Lowijs Perquin, Free University of Amsterdam

Neuroscience and its significance for psychotherapy
An overview from the perspective of Pesso Boyden System Psychomotor

ABSTRACT

How neuroscience might contribute to our understanding of the underlying principles of psychotherapy is the subject of this article. After some arguments for psychotherapists to study the latest discoveries of the 'science of the brain', a description of the steps in a therapeutic session according to Pesso Boyden System Psychomotor therapy (PBSP) will illustrate the interconnectedness of neuroscientific and psychotherapeutic viewpoints. As a body-based psychotherapy, PBSP highlights the fact that body, brain and psyche function inextricably as one unit.

Key words: Neuroscience, Psychotherapy, Pesso-Psychotherapy, Pesso Boyden System Psychomotor PBSP, Body based psychotherapy.

How can studies of the brain support our understanding of the fact that memories of emotional events more than any other thought process determine our actions? How do we process physical information, emotions, memories and sensory input in such a way that we can say: 'I am aware. I am in the centre of my being. I am conscious.'?

In this article you will find a preliminary exploration of a selected number of subjects in the field of neuroscience. These are only sketches that do scant justice to the complexity of the subject matter and by no means provide definitive answers to the comprehensive questions they seek to discuss. The functional neuroanatomical perspective is the primary focus; neurotransmitters and hormonal processes are addressed only indirectly. Readers who wish to be inspired by the richness of these fields of knowledge can turn to the original sources: LE DOUX (1996), SCHACTER (1996), DAMASSIO (1994, 1999) and EDELMANN (2000).

The significance of neuroscience

No other part of the human organism communicates as intensively with the outside world as the central nervous system. Information finds it way at lightning speed in successive series of nervous impulses and chains of neurobiochemical and hormonal reactions. Sensory information is continuously selected and transformed into feelings, thoughts and behaviour: if you are

cold you turn up the heat; if a passage in a detective story is full of suspense, your skin crawls. Every perception is accompanied by a, usually unnoticed, physical response.
The brain mediates between the inner and the outside world, between body and mind, matter and non-matter, object and subject, concrete and abstract, self and other, past and present. Emotion is linked to cognition, perception to imagination, reality to fantasy. The brain of the 'naked ape' has evolved into an extremely flexible system that constantly adapts to ever-changing circumstances. In humans, unlike in any other animal species, a large part of the cerebral cortex is dedicated and alert to tasks that enable communication with others: language and implicit knowledge help us to understand the other person's perception of his environment. Just as the liver of an alcoholic has learned the simple lesson of metabolizing alcohol more quickly than normal to increase the tolerance level, the alcoholic's brain can invent a complex line of reasoning about why to stop drinking after four drinks instead of two. The brain is the most 'plastic' organ of the human body.
The brain's central task in communicating with internal and external realities, and its ability to constantly adapt, are good reasons for the psychotherapist to have some insight into how the brain works. Specifically, studying the rapidly increasing knowledge of neuroscience is an important challenge for therapists using Pesso Boyden System Psychomotor and other body-based methods, for in the apt words of neuroscientist ANDREASEN: 'The Mind is in the Brain, the Brain is in the Body' (1997).

Neuroscientific studies of the dynamic relationship between brain, environment and behaviour, and of the biological foundation of emotions, memory and consciousness constitute an extensive field of research. Thousands of neuroscientists are building a better understanding of how the human mind functions. Neurophysicists, neurologists, neuro-anatomists, biochemists, ethologists, physiologists, endocrinologists, pharmacologists, psychologists and psychiatrists are developing research techniques to make our thoughts, memories and emotions visible, much as an X-ray does for the skeleton (CARTER 1998). As their research progresses they are putting behind them the Cartesian dichotomy in which medicine is concerned with material diseases and medication of the brain, while psychology focuses on problems of the immaterial mind; in the longer term the distinction between body and mind will be a purely semantic one. Evolving research is showing that what we refer to as the psyche is also the sum of the activities in the brain at the cellular, chemical and molecular levels. The brain reflects the activities of the mind: perception, memory, mood, emotion, thoughts and behaviour. This can be vividly seen nowadays through the use of the fMRI (functional Magnetic Resonance Imaging) scan, which shows how an unpleasant memory can literally light up a particular area in a subject's brain.
So the latest neuroscientific views, in which brain and mind are approached as an integrated unit, are developing at such a pace that in the long run it will be unthinkable that questions about psychological problems and treatment methods could be addressed without referring to brain studies. In time, the neuroscientific study of consciousness, emotions and memory will

help us gain a better understanding of how psychotherapy can help and which interventions will be effective.

As a body-based psychotherapy, PBSP highlights the fact that body, brain and psyche function inextricably as one unit. Brain research seems to offer a retrospective validation of several principles of PBSP, a therapeutic approach founded by Al Pesso and Diane Boyden 40 years ago which has been developed during the last decennia into an articulated psychotherapeutic method. In his lectures of recent years Al Pesso has been devoting more and more attention to three themes: consciousness, memory and emotions. In this article the following questions are central:

- How are consciousness, memory, sensory perception, physical information and emotions connected?
- How can knowledge of the organization of the brain explain that memories of emotional events influence our daily actions to such a high degree?
- How is a Pesso-Boyden therapy session to be described from a neuroscientific perspective?

