Current developments in the understanding of brain function reviewed in a clinical context

Reflections on brain and mind

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Summary

A comprehensive and coherent picture of the brain-mind relationship can only arise from a combination of subjective experience and scientific objectivity. Current developments in the understanding of brain functions are reviewed in a clinical context. The authors discuss neuroscientific advances in the fields of consciousness, memory, emotions, language, trauma and pain. They explore how stressful events impact mental health and interrupt the continuity of one's sense of self. Neurological and mental affections find expression in somatisation, dreams and narratives, and reveal coping and grieving processes.

Key words: brain-mind relationship; scientific objectivity; subjective experience

Introduction[1]

Our view of the human brain has been profoundly influenced by major developments in neuroscience. To explain thoughts, feelings and behaviour, the corresponding mental representations in the brain have to be described in their full complexity. While the mapping of brain structure and function is not new, links between physiological knowledge of the brain and features of the mind are conceivable due to the unprecedented development of technological innovations. However, achieving a comprehensive theory of the mind and the brain is not yet within reach.

The brain attains its adult and full pattern of connectivity by a process involving genetic and epigenetic factors [1]. Brain plasticity consists of remodelling and stabilisation of synapses; these are the two underlying functional aspects of the mind and brain throughout life at the root of neuronal and molecular mechanisms of learning and memory. The development and organisation of higher brain functions is based on an adaptive selection process of neuronal ontogenesis [2]. More recently neuroscientists have taken advantage of the possibility to study and map large-scale neuronal networks in order to investigate the biological basis of consciousness [3]. While the centres, pathways and neurotransmitters regulating alertness and awareness are well described and understood, fully translating what psychologists or philosophers call our conscious space or our lived mental experience into neuronal terms remains a formidable task.

Neuronal representations are not only widely distributed across brain regions but depend on dynamic interactions between regions. The brain does not function independently of the body and this is especially true for emotions. There is an intense interest in understanding emotions and how they influence and affect our mental life. Our reasoning and decision-making processes are instinctive and influenced by our emotional evaluations [4]. Neuropsychoanalysis, a new discipline [5], seeks to connect psychoanalytical and neuroscientific perspectives of the mind and aims at advancing our understanding of scientific objectivity and subjective experience in mental life.

The issue of childhood adversities in the development of mental disorder is a topic of considerable interest. Distress and turmoil experiences of infants and young children have great impact on developmental structures and functions of the brain [6]. Research in infants and children shows the importance of the quality of the early emotional relationship between infant and mother. Sensitive receptiveness of parents or primary caregivers to the spontaneous expressions of their infants and children will shape their unique personalities. There is still a huge gap between the clinical and neuroscientific disciplines, rooted in their history and scope, but our capacity to understand better the brain-mind relationship can only arise from combining clinical experiences with scientific facts.

The complexity of consciousness

To anybody interested in the matter of brain and mind, consciousness is probably its single most important property. The very nature of consciousness remains controversial. In a recent book Damasio [7] asks two essential questions: How does the brain construct a mind and how does the brain make that mind conscious? When answering these questions from a neurological perspective, the current conception that "consciousness is entirely caused by neurobiological processes and realised in brain structures" [8] is widely shared. Combining neuroanatomical, neurophysiological, neuroimaging and neurobiological methods, modern studies of consciousness describe its cognitive nature, its behavioural correlates, its possible evolutionary origin and its functional role. By taking into account the many levels of organisation on which the nervous system can be studied, from molecules to

1 Most of the material discussed here is based on our book "Brain and Mind, Subjective Experience, Scientific Objectivity", Andreas Steck and Barbara Steck, Springer, New York, 2016.

synapses, from neurons to local circuits, from large-scale networks to the hierarchy of mental representations they support, neuroscientific research has attempted to identify the neuronal base of consciousness.

Current theories seek to explain how the neural events organise into larger active circuits, how these circuits carry specific representations and forms of information processing, and how these processes are ultimately associated with conscious reports. A theory of consciousness should explain the range of possible conscious contents, why some cognitive and cerebral representations are permanently or temporarily inaccessible to consciousness, how they map to specific cerebral circuits, and whether a generic neuronal mechanism underlies them all.

