In: *Body, Mind and Healing after Jung: A space of questions* (Raya Jones, ed.), London: Routledge, 2011.

Chapter 3

The embodied psyche

Movement, sensation, affect

Dyane N. Sherwood

Prelude

The opera *A Flowering Tree*, composed by John Adams with a libretto by John Adams and Peter Sellars, premiered in 2006 at the Vienna Festival celebration of the 250-year anniversary of Mozart's *The Magic Flute*. The libretto – based on a South Indian women's oral tale in the Kannada language (Ramanujan 1997; Narayan 2008) – tells the tale of Kamudha, a poor but lovely and graceful young woman, who marries a prince. Unlike the European Cinderella tale, most of the trouble begins after the marriage. A handsome young prince becomes fascinated by the beautiful Kamudha, who daily brings exquisitely fragrant blossoms to sell at the gates of his palace. He follows her home and spies upon her, witnessing her gift of being able to transform into a tree covered with the fragrant blossoms. With the assistance of her sister, she then turns back into her human form. He determines to marry her, and, used to getting his own way, he eventually prevails despite his mother's reservations. The happiness of the newlyweds is joyous, and Kamudha, who grew up deferring to royalty, obeys her husband and turns into the tree whenever he wishes. This honeymoon is disrupted, however, after Kamudha naively agrees to perform her transformation for the amusement of the girls at court. The girls gather fragrant blossoms and in their excitement run off without carefully attending to the ritual required for Kamudha to complete her transformation back into human form. The princess is as an unrecognizable monstrosity, part-tree and part-human, unable to move or speak. She is cast into the gutter, and no one can locate the princess. Both the prince and the princess endure years of separation, suffering, and *inner* transformation. The princess survives through the compassion of other misfits, who wander from place to place. The prince wanders in a frenzied grief, becoming unrecognizable through his self-neglect. Outside a distant palace, Kamudha is fed by a kind-hearted servant, who recognizes her inner beauty and brings her to live in the servant quarters. The prince, also at this palace, visiting his married sister, recognizes her and restores her to her fully human form. She and the prince are joyfully reunited, aware of the sacredness of her gift and of their union.

This tale of transformation and suffering was intensified in Peter Sellars' visionary production by the inclusion of three extraordinary Javanese dancers. Their subtle body movements and gestures *implicitly* conveyed complex, body-based emotions, which were simultaneously expressed through music, voice, narrative, and the vibrant forms and hues of the design. Sellars had recognized that human opera goers, like all primates, are exquisitely sensitive to affective, non-verbal communications.

Preliminary reflections

As primates, our very survival depends upon being able to express and to interpret movements appropriately. Parr *et al.* (2005) have postulated that the evolution of the human brain was interwoven with the need for group cooperation and communication:

> The evolution of greater flexibility in emotional communications ... might have played an important role in socially derived emotions, such as guilt, shame, pride, and embarrassment. The emotions ... require some degree of social awareness, such as a theory of mind [the ability to attribute mental states to others and to reflect upon one's own mental states] that enables an understanding of how one's actions are perceived by others.
>
> (Parr *et al.* 2005: 176)

Communication through movement and facial expressions is also crucial for pair-bonding (Dunbar and Schultz 2007) and the cooperative rearing of young (Hrdy 2009). The evolution of language (*explicit communication*) did not replace already evolved forms of perceiving and communicating through gesture, facial expression, and voice tone (*implicit communication*). Rather, communication through language became integrated with non-verbal communications to form yet more complex, multifaceted interactions (cf. Fogassi and Ferrari 2007).

Jung's early interest in the body-based affective experience can be seen in his word association experiments (1904–9) and in his 'Psychophysical Researches' (1907–8), which employed a variety of physiological measures of affectively related responses, such as galvanic skin response. Together these two series of experiments take up the entire Volume 2 of his *Collected Works*. By the time of his 1932 lectures on Kundalini yoga (Jung 1996), he was interested in *the imagery that emerges from body experience*. He spent his mature years in the study of alchemical texts and imagery, which is fundamentally an exploration of embodied transformation (for a summary discussion, see Henderson and Sherwood 2003: 1–33). This can be seen in the illustrations from the *Rosarium philosophorum*, which Jung used as a basis for a discussion of transference. Indeed, 'The Psychology of the Transference'