As unity of experience is a central characteristic for the psyche, there is no classification that can do justice to this wholeness. Thus, consciousness, memory and emotions are addressed in three separate paragraphs only for purposes of clarification. Each refers to the others, and implicitly attests to this interrelatedness. For each subject you will find some references to the practice of Pesso-Boyden psychotherapy.

1. Consciousness

Clients in search of psychotherapeutic and psychiatric help expect, apart from a decrease of symptoms, insight into the nature of their problems. They want to understand what is going on. This contemporary wish corresponds with the ancient ideal of the Stoa: 'Gnoti seauton', 'Know thyself'. The goal of psychoanalytical treatment as formulated by Freud: 'Wo Es ist, soll Ich werden', corresponds closely with this Greek ideal. Wanting to understand oneself and the world, wanting to be conscious of one's existence and its meaning, is characteristic of human beings. For the person in psychological distress who has lost emotional and social orientation, it is essential to gain control over his or her physical wellbeing and to be able to redefine the purpose and meaning of life. And most of all, to regain a sense of identity and reclaim control of one's own existence.

Halfway through the 19th century, John Harlow's description of the damage to the frontal brain of construction worker Phineas Gage was a first lead for the scientific study of the 'localization' of consciousness and personality in the brain. Before his accident, Gage's task was to tamp down dynamite between two rocks with an iron bar. An unforeseen explosion propelled the iron bar through his left eye socket at enormous speed, and it exited through the crown of his skull. Miraculously, all his mental and motor functions remained intact after the accident: he

could walk, talk, think and remember. Yet he was not the same person he was before. The highly esteemed foreman, who had been praised for his work ethic, lapsed into unpredictable, capricious behaviour. For no apparent reason he left employer after employer, and women were no longer safe around him. Eventually his life went completely off the rails. His condition, the result of the damage to his pre-frontal cortex, was characterized by the inability to make motivated decisions, and to develop, execute and evaluate plans.

Longitudinal research has revealed that emotional neglect in early life predisposes men to anti-social and criminal behaviour. We also know that the success rate of the treatment of violent offenders is disappointing. The neurons of the frontal cortex that are available to curb the activity in the lower brain centres as the brain matures in the first years of life develop in a less differentiated way in children who are not cuddled. PET-scans (Positron Emission Tomography), used to measure the glucose metabolism of the brain, show that the frontal lobes in repeat offenders display less brain activity than those of normal people (RAINE ET AL 1994, BLAIR 2003).

The following test illustrates the importance of the frontal brain structures. Raise the index finger and middle finger of your right hand for a period of three seconds. This task involves language centres and parts of the motor cortex. Now raise as many fingers as you like and choose which hand you want to use. A functional MRI-scan of your brain might reveal that this task, in which you make your own decisions, also activates parts of the pre-frontal cortex. These parts are less active in the first task, where you simply carry out an instruction. These areas of the brain, in which a conscious exercise of one's will is generated, were damaged in Phineas Gage's case and they showed reduced frontal activity in the PET-scans of repeat offenders.

1.1 Brain and consciousness

The frontal brain has the following functional structures.

The *orbito-frontal cortex* inhibits inadequate, impulsive action and curbs the immediate satisfaction of needs. We can postpone satisfaction or consciously learn to sublimate it. Whereas the orbito-frontal cortex is hyperactive in patients with obsessive-compulsive disorders, it probably has an average level of activity in people whose needs as children were met sufficiently, who were guided when they experienced anger and frustration if satisfaction of needs did not occur, and who were given responsibility for their actions not too late, and not too early (HARRIS 2003). A client in a Pesso Boyden therapy group must be able 'to count on this part of his brain' to some degree when it is not his turn for a therapeutic session, when he is only available as a role player for the other client, and he must postpone his own needs. In other words: empathy, the ability to identify with another person's feelings – vital for the survival of mankind– cannot exist without this part of the brain (MITCHELL ET AL. 2002, GALLESE 2003).

One of the functions of the *dorsolateral prefrontal cortex*, located at the lower end of the side of the frontal cortex, is to retrieve information stored in the emotional and autobiographical

memory. Also things are 'kept in mind' here, formed into plans and ideas, and decisions are made about behaviour to be carried out.

At the lower front end of the frontal brain lies the *ventromedial cortex*, where emotions are consciously experienced, interpreted and understood, while the *cortex cinguli anterior* plays a part in focusing the attention and tuning external input to our own thoughts and distinguishing between external and internal stimuli.

During the preparatory exercise phase of a Pesso Boyden therapy group, exercises with 'consciously controlled movement' appeal to the above mentioned frontal functions of the brain: focusing attention, planning and control. The participants concentrate on one arm, in order to lift it slowly according to a predetermined plan. Afterwards the therapist asks the participants to evaluate whether the movement was an accurate execution of the plan. The exercise is used as a metaphor for how the participant generally handles planning. One might say that the (pre)frontal brain is the seat of what Albert Pesso calls the 'Pilot Ego': 'The Observing and Executive Ego, the President of the United States of Consciousness'.