Current neurobiological models of consciousness emphasise the role of groups of neurons with long-distance connections, particularly dense in prefrontal, cingulate and parietal regions, that are capable of interconnecting multiple specialised processors and transmitting signals on a large scale in a spontaneous and fast manner [9]. Eventually these neurons form a "conscious spotlight" [10], which breaks the modularity of the nervous system, creates a global availability that is experienced as consciousness and results in reportability. An essential feature in this model is the connection via long-distance axons to many, if not all, cortical processors permitting locally available information to be brought into consciousness. These long-distance axons are more densely accumulated in some areas than in others.

A fully developed human consciousness cannot function without memory.

Anatomically, long-range cortico-cortical and callosal connections originate mostly from pyramidal cells in the cortex, which give or receive the so-called "association" efferents and afferents. These layers are thicker in the dorsolateral prefrontal and inferior parietal cortical structures [11]. The high concentration of neurons with long-distance axons in these areas may explain why they frequently appear co-activated in neuroimaging studies of conscious effortful processing [12].

Consciousness is, however, not merely understanding how images and mental representation are processed and stored in the brain. A fully developed human consciousness cannot function without memory. Consciousness arises from a dynamic interaction between the past, the present and our bodily images, sensations and feelings. This is best exemplified when we consider the neurological and psychiatric literature describing patients with neurological deficits or altered perceptions. Sacks [13] has vividly described the personality changes in patients with memory deficits who can only live in the past or patients with deficits in self-awareness, unable to recognise their own ands or feet. In psychosis the inner reality may dominate the perception of external reality. It is a major challenge for modern neuroscience to investigate the neurophysiological correlates of these altered states of mind.

Memories

Memorising is one of the most fundamental capacities of our brains, allowing us to perform not only the simplest physical acts but also the most complex mental tasks. Human memory is creative, not only replicative [2]. The representational capacity of our memory grants us the many symbolic activities that characterise our mental lives and our many skills, including, most importantly, language. We store different types of memory. Working or short-term memory has limited capacity. On the other hand the two fundamental types of long-term memory, explicit or declarative and implicit or nondeclarative memory are almost unlimited. It is well established that the hippocampus plays a crucial role in the initial encoding and storage of memories. Gradually the neocortex becomes involved in maintenance and storage of lasting memory traces in a process called consolidation, the phenomenon by which a newly formed memory trace is stabilised. Stabilisation of memory involves changes in synaptic efficacy [14].

Events occurring before the age of three years are rarely consciously remembered. As the hippocampus is not fully functional in the first two years, memories will be implicit and procedural. Memory traces or connections may either be lost or remain if constantly reactivated. The "use it or lose it" principle is essential in early brain development, but is, according to Solms and Turnbull [15], a lifelong process that takes place without conscious awareness. There is no need for a repression hypothesis in infantile amnesia as Freud [16] postulated. Reactivated early childhood memories can be very strong – as memories of traumatic events – but still consciously not retrievable as they are stored as implicit memories.

There is a lower level of neurocognitive processing of memory traces in early childhood, compared with a higher level in later childhood. This transformation reflects a maturation process in memory circuits in the hippocampus and cortex. According to Pillemer [17], the very rapid increase in narratives occurring after

three years of age is linked to the formation of new cognitive patterns and developmental achievements such as language and the establishment of an autobiographical self.

Emotions that are expressed exclusively by the body in the form of pain, for example, often correspond to somatosensory sensations of early childhood. Traces of these experiences can be constantly reactivated and therefore influence a person's affective, emotional, sexual and cognitive life. The frontal cortex is poorly developed in the first two years of life; there are two growth spurts around two and five years. Yet the frontal cortex is crucial for the retrieval of memory in a realistic, rational and orderly way.

Childhood memories of the first years of life are modified or constructed at later developmental periods by the process of "retrospective attribution" [18]. Events and intrapsychic experiences of the past, which the small child was not able to accommodate, only later find meaning and interpretation [19]. In this context the concept of "historical truth" is highly complex, as it is the result of biological, cultural and individual influences. The historical truth does not correspond to the truth of the (re)constructed story, but includes the currently valid, often rapidly-again-modified "truth" that has been elaborated by the patient and therapist. Enclosed are the reflections of the intrapsychic dialogue of the patient with himself[2] and the emerging and shared "certainty about the current truth" of patient and therapist, which is constantly modified by conscious and unconscious contributions of both participants leading to new insights.

