walking and even talking³¹ mirror the child's ability to defy the gravitational force.^{45,46}

6. Exercises in an erect position. The last part of the programme is balance training in erect position.

The client is training at home fifteen minutes a day according to a specially devised program and is re-assessed every eighth week during a period of at least 2.5 years.

7. Auditory Discrimination Training (ADT) is running parallel to the sensory motor training.

Final Assessment

The whole set of fmp and postural reactions as well as gross motor milestones and rotations are tested. Each test is scored 0 – 4.

A Case Study

History

A.B , a 52 year old married man was affected by a 'strokelike' attack, lapsed into coma for three weeks.

During the time before the injury A.B worked a lot and lived a very stressful life. He was a smoker and suffered from tinnitus. Six months before his breakdown he was diagnosed with adult diabetes. By the time of the attack his wife considered him overstressed and almost depressive. She bought a surprise trip abroad and A.B was struck on the first day.

Examination showed that the brain was globally injured by hypoxia (lack of oxygen) not by the 'stroke' itself. Specifically the basal ganglia and the cerebellum were affected. "The basal ganglia, like the cerebellum, are another accessory motor system that functions not by itself but always in close association with the cerebral cortex and corticospinal system. In fact, the basal ganglia receive almost all their input signals from the cortex itself and in turn return almost all of their output signals back to the cortex".¹⁹

The weeks following his awakening he was very aware, his level of consciousness was high. His speech was good but he had difficulty using his body.

He was trained to use his body in up-right position and developed a stereotypical, somewhat spastical gait. As he became more physically competent his mental awareness decreased. After a year his trained movement patterns got

worse. It became more difficult to move but his mental awareness continued to rise, later to decline. So far he had received physiotherapy. Traditional medicine could not offer anything more so he tried acupuncture. Through his acupuncturist we came in contact with each other.

Early history

After spending his first 1.5 years in an orphanage he came to foster parents with whom he never felt any connection.

As an infant he was a bottom-shuffler.”..,bottom-shuffling develops as a progression from earlier activities in supine and sitting postures, and not because of a previous ability to scoot; nor does shuffling prepare a child for future ability to crawl”.⁴⁷ Bottom-shufflers also tend to walk later.⁴⁸

When he grew up he was shy and blushed easily. He never was too talkative and when he spoke his speech was a bit unnuanced.

A.B never liked to read nor to write essays. Though he was very interested in technical things and even worked in construction his fine motor skills were always bad. He found it difficult to use a screw-driver and to open screw-capped jars.

Although stubborn his humour was smooth and he gave an impression of being calm. According to his wife he did not get into conflicts and he had difficulties saying no. He avoided new activities that offered the opportunity to fail.

Initial assessment

A.B was 54 years old at the time for our first meeting, 1.5 years had past since the injury. His wife identified his problems as “he can’t find either his muscles or his balance. He has difficulties when it comes to contraction and relaxation. It is very difficult to pull up from a chair”. His reasons for starting the training were purely of sensory-motor character.

We could not do all the tests at the first assessment. A.B had great problems when it came to changing positions. We had to work slowly as most of the tests demanded great effort.

In summary the tests showed;

1. Scoring ‘4’ in prone. Impossible to lift the head and/or the legs.
2. Scoring ‘0’ when it came to lifting the head in supine and ‘4’ when it came to lifting the legs.
3. Passive turning of the head in supine, (ATNR) very stiff. Most probably score ‘4’. Very difficult to cross the midline.
4. Almost impossible for him to stand on all four.
5. He was very stiff when tested in erect position.
6. He could not roll, creep or crawl. Difficult to use his legs. More difficult to use the right side of the body. Difficult to cross the midline. When eating there was a distinct midline on his plate which he could not cross.
7. He could not grip properly.

8. He could not control the posterior part of the tongue.
9. He did not sense the rotation when rotated.

Later he was given an auditory discrimination test which showed discrepancy between the left and the right ear as well as difficulties within the higher frequency range.

The Training Process

A.B started his sensory motor training according to the Method Education in Balance in March 2001 (Fig.1). The auditory stimulation training was included later. He has also continued to see his acupuncturist.

A.B did his 23rd assessment in February 2005 and he is still in training.

All the way through the training there have been ups and downs both physiologically and mentally. In many ways, but especially when it comes to the psychological behaviour, he has followed the same mood pattern as our younger clients and other adult clients do. Midway through the programme we always see an increase in emotional sensitivity. Instead of anger we see a lot of weeping. At the end of the training most clients show a tendency to behave like teenagers. A.B showed more obstinacy and he became more determined.

Figure 2 was painted by an adult client showing her way through the process.