In patients with a schizophrenic disorder, the cortex cinguli anterior and the dorsolateral prefrontal cortex are hypoactive. This could explain the frequently observed symptom of reduction of spontaneous and planned behaviour and the inability to distinguish between voices that come from outside and inner voices (hallucinations). In depressive patients the ventromedial cortex, the area that registers emotions, is hyperactive, whereas the dorsolateral frontal cortex, which is involved in planning tasks, is repressed. The depressive patient is unable to act, is abnormally fixated on his own emotional condition and cannot stop brooding. Research by POSNER ET AL. (1994) shows that when a person is asked to think of something sad, the same areas are activated that are also activated in depression. This finding brings the pathology closer to everyday life. When women are asked to think of something sad, they exhibit more brain activity in the emotional brain centres than men, which suggests that women have a stronger emotional response to thoughts and conscious memories they generate themselves (NYSTRAND 1996). Perhaps it explains why women are more aware of the need for therapeutic and medical assistance and seem to be more empathic than men. What is not clear is whether this effect is innate or learned.

1.2 Consciousness as 'working memory'

One non-comprehensive but useful model sees consciousness as the *'working memory'* or the highest information processing system of the brain (LE DOUX 1996). The frontal cortex areas described above have a central role. Information from different cerebral systems becomes interactively available in the working memory. Three incoming information flows are central: sensory information (1.2.1), memory information (1.2.2.) and physical information (1.2.3).

1.2.1 Sensory information

Human consciousness cannot exist without external sensory stimuli – seeing, hearing, smelling,

tasting and touching. Sensations of temperature and pain, and sensorimotor input such as joint position sense, sense of balance, sense of posture and sense of movement are less conspicuous sources of information, but no less important for consciousness. Via the thalamus, which is located in the midbrain and the reticular formation in the brainstem, the cortex is activated and kept on standby. An alert cerebral cortex waiting for whatever is about to happen, shows relatively little brain activity, but is ready to respond immediately to new stimuli, whereas during a dream the entire visual and auditory cortex are active and light up on a brain scan, probably preventing the sleeper from being awakened by outside stimuli.

Experiments with *sensory deprivation* demonstrate how necessary sensory information is to consciousness. A healthy subject who floats motionless in a darkened swimming pool with warm water and breathes through a tube, sees, hears and smells nothing, and experiences almost no tactile, temperature or movement stimuli. After a few hours the subject loses his sense of time, place and person, and has a strong urge to start moving. Even the prospect of a high reward will not be enough to persuade him to stop moving his 'piano-playing' fingers. These attempts at self stimulation still cannot prevent a delirious mind-state from developing: reduced consciousness with hallucinations, delusions, disorientation, loss of ego-sense and motor unrest. The person will become seriously upset if the brain does not receive sufficient exogenous stimuli. To stay awake and alert the brain needs constant sensory stimulation.

Less striking, but more common is the change in ego-sense as a result of a slight lack of normal sensory stimuli, for example after a long car trip. After hours of driving and straining the eyes, the driver is suddenly on the balcony of the holiday cottage. The wonderful view of the lake looks unreal: 'it's like a painting'. The long, intense concentration on the monotonous visual stimuli of the motorway, and the constant traffic noise, has suppressed the normal processing of sensory and sensorimotor information, kept it 'outside consciousness'. The sense of self has diminished – depersonalization – and the new environment is perceived as unreal – derealization. In other words: the quality of the perception of consciousness is strongly influenced by sensory input.

More extreme forms of depersonalization and derealization occur in people who have been traumatized. A simple cause, a trigger, can suddenly reactivate fierce emotions such as panic, anger and despair, and set off related behaviour. To the traumatized person, emotions have become enemies that always lie in wait to confuse or take over. Often the person in question develops, almost automatically, a technique for physical control: agonistic and antagonistic muscles are flexed at the same time. The resulting perpetual state of slightly elevated muscle tension in the throat, neck, chest and abdomen ensures that physical sensations which are related to the emotion are kept below the threshold of conscious perception. The 'contract-intervention' in a Pesso-Boyden therapy session is an attempt to restart, in a safe and structured environment, the physical movement connected to the emotion so that the client's awareness and understanding is supported. The client is asked to flex all muscles around the area of physical tension 'to see what will emerge, for example movement, sound or inner images'. The

established balance between agonistic and antagonistic activity is temporarily disrupted, so that the original movement of the agonistic muscles and the related emotion can re-enter consciousness.

Whereas a short run is enough to bring the driver out of his temporary state of alienation, sexually abused and chronically depersonalized clients frequently report that they try to re-establish contact with their own body by inflicting pain on themselves. The act of self-mutilation is directed by implicit memory centres that reproduce the original scene: in the act of auto-mutilation the client is perpetrator and victim *at the same time*. In a Pesso-Boyden therapy group protective role figures can, with the client's consent, physically limit the inwardly-directed anger by holding the client's hand, so that the impulse of self-hatred can be expressed without the client hurting himself (Perquin 2004). Through the 'central communications room' for sensory information - the thalamus - the re-experienced physical pain activates the emotion centre: the amygdala. The amygdala in turn stimulates the frontal centres where meaning is attributed to the experienced emotion (ventromedial cortex), and attention is focused (anterior cingulate cortex) on the hippocampus, the explicit memory centre. The tendency to direct the hatred inward in response to information from the implicit memory now connects with memories from the explicit autobiographical memory. Doing justice to the original outrage, the anger can now be directed outside the subject towards the original object, the perpetrator, represented by another group member in a role, who will act as *if* being hurt.