A progressive amnesia, where dissolution of memory is continuous, can result from a chronic degenerative brain disorder, such as the Alzheimer type of dementia. The well-known retrograde memory gradient impairment, with better memory for remote compared with recent events, is due to the particular pattern of neurodegeneration. The memory loss of recent events results from the hippocampal damage that occurs early in the disease, whereas remote event memory loss is related to the gradual damage of cortical areas. Memory loss in Alzheimer's disease has a striking aspect, namely that patients lack awareness of their illness, also called anosognosia. Anosognosia can be considered as resulting from missing blocks in the construction of self-representation [20]. The self can be viewed as a constantly updated construction resulting from the integration of different functions such as autobiographical memory, somatosensory perceptions and language. As all these processes are impaired in Alzheimer's disease, the self is progressively "petrified" and eventually vanishes.

The failure to update self-representations results in a mismatch of personal evaluation capacities giving rise to an awareness deficit, showing us to what extent the contents and preservation of the self is dependent on intact memory systems and other cognitive and emotional abilities.

The emotional network and self-development

Emotions arise from visceral and body changes and represent positive and negative states of mind. The brain circuits that channel emotions were called the "visceral brain", later the limbic system [21]. The role of the amygdala in regulation of emotion and fear is supported by animal experiments and human studies. Widespread connections between the amygdala and the medial and prefrontal cortex suggest that this complex system is involved not only in emotions, but also regulates mood and behaviour.

Emotions arise from the integration of sensations from the external world with information from the body. Thus emotions can be considered as a "translation" of somatic processes. However, to be fully perceived and appreciated, an emotional experience combines high-level cortical representations with perception of bodily changes. Emotions directly shape our affective states and are by nature subjective. They are important ingredients of consciousness or conscious experience. The same brain structures involved in consciousness are also the structures of the emotional system. The self can be considered as an extension of self-consciousness. Emotions, reflecting the perception we have of our body, are an important feature in the formation of our self and our sense of being.

Damasio [22] underlines the fact that there is a strong interconnection between cognition and emotions, and points out the tight connections between the limbic system and the prefrontal cortex. It is well known by neurologists and neuropsychologists that patients with damage to the prefrontal cortex display marked changes in personality with striking emotional and decision-making deficits. For example, damage to a small region of the prefrontal cortex, the ventromedial prefrontal cortex, has profound effects on social behaviour without inducing obvious impairments in cognitive performances [23].

In the "somatic marker" hypothesis, Damasio [22] postulates that decision making is influenced by signals coming from the emotional brain, the limbic system. In decision making, a signal from the limbic system generates a somatic marker. This signal, which includes all kinds of sensations from our body, can be conscious or unconscious. Decision making is a two-way process combining a reasoning aspect, carrying a

2 For simplification and readability we use the male form.

logical or cognitive analysis of a given action, with somatic marker signals, carrying bodily sensations. This peculiar combination helps us assess how rewarding or punishing a given action may be.

Anatomical, physiological and neurochemical changes take place throughout life in a complex interplay with surrounding forces to continuously shape behaviour, knowledge base and skills of the individual. Brain plasticity allows for great adaptability but can be detrimental for infants and young children who are highly vulnerable to the long-ranging impacts of adversities and traumatic events. Whereas the basic wiring diagram of the brain is genetically preprogrammed, its fine-tuning throughout the different phases of infancy, childhood, adolescence and adulthood is highly experience dependent. Acquiring skills increases myelination [24], while social isolation or severe stress results in impaired myelination [25]. Some areas of the nervous systems need to be adequately stimulated in crucial developmental phases – through interaction of subjects with their surroundings – in order to function optimally. The opening and closing of these windows of opportunity are regulated by genes which are turned on through the activation by neurotransmitters. A disturbance at critical development periods in infancy or adolescence can lead to long-lasting behavioural changes. In adolescence the plasticity of the brain is highest. This is also the peak time for clinical onset of mental diseases such as mood disorders or schizophrenia [26].

The development of the self follows a well-defined path and is rooted in biology. According to Stern [27], the emergent sense of self is progressively layered so that an infant will successively develop an increasingly interpersonal sophisticated sense of self. The development of the self and the formation of self-representations take place in a continuous process between the infant and his mother. "... it is the overall quality of the emotional relationship between infant and caregiver, and its internalisation as part of the representational world, which is of crucial importance for growth and development" [28, p. 105]. These processes are based on interpersonal communications with all their asymmetrical needs, desires and satisfactions. Infants' emotional self-regulation is dependent on their affect-regulatory interactions with primary caregivers. Their mental representations underlie their understanding of feelings, beliefs and behaviours of other persons. If these complex exchanges are impaired, disturbances of intrapsychic, interpersonal and social relatedness ensue.

