

Corso di Psicosomatica

Scheda n. 6

Il problema del rapporto mente-corpo: l'approccio neuroscientifico

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Per gentile concessione del professor Silvio Merciai, docente al corso di Psicosomatica presso il corso di laurea in Psicologia dell'Università di Torino

Riferire degli sviluppi attuali delle conoscenze neuroscientifiche è un compito in qualche modo impossibile - ovviamente - ma anche indispensabile se si vuole sostanziare la posizione per la quale comprendere la mente implica analizzarne adeguatamente il substrato cerebrale. Ed è questo che cercherò di fare brevemente in questa scheda, che si inserisce in un discorso più ampio che - partito dalla concezione classica (dualistica) della psicosomatica - vuole approdare alla clinica psicosomatica ed alle sue prospettive future passando attraverso la neuropsicoanalisi ed i suoi modelli di riferimento, a cominciare da quello di Antonio Damasio e passando attraverso ai concetti di emozione, regolazione affettiva ed attaccamento ...

L'anno passato avevo dedicato a questo argomento una scheda specifica:

Il problema mente-corpo: il contributo delle neuroscienze

che lo studente potrebbe rivedere a mo' di introduzione (scontandone l'inevitabile invecchiamento); anche qui però, come nel caso della scheda precedente, mi limiterò ora ad una succinta delineaazione dei principali temi e delle principali acquisizioni in argomento ...

Partirei dalla considerazione del capitolo dedicato alla neurobiologia (*Inside the Brain*) nel libro Thinking About Thoughts di Piero Scaruffi, che inviterei lo studente a consultare direttamente ... Il capitolo in questione affronta le tematiche essenziali di una moderna sinossi neuroscientifica dedicata al problema della mente e della coscienza, trattando in successione vari argomenti tra cui i seguenti:

- il **connessionismo**;
- la **struttura neurale del cervello**, con particolare riferimento alla **corteccia**, al **talamo**, all'**ipotalamo**, all'**amigdala**, all'**ippocampo** e al **tronco cerebrale**;
- la **dominanza** e la **specializzazione emisferica**;
- i **neuroni** ed il **meccanismo sinaptico**;
- i **bioritmi** e l'**omeostasi interna**;
- l'analisi delle varie funzioni psichiche (**percezione e sensazione, concetti e ricordi**) dal punto di vista delle neuroscienze;
- la **concezione dinamica del cervello**;
- la **concezione evuzionistica del cervello** (il **darwinismo neurale** di Gerald Edelman, l'**epigenesi per stabilizzazione selettiva delle sinapsi** di Jean-Pierre Changeux, ecc.);
- il concetto di **zone di convergenza**;
- il concetto di **encefalizzazione**;
- i concetti di **microgenesi** e di **cervello trino**.

Forse, però, potrebbe essere utile offrire una breve ricapitolazione dei dati neuroscientifici a nostra disposizione e che forniscono le basi del concetto di neuropsicoanalisi, su cui più avanti ci intratterremo. di quelle cognizioni, cioè, che più direttamente ci tornano utili nel momento di cercare di comprendere il funzionamento mentale avanzato dei nostri pensieri, delle nostre emozioni e delle nostre condotte. Una trattazione assai completa ed articolata mirata ad evidenziarli (*a schematic overview of neuroscience topics that are relevant to the theory and practice of psychoanalysis*) è la serie di articoli pubblicati da Regina Pally sull'*International Journal of Psychoanalysis* [i testi in questione sono stati ripubblicati dall'Autrice nel volume **The Mind-Brain Relationship**, Karnac Books, London, 2000]:

- **How Brain Development is Shaped by Genetic and Environmental Factors** (1997, 78, 587-593);
- **How the Brain Actively Constructs Perceptions** (1997, 78, 1021-1030);
- **Memory: Brain Systems that Link Past, Present and Future** (1997, 78, 1223-1234);
- **Emotional Processing: The Mind-Body Connection** (1998, 78, 349-362);
- **Bilaterality: Hemispheric Specialisation and Integration** (1998, 78, 565-578);
- **Consciousness: a Neuroscience Perspective** (con David Olds, 1998, 79, 971-989).

Lo studente intenda quanto segue non come un *Bignami* delle neuroscienze del comportamento, ma come un sostituto degli appunti che cercherebbe di prendere a lezione; io lo userò come scaletta della mia esposizione [sono in lingua originale le citazioni dai lavori ed in italiano i miei sunti o appunti] ...

How Brain Development is Shaped by Genetic and Environmental Factors

... all mental phenomena are assumed to be the result of biological activity of neuronal circuits in the brain. The development of these circuits relies in part on genetic programmes, but is also heavily dependent on the individual's experiences with the environment.

Recognition of the remarkable degree to which brain development is experience-dependent is a striking example of how neuroscience can be integrated with psychoanalysis. These ideas can be considered to lend support to analytic assumptions that early developmental experiences shape subsequent psychological functioning.

The brain consists of approximately 10 billion neurons ... Each individual neuron, with its axon and branching dendrites, makes a synaptic connection with approximately 60.000 to 100.000 other neurons. The total number of synaptic connections is in the range of 10²⁷

The architecture and organisation of the brain is the product of its evolutionary history, which indicates that the human brain has evolved and expanded, while still retaining features of three basic 'evolutionary ancestors', reptiles, lower mammals and primates ...

The most primitive part, the brain stem, is responsible for vital functions of physiological survival, such as the sleep-wake cycle, heart rate, respiration and body temperature ... Derived from reptilian ancestors is the striatum, also called the basal ganglia. It is responsible for behavioural motor routines that are unique to the particular species, such as territorial displays. ... in humans, once a particular behaviour is repeated many times ... the motor patterns are stored in the basal ganglia and can be activated as automatic motor routines.

Derived from lower mammals is the paleomammalian brain, or limbic system. It is associated with emotion and memory, as well as with uniquely mammalian behaviours, such as nursing, parental care, play and the infant distress cry.

The most highly evolved part of the brain is the cortex, or neomammalian brain. The part of the cortex that reaches the greatest degree of development in humans is called the pre-frontal cortex. It is the 'executive centre' of the brain, responsible for planning for the future, direct attention to a task, delay of gratification, affect regulation and voluntary control of movement ... The 'higher', more advanced pre-frontal cortex modulates the emotion, behaviour and body physiology processed by the 'lower', more primitive subcortical regions.

There is a tendency to speak about the brain as if a particular function is localised in a particular brain region. However, the brain operated as a dynamic integrated whole ... Even a single perception, such as seeing a cat, involves circuits that traverse the brain stem, limbic system and pre-frontal cortex.

One half of the entire genome is dedicated to producing the brain, an organ that constitutes only 2 per cent of our body weight. ... Primary sensory areas myelinate in the first months of life. The pre-frontal cortex, a region of higher cognitive skills, begins myelinating at about three months of age and continues into young adulthood!

The brain is 'born' prematurely. Therefore much of its development occurs postnatally and for many years afterwards. ... To a startling degree, it is interactions with the environment that stimulate the more precise wiring of neural connections ...

Neuroscientists believe that the functional unity of mental activity is not the single neuron but a circuit of interconnecting neurons all activated at the same time. ... Interactions with the environment cause neurons to wire into circuits, which are sometimes called neural networks or neural assemblies, terms derived from computer models of brain activity. When the brain is exposed to a new event, ... a unique pattern of neurons is activated. ... In other words, information from internal or external sources is represented in the brain by complex configurations of interconnected neurons ...