1.2.2 Memory information

As indicated above, the sensory and emotional information that is temporarily stored in the working memory connects with information that is retrieved from the *long-term memory*. With lightning speed the new input is compared to the old information, which makes it possible to interpret the current sensory input. Everything we perceive is constantly assessed against the background of what we have stored in our memory. Without our memory, any understanding of the situation around us would be impossible. Normal consciousness feels like a stream, a movement in time. Each moment consists of a series of perceptions that only acquire meaning within the context of that stream. If one could experience a single moment without any information about all previous moments, the moment would be totally meaningless. Even our identity requires knowledge of who we were a moment before.

The brain has many separate and partially connected memory circuits. On the one hand there are associative areas and networks we need for example to recognize faces, which enable us to pick out a relative on the other side of a football field. On the other hand there are areas and pathways through which emotional stimuli pass.

In a famous case study GAZZANIGA (1992) presents an example of how the implicit, emotional memory works. A subject who, as a result of brain damage, had lost all ability of visual recognition, always greeted the researcher with the same enthusiasm. Each time they shook hands as if it was the first time. One day, Gazzaniga had a drawing pin in his hand. When the

subject shook it, he pulled back indignantly, a painful grimace on his face. The next time they met, the subject was as cordial as ever. Yet when the researcher held out his hand in greeting as usual, the patient pulled his own hand back hesitantly, without being able to explain why. Apparently a memory of the negative emotional stimulus, caused by the researcher's outstretched hand which was now associated with pain, had been stored in an independent memory area. Partly as a result of this experiment, further research was initiated into the anatomy of visual and emotional memory formation, and its significance for consciousness. The different memory systems will be addressed in more detail in the section on memory.

1.2.3 Physical information

Apart from communicating with the outside world and the experiences, knowledge and memories stored in our memory, the brain also communicates with other systems in the body through complex regulating mechanisms. These interactions take place almost completely outside our conscious perception. A soon as a sprinter thinks of the start of a 100 metre race, the frequency of his heartbeat and the muscle tension in his legs increase immediately. If the visual associative cortex interprets the projection of an irritated boss on the primary visual cortex, within a fraction of a second the hypothalamus will secrete the hormone that stimulates the pituitary gland, which in turn activates the adrenal cortex to release an extra dose of adrenaline and stress hormones such as cortisol: the body is being mobilized.

One can imagine the complexity of the physical information control circuits to some extent by thinking about what it takes perform a musical task, like playing a violin. The motor cortex activates the striated muscles, the cerebellum takes care of coordination, posture and modulation of locomotion and the basal nuclei of the extra-pyramidal system regulate tempo, power and smoothness of the movements. The sense of touch makes accurate placement of the fingers possible, joint position sense registers tempo and amplitude of the vibrato, the corpus callosum synchronizes the movements of the left hand and the bows of the right hand. The entire process is constantly adjusted by means of the continuous feedback of visual, kinesthetic (sense of movement), proprioceptive (sense of joint position) and auditory input and emotion-modulating centres: this is how the seemingly simple movement that characterizes the pure, poignant tone of the master violinist comes into being.

Every external stimulus is judged more or less consciously as positive or negative, which can subsequently result in *physical reactions and sensations* such as turning pale, perspiring or having palpitations. According to ARNOLD (1960) and FRIJDA (1986) these reactions and sensations can be viewed as action tendencies, preparations for potential behaviour such as fight, freeze, flight or appease. The process is accompanied by contractions of skeletal muscles, which are often not noticed by the person in question, and are not visible to an outsider. In Arnold's view, the physical sensation or action tendency *precedes* the formation of a feeling or emotion:

stimulus assessment → action tendency – physical sensation → feeling

A particular stimulus can be assessed in different ways and be accompanied by different physical sensations and feelings. An insulting remark can be regarded as an invitation to fight, and be physically manifested in a clenched fist which expresses the feeling of anger. In another situation it can be seen as a signal to withdraw (flight) and it evokes feelings of fear. Depending on the stimulus and how it is assessed, abdominal tension, palpitations and sweaty palms can indicate either fear or infatuation.

Recent neuroscientific research confirms Magda Arnold's above hypothesis from the 1960s. Conscious emotions develop directly through signals from the amygdala to the frontal cortex, but also indirectly. The indirect route goes through hormonal messages from the hypothalamus to the body, which generate, among other things, increased muscle tone, higher blood pressure and heart rate. Subsequently these changes are passed on to the somatosensory cortex. This then sends the information to the ventromedial area of the frontal cortex where the stimuli are interpreted and experienced as emotion. Physical sensations, therefore, are confirmed to precede conscious emotions.