Infant research demonstrates the major influences of family relationships on child development. The observation of parent-child interactions in behavioural and emotional aspects marked an important step in understanding the infant's and child's self-formation and -maturation and associated disorders. The construction of the self cannot be dissociated from the parents' personal history and as such represents a heritage that transcends genes [29]. Transmission of parents' unconscious desires and fantasies to their children takes place through nonverbal communication, the variants being of a sensory-motor nature, of tactile, visual and auditory modalities. Parenthood is based on the notion of kinship in its dual biological and social dimensions. What constitutes the parents' intrapsychic reality will unfold in fantasised and emotional interactions with the baby, then the child, by intersubjective exchanges and interpersonal relationships and thus contribute to the attachment modalities of the young child to parents and family. The child will react to the fantasies expressed by the communicative behaviour of his parents according to his own motivations, in particular his desire for communication and his need for relatedness and containment, deriving from his own impulses and defences.

Language, communication and music

Language has been shaped by natural selection and genetic mutations. Contrary to the idea that children learn language by simple imitation, trial and error, Chomsky [30] proposed that language abilities are universal and preprogrammed in the brain. Thus every child has the biological capacity to learn any language. Lieberman [31] argues that language is a learned skill, based on a functional language system distributed across numerous cortical and subcortical structures. These circuits constitute a genetically predetermined set that defines the characteristics of language.

Infants' self-awareness proceeds from birth on, particularly through their own actions. Young children's understanding of others probably increases in analogy to their own self, that is from their experiences of self-induced actions. Trevarthen [32, 33] assumes that children, in the sense of a primary intersubjectivity, are born with a model of dialogue, with an inborn sense of the "virtual other"; they need only to acquire the motor skills to express this "knowing" in language and behaviour. As a result an infant's active exploration of his environment, he constructs "reality" with sensory and motor information.

Hearing ability evolves from the fifth foetal month onwards. Among all sounds, human speech is particularly attractive for the infant. Neural memory traces are formed by auditory learning before birth. Tactile and auditory perceptions are foetus's main sensory modes

in the interaction with their mother. The foetus has no means to influence his mother's voice, but is probably apt to recognise or differentiate the emotional state of his mother's mind. Does her voice express joy or sorrow? Only at and after birth is the infant capable to cry, and to create and evoke sounds [34].

The infant is receptive to the mother's "language" [35]. Infants' affective perceptions are stimulated by mother's sounds and the awareness of her face. In response to being addressed, infants smile earlier to the specific language of the caregiver than to their facial stimulus. Parents or care persons regulate the wake- and attention-state of the infant through their language (tone, intensity, melody).

From a neuroscientific point of view music has strong links with speech. Neuroimaging studies show that music and speech engage similar overlapping brain regions such as the temporal, parietal and infero-frontal areas, including the speech centres of Broca and Wernicke [36]. The origin of music is rooted in social experiences. It goes back to the early interactions between mother and child, where musical aspects of speech such as rhythm and melody are the first means of communication [37]. According to Oliver Sacks [38], music involves more areas of the human brain than language. Patel [39] stresses two aspects that are particular important for music perception. First, music requires a much higher precision in tone or pitch perception and in timing, whereas speech communication is not so dependent on subtle acoustic constraints, because it relies on semantic and syntactic content.

The second feature of music is its very close connections to emotional systems, such as the mesolimbic circuit and in particular the nucleus accumbens [40]. The strong interaction between the auditory system and the dopaminergic mesolimbic circuitry is at the root of the rewarding aspect and aesthetic sensation when listening to music [41]. Music may influence perception of time, appears in dreams, creates meaning for emotional states, contributes to conscious awareness and is helpful in mourning.

Stress, trauma and posttraumatic stress disorder

The brain is the central organ for adaptation and is part of a homeostatic regulation mechanism to maintain personal and bodily integrity. The brain processes environmental stimuli and our experiences involving social interactions. As a result the social and physical environment in which we live has a huge effect upon our mental state [42].

The brain ascertains what is threatening and therefore potentially stressful, and initiates the physiological, emotional and behavioural responses to stressors. This response can be either adaptive or harmful. Stress always involves bidirectional communication between the brain and the cardiovascular, immune and metabolic systems through the autonomic nervous system and by endocrine mechanisms. The complex effects of these different networks will eventually lead to positive or negative changes in the brain and the body. Dysfunction of the hypothalamic-pituitary-adrenal axis is postulated to play a key role in stress-related disorders such as depression and posttraumatic stress disorder (PTSD).