Recognition occurs when we encounter something that evokes a neural pattern similar to one already preserved ... Because there is redundancy of brain circuits, it is even more accurate to say that a number of specific neural circuits underlie a particular brain function ... Redundancy is adaptive, because if one circuit becomes damaged, another can take its place. Not only is there more than one circuit per function, but individual neurons participate in many circuits, in the way that pixels in a television screen participate in a number of images.

The process by which connections between neurons are forged is called 'Hebb's rule', which states that if two neurons tend to be electrically active at the same time they will automatically form a connection (Hebb, 1949). If they are already weakly connected, the synapse between them will become strengthened. With regard to brain development it is a matter of 'use it or lose it'. ... In the neonatal period a pruning process begins. As a result of experience-dependent circuit development, the neural paths that are used remain, while those that are not used die off.

All localised brain regions are richly connected to other brain regions by interconnecting neurons that form re-entry circuits ... These circuits ... automatically feed information processed in localised brain regions back and forth to other localised regions. It is known that individual attributes of the environment are processed separately. ... Through re-entry the brain coordinates the information from these separate stimulus processing

regions.

... it is considered a general principle that for normal perceptual capacity to emerge, the sensory cortex must receive very specific kinds of stimulation within a particular time frame, or 'sensitive period'. ... Animal experiments were conducted to illuminate the clinical observation that childhood cataracts, if not treated promptly, can lead to permanent blindness. These effects are limited to a sensitive period in childhood. Cataracts that develop later in life, but are surgically corrected, do not lead to blindness. ...

Using a combination of animal and human studies, Schore (1994) proposes a sensitive period of between approximately six months and one year for the development of circuits in the pre-frontal cortex that subserve the capacity to self-regulate high positive affect states. Within the sensitive period, the infant must engage in mutually responsive face-to-face, gaze, vocalisation and smiling interactions with the caretaker. ... During these interactions, the infant experiences intense states of excitement that are modulated by the mother's responsiveness (Stern, 1985). Schore argues that these high arousal states specifically induce the sprouting of dopamine-releasing axon terminals, which grow upwards from their cell bodies located in the midbrain to site deep in the pre-frontal cortex. The increased release of dopamine into pre-frontal areas, in turn promotes a growth spurt of synapses and glial cells in this region. These dopaminergic circuits linking midbrain with pre-frontal cortex are a key element of the maturing ability to self-regulate affect states.

... throughout life every part of the nerve cell, from soma to synapse, alters its dimensions in response to environmental stimulation. ... It is just as important to stress that decreased stimulation diminishes a nerve cell's dendritic arborisation. ...

As far as we know, the hippocampus (involved in long-term memory) is the only region of the brain where new neurons continue to grow even into adulthood. ... in the hippocampus environmental stimulation can increase the number of neuronal cells. ...

It is characteristic of mammalian brains that they develop in co-ordinated systems with other brains. ... Hofer (1996) believes that species-specific separation and reunion behaviours link the infant brain neuromodulatory system with the mother's behaviour. [Nei ratti] separation from mother triggers the infant's 'separation distress cry'. The mother responds to the pup's call by retrieval, licking and facilitation of milk ejection. Reunion and proximity to mother terminates the distress cry, thus completing the loop in this control system. He proposes that maternal behaviours modulate the infant's physiology by affecting the neuromodulatory system in the infant's brain. Support for this theory rests on the fact that neuromodulatory substances, such as benzodiazepines and opiates, can act directly on the infant brain to decrease the distress cry during separation. Using rhesus monkeys, Kalin et al. (1995) provide evidence that reunion behaviours ... operate not only on the brain of the baby but on the brain of the mother as well. ... The implication is that the opioid system, in the brain of mother and infant, mediates affiliative behaviours upon reunion.

The brain 'design' strikes a balance between circuit permanence and circuit plasticity. As a rule of thumb, more plasticity exists in cortical circuits, where new dendrites can grow and synaptic connections can continue to be made throughout life. For cortical functions, such as vocabulary and maths, there is a lot of plasticity. ... On the other hand, the subcortical limbic 'emotional' circuits that develop in infancy have less plasticity and therefore may have a long-lasting effect on subsequent psychological development ... Such 'conservatism' may seem rather limiting, even 'maladaptive'. However, it is circuit permanence that allows children to form and maintain attachments to their parents over the long period of their development and to seek familiar reliable sources of safety and comfort. As mentioned early, through maturation the cortex develops the capacity to modulate emotional responses of the sub-cortex, a process easily observed as children and adolescents grow. ... Since it is known that consciously attending to and verbalising something can enhance cortical activation, it could theoretically be argued that treatments such as analysis enhance cortical functioning, and take advantage of cortical plasticity, to modulate deeply engrained emotional responses.

How the Brain Actively Constructs Perceptions

Although subjectively it seems that we simply 'take in' the world as it exists, each and every perception is in fact actively constructed by the brain from the building blocks of individual sensory cues under the guidance and influence of emotion, motivation and prior experience ...

The brain detects the individual stimulus features of the environment such as edges, contour, line orientation, colour, form, pitch, volume and movement and processes them in separate regions of the cortex. There is no place in the brain 'where it all comes together' as a whole image. To create a perception, the brain takes the pattern of neuronal activity created by the simultaneous processing of all these individual environmental features and compares it with patterns stored in memory. When a match for the current pattern is found, perception occurs. The vast majority of perception occurs non-consciously. Only for the purpose of consciousness does the brain bind together the separate stimulus cues into coherent objects that pass our awareness in a continuous stream of experience ...

Despite the fact that each person's brain constructs its own perceptions, the results are not specific to each individual. Generally people arrive at a fairly accurate picture of the external world and there is a good consensual agreement between people about what they are perceiving. This is because there are constraints and

rules built into the constructive process. Our brains were developed under evolutionary survival pressures for adaptively responding to the environment, and the rules and constraints of construction reflect our survival needs in the average expected environment. ...

The system of perception ... illustrates that perceptual processing contains both ubiquitous, species-wide elements and personal, individual elements. Neuroscience offers psychoanalysis the opportunity for a deeper understanding of how our perceptions are shaped by the past, by our emotions and by influences of which we are unaware.

The perceptual processing system is organised hierarchically. This refers to how the flow of sensory information begins with the sensory end organ (e. g. retina) and moves along a designated anatomical path to the thalamus, then the sensory cortices and finally the parietal, temporal and frontal association cortices. ... Perception is built up from contributions at all levels of the processing hierarchy. ...

'Bottom up' processing refers to how individual sensory stimuli activate brain cells and how simple individual features of the environment are co-ordinated with one another and built into more complex features of the environment at a neuronal level. The term ... relates to the mechanisms within the anatomical hierarchy as a whole. 'Bottom up' mechanisms are involuntary, always unconscious and are more closely related to the physical properties of the environmental stimuli and the architectural organisation of the sensory cortex. ... [In questo ambito si possono ricomprendere: le connessioni cortico-corticali, che sono per esempio responsabili di illusioni ottiche come quelle del triangolo di Kaniza; il contesto sensoriale; l'informazione sensoriale polimodale e le modalità attraverso le quali una modalità sensoriale ne influenza un'altra; e la sincronizzazione temporale, intesa come il meccanismo che consente di legare assieme le specifiche caratteristiche, separatamente percepite, di un determinato oggetto in largo accordo con le leggi della psicologia della Gestalt.]