In an individual session in a Pesso-therapy group, 'Microtracking' is the therapeutic technique to carefully observe and name the client's physical messages, facial expression in particular. The therapist follows, from moment to moment, what the client expresses with his facial musculature. By observing subtle contractions in the mimetic muscles, changes in the eyes and intonation of the voice, and reporting it back to the client as affective information, the therapist feeds the client's consciousness (Pilot) with information on his affective condition as reflected by his physical action tendencies.

The motivation for focusing attention mainly on facial expression and less on body posture and movement can be understood from a neuroscientific perspective. Two systems direct the mimetic muscles independently of each other:

1) Without interference from the frontal or motor cortex the *limbic system* directly innervates the motor nuclei of the mimetic muscles in the brainstem; this results in uncensored, spontaneous, emotional mimetic expression.
2) Social, learned mimetic expression is innervated from the *motor cortex* that operates in a consciously random manner. There lies the difference between the polite – 'cortical' – and the friendly – 'limbic' – stewardess, between a strict and an angry superior, between whining and genuine sadness.

The ability to understand facial expression is a complex and very important social function, characteristic of the species and necessary for orientation to other humans. There are generally recognized facial expressions for curiosity, surprise, disgust, delight, anger, sadness, fear and shame in all cultures. Most of these are expressed by the baby from the day he is born. A child does not need to learn these expressions, they are part of the behavioural options of each member of the human species, and are recognized without training or explanation. People who have trouble interpreting emotional expression in others due to a minor brain dysfunction, are

disabled in even a simple conversation. The following passage from 'Eccentric and Bizarre Behaviours' by Franzini and Grossberg can illustrate this: "I have learned to watch the mouth of the person I am talking to and to pay attention to when he shows his teeth. That tells me he is smiling. Then I try to remember to smile back. I also watch the eyes. When people smile they get small wrinkles around their eyes. The problem is that it takes a while before I have noticed everything. Meanwhile the conversation has continued, so I am always a little late with my smile. People don't like that, they think my mind is on other things. Because of this I find that dealing with people is a strain. Sometimes I feel so tired that I withdraw. It can be very lonely."

Recognizing and being recognized in affection are both essential to emotional development in early childhood. Some clients have experienced an emotional vacuum during the first years of their lives. A depressive, neglectful or aggressive parent is not sensitive to the emotions of the child. The child does not learn a language for his most individual affective experiences. This may be a reason why he or she will have trouble as an adult connecting with his or her emotions or the emotions of other people.

2. The Memory

First we had to learn to remember what is edible. A 16 month old child will put a piece of mud pie in its mouth. A two-year old will not. Monkeys that eat a large number of different tree-fruits have a large visual memory capacity and a correspondingly large brain area. In humans the estimated memory capacity is 100 trillion bits of information, which corresponds to a billion one centimetre high modern office computer hard drives. Stacked they would make up a tower some 100 kilometres in height. Each one of us carries along a gigantic private library. Without the long-term memory the interpretation of current sensory information would be impossible. Everything we perceive at this moment is influenced by data gathered before. 'We observe and experience the present through the lens of memories of the past' (Pesso 2000). Life without memory is a life with no past and no future.

A person walks through a dark alley at night and feels goose pimples and a sensation of tension between his shoulder blades. The echo of his own footsteps is unconsciously associated with a mugging that happened ten years ago. Sensorimotor and kinesthetic stimuli and experiences, like auditory and visual stimuli, are stored in the memory. Every time we detect a physical sensation, it connects with previous physical sensations and experiences gained in the past.

The awareness that we can only perceive and understand everyday reality thanks to the availability of the memory motivates the Pesso-Boyden therapist to embark on a search with the client for the basic patterns in his history that, recorded in his memory, still determine the interpretation of events in the present.

There are several ways to classify the memory. We have already mentioned the distinction between short-term and long-term memory and working memory. Insight into how the

memory functions has consequences for psychotherapy. Experiencing a therapeutic session as pleasant – 'a good talk' – in itself does not guarantee change. One can only hope that the information that goes into the client's short-term memory during the session is eventually stored in the long-term memory. That is the only way a therapeutic experience can contribute to the long-term generation of alternative, more satisfying reaction patterns in familiar as well as unfamiliar situations.

A second, much used division of the memory functions is the division into semantic, procedural and autobiographical memory. Knowledge of the world is stored in the *semantic* memory, for example the meaning of words (semantics) and visual patterns. The *autobiographical* or episodic memory stores memories of events (episodes) you have personally experienced. In the *prodecural* memory we find learned, ingrained behaviour patterns (procedures), such as the steps required to use the gear stick of a car, but also reaction patterns in relation to other people. Mother-child interactions are stored in the procedural memory from birth, especially in the case of procedures which involve primary emotions, such as fear. If the child cries because mother has left the room, and mother then comes back every time and picks the child up, this action sequence is stored in the child's memory as an interactive procedure. The ability to cry and the mother's instinctive reaction turns the helpless baby into a 'competent infant', who takes the initiative and has an effect in a chain of mother-child interactions, whose basic patterns are genetically embedded and enable the species to survive (Dornes, 1993).