(Jung 1946) can be taken as his assertion that the body-unconscious, implicit communication, and projective identification are central to human experience and psychoanalysis. Although the terminology was not yet in use, these concepts were elucidated in this work. Implicit, body-based communications, by their very nature, cannot easily be named – yet words are the medium of intellectual discourse. Jung's focus on unconscious communication and his use of alchemical imagery was one factor that made his work unappealing for academics. Scholars could not easily grasp his image-oriented mind, and it was not easy for them to glean intellectually based interpretations that could be applied to their own disciplines.

The emerging field of 'embodied cognition' is a welcome development (see further discussion below), but even within psychology, the contemporary Zeitgeist in the United States remains dominated by cognitive-behavioural approaches and relies on explicit communication. In psychotherapy, so-called 'evidence-based' treatment is becoming a standard in the United States, where psychologists may be at risk of malpractice unless they use an experimentally validated protocol to treat a particular diagnosis (Kazdin 2008). Research questions are limited to defined protocols that can be replicated by different experimenters across many individuals. This approach implicitly denies the significance of therapy as an art and the psychological uniqueness of individuals. Ironically, many who come for analysis are suffering from the depersonalization that so called 'scientific' and 'rational' cultural attitudes create.

It is therefore no surprise that some of our most talented psychotherapists do not write clinical papers. They cannot *explain* what they do. Rather, they deepen as human beings, and hence as clinicians, through continuing analytic work and consultation, as well as self-exploration or creative expression, such as painting, writing poetry or fiction, or dance. Many participate in an experience-based spiritual practice and explore the paradoxes of spirit and matter, mind and body, being and non-being. Many of these practices entail a refined awareness of body-sensation and of inclinations to move or to remain still.

Jung's emphasis on unconscious, affective communication is receiving support from studies of implicit communication (for a discussion, see Sherwood 2006). Non-invasive neuroimaging techniques, such as the fMRI (functional Magnetic Resonance Imaging), have helped to validate the importance of unconscious (implicit) communication and body experience to our emotional and cultural lives. *While keeping in mind that the psyche has its own reality*, contemporary research in neurobiology has become more relevant to a theory of mind (Gallagher 2005) and to clinical practice (Cosolino 2002; Schore 2003a, 2003b; Corrigall *et al.* 2006; Wilkinson 2006). Developmental research has been linked to neurobiology in a number of books (Siegel 2001; Schore 2003a, 2003b; Cosolino 2006; Goswami 2008). Moreover, cognitive approaches informed by evolutionary theory are refining the questions studied by neurobiologists, for example in devising ways of looking at semantic and context-specific influences on mirror neurons (see below).

Indeed, the centrality of the body as a source of emerging psychological awareness is the single greatest challenge to the traditional frame of the talking cure, as well as to the formal analysis of the arts and literature. The fascinating but still nascent research in primate neurobiology, using neuroimaging, complemented by electrophysiological recording from single cells, allows us glimpses into ways our psyches are formed and informed by *embodied imagery*. This imagery is re-evoked through therapeutic approaches Jung called 'active imagination' (Chodorow 1997), which is a subject of renewed interest.[1]

In the future, perhaps it will be possible to use neuroimaging to study the ways that psychophysiological state changes affect our *access* to narrative memory, the embodied imagination, and symbol formation. Moreover, we may develop a more refined appreciation of changes in psychophysiological states that occur when we see our movements and expressions mirrored back to us in the therapeutic setting – as they take form in a sand tray or painting, in the movement of another, or by recognition and empathic understanding. Those who work therapeutically have seen symbolic forms emerge during authentic movement, as shapes in time and space, and through unintended forms created in a sand tray or on a canvas. We know very little about the way body-based, unconscious imagery produces these symbolic forms, which are often relevant and meaningful. This dimension may be missed if the literary scholar, art critic, or analyst focuses primarily on theory, on the known developmental narrative, or the psychodynamics of the family drama. An argument against the typical modern, theory-based interpretive approach has been made by James Elkins, of the Chicago Art Institute. His book, *What Painting Is* (1999), presents a compelling critique of the interpretive methods of art critics: he likens the process of painting to an alchemical process rather than the artist's attempt to express an abstract idea.