Current theories about the pathogenesis of mental disorders emphasise the dual role of genetic and environmental risk factors [43]. The role of acute and chronic forms of stress and trauma has been discussed not only in anxiety disorders and posttraumatic stress disorders, but also in a wide range of mental health diseases such as autism and schizophrenia. Understanding how genetic predispositions are activated by environmental influences such as psychic or physical trauma will help set up new preventive strategies and more effective treatments [44]. Adverse experiences at critical or sensitive developmental phases during early childhood influence to a great degree brain development and may have long-lasting impacts [45, 46]. Traumatic events in early childhood, leading to epigenetic modifications that alter gene expression, play an important role in the development of stress-related psychiatric illnesses. These changes are often enduring, but do not have to be permanent [46, 47].

The social and physical environment in which we live has a huge effect upon our mental state.

Early childhood traumatic experiences affect the normal development of the cerebral cortex and the limbic system and lead to long-term changes in multiple neurotransmitter systems. Central nervous system structures such as the prefrontal cortex, thalamus, amygdala and hippocampus are involved in the progressive integration of incoming sensory, visual and auditory information. This integration can be interrupted by an extreme emotional arousal [48]. The hippocampus has the function to transform unconscious preverbal memories (procedural implicit memory), which are largely mediated by the amygdala system, into conscious verbal memory (explicit declarative memory, [49]). Extreme emotional arousal prevents the adequate evaluation and categorisation of a lived event as it inhibits hippocampal functions. These memories remain stored in the amygdala as affective or sensorimotor states of physical sensations and visual images, and are indelible. Adequate assess-

ment and integration of emotional experiences do not take place. Therefore trauma-related memories remain timeless and self-alien.

Multiple or repeated traumatisation (cumulative traumata) in childhood have severe outcomes and affect multiple developmental domains such as regulation of affect and impulses, memory, attention and consciousness, self-perception and interpersonal relations. They result in complex symptoms and disorders also in adulthood [50–52]. Emotional maltreatment (without physical aggression) and hostile, rejecting or inconsistent parenting are among the highest risk factors for children's physical and mental development [53]. Children are particularly vulnerable to compulsively re-enacting traumatic experiences, leading to repeated suffering either for themselves as victims or for others as perpetrators.

PTSD is a disorder occurring after exposure to traumatic events associated with a significant stress response. A genetic susceptibility seems to play an important role in building particular persisting memories; an increased risk of developing symptoms of PTSD has been linked to genetic traits predisposing to the formation of a strong aversive memory [54]. Research in the field of posttraumatic consequences of cumulative traumata or poly-victimisation of children and youths has shown the importance of developmental aspects and familial context in the assessment of the multiple and serious mental health problems in children, youths and adults. Earlier preventive and therapeutic measures are imperative [50, 53, 55]. Resilience research arose from an effort to better protect children, adolescents and young adults against the impact of adverse life experiences [56].

Adults who have experienced multiple or cumulative traumata in early childhood often present not only symptoms of PTSD, but additional symptoms, including difficulties in affective and interpersonal situations and disturbances in self-regulation skills. Psychotherapeutic interventions for adults with such complex symptomatology have therefore to take into account failures of reliance in early relationships with primary care persons and the resulting developmental, emotional and interpersonal problems [51].

Pain, somatisation and psychosomatics

There is no question that pain is inherently subjective, though medicine attempts to objectively measure pain with clinical scales, while neuroscience tries to visualise it with brain imaging techniques. Pain in neurological affections like trigeminal neuralgia can be understood in terms of a physiological and anatomical framework; pain in conversion disorders appears to translate psychic conflicts into bodily symptoms. The emotional affective aspects of pain we experience in the context of loss of a loved one, a pain that may stay for a long time as part of a grieving process, will by its complex nature mobilise very large neuronal networks and thus profoundly affect our mind. Comprehending these complex interactions requires an understanding of the neural correlates of emotional states. There is evidence of similarities between physical and emotional pain, explaining why it "hurts" when a person mourns a loved one [57, 58]. The cingulate gyrus, in particular its anterior part, is activated when we experience feelings such as sadness [59]. Pain is caused by the fact that the significant person is indeed irreversibly lost, but the deprived subject nevertheless holds on to the loved one [60].