As the motor abilities improved the speech got worse and the opposite. When the mental side improved the speech got worse and the opposite. Generally, before a skill improved the ability disappeared or just got worse.

A.B's wife noticed that increased utility in muscles and joints was always preceded by small red spots in a line on that area. Sometimes the skin would turn blue and the muscles would become stiff, but always, hours later, would return to a healthy colour and become soft and usable. The directions of muscle re-development and red spots have mainly been from top-down and from hands/feet – toward the center of the body. During the first years of training improvement was followed in succession by heavy defecation, impairment and greasy skin.

Rolling, creeping and crawling unfolded.

A.B's ability to sweat improved.

We could see how red spots appeared on his throat, the tongue became a bit swollen and the salivary secretion increased. He was then able to belch/burp, cough and spit. He also re-developed the ability to breathe, eat and drink more normally.

A.B has been very disturbed by head itching. The itching is generated under the skull bone. It started at the back of the head and went to the side. Then to the front and it also affected the midline. The itching is still there.

There has been, and still is, an increased heat coming from his head. Especially from the forehead, when he is concentrating hard. He is not sweating, he is just warm.

The blood sugar level has fluctuated but surprisingly often it has been low especially when he is in harmony.

A.B's ability to control his bowel and bladder has also been better and worse. Now he is doing well.

During the first three years of training he needed to sleep after his exercises. More nightmares as the training continued.

A.B's sense of time improved and his memory got better.

As his mental level rose he became more easily moved and more sensitive to words, music and memories. He could weep and feel sorry for himself because he was trapped in his body.

More recently he has shown contempt and obstinacy.

Result

Initially A.B's aim with the training was to get better coordination and strength. He needed to be more able to balance his body.

Now that he has become stronger and more coordinated we can also see that his higher cognitive abilities have become more acute. This increased awareness together with his lack of language are very frustrating for him.

Surprisingly, although training only sensory motor functions, improvements in cognitive functions have so far been running ahead of improvements in sensory motor functions.

“ An interesting feature of recovery is that it can be gradual and orderly and proceed in what appears to be stages. In some ways these stages seem to parallel the well-known rostral-caudal and proximal-distal ontological development of the body and behaviour. The recapitulation of development as seen in recovery from spinal shock or motor cortex damage in humans or feeding and walking in the rat is remarkable but can also be used as a diagnostic indication of how recovery is proceeding. It is not clear that cognitive functions show the same orderly sequence of recovery, but speech sometimes recovers in a sequence of global-to-anomic aphasia and memory sometimes returns in a past-present sequence”.^{41b}

Compared to the initial assessment he has progressed as follows;

1. Today his neck stability is much better. He can lift his head in prone but he still cannot lift his legs.
2. Today he can lift his legs in supine.
3. Today he is much less stiff. He is able to cross the midline and he can use knife and fork when eating. No midline on his plate any more.
4. Although it is still difficult, he is much more capable of keeping his balance on all fours.
5. To keep balance in erect position is still difficult but easier than it was initially.
6. Today A.B can roll, creep and crawl. His right side is still his weakest side but it is improving without having been trained separately.
- 7 He can grip more easily today. His fine motor gripping is better. He has also inhibited / integrated the Moro 'reflex'. This makes him more alert when he loses his balance. Instead of just falling to floor he is better able to grip and keep his balance. “Moro considered it an atavistic embracing reflex which disappears, in normal infants, after the first trimester. It is not considered a positional tonic neck reflex; it is exclusively a vestibular reflex”.⁴⁹
8. Today he can control his tongue. Apparently this influences his eating, breathing, coughing, and most probably also his speech.
9. Today rotation has a very strong effect on him. The vestibular system is more sensitive to movements.

We have also seen that;

His blood sugar level has decreased.

According to his acupuncturist he is more sensitive when it comes to the perception of touch.
His original facial expression is back.
His body perspire. According to his wife it smells as before the injury.
He can feel thirst, hunger and he has a feeling of satisfaction. His sense of taste has re-developed.
He does not suffer from tinnitus anymore.
He does not need to rest during the day any more.
If he falls he can react and grab instead of just falling to the floor.
He can pull up from a chair.
He can control his bladder and bowel.
He can blush.
He can react strongly if those around him don't understand his wishes.
He is more determined.
His memory is getting better.

His wife's impression is that his gait is smoother and more normal now but in total he walked better before the training started. She also says that during the training, as the level of awareness has risen, it has become more difficult for him to speak. When speaking, his voice is stronger and more nuanced today. Her impression is that now and then he is doing better than ever. His overall behaviour is still very much up and down with easily triggered mood swings. Walking as well as talking is easier when he does it reflexively. It seems much more difficult when he is thinking.