Young rats who went without their mother's care and who were not licked on the back by her for only twenty-four hours in the early weeks of life, proved to have a permanently increased susceptibility to stress at a later age, unlike rats who were not separated from the mother. Once they are adults, these rats have an increased concentration of the stress hormone cortisol in their blood, fewer receptors in the hippocampus to regulate stress hormones, and their learning and memory functions are less developed. However, if during the separation the researcher regularly strokes the baby-rat across the back with a wet paint brush – imitating the mother's licking – the rat will be as immune to stress as its brother who was not separated from its mother. Apparently there is a minimum need for stroking, and it is possible to replace the mother's touch.

An example of the interaction between genetic predisposition and procedural knowledge stored in the memory is given by Suomi (1991). He describes permanent changes in rhesus monkeys who were separated from their mother. They exhibited a form of social anxiety, which they could overcome if they were placed among stable peers that were raised by their own mothers. However, the higher level of the adrenocorticotropic stress hormone (ACTH) remained elevated the rest of their lives. Monkeys that had an inborn increased stress reaction when taken away from their mothers were adopted by extremely caring 'super-mothers'. As adults, these monkeys ended up at the top of the hierarchy. This suggests that these mothers helped their sensitive adoptive children to apply their inborn sensitivity and to learn to use it for a higher level of social adaptation. The excessive genetically determined increased ACTH reaction disappeared in this group.

In psychological terms the young child absorbs the experience of being touched. He derives from it a positive sense of self and trust in caregivers, and as an adult he will feel comfortable relying on other people. Thus his experiences in the world are pleasurable, satisfying, meaningful and connected. Being touched lays the foundations for the development of personal individuality and assertiveness (ANZIEU, 1989). Early parent-child interactions are reflected in similar complex processes of emotional regulation that are recorded in the procedural memory.

3. Emotions, Feelings and Affects

Feelings colour our perception and our behaviours, consciously or unconsciously. We can talk about our feelings and this enables us to manage them more freely and also to some extent become free of them. However, in a person whose brain does not recognize feelings due to a neurological disorder, rationality founders (DAMASSIO 2000). This person is unable to take emotions into account when making decisions. This fact supports the Pesso-Boyden therapist in the joint search with the client for physical sensations and emotions, and related feelings and meanings. Consciousness is 'The *feeling* of what happens' (DAMASSIO, 2000).

LE DOUX (1996) defines *emotions* as the basic mechanisms to escape danger, passed on through the genes, which drive us towards what we need to survive. With some variation, most researchers consider the following to be 'primary' emotions: disgust, fear, curiosity, anger, joy and (parental) love. Emotions occur in all mammals, are accompanied by strong physiological changes and first develop without interference from the neocortex. Primary emotions do not require consciousness. They can cause us to turn away from something, or go towards something without any conscious decision. Feelings can be viewed as complex, compound emotions that are variegated and furthermore consciously experienced. Feelings develop through a complex interplay between higher brain centres and the limbic system located deeper inside the brain.

Tests carried out on people with a so-called 'split brain', where the connection between the left and the right hemisphere – the corpus callosum – is severed, illustrate the priority the human brain assigns to emotional information. If a stimulus is offered to the right hemisphere, the *literal* meaning does not go to the language-forming left hemisphere. When the person sees the picture of a devil, he does not think of the word 'devil'. However, the *emotional* meaning of the stimulus can be conveyed and understood, and is subsequently transformed into language. The subject reports to the researcher: 'evil'. The left hemisphere turns out to be able to make an emotional assessment and form language without knowing which object is observed.

Without feedback from the body, emotions cannot be distinguished from thoughts (CARTER 1998). A patient with a high spinal cord lesion who has no physical sensations below the neck can *reason* that he should become angry in an unjust situation, because 'I have *learned* that people will take advantage of me if I don't', but he feels almost none of the authentic indignation familiar to him before he had the accident.

3.1 Amygdala and hippocampus

Neuro-anatomy offers four different starting points that help explain why emotions are able to temporarily gain dominion over the brain. The nucleus amygdala, the storage and regulation centre of general, mainly negative emotional memories, plays a central role here.