According to psychoanalytical theory the origin of psychosomatic illness is caused by an excessive drive and physical sensation that cannot be thought about and made sense of, the so-called "speechless mind" (Paris school of psychosomatics, [61]). Patients with psychosomatic disorders have great difficulties with fantasising and expressing feelings, and manifest emotions in somatic complaints. According to the attachment theory, somatisation is the failure to build up a secure attachment in infancy; if a mother fails to regulate her infant's emotional states, the child does not develop sufficient mentalisation abilities to reflect on experiences. He then expresses emotional states through the "speaking body". Both theories contain the idea that psychosomatic illness results from disturbances in early development [62].

Fischbein [63] distinguishes patients who suffer from acute and transient psychosomatic episodes from patients whose identity is organised by illness. "They 'are' the illness ..." In the former "the body is responding to an inability to process conflict adequately at a mental level" (p. 197–198); in the latter patients "are unable to go through the experiences of mourning, disintegration and emptiness involved in moving towards an identity organised outside their pathology" (p. 197). Somatisation is then a dysfunctional interpersonal behaviour that is driven by an anxious and maladaptive attachment style and is fostered by real or perceived rejecting responses from significant others. The attachment to psychic pain favours the past over the present and future. Patients with psychosomatic disorders show regressive behaviour to preverbal somatosensory states; their lack of internal representations renders them dependent on external relationships, yet establishing bonding in order to build up meaningful relations often remains extremely difficult. The ability to refer to and rely on one's own

mental world seems to have protective features against psychosomatic illnesses, whereas psychosomatic complaints have mainly the function to sooth psychic pain [64].

In children, psychosomatic symptoms are relatively frequent as they are not as able as adults to separate psychic conflicts from somatic sensations. Somatic dysfunction without detectable somatic substrate may show up in motor, sensory, visceral and other functional areas. Psychic distress may have a visible or sometimes more hidden impact on the body. For assessment of psychosomatic symptoms in infants and young children it is essential to consider developmental aspects and the family context.

Grief

Grief, pain and depression are states of mind that remain subjective, not truly measurable because they contain a major personal and cultural dimension. The neurobiological strategy proposed to comprehend these affects and emotions is to relate them to neuronal structures and specific brain systems. In its intensive form, grief activates the panic-loss system, resulting in feelings of distress and helplessness [65]. This panic-loss system includes the periaquaductal gray in the midbrain and ascends through the dorsomedial thalamus to various basal forebrain nuclei.

Rage or anger is very often a symptom of grief and depression. Impulsive and aggressive behaviour has been linked to dysfunction of the neurotransmitter serotonin. Of interest is the fact that serotonin reuptake inhibitors are useful to treat patients with depression, but are also used in the treatment of aggressive personality disorders [66]. Patients with brain injuries, particularly of the basal forebrain, have difficulties regulating their emotions and often suffer from violent rage outbursts. Many research findings point to the fact that deficits in emotional regulation resulting in aggressive and violent behaviour can be attributed to dysfunction of the serotonergic system [67]. The networks generating negative affects, activated during grieving, such as the panic-loss system, will ultimately impair the brain reward system leading to further emotional imbalance and depression.

Grief is an internal process following experiences of loss and/or psychic injuries that involves an active engagement of the subject. The grieving person recalls all his experiences with the loved one and must recognise the loss as permanent and irrevocable. The traumatic loss of a significant person may reactivate all the painful emotions of previous losses an individual has experienced. Yet one of the most difficult aspects of mourning is enduring the continuous internal presence of the loved one and at the same time being confronted with his external absence [68].

Prolonged grief disorder or complicated grief occurs in about 10% of bereaved persons, the rates being higher among parents who have lost a child [69]. There is a symptomatology of persistent and intense yearning for the lost one with feelings of loneliness, emptiness, bitterness, and great difficulty to detach from and accept the loss of the significant person. The surviving person is affected by images, hallucinations and nightmares of the deceased person, and preoccupied with questions of why, accompanied by feelings of worthlessness and loss of meaning of their own life [69].

Mourning in children is different from that in adults. Children have to grieve their loss at each new developmental phase. Only at the age of latency can children understand at the cognitive level that death is a loss for ever. Often children imagine that death is reversible as their desire for reunion with a lost parent is so strong that even if they know the truth, their fantasies have a greater impact. Children are not able to accomplish a mourning process alone; they need to share their memories, fantasies and feelings with a meaningful adult person in a continuous relationship. A grieving process proves necessary, not only for the child to continue his development but also to prevent him from reproducing his traumatic experience and undergoing additional traumatisation. The assessment of pathological grief in children must consider the circumstances of the loss, the mourning process, subsequent events and personal developmental changes [70, 71].