Discussion

Working from the hypothesis that normal motor development is a basis for the restoration of motor function after a brain injury and that fundamental movement patterns can reappear after injury to the cerebrum, the result of the training shows that it is possible to re-train an injured brain. The results also show that a view of the body as a resource for regaining cognitive abilities should be of importance for further consciousness studies.

The observation that A.B's awareness and cognitive abilities have developed to a greater extent than have his motor skills, is of interest especially as no cognitive training at all has been involved. It gives support to Cotterill's remark "Thinking is a bodily function".⁵⁰

The training has followed normal infant sensory motor development - stressing the importance of vestibular stimulation for inhibition of the fundamental movement patterns. This way of training has been practiced with mostly younger, uninjured clients for 16 years at Vestibularis in Mönsterås, Sweden. Using stereotypical neonatal movements and vestibular stimulation we have generally experienced creeping and crawling unfold in children and adults who missed these stages as infants. These observations have fortified my opinion that we are pre-programmed concerning motor development.

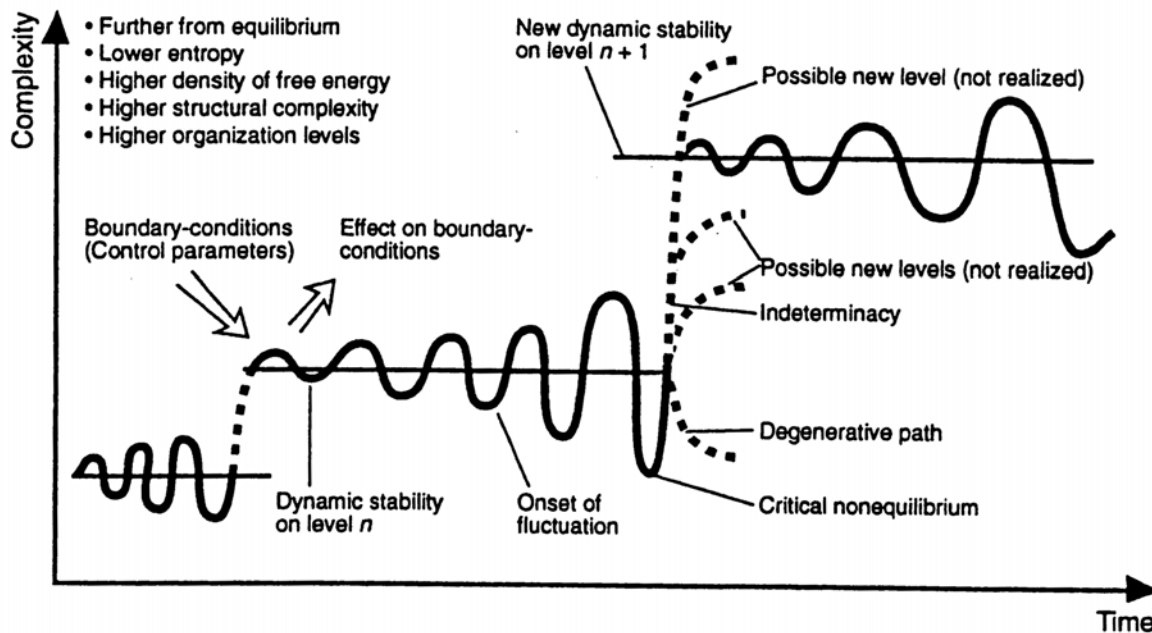
The motor milestones (see **Method, Education in Balance nr 5**) are bifurcation points in the nervous systems' history.

An infant should be able to lift his head in prone to be able to develop creeping and crawling. If gravity is stronger than the infants ability to lift his head, 'true' creeping and crawling would not unfold. Development will use a different path which will give other bifurcation points. One risk might be that these bifurcation points are not as stable as the original, true, ones.

The original milestones have been imprinted fylogenetically through our evolutionary history and will unfold ontogenetically when the nervous system is stimulated properly and sufficiently. 'The "historical path" along which the system evolves as the control parameter grows is characterized by a succession of stable regions, where deterministic laws dominate, and of unstable ones, near the bifurcation points, where the system can "choose" between or among more than one possible future'.¹⁰ (Fig 3⁵¹) See also fig 2.

Fig 3

3. TRANSDISCIPLINARY UNIFICATION



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I speculate that one reason for choosing a different developmental path is that the vestibular system and the body's gravity receptors are unable to respond properly to the gravitational force. They will in various degrees fail to transmit the energy / force which is necessary for bringing the nervous system in harmony with the gravity. When properly stimulated it will take the growing child about fifteen years to get in harmony with the gravitational force.³

My opinion is that vestibular activity is a driving force when it comes to motor development as well as to mental development.