The separate features of the environment stimulate particular patterns of neuronal activity in the brain. The brain does not perceive the external environment, nor the separate stimulus features. Rather, the brain recognises the patterns of neuronal activation within the brain itself. For perception to occur, the brain searches for a match between the current pattern of neuronal activation and patterns stored in memory from prior experience ... To minimise effort expenditure, the brain does not analyse every detail of a pattern, but makes a quick assessment of just enough details to find a 'good enough match'. When a 'good enough' match is found, perception occurs.

If no match is found, the brain assesses more details of the pattern or consciously pays attention to the situation to seek more information until a match can be found. If still no match is found, a new category of experience is generated, whose pattern is now stored in memory for later pattern matching. Each category of experience is represented by its own pattern.

The brain automatically and continually processes sensory stimuli, matches patterns and generates perceptions. This is why when you see a cloud, you inevitably 'see' objects ...

... memory is the classic example [invece] of 'top down' processing. ... Since the brain only requires that the match be 'good enough', current perceptions are strongly biased by previous experiences. Pattern matching has special relevance for psychoanalysis, particularly transference. If a current situation activates a pattern that is similar to one stored in memory, because the brain only looks for a 'good enough' match, the brain may conclude that two different situations are the same. For this reason we tend to 'see' what we have seen before.

We are more likely to perceive cues from the environment that are relevant to our current needs than stimuli that are currently irrelevant. ...

Emotions influence how stimuli are interpreted. Fear and anxiety enhance the tendency to interpret stimuli as dangerous. ...

What is important to keep in mind is that amount of activity is the key factor in capturing the perceptual system. The patterns with the most activity 'win' ... When attention enhances activity in a particular group of cells, the pattern of that group is more likely to be the dominant pattern and thus more likely to be what is perceived. ... what you are intentionally looking for has an impact on the activity within the perceptual processing system ... Visual imagining a cup of coffee, even with one's eyes closed, activates the same visual cortex as seeing the cup. As a result of shared circuitry, visual imagery can influence visual perception ... Experiments conducted on humans reveal that imagining an object prior to being shown a jumbled-up version of the object enhances the likelihood of recognising what the object is ...

Evidence suggests that processes related to voluntary visual imagery occur routinely, but unconsciously, as facilitators of perception. Neuroscientists assume that when sensory input is insufficient or ambiguous ... input derived from stored images, real or imagined, routinely adds activity to the sensory cortex, providing additional sensory information (albeit from internal sources) to resolve uncertainties and ambiguities in perceptual processing. ... The influence of imagery on perception blurs the distinction between fantasy and reality. ...

Visual imagery, such as visually imagining writing letters, activates not only the visual cortex but also the motor regions that execute these motor actions ... Visual imagery is even constrained by the same constraints as the physical body ... It takes longer to mentally rotate an object through more degrees, just as it takes longer to actually rotate that object in the external environment.

The link between visual perception and motor actions may be a bridge to understanding imitation ...

Object permanence is the knowledge that an object is still present even though it is no longer visible. The link between the visual sensory system and the motor system provides some neurobiological explanations for this

psychological capacity [perché] motor cells remain active even after the lights are turned off ...

Perception evolved to facilitate adaptive behaviour. ... However, the pressure for speed of response is balanced against a pressure for accuracy ... As a result of these two survival mandates, speed and accuracy, the brain has a split perceptual system [Viene qui fatto riferimento al modello elaborato da Joseph LeDoux, di cui parleremo in una scheda successiva]. ... The brain does not know if it is making the wrong interpretation ... Most of the time the brain interprets stimuli correctly enough, otherwise our ancestors would not have survived to pass on this system to us. What pressures exist for the perceptual system to correct significant inaccuracies? We are more likely to use the accuracy-enhancing properties of consciousness in situations that matter to us physically and emotionally or situations that are novel or unexpected ...

The role of pattern matching in perception suggests an explanation for people's tendency to repeat painful situations from the past. The implication is not so much that people in fact repeat the same experience but that they tend to interpret current situations with a bias towards what has occurred in the past. Although consciousness is only a small part of perception, it serves a crucial function, since it enables the brain to pay more attention to environmental details, to gather more facts, so to speak, to enhance perceptual accuracy. ... One way to conceptualise psychoanalysis is a treatment method that encourages paying conscious attention to the specific details of the interpersonal transference situation in order to develop greater perceptual accuracy and, when necessary, to be able to generate new categories of interpersonal experience.

Memory: Brain Systems that Link Past, Present and Future

There are many kinds of memory. ... What unites them under the term 'memory' is that all involve the neural representation of information to which a person was previously exposed and which can be reactivated for use in the present ... Memory is closely allied with learning ... Memory, then, is about the past, but it also helps to anticipate the future. ...

The neuroscientific understanding of memory centres on issues related to the unconscious mind, and therefore ought to be of particular interest to psychoanalysis. Research findings support the analytic idea that unconscious material can affect conscious functioning. However, neuroscience does not explain these phenomena differently from psychoanalysis, since neuroscience goes beyond the idea that unconscious material is the result of repression. I think the ideas of neuroscience are compatible with analytic approaches, but do challenge analysts to broaden their thinking on this subject.

Information flows through the memory system in a series of stages: sensory input <-> iconic memory <-> working memory <-> long term memory.

Iconic memory lasts less than a second ... Iconic memory occurs when external stimuli activate sensory end organs and these areas remain in an active state long enough for the information to be processed and lead to a perception. ...

Working memory, also called short-term memory, refers to information that is held for only a few minutes, making possible a brief lingering impression of the individual's world, beyond the duration of the actual physical presence of environmental stimulation ... Information represented neurally in working memory remains in a labile state, subject to influences that can either disrupt it or strengthen it so it is stored more permanently in long-term memory. Information in working memory can come from the current stimulus situation or be temporarily 'copied' from long-term storage ...

Working memory is considered to be a temporarily, 'erasable work space', able temporarily to hold a number of pieces of relevant information at the same time and manipulate them if necessary. Working memory depends on the prefrontal cortex ...

Working memory is responsible for the search and retrieval of information from long-term memory that is involved in many higher cognitive functions. In fact all higher cognitive functions, such as the comprehension of complex information, reasoning, decision-making and planning for the future depend on the ability of working memory to hold a number of pieces of information simultaneously. Intelligence itself may be the result of working memory's ability to 'juggle' many possibilities.

Long-term memory is the permanent storage of information. ...

Long-term memory itself is divided into explicit and implicit memory.

Explicit memory, also called declarative memory, is the memory for consciously processed events. ... This is what is typically thought of memory, since when these memories are recalled they are experienced as memory, i. e. as something remembered from the past. Explicit memory is further divided into semantic and episodic. Semantic memory is for general facts and knowledge (who is president) and personal facts and knowledge (where you were born). Episodic, also called autobiographical, memory is for specific events (yesterday's visit to the dentist, last year's birthday celebration). ...