- The nerve bundles that go from the amygdala to higher centres are much more numerous than those in the opposite direction. The objective memory information of the hippocampus, the substantial knowledge of the semantic memory that contains general facts about the world, and the neocortex, the location of sensory and cognitive integration and interpretation of data, are easily overrun by the emotional centres, which can foul up social behaviour. GOLEMAN (1995) calls this 'emotional highjacking'. Conversely, the ability of thoughts to chase emotions off the mental stage is limited: the thought alone that the fear or depression should go away has very little effect (Le Doux, 1996).
- Via special networks (arousal networks), information from the amygdala can directly mobilize the entire cortex. When we are confronted with danger or other emotional situations, the whole person becomes involved. Such 'arousal networks' play a part in post-traumatic stress disorder. Emotions generate a general, non-specific mobilization and synchronization of the activities of the brain. Thoughts have no such influence. In combination with the point made above, this constitutes a functional neuro-anatomical argument for a psychotherapy with a cognitive and emotional focus.
- The amygdala has direct connections with networks that control behaviour specific to the human species, such as freeze, fight, flight and mimetic expression, the autonomous nervous system that regulates heart rate, blood pressure, perspiration and peristaltic movement, and, finally, with hormonal glands that produce, among other things, adrenaline, cortisol and peptides.
- There are two different circuits, a fast, 'low' road and a slow 'high' road, that process the perception of emotional stimuli, for example seeing something that looks like a snake when you are walking in a forest. In the low, short circuit, the retina sends impulses through the optic nerve to the thalamus, which sends the stimulus directly to the amygdala. The visual cortex is ignored, resulting in a rough, not-so-accurate representation of the stimulus in the amygdala: the sight of the 'snake', which is only the shiny root of a tree, makes you jump back. So the short, more primitive road, in the lower parts of the brain, enables us to respond to potential danger even before we have had a chance to interpret the stimulus in the visual cortex. When the visual stimulus subsequently sends a more accurate representation to the amygdala, the initial primitive flight response can be adjusted. With a slightly elevated heart rate the walker, slightly ruffled, continues on his way as if nothing happened.
- The *hippocampus* processes *explicit* images and memories of emotional events, so-called episodes, for the long term. In a child, this area has not yet matured. In the *amygdala*, *implicit* emotional memories are stored. This extremely important small area is ready to store information from the time of birth. A baby can 'remember' abuse and neglect as physical,

nameless and indefinable information. The baby will start to look, move and talk, based on this information, without having any concrete memories. The events have not left a concrete memory trace in the cortex, because the immature hippocampus couldn't yet process the information. The events can no longer be retrieved *as facts*, they can only be felt as an experience. Freud's discovery of the unconcious was much more accurate than we realized.

4. The Therapeutic Session in PBSP from a neuroscientific Perspective

We will now outline a therapeutic session (*structure*) in Pesso-Boyden therapy in order to bring the subjects discussed above together.

In a structure, a client stages a visual and auditory representation, a reflection of his emotional-cognitive state of consciousness in the actual scene of the session. The information activated in the client's working memory is also visibly and audibly represented outside the client in the actual situation (True Scene). This generally involves three role figures: the witness figure, a negative voice,and a potentially positive figure.

Witness statements reflect the emotions unwittingly displayed in the facial expressions of the client. These are at first observed and identified by the therapist and secondly verbalised by a *witness-figure*, a member of the group in a stylized role. These emotional signals run parallel to the client's story and are transmitted by the limbic system to the facial musculature, *uncensored* by the cortex. The external naming of these affective expressions by the therapist and the witness figure supports the client's 'Pilot Ego'. The ventromedial cortex of the frontal brain is activated, the location where emotions are consciously experienced and interpreted. Because the therapist checks the accuracy of the naming of each affect with the client (therapist: 'Disappointed, does that fit?' Client: 'No, I feel bitter that he reproached me'), the client stays in control. By continuously checking whether the witness statements offered by the therapist correspond with the client's inner experience, the 'highest level of consciousness', which is located in the frontal cortex, remains active: recognition of the named affect makes 'the right neurons light up'. These in turn stimulate the brain centres associated with feelings: explicit memories of emotional events in the past will be aroused.

Internalized convictions about his current reality ('How can I possibly defend myself against my boss? '), distilled from the client's life history ('My father did not respect my opinion') and recorded in the procedural memory, are articulated by a *negative voice* outside the client in the form of an injunction, a prohibition or a pessimistic prediction about the future: 'There is no way to protect yourself'. The combination of witness statements, fitting exactly to the affective state of the client, and the pointed, critical words spoken by different voices, make the client aware of his inner conflict and its historical foundation. His automatic behavioural pattern

ingrained in his procedural memory does not correspond with the reality of daily life or with his basic human needs. This awareness might mobilize indignation, protest or even anger. Now associative networks that have generated the negative message are stimulated: connections are activated between the limbic system (basic needs and primary emotions), the procedural memory (automatic behaviour) and the explicit memory (biographical information). In a state of emotional arousal and lucid awareness, the client sees in his mind's eye situations from his past, which still affect his everyday behaviour, and which were produced in the past in action, movement and physical contact. These experiences have led him to develop the conclusions and response patterns that he normally 'throws into the fray'.

Now a *positive role figure*, one for example with validating, supporting or stimulating qualities, can be brought in. As a precursor of the good parent he can also convey the good parent's message in an interactive-physical way. The client recognizes the past lack of validating contact and his own underlying desire for recognition, appreciation, support and protection. The client checks whether the physical contact that would have been appropriate for the child 'fits', and if necessary adjusts the physical touch until it is exactly right.

Guided by the therapist and with the aid of role players, the client constructs an alternative memory-script: new experiences that can provide emotional compensation for the implicit and explicit memory traces from the past. These positive interactions, exactly opposite to the original events, offer a concrete, physical experience, at the memory-level of the yearning child. One might say that the new experience is incorporated as an *alternative* explicit, emotional memory. The physical contact with group members symbolizing people the child needed in the past, who now offer exactly what fits, will enhance the image of a new memory, the client being consciously in contact with all his senses: visual, auditory, kinesthetic and motor information. In this new script the client experiences joy of movement and sensory input from behaviour that has never before or rarely been executed, and from physical contact that has never previously been received. This alternative opposite to the old experiences is recorded in the episodic memory as a New Map. It offers a more optimistic experience of oneself and others, which counterbalances the Old Map - the negative conditioning of the procedural and implicit memory. As described earlier, memories are subjective 'imprints' of interactive events that are coloured by emotions. They are not definitive or static, they can be changed. They can be 'rewritten' in a brain that actually still knows what its owner needs.