Traumatic experience of loss in a family, which could not be dealt with and overcome, often represents the starting point for the formation of family secrets. A secret always arises in a meaningful relationship and is a shared experience [72]. If mourning cannot be fulfilled, the impact of critical events can be transmitted from one generation to another. What happened in the parents' past is transmitted to the child and becomes his present reality. Transgenerational and unconscious conflictual patterns of the child's primary caregivers are through identification with their emotional experiences internalised by the child [73].

Dreaming

Dreaming is a particular state of mind, sometimes a very emotional experience. Anything that "arouses the sleeping brain" can trigger the dreaming process. Solms and Turnbull [15] state that, in order to dream, arousal of the inner source of consciousness – an activation of the basic mechanisms of core consciousness – has to take place. The arousal trigger can be

waking thoughts before falling asleep or the REM sleep state, the latter being the most reliable trigger. Even though most dreams occur during REM sleep – a state triggered by brain-stem generators – dreaming is dependent on the integrity of cortical structures. For example, the ventro-mesial frontal region, an area involved in motivational behaviour, is essential for dreaming, suggesting that dreaming is a "motivated" process or action [74]. The motor system being inhibited in REM sleep, voluntary motor activity does not take place during dreaming. The frontal lobes are inhibited or underactivated during sleep. "In the absence of the ability of the frontal lobes to program, regulate and verify our cognition, affect and perception, subjective experience becomes bizarre, delusional and hallucinated" [15, p. 212]. This explains the backsliding or "regressive" nature of the dreaming process. The "primary driving forces of dreaming" are to be found in activation of the meso-cortical, mesolimbic-dopaminergic system, which is implicated in motivated behaviours, emotional processing and, most importantly, in reward processing [75]. The link to the rewarding system validates Freud's [76, 77] idea that dreams are a form of "wish fulfilment". The fear system, part of a defence mechanism in which the amygdala plays a key role [49], is also activated most evidently in nightmares. These two systems are in fact widely interconnected, both relying heavily on limbic structures and exerting a mutually inhibitory influence. One assumes that these systems constitute an essential chain of behavioural control that is central to the dreaming state. Although it is generally admitted [78] that dreaming is essentially generated by the dopaminergic reward-seeking system, the high incidence of threatening dreams argues for an important role of the fear system in colouring the content of dreams. A strong feeling of terror is the consequence of a "misinterpretation" by the dreamer and originates from amygdala activation, resulting in a sense of deep fear.

According to Modell [18], the dream is an example of the autonomy of imagination, "bears the imprint of an individual self" (p. 58) and is at the same time a product of a neurophysiological process. The biological functions of dreaming are still controversial and there are probably multiple functions of dreaming. Some dreams may reflect an unconscious intentionality, may process memories of the previous day, anticipate a task of the following day or illustrate a problem-solving process. The brain is a self-activating system and so is dreaming, which expresses the autonomy and uniqueness of an individual's imagination.

The dreaming experience has a direct connection to the unconscious and is not inscribed in temporality. For Bollas [79], dreams allow us to gain wisdom of unconscious features of our life and to experience new creative meaning, thus enhancing our self-knowledge: "... dreaming, together with the experience of recollecting, recounting and exploring dreams in analysis, increases and deepens communication between conscious and unconscious selves" ([79], xxii). The narration of a dream relates to the subjective emotional experience of past events of a patient, but does not necessarily represent the historical truth. Identifying connections between the past and the present history allows the elaboration of gradual emotional understanding and significant meaning. Implicit memories of the past history, with their impact on the present of the patient, gain, over time, conscious representations and relieve the patient of confusion and anxiety states [80].

Dreams are the expression of mental processes that differ qualitatively from waking thoughts. On telling a dream it gains consciousness and its presence demonstrates its actuality. "Those processes that (are) not yet inscribed in a time sequence (past–present–future) tend to repeat themselves – that is, to occur in an ever-present form" [81, p. 827]. Working through an unconscious fantasy system of a patient's nightmare includes retrieval of painful memories and eventually (re)construction of a tormented childhood. In the process of a psychoanalytical therapy through the narration of dreams, meaning is discovered, enlarged, transformed. The accompanying emotions are revealed, understood and framed in a time sequence.