... it is known that MTL (medial temporal lobe), particularly the hippocampal complex, is involved in the encoding, storage and retrieval of long-term explicit memory, that is the memory of conscious experience ... Memory is not actually stored in the hippocampus. It is stored in the same cortical sites that are involved in the original experiencing ... Eventually after some indefinite period of time, the connections in these cortical sites are strengthened, and the memory is said to be 'consolidated', which means that it is less susceptible to disruption and impairment ... After this cortical consolidation, the role of hippocampus in retrieval wanes, as the strength of the cortical connections themselves are adequate to support retrieval. ... While this has been the most widely accepted theory, more recent work (...) suggests that the hippocampus continues to play some role in all explicit memory retrieval even after consolidation. To retrieve explicit memory, the hippocampal complex together with the frontal lobes serves as a kind of index that 'points to' the relevant information (sights, sounds, images, etc.) that is stored in cortical sites, and holds them simultaneously in an activated state, which results in the experience of 'remembering' ...

During the encoding of memory, the sensations and thoughts involved in conscious experience are provided by the primary and association cortices mentioned above. The spatial context of experience (where something happened) is specifically provided by the hippocampus and the temporal context (when it happened) by the prefrontal cortex. It is the spatial and temporal context added to the sensory elements of experience that convey the sense that these sensory elements have occurred in an 'episode' ...

A balance exists between encoding events as completely unique episodes (...) and encoding the general aspects 'across' episodes (recognising a person in different situations). The hippocampus itself appears to be involved in encoding those elements of events that identify them as unique episodes, and other parts of the hippocampal complex encode elements that occur as more general aspects of experience ...

All information comes from a source, either external (...) or internal (...). The memory for the source of information is called source memory ... Source memory often fades when remembering impersonal facts ... Crime reporting errors are often the result of flaws in source memory ... As with working memory, source memory depends on the prefrontal cortex. Therefore, since children have immature prefrontal cortices, they also are susceptible to source memory errors, which makes it difficult for them at times to discern whether

information originates from within themselves (imagery, fantasy) or from external events.

... For explicit memory, encoding involves paying conscious attention to information. ... a process called 'elaborative' or 'deep' encoding involves consciously reflecting on information and making associations between what is to be remembered and information you already have ... 'Semantic' elaborative encoding is the making of conceptual associations with the information to be remembered. ... During elaborative encoding, PET scan studies show increased blood flow to the prefrontal cortex ...

Novelty of information enhances the likelihood that the information will be encoded explicitly ... because increased conscious attention is generally given to novel aspects of the environment ...

Emotionally arousing information and personally relevant information are more likely to be encoded than neutral or irrelevant information ... The impact of emotional arousal on encoding is mediated by 'stress hormone' (cortisol, epinephrine, norepinephrine) activation of the amygdala. ... The amygdala itself does not do the encoding, but gives a signal to other areas involved in attentional focus and memory encoding, such as the hippocampus ...

What enhances memory retrieval is the degree of similarity between the retrieval situation and the encoding situation ... This is why memory is state-dependent. ... The closer particular aspects of the current situation, called retrieval cues, approximate to particular aspects of the encoding situation, the encoding cues, the more likely they are to elicit explicit recall of the memory. ... This occurs in analysis frequently, when for example a particular word or gesture of the analyst calls to mind a vivid childhood memory in the patient that contains that or a closely related word or gesture. ...

The close relationship between encoding cues and retrieval cues explains why elaborative encoding is so effective for enhancing explicit memory. It provides more associative encoding cues and therefore increases chances for retrieval cues to reinstate a memory. ...

Just as perception is a constructive process, memory retrieval is a reconstructive process ... The hippocampus-frontal 'index' joins together the individual sensory features, time and place of the experience to be remembered. What is remembered is constructed 'on the spot' and is not an exact replica of what happened in the past. Since what is encoded in explicit memory is all the neural elements that are involved in the conscious processing of events, consciously retrieved explicit memories themselves serve as new information to be stored as additional memory traces of the event ... In fact, the more often an event is recalled the more memory traces there will be for that event, and the more opportunity for alteration of that memory, since each new retrieval event is a reconstructed phenomenon and not an exact duplicate of the original. The repeated re-telling of painful childhood events or conflicts during an analysis alter the memory of these events as more modified memory traces are laid down that include aspects of the therapeutic situation, and therefore they are somewhat less painful and conflicted, it is hoped.

...non-declarative, also called implicit, memory is the memory for the aspects of experience that are non-consciously processed ... What this means is that certain information can be stored in memory without our being consciously aware of its occurrence; it can non-consciously influence current functioning but does not feel like conscious remembering. Implicit memory includes the memory for shape and form (primed memory), emotion (emotional memory) and skills, habits and routines (procedural memory), each of which is processed in a different brain system. ... from an evolutionary perspective the brain systems that support procedural memory, the basal ganglia, were well developed in reptiles, whereas the hippocampal-based memory systems did not evolve except with lower mammals.

Priming means that prior exposure to words, sounds or shapes facilitates the subsequent identification or recognition of them from reduced cues or fragments ... Priming enhances recognition based on appearance or form and is independent of semantic meaning, which is an explicit memory function. The brain systems that subserve priming are the 'pre-semantic' perceptual centres in the posterior sensory cortex, such as the occipital lobe for visual priming, and are distinct from the centres involved in semantic meanings, which are more anterior. ... Even subjects with amnesia from MTL lesions can show normal priming. ... Priming operates in each sensory domain separately. ... Priming not only enhances recognition of words and objects but alters judgements and preferences for them ... These priming effects can be long-lasting even after a single exposure. ...

Procedural memory is the memory for motor, perceptual and cognitive skills and habits ... Procedural memory involves the basal ganglia ... Some brain researchers (Grigsby & Hartlaub, 1994) theorise that what is considered a person's 'character', those things that people do routinely, automatically and unconsciously, may be mediated by procedural memory. What they suggest is that the repetition of any task, such as writing, throwing a ball, or even a way of interacting with others, can be supported by procedural memory systems once it becomes routinised and automatic, although at first it may involve conscious attention and the declarative, explicit memory systems. Calvin's (1996) work implies it is adaptive for the brain to shift memory in this way. Since prefrontal cortical space is somewhat limited, it should be reserved for processing novel situations or ones that continue to need close attention. Routinised situations can be 'turned over' to other brain systems. Emotional memory is the conditioned learning of emotional responses to a situation and is mediated by the amygdala ... [e ne parleremo più avanti, discutendo i modelli di LeDoux e di Damasio ed in una scheda specificamente dedicata all'emozione].

Some important clinical implications for psychoanalysis regarding current neuroscientific research on memory relate to the finding that explicit and implicit memory are processed differently and can become disconnected from one another. ...

In the very early years of normal childhood, explicit memory is impaired because of the immaturity of the hippocampus, whereas the basal ganglia and amygdala are well developed at birth ... This is part of the neuroscientific explanation for childhood amnesia. Theoretically there might be implicit memory for infant experiences, such as fears, somatic symptoms, or patterns of interaction derived from the mother-infant relationship, in the absence of explicit memory for this period.