As mentioned earlier, the developing nervous system is an open system and an open system is far removed from equilibrium and in a dynamic state. My view is that vestibular stimulation will energize the nervous system, make it oscillate and move further from equilibrium. This oscillation might be what we see as mood swings and as improvement and impairment during training. In other words, I think that these oscillations will unfold different sensory and motor milestones (see fig 2 and 3).

I think that true milestones make the nervous system more flexible and more easily restored if injured. Rolling, creeping and crawling will act as girders. I speculate that developed motor milestones make the nervous system more stable and more easily restored if injured.

Therefore, the unfolding of motor milestones during the first year of life makes a difference.

As an infant A.B was a bottom-shuffler. Therefore it is most probable that he missed out the vital stages of rolling, creeping and crawling. During training they unfolded. I hope this new 'motor grounding' will support further development of more advanced skills. As mentioned earlier A.B was left twice as an infant. Most probably there are emotional scars left which might be of hindrance when it comes to his further development. Though, it is not within the limits of this presentation to go deeper in to the importance of attachment. As we now know the sound development of the infant is only possible in close connection to another human being.

“What does seem to be important, however, is *how* the brain reorganizes after injury; that may be the determining factor in whether there is recovery or permanent impairment”.²⁸

Regarding mental development Llinas wrote: ‘So we have developed this simple rule that sort of brings together everything into one single entity we call the self. *It stands on the vestibular nucleus and pokes its head into the brain* - it has an up and a down to it, it has a visual component, a sound component, and so on’.⁵² Bergström, who has done influential research on the brain, has this view; “So ‘matter’ refers to the representation of material objects in the cortex and ‘psyche’ or ‘consciousness’ refers to the activity of the brain-stem. The ‘self’, then, refers to the *interaction* of these two brain processes – in this sense the self is between the ‘psyche’ and ‘matter’. The ‘self’ refers to a third type of brain process which arises when the brain-stem activity (‘psyche’) and the cortical activity (‘matter’) meet”.⁵³

It is reasonable to believe that sensory motor development and mental development go hand in hand.

In the case of A.B we can see that there is a close connection between physical re-developmental training and the regaining, and even further development of, mental capacity. However, I find it important to ask whether this progress would have been likely after traditional rehabilitation training. My answer is no, because the traditional medical programme does not incorporate either vestibular stimulation or the necessity to inhibit fundamental movement patterns for further developmental progression. Following the Method Education in Balance might have made A.B’s body capable of sustaining further mental development. If so, it is reasonable to believe that physical and mental abilities develop together right from the beginning. Therefore research within the field of consciousness studies has to start to look at the gravitational force. We need to incorporate how, and on which level, it affects the nervous system.

Jaynes (1984) wrote:“At the present, a plausible nominee for neural substrate of consciousness is one of the most important neurological discoveries of our time. This is that tangle of tiny internuncial neurons called the reticular formation, which has long lain hidden and unsuspected in the brainstem”.⁵⁴

“In essence, then, the reticular formation provides the nervous energy to support the body against gravity. But other factors, particularly the vestibular apparatus, control the relative degree of extensor contraction in the different parts of the body, which provides the function of equilibrium”.⁵⁵

“Because the vestibular nuclei are intervoven into the reticular formation, any vestibular process may effect the entire reticular formation, while an activity anywhere in the reticular formation may influence vestibular responses”.²⁰

“Other phylogenetically old and early developing pathways, such as some of the reticulospinal tracts, probably participate also, as has been suggested earlier (...) for internuclear connections probably reach cells of the reticular formation early in development, since the reticular formation is an old system phylogenetically (...)”.⁵⁶ The reticular formation is not fully myelinated until after puberty.

This brings us down to cellular level. Pribram (1999) wrote: “One of the most striking facts regarding neurons is that, when stimulated, neurons produce more RNA than any other tissue in the body (Hydén, 1961)”.⁵⁷ An interesting observation is that Hydén used vestibular stimulation in this experiment.¹

One challenge for further studies would be to try to find the gravity receptor within the cell. Finding the receptor might be helpful for the solution of the hard problem of consciousness which is the problem of experience. “It is widely agreed that experience arises from a physical basis, but we have no good explanation of why and how it arises. Why should physical processing give rise to a rich life at all?”⁵⁸

The case of A.B shows that the active use of the body’s gravitational receptors will add meaning to life.

Schilder (1935) wrote “We have only to add that where there is a vestibular after sensation it becomes the carrier of the ego. It is in this respect more important than the body-image based on other senses”.⁴⁹

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