Psychoanalytical psychotherapy

One of the goals of psychoanalytical treatment is to understand the inner world of a patient, which unfolds in the significant relationship between patient and therapist. The patient's personal experiences and the meaning he attributes to his experiences are at the core of psychoanalytical investigation, with the aim to favour the patient's specific processes to understand the affective and cognitive contents of his mind. The intention of a therapist is to try to perceive the patient's unconscious emotional experiences and to achieve, together with the patients, a careful common understanding of what is "true" for the patient in his unconscious emotional experience [82].

Transference is one of Freud's [83] most important contributions and describes a process that takes place in therapeutic interactions and, more generally, in interpersonal relations. In psychoanalytic theory "transference" refers to the process in which an analysand's unconscious desires are actualised and projected ("transferred") onto the analyst. In psychotherapy, the

transference relationship facilitates communication of the patient's unconscious formations and permits searching for the meaning of unconscious phenomena in a context of containment [84]. The unconscious includes thoughts, memories, affects, motivations and dreams and tends to create meaning and influences behaviour. It is constantly working in sleep as well as in the waking state. Conscious and unconscious processes are considered more and more as representations of mental phenomena emerging in a continuous form. Breuer and Freud [85] already postulated that the unconscious had a function in sustaining "psychic continuity" when there was discontinuity in consciousness. Transference contains all the patient's communications in the analytical psychotherapy: verbal expression such as dreams and narrations, nonverbal communication such as posture, bodily movements, facial expressions, gesticulations and, most importantly, his voice, the "musical dimension" of the transference [86]. The relationship between patient and analyst represents in part a shared "musical experience", allowing the affective and emotional world to be expressed. This musical dimension is an essential means in the analytical work as it facilitates the affective and emotional, often traumatic experiences, stored in the patient's implicit memory, which cannot be consciously remembered, to be re-experienced in the transferential encounter.

Psychotherapists have to listen carefully to how and what their patients hear from their interventions, interpretations, their voice or their silence. Often only after a process of "retrospective attribution" [18] is the therapist able to know what his patient has recalled and what meaning he has associatively attributed [87].

The psychoanalytic process is based on an intersubjective relationship, involving the creation of a relational space in which latent development resources and resilience perspectives of a patient and mutual expectations of the patient and therapist are recorded. New functional possibilities and opportunities for more suitable integrations are explored and a more profound understanding of a commonly shared narrative is elaborated. The aim of the psychoanalytical process is directed towards working out new scope, open space and freedom and creation of alternatives and more suitable forms of coping with life events [88].

For Stern "the desire for intersubjectivity is one of the major motivations that drives a psychotherapy forward. Patients want to be known and to share what it feels like to be them" [89, p. 97]. Unconscious emotional movements and contents emerge in the patient-therapist relationship, which often follow a latent plan, sometimes like a table of contents, sensitising the therapist for what is to come. Both intrapsychic fantasies, past relationship patterns and current relationships outside the therapy (especially in the family environment) arise in the transference relationship. These fantasies represent partly conscious, partly unconscious, figurative-scenic processes; they correspond to the sum of different intrapsychic driving forces. Often they are also used as defence configurations against actual drive-impulses.

The interpersonal exchange – a significant dialogue in a sustainable relationship – opens a window to the (un) conscious mental life of an individual. Especially for children suffering from developmental psychopathologies, the therapeutic aim, with respect to the anguish of the patient and his family, has to foster the child's developmental progression, helping him to experience a sense of coherence and personal continuity over time. The emergence of his self, his inner reality with feelings and fantasies, the frontier to his outer world, finally define a child's personal experience, his inner freedom and creativity [90].

Narratives promote a grieving process and the working through of loss and psychic trauma. They reveal un- and preconscious representations and phantasms of individual experiences [91]. Telling a story connects – by means of symbolism – memories, images and scenes with the associated emotions and language [92], and serves to ascribe meaning and significance to life events that interrupted the continuity of personal experiences [93]. In the psychoanalytical relationship implicit emotional and sensory memories have to be transformed into explicit memories, which can then be verbalised and no longer need to be expressed through reenactment. This transformation of unconscious, procedural memories through jointly developed semantic contents into verbal and symbolic representations allows mutual insight of the patient-therapist couple and promotes the psychotherapeutic process. The (hi)story of the patient is continually (re) created in the course of a psychoanalytical process. Patients attempt to establish a self-continuity, so that their past feels connected, without ruptures, with the self-experience they live in the present.

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