The onset of verbal ability parallels the 'coming on line' of the hippocampus at 18 months. It is theorised that the narrative interactions between parents and children, when recounting the child's day at bedtime for example, enhance explicit memory processing for childhood events, by providing conscious attention to them ... it appears that excessively high levels of emotional arousal can actually impair memory. ... In human beings ... some patients with post-traumatic stress disorder (PTSD) have been noted to have decreased size of the hippocampus ... It is presumed that this is because of very high levels of circulating cortisol causing hippocampal cell damage. As a result of hippocampal damage, trauma victims may have a number of memory impairments. They may incompletely recall the trauma, but retain the physical and emotional feelings associated with it. Or the events may be explicitly remembered while the implicit memories for them are expressed in a way that is disconnected from the events. ... One theory about flashbacks is that they are memories of the traumatic events without the location and temporal signature of hippocampal processing that would place them as events having occurred in the past. ...

Therapeutically the verbalisation of traumatic symptoms, with the analyst's assistance in linking these up with past experiences of trauma, can facilitate explicit processing of trauma. This helps put the location and time signature on these events. ...

The dissociative defences used in trauma may also impair explicit memory for these events in a number of ways. ... Dissociation resulting from altered states of consciousness can somehow sever the link between memory systems, so that memory is not erased but becomes detached from a person's conscious awareness. Dissociation can also involve directing conscious attention to neutral aspects of the scene, to avoid the overwhelmingly painful aspects of the trauma. ...

Repression may involve explicit memory that is blocked from being retrieved by the inhibitory affect of other information stored in long-term memory ... Also, the right frontal lobe may act to prevent particularly painful or unpleasant memories from gaining access to the left hemisphere in an attempt to protect verbal information processing ...

However, since implicit memory is non-conceptual and non-linguistic it may be difficult to investigate it fully utilising the verbal free associative method. [Resterebbe da dire del fenomeno dei 'falsi ricordi', ma non lo faremo in questa sede ...].

Emotional Processing: The Mind-Body Connection

[Utilizzeremo questo articolo nella scheda dedicata all'emozione ...]

Bilaterality: Hemispheric Specialisation and Integration

The two cerebral hemispheres are identical in appearance. ...neuroscientists have realised that the brain is functionally asymmetrical ... During the 1960s the initial work of Sperry and Gazzaniga (Gazzaniga et al., 1962) at first seemed to corroborate the 'two minds, two consciousnesses' view held by some late nineteenth-century scientists. Subsequent work, however, resulted in the now generally accepted 'asymmetric but integrated' perspective. The right and left cerebral cortex are each lateralised for specialised functions, but in the healthy brain the two hemispheres share their information and operate collaboratively ... Research regarding lateralisation of specialised functions pertains mostly to cortical functions. However it must be remembered that specialised functions of each cortex are influenced by input from subcortical structures, as well as from other cortical sites in the same or opposite hemisphere. ... Neuroscientists assume that the reason language and fine motor movements are lateralised to the left cerebral cortex and emotion and musical ability to the right cerebral cortex, is because of a fundamental difference between the left and right cortices, with respect to information processing (...). The left is better at analysing rapid temporalsequential aspects of information. Therefore the left hemisphere more readily identifies 'details' and notices precise distinctions, rendering an advantage to the left in the specialised functions of language, causal relationships and fine motor movements. By contrast, the right is better at analysing the global, overall relationship aspects of information. Therefore the right more readily identifies context and gets the overall picture of the situation, giving an advantage to the right hemisphere in processing social interactions, emotional experience, and visual-spatial tasks. One metaphor often used is that the left is a digital 'computer' and the right an analog 'computer'. Another is that the left provides the 'text' and the right the 'context'. Hemispheric dominance is relative, not absolute. ... The left and right cerebral cortices share their specialised skills by communicating with one another across the corpus callosum. Therefore, in the healthy brain modular lateralised cortical functions are integrated. The emotional processing right side influences what the verbalising left side is aware of, and conversely left hemisphere linguistic input can influence right hemisphere emotional experience. ...

The right hemisphere is dominant for socio-emotional functioning, visual-spatial tasks, musical ability, somaesthetic sensation, contextual information and shifts of attention. ...

Right hemisphere superiority for emotion includes perception, expression and memory of social and emotional information. Right hemisphere dominance for emotion is related to its bilateral control over the autonomic nervous system and cortisol production, and its greater connectivity to limbic structures ... Dominance over social and emotional processing explains why the right hemisphere is specialised for face recognition and identification of emotional expressions of the face, as well as why the left half of the face is more expressive of emotion ... Related to its socio-emotional dominance, the right hemisphere is superior for non-verbal prosodic elements of speech, including rate, inflection, pitch, timbre and melody of vocal expression. Human vocal prosody probably evolved from animal vocalisations. It contributes emotion and intent to spoken language and is crucial to the 'meanings' of verbal exchange ... Specialisation for prosody, emotion and context explains why the right hemisphere is better at processing jokes, since this depends on nonverbal inflections, facial expression and the overall intent of what is being said.

Musical ability is localised on the right, perhaps because music involves relationships between sounds and like emotion, music is expressed in pitch, timbre and frequency. ...

The right hemisphere is superior for perception and analysis of visual space including depth, distance, direction, orientation and perspective. Therefore it is considered the 'artistic' side of the brain ... The right is better at detecting contextual information such as figure-ground relationships, and perceiving whole objects from incomplete sensory information, such as a cup partly obscured by a milk carton. The right is also better at finding the correct route, learning mazes, and determining the positional orientation of the body and body parts. Therefore the right hemisphere allows us to orient ourselves in space, find our way without getting lost, and in general 'see the wood for the trees'.

The right parietal lobe processes somaesthetic sensation. These sensations include light touch, pressure, temperature, pain, vibration, overall body position and position of individual joints. Sensory input from each side of the body, such as vision and hearing, is generally processed by the contralateral hemisphere. However, for somaesthetic sensation, parietal cortex on the right is sensitive to input from both sides of the body, though more so on the left. As a result the right hemisphere is intimately involved in representations of the body and body image.

Frontal lobe damage, particularly on the right, causes deficits in socio-emotional functioning. Such patients show inappropriate ... Damage which includes the right parietal lobe, can result in a strange clinical condition related to body representation, known as 'hemineglect' or 'anosognosia' ... Damage to the right hemisphere, which includes the occipital-temporal region, may lead to another bizarre clinical condition, 'prosopagnosia' ...

The left hemisphere processes information as discrete units in a linear sequential time frame. Since fine motor control requires precisely coordinated muscle contractions and language depends on linear sequencing, it is assumed that left hemisphere superiority for temporal sequencing is the basis for its dominance for handedness and linguistic functioning ...