5. Neuro-imaging and PBSP: Preliminary Results of a fMRI Pilot Study

A pilot study with functional Magnetic Resonance Imaging (fMRI) was performed at the department of Neurology at Charles University in Prague with the following two *objectives*: 1) to identify the brain regions that were activated (or deactivated) by emotional stimulation related

to psychological trauma; 2) to measure the effect of PBSP-therapy sessions on the activity of different brain areas in traumatized people (HORACEK ET AL. 2004).

According to the *study design* each client (9 clients, aged 18-65 years), underwent a pre-treatment series of eight fMRI scans. The next step was to let the client participate in two individual PBSP-sessions of one hour with Albert Pesso in a three days-workshop group meeting. One week after the first series of scans, a second series of fMRI scans was performed after treatment.

Before the study started, each client had to bring a photograph that would awaken his or her individual traumatic history, as well as a neutral photo which had a calming effect on the individual. Watching the monitor inside the fMRI-scanner while being scanned, the client was first exposed to the trauma-awakening photograph. The neutral photograph was showed in the subsequent rest period of the same pre-treatment scan series. Statistical Parametric Mapping-software (SPM99) for fMRI Studies (voxel-to-voxel analysis) was applied to analyse which brain areas would show diminished or increased activity during emotional stimulation, in comparison with the neutral stimulation. The second analysis comprised a paired comparison between pre- and post-treatment findings. Clients' own reports of their post-treatment emotional states were also measured with the 14-item Hamilton Anxiety Scale (HAM-A), the 17-item Hamilton Depression Scale (HAM-D), the 21-item Beck Depression Inventory (BDI) and the 15-item Impact of Event Scale (IES) for posttraumatic symptoms.

The *results* showed that trauma-awakening photographs were activating brain areas involved in processing emotionally loaded pictures and images. The trauma-activating photographs provoked a kind of 'looping pattern' in these areas. This pattern is typical for patients with obsessive compulsive disorders and is also associated with the invasive thoughts and images (intrusions) of clients with posttraumatic stress disorder. The neutral photos did not show this looping activation. There was a significant contrast between emotion-awakening pre- and post-treatment conditions: after PBSP-treatment the fMRI-scans showed *diminishment* of the pre-treatment looping pattern, while stimulation by the neutral photos did not differ between pre- and post-treatment. In line with this result clients reported to feel less overwhelmed by their emotions after the second session, as was confirmed by the results of the four above mentioned symptom scales.

These findings were consistent with the observed *increased* activation on the fMRI-scans of some frontal brain areas which may contribute to the handling of intrusive thoughts and images: the cingulate cortex (e.g. focussing attention) and the inferior frontal anterior lobe (e.g. decision making).

The preliminary results of this pilot study suggest positive effects of PBSP-sessions on brain activity associated with posttraumatic symptoms. The therapy sessions seem to result in a reduction of brain activity in areas generating repetitive intrusive symptoms as well as an increase of activity in brain areas playing a part in enhancing mastery over overwhelming emotions.

6. The Almighty Brain?

An enthusiastic argument on the significance of neuroscientific knowledge does not automatically mean that the complexity of the unique and subjective personal experience can be reduced to the anatomy, chemistry, and physiology of the brain. It is not very likely that 'La Condition Humaine' will ultimately be understood when we know 'everything' there is to know about the brain. The brain of one human being is probably incapable of totally overseeing its own functioning (DAMASSIO 1999). In the foreseeable future neuroscientists, not unlike the philosophers of past centuries, will be raising more questions than they can answer. A second point against the case for the supremacy of the brain lies in the fact that the increased understanding of how the brain works does not automatically mean that future treatment of the psyche will involve direct manipulation of the brain. However, in the long run, we do expect to gain a better understanding of how the processes in the brain can be influenced with psychological and social methods. The plea for a bio-psycho-social life science is still totally relevant: mind, brain and body constitute a whole, are in constant interaction with the environment, and will have to be included in future psychotherapeutic research as an indivisible unit. This is an argument in favour of further research into psychotherapies that use a systematic and integrated approach of Body and Mind, of which Pesso-psychotherapy, or Pesso-Boyden System/Psychomotor Therapy, is an outstanding example.

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Correspondence address:

Dr. Lowijs Perquin, MD. PhD.
Psychiatrist-psychotherapist
Certified Trainer Pesso Boyden System Psychomotor Therapy
Department of Psychiatry, Free University of Amsterdam.
Frans van Mierisstraat 95
1071 RN Amsterdam, Netherlands
Phone: ++31 / (0)20 / 6735234 (home) ++31 / (0)20 / 5736666 (work)
Fax: ++31 / (0)20 / 5736687
e-mail: LPerquin@planet.nl