In the majority of people the left hemisphere is dominant for fine motor control of fingers, hands and arms,

which is why most people are right handed. While the right hemisphere better locates an object in space and solves manipulo-spatial problems such as aiming, it is the left hemisphere that is responsible for accurate throwing. This is because the accuracy of the throw requires a series of linearly sequenced motor control reactions in the throwing arm, hand and fingers. The left hemisphere is also dominant for fine motor control over the articulatory 'speech' muscles of mouth, tongue and pharynx. From Calvin's (1993) evolutionary perspective, speech involves the precise and accurate 'throwing' of words. He theorises that linear sequencing of language is built on the same neural circuitry that is responsible for the accurate throwing needed to hunt game. Left hemisphere dominance for language exists in over 80 per cent of right-handers and 50 per cent of left-handers. Therefore for a majority of humans, the left hemisphere mediates linguistic functioning, including all aspects of receptive and expressive speech, reading, writing, spelling, and naming. It is also dominant for grammar, syntax, verbal concept formation, verbal memory, analytic reasoning. Most likely the left hemisphere is associated with those aspects of consciousness dependent on language. While the left hemisphere eventually dominates over linguistic functions, the development of language reveals the important role played by the right. The right hemisphere matures before the left (...). From birth to 3 months, vocal expression involves purely reflexive vocalisations under the influence of subcortical limbic and brainstem structures (...). By 3-4 months, the 'early babbling' stage, the orbito-frontal cortex, particularly on the right, begins to mature and gain control over the limbic system. In this way reflexive vocalisations are linked with specific emotional states and take on emotional meaning (...). The first words, such as 'no', are most probably due to right hemisphere activity. Although the left hemisphere does not significantly begin to mature until about 18 months, by 4 months there is evidence of increasing dendritic growth on the left (...). This corresponds to the 'late babbling' stage, when infants begin to respond to specific speech sounds and their phonemic characteristics. The left hemisphere places a temporal sequential 'stamp', on speech sounds and the accompanying prosodic expression of pitch, melody and contour. ... Three regions on the left are most often associated with language function (...). Wernicke's region is an auditory association area in the superior temporal lobe. The inferior parietal lobule (IPL) is a multimodal association area at the junction of the temporal, parietal and occipital lobes. Broca's area in the frontal lobe is involved in 'premotor' aspects of speech. These regions form a 'language axis' and are highly connected with one another, as well as with other brain regions. ... [Ometto in questa sede di occuparmi della neuropsicologia del linguaggio, di cui lo studente è verosimilmente già a conoscenza ...]

Much understanding of the bilateral nature of the brain derives from pioneering work by Gazzaniga and Sperry in the 1960s. They studied patients in whom the fibre tracts (corpus callosum and commissures) that connect the right and left cortices are surgically cut for the treatment of intractable epilepsy, leaving the two hemispheres essentially disconnected from one another ... What startled scientists most about these 'split brain' patients is that information presented to one half of the brain can lie completely outside the conscious awareness of the other half, and each hemisphere can behave independently of the other. ... Gazzaniga considers that the left brain acts as an 'interpreter' of information, capable of logical deductive reasoning and causal relationships. In fact it appears as if the left hemisphere continually and automatically assigns causal meanings to the stimuli it receives. ... The left hemisphere is constantly, almost reflexively, labelling experiences and giving causal explanations. ...

The prefrontal cortex performs the 'executive functions' of the brain—the ability to regulate emotion, anticipate and plan for the future, make rational decisions and shape behaviour towards attainment of motivational goals. Psychological development, in neuroscience terms, is maturation of the prefrontal cortex. Maturation is a measure of growth of circuits, synaptogenesis and myelination of neurons (...). The right hemisphere, including the prefrontal region, begins to mature earlier than the left. At approximately 18 months a shift occurs and the left hemisphere begins to mature. This coincides with the emergence of spoken language and the onset of myelination of the corpus callosum.

Of particular importance to psychoanalysis is the maturation, on the right, of the orbito-frontal region of the prefrontal cortex during the first year and a half of life. This is because the orbito-frontal region is the seat of emotional self regulation. Schore (1994, 1997), as a result of his analysis of research data from a vast number of neuroscientists, has formulated a very detailed theory of how orbito-frontal maturation occurs in stages and is dependent on emotion-laden interactions between the infant and its caretakers. He proposes that ultimately the orbito-frontal cortex subserves the self-regulation of affect states.

Prior to 3 months of age, emotion is mediated by subcortical limbic structures such as the amygdala. According to Schore's account, starting about 3 months of age the onset of orbito-frontal cortex maturation is heralded by the emergence of smiling exchanges between mother and infant. These affect-laden interactions stimulate myelination of neural circuits that connect visual cortex with orbito-frontal cortex.

At about 6 to 9 months, the multimodal (including vocalisation, body movement, smiling, and eye contact) high intensity positive affect exchanges that occur between mother and infant, specifically stimulate growth of dopaminergic circuits. Dopaminergic circuits subserve the infant's ability to sustain the high levels of sympathetic nervous system arousal that can be considered as the neural basis of emotional excitement and joy. At approximately 10-12 months, growth of the dopaminergic circuits ushers in a period of high positive affect. During this phase parents begin to inhibit their child's behaviour and say 'no'. This inhibitory input stimulates growth of noradrenergic circuits. These noradrenergic circuits regulate parasympathetic nervous system activity to decrease arousal and excitement and can be considered as the neural substrate of the emotion of shame (...). Activity of dopaminergic and noradrenergic circuits is initially dependent on the caretaker as external regulator. When mature, these circuits serve as the infant's internal self-regulatory system. Growth of these circuits link the right orbito-frontal cortex with subcortical limbic circuits, which is why the right orbito-frontal cortex retains dominance over emotional nonverbal processes for the life of the individual.

At about 18 months, maturation switches from right hemisphere to left. At the same time, within the prefrontal

cortex, maturation shifts from orbito-frontal to dorsolateral prefrontal cortex. Maturing circuits now link dorsolateral prefrontal cortex with non-limbic regions of the brain such as the inferior parietal lobule (...). Dorsolateral development, more on the left than right, corresponds with the onset of language and increasing nonemotional executive functions, such as the ability to hold in mind sensory information during periods of distraction. While the orbito-frontal region, particularly on the right, is linked with expression and regulation of emotion, the dorsolateral region, particularly on the left, is linked with abstract thinking skills.

An important clinical implication follows from the neuroscience perspective that comprehension of the world around us depends on the integrated function of both hemispheres. The right hemisphere 'knows' through grasping the emotion, intent and background context of what is expressed, and can do so outside of conscious awareness. The left contributes linguistic and causal understanding, both of which occur consciously. What this implies for psychoanalysis is that treatment needs to include attention to the (often unconscious) non-verbal emotional cues communicated between patient and analyst, as well as the verbal content of the session. Not only are both equally important but, as the scientific data suggests, words and feelings mutually interact to enhance the processing of each. Access to emotion enhances the ability to arrive at linguistic meanings of experience, and putting feelings into words enhances affect regulation.

The work of Dawson & Fischer helps explain two commonly observed clinical phenomena.

A patient's ability to put feelings into words (a left hemisphere strategy), often aids in diminishing the intensity of painful affects. When a patient switches attention to a new subject matter (a right hemisphere strategy), he may be attempting to decrease painful affects.

One of the more intriguing scientific findings to theorise about as to clinical relevance, is the lateralised left hemisphere 'interpreter' function. The left hemisphere continually arrives at interpretive meanings and causes for the information it receives, whether it be the external sensory data of environmental stimuli or internal sensory data of emotion and body sensation. Both patient and analyst continually and automatically generate theories and explanations for feelings, behaviours and the contents of verbal interaction. Rationalising defences are perhaps a left hemisphere function. The humbling factor is that the left hemisphere takes the data available and draws inferences and causal explanations that feel accurate, but may not be. This is why we as analysts, even when we feel we are 'right' about a patient, need to remain open to the fact that our conclusions may be faulty. Perhaps paradoxically, the 'interpreter' function suggests that 'reconstructions' or 'co-constructions of narrative' may be useful in containing a patient's affect even if they do not have exact historical truth.

The functional disconnection that occurs between right and left hemisphere has been used to explain a number of clinically relevant issues. The findings of the Wada test suggest that when information is sequestered in the right hemisphere and not available to the talking left hemisphere, an individual is not only unable to speak about the information but may also be unconscious of the information. As mentioned earlier, Joseph (1996) uses these findings to support the concept of 'repressed memory', with the memory of the trauma sequestered in the right hemisphere. Henry (1993) believes that a deficit in interhemispheric transfer results from impairments in the corticosteroid and catecholamine hormonal systems during stress. This leads to the failure to sufficiently process right hemisphere distress affects in left hemisphere linguistic terms. As a consequence the patient may develop alexithymia, the inability to put feelings into words. Levin (1997) theorises that certain defences result from functional disconnections between the right and left hemisphere. A disconnection from right to left leads to repression, in which emotion-laden experiences cannot be adequately verbalised. A functional disconnection from left to right leads to disavowal. Patients can speak about emotional events but deny their emotional significance. Levin (1997) and Modell (1997) believe that the use of metaphor can enhance the integrated function of the right and left hemisphere. By containing within them sensory, imagistic, emotional and verbal elements, metaphors are believed to activate multiple brain centres simultaneously. A failure to integrate right and left hemisphere might also underlie the common clinical phenomena in which a patient intellectually 'knows' they must be having certain feelings, such as sadness or anger over a loss, but cannot consciously access any 'felt' experience of emotion. From a developmental perspective, although the right hemisphere develops prior to the left it is assumed most right sided information gets re-encoded by the later maturing left. It is postulated however that some does not. Thus some very early affective experiences may remain inchoate and impossible to be verbalised.

The neuroscience emphasis on integration of brain function suggests that theoretical debates over what is more 'fundamental' to the analytic process are essentially dead ends. Affect attunement, causal interpretation, understanding of meanings, even perhaps subjectivity and objectivity may all be required, in order to understand the patient's unconscious longings, conflicts and beliefs and to modify the patient's defences.

Consciousness: a Neuroscience Perspective

While initially 'the binding problem' was identified in relation to perception, it now has expanded to other brain functions such as memory, consciousness and representation in general. As well described by Crick (1994), 'the binding problem' refers to the fact that modular brain areas are specialised for processing different aspects of sensory experience, such as colour, shape and spatial location, yet the brain is able to integrate signals that are separated in space and time into a whole unified experience. In object recognition, the separate modalities of touch, sight and sound are integrated into whole objects. In conversation, separate phonemes are integrated into words and into sentences and into whole conversations. In binocular vision, the two separate images from each eye are integrated into a single visual image. Thus when we see a blue ball moving diagonally down a ramp, although the brain processes each feature in a separate modular brain region, we nevertheless 'see' the whole event, not the blue colour separate from the spherical shape, separate from the diagonal line of motion. For philosophers, and neuroscientists alike, 'the binding problem' is a central dilemma that must be explained by

any neuroscience theory of consciousness.

There is a growing consensus that whatever consciousness is, it is not a unitary thing, but is a class of phenomena that includes several different states, all having in common the general property of being aware (...). Philosophers and neuroscientists emphasise that understanding 'subjectivity', the experience of being conscious, is the 'hard' problem in contrast to the 'easy' problem of describing the neurophysiology and neuroanatomy of consciousness (Chalmers ...). Although it is very difficult for neuroscientists to agree on an exact definition, most use consciousness in the ordinary sense of the word, meaning awareness (...). Consciousness is a psychological or mental phenomenon in which we are aware of perception, of memory, of thought, of action, of self, and of the very process of being conscious. Consciousness is not an 'all or nothing' phenomenon (...). There are varying degrees of consciousness; unconsciousness gradates into consciousness; and unconscious mental contents can have an effect on consciousness. Whether a stimulus becomes conscious depends, in part, on the degree of sensory analysis and on one's exact definition of unconscious versus conscious. Using a strict definition, Hirst argues that 'unconscious' applies when stimuli are processed only to a 'shallow' degree or 'low-level'. 'Low-level' analysis includes only the physical attributes of stimuli and most probably involves the primary sensory cortices. These representations are so impoverished they cannot support conscious recognition, but can still influence other mental events. Examples of 'low-level' analysis are the shape of the letters of the word 'bottle', the circles and contours of a face and the spatial location of an object. Hirst proposes that 'primed' memory, implicit learning tasks, and 'subliminally' presented stimuli involve only 'low-level' sensory processing and therefore remain fully unconscious in the 'strict sense' (...). These findings are consistent with the work of Shevrin, who proposes that stimuli that involve a paucity of exposure (e.g. 'subliminal' stimuli), although not consciously registered, may in fact 'prime' later thoughts and images that emerge in the clinical situation (Shevrin et al., 1996). In a less strict definition of unconscious, the 'iffy' 'twilight' area where there is some, albeit very vague, degree of awareness, a more complex or 'deep level' of analysis is involved, most probably involving association cortices. Analysis is considered 'deep' once it involves some degree of identification of objects and their meaning. ... Unlike psychoanalytic theory, neuroscientific paradigms of the unconscious involve 'lower-level' representations that do not involve symbolic meanings. Also that which appears to operate unconsciously might rather be considered a dissociated state of consciousness. Some neuroscientists consider that desynchronised EEG activity correlates with conscious states (Edelman, 1989; Hobson, 1994; Llinas & Churchland, 1996). From this perspective, since both waking and REM sleep involve dysynchronised EEG activity, waking and dreaming are considered to be alternate states of consciousness, that differ only in the origin of their sensori-motor inputs.

Consciousness is often discussed in relation to the 'a' words, awake, alert, aroused, attentive, aware, self-aware, all of which depend on activation of circuits ascending from the brainstem to the cortex. Because of their wide anatomical distribution and neurochemistry, brainstem systems are able to provide the global activation of the brain necessary for consciousness to occur. The reticular activating system drives arousal. It 'announces' to the brain regions higher up, 'stimulus coming! get ready!' The locus coeruleus, the major source of brain norepinephrine, contributes to alertness and attention. Activity in the locus coeruleus 'turns on' in the morning to wake us up from sleep. Activation of the pontine circuits is necessary for the 'consciousness' of dream sleep. Attention is necessary for something to reach conscious awareness. Attention implies focus on something, whether an object, sensation, thought or image. While we can pay attention to, and be conscious of more than one thing at a time, there are limits. Consciousness cannot hold on to many things at a time. The ability to attend to more than one piece of sensory information depends on how hard it is to keep the two pieces of information segregated. It is easier to hold in consciousness one auditory and one visual message than either two auditory or two visual ones. It is easier to hold in consciousness a list of animal terms and a list of vegetable terms than two lists of either animal terms or vegetable terms.

For events to be consciously perceived, they must be significant to the 'self'. The 'self system' is as essential to consciousness as an intact perceptual system is to perception. One way to conceptualise consciousness is as the interaction of the 'self system' and 'non-self system' (i.e. external world). ... [Ritroveremo argomentazioni specifiche in questo senso studiando il modello di Antonio Damasio].

A distinction is often made between the content of consciousness and the process that produces it. We are conscious of objects, ideas, meanings, decisions and actions—but not of the brain processes themselves that produce consciousness. There is a tendency, perhaps unfortunate, to conceptualise 'process' and 'content' as a kind of 'container' and 'contained' model. Clearly this distinction is problematic since it is hard to imagine that there could be a container that did not contain anything, or a conscious content with no process. However, Lakoff & Johnson (1980) contend that although 'container models' may be conceptually flawed, we are nevertheless somewhat constrained into using them. This is because, as they argue, language and thought derive from bodily experience. For example, we conceptualise feelings as derived from within the body, such as 'the love in my heart'. A strong advocate of the container model, Baars (1996) conceptualises a 'global workspace' in which processes such as attention and short-term memory contain the mental contents of which we are conscious at that moment. ...

A number of neurological syndromes initially led neuroscientists to the conclusion that some localised region was the 'seat' of consciousness. ... However, most neuroscientists today believe that there is no anatomical locus of consciousness, no 'Cartesian Theatre' where 'it all comes together', nor any specialised consciousness centre. Consciousness is not a localised process, but involves the integration of widely distributed modular brain regions. Except for a few types of brain damage, such as to intralaminar nuclei of the thalamus and perhaps to the brainstem, there are few brain lesions that produce a global loss of consciousness (Llinas & Churchland, 1996).

Even removal of an entire hemisphere in cases of tumour leaves the patient fully conscious. ...

In our subjective sense, consciousness appears to be the initiator of behaviour, the decision maker, the centre of will. The work of Libet et al. (1983) suggests otherwise, by revealing that conscious awareness occurs after the fact. Subjectively we experience that first we decide what we want to do and then we act on it. However, in fact the conscious mind is the 'last to know'. For example, the reflex withdrawal from stepping on a tack is followed by consciousness of the act. But Libet's work also demonstrates that even with a voluntary decision to act, an electrical readiness potential in pre-motor areas is detected almost half a second before conscious awareness of the decision. Computations and cogitations leading to the decision to act are initiated first; then later some of them enter the narrow stream of consciousness. Although Libet's experiments demonstrate that subjects are consciously aware of their decision to act shortly after their 'brain' has made the decision, the conscious awareness is registered so quickly that our subjective experience is that we consciously made the choice.

Some argue that life's tasks could all be done without consciousness, that consciousness is only an 'epi-phenomenon' that 'just happens to accompany' thought and action, and serves no evolutionary adaptation (Gray, 1995; Chalmers, 1996). However, most neuroscientists believe that consciousness evolved as a means by which we can adaptively tailor our responses (Edelman, 1989; Tononi et al., 1992). ... The need to tailor one's behaviour in ways that are not pre-wired reflexes requires self-monitoring of one's own behaviour as quickly as possible. The quickest we become conscious of something is about .5 seconds after the fact—'almost but not quite' instant self-monitoring. Such selective choice and behavioural inhibition most probably involve circuits in the pre-frontal cortex ... consciousness of a decision, although 'after the fact' of decision making, is adaptive because it occurs 'before the fact' of actual action. Without consciousness, you would have to wait ... until you saw what action you took ... to know what action you had decided to make. ... In self-reflective consciousness, the ability to reflect on mental processes including primary consciousness, human beings maintain a kind of 'virtual reality' in which we can make speculations and plans that anticipate changes in the environment. This helps us deal with very rapid and complex changes of human environments. ...

It is becoming more apparent that the 'self' and consciousness arise from a dyadic, interpersonal milieu. The infant has many inborn potentials, but they flower only in intense and frequent interactions with the mother and other caretakers. The epigenetic development of mental and physical capacities require time and synchrony with body growth, CNS growth and the attunement of the mother. By implication, conscious awareness of perceptual events, emotional events, social events and aspects of one's own inner life develop over time within a socio-emotional context. Some current developmental theories suggest that the 'sense of self' emerges out of the internalisation of the dyadic relationship with the mother, and that the development of 'self' consciousness emerges as the infant takes the 'self in the dyad' as an object in its inner world. ...

For every evolutionary advance there is a price. The symbolic thinking embedded in self-reflective consciousness affords an almost infinite flexibility in the ways human beings can conceptualise the events of their life. The price is indecision. Too many possibilities as to how to interpret events leads to confusion over what behavioural response to choose. According to a theory of Ramachandran (Ramachandran et al., 1996), coherent belief systems evolved to narrow the number of choices in order to provide consistency and coherency in determining what to think and how to behave. Ramachandran uses the condition known as anosognosia to support his theory. ... He argues ... that anosognosia results from the different role played by the right and left hemisphere with respect to belief systems. The left hemisphere is the interpreter, and is primarily concerned with taking all the bewildering sensory inputs and making sense of them by ordering them into a coherent belief system. By limiting the number of ways to interpret events, the brain is not overwhelmed by all the possible explanations that could be arrived at. This protects the brain from being paralysed by indecision as to how to act. The left hemisphere's goal is to maintain its belief system at all costs. When information inconsistent with the belief system occurs, rather than revise the belief system, the left hemisphere either denies the inconsistent information, or 'confabulates' to make it consistent. Thus we analyse the data in our sensory environment in terms of the belief systems we have constructed. The strategy of the right hemisphere is fundamentally different. The right hemisphere functions as an anomaly detector. When inconsistent information reaches a sufficient threshold, the right hemisphere 'decides' it is time to revise the belief system. ... Gazzaniga (1998), who originated the concept of the left-hemisphere interpreter function, supports Ramachandran's theory of a differential cognitive role for right and left hemisphere that can lead to incorrect perceptions. ... Although the theories of Ramachandran (the right-hemisphere anomaly detector) and Gazzaniga (the left-hemisphere interpreter) are speculative, they suggest a number of clinically relevant points. Our conscious belief systems influence what we consciously perceive. The result is that conscious perceptions may not accurately reflect what occurs 'out there' in our environment. Additionally it implies that not only do people resist knowledge of unconscious mental contents, they resist knowledge of conscious material as well, if it does not fit with their consciously held interpretations of reality. What may occur during the interpretation of transference is the engagement of the anomaly detector in the right hemisphere, alerting the individual to the need to revise their neurotic belief system.

In conclusion, primary consciousness and self-reflective consciousness evolved to enhance survival. Presumably primitive organisms do not have consciousness. They respond with 'hard-wired' inborn reflexive behaviour. Even in human beings, that which we do automatically, such as riding a bike or tying shoelaces, does not require conscious monitoring. Also, when no salient or meaningful change occurs in the environment, we do not attend consciously, as in the case of driving and not consciously paying attention. What consciousness provides is a means by which we notice changes and can flexibly choose the most adaptive response to that change. Consciousness provides a feedback system for the individual to monitor rapidly not only changes in the

environment, but also their own minute-to-minute responses to those changes. We attend to and may be conscious of the most salient changes that occur.

In self-reflective consciousness, the self is taken as an object. Once the self can become an object of perception and interpersonal interactions can become internalised, one can reflect on one's own patterns of behaviour, and one can represent them symbolically. A representation of any sort is more malleable than that which it represents. At the level of human self-reflective consciousness we have 'representations of representations' that can be manipulated independently of 'concrete reality'. As a result of the flexibility inherent in consciousness we are open, on one hand, to forgetting and distortions, but on the other to the possibility of learning, growth and therapeutic change.

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