The biology of embodied imagery

In order to develop the capacity to perceive accurately and to integrate cross-modal functioning, we must be able to move (Legrand *et al.* 2007). Held and Hein (1963) pioneered this area of inquiry with their study showing that kittens who were allowed to see their environment while remaining passive (in a sling) performed very poorly on tasks that involved guiding their paws using visual cues. Without movement, an accurate inner map of three-dimensional space could not develop. The importance of the body for perception, cognition, and problem solving is changing the nature of cognitive psychology research (Damasio 2000; Anderson 2003, 2008; Noë 2004; Thomas and Lleras 2007). For example, in his review of the field of embodied cognition, Anderson (2003) states in his abstract:

> The nature of cognition is being re-considered. Instead of emphasizing formal operations on abstract symbols, the new approach foregrounds the fact that cognition is, rather, a *situated activity*, and suggests that thinking beings ought therefore to be considered first and foremost as acting beings.
>
> (Anderson 2003: 91)

Research that focuses on interactions has posed an equally important question: how are we affected when we watch another person move? The answer is complex and multilayered. Some responses are conscious, others completely unconscious. We are especially sensitive to facial expression (Dimberg *et al.* 2000). Paul Ekman (e.g. 1998) has spent his career corroborating and extending Darwin's seminal research on universal human facial expressions. The human nervous system reacts quickly, within a few hundred milliseconds, to facial expression, *before* the *image* of the movement reaches the visual cortex and prior to any consciousness of the observation (Dimberg *et al.* 2000). Ekman and his colleagues have studied micro-expressions, fleeting facial expressions that are quickly overridden by conscious intent, and he has even developed training videotapes to help one recognize micro-expressions as indications of the person's unconscious affective response (Ekman and Rosenberg 1997).

Developmental research, using observation and the analysis of slow-motion film, demonstrates that the quality of an infant's affective life depends upon the infant emitting signals that evoke caregiving responses and the ability of caregivers to read the infant's and toddler's communications. This early emotive movement patterning has lasting effects. Affective experience during the first years of life, during the rapid development of the brain's emotional and self-regulatory systems, plays a crucial role in the development of all parts of the nervous system: central and peripheral, voluntary and autonomic, and neuro-endocrine (Bowlby 1969; Fonagy *et al.* 2001; Schore 1994, 2003a). It has been known for half a century that the growth of the body can be affected by maternal deprivation (Bowlby 1969; Schore 2005).

Research emphasizing the importance of early affective experiences and self-regulation (Bowlby 1969; Fraiberg 1969; Stern 1985, 2004; Schore 1994; Fonagy *et al.* 2001; Golden *et al.* 2008) gives support to Jung's emphasis on self-regulation:

> The unconscious processes that compensate the conscious ego contain all those elements that are necessary for the self-regulation of the psyche as a whole. On the personal level, these are the not consciously recognized personal motives which appear in dreams, or the meanings of daily situations which we have overlooked, or conclusions we have failed to draw, or affects we have not permitted, or criticism we have spared ourselves. But the more we become conscious of ourselves through self-knowledge,

> and act accordingly, the more the layer of the personal unconscious will be diminished. In this way there arises a consciousness which is no longer imprisoned in the petty, oversensitive, personal world of the ego, but participates freely in the wider world of objective interests . . . At this stage it is fundamentally a question of collective problems, which have activated the collective unconscious because they require collective rather than personal compensation.
>
> (Jung 1928: par. 275)

(Regarding the personal unconscious, I would say *influence* rather than 'layer'.) Most notably, the psychoanalyst Allan Schore has published three volumes on affect regulation (1994, 2003, 2005), which integrate developmental research with contemporary neurobiology. He emphasizes the hemispheric specialization of the right brain for affective processing and regulation, with the left brain specializing in language, as well as cognition and sequencing skills, which develop rapidly during latency. Schore has helped to redirect psychoanalysis and to question some of its most accepted practices, such as the use of the couch.

Future work will need to take into account the ways in which emotion and cognition develop simultaneously and are integrated through the vast number of inter-hemispheric connections, including the *corpus callosum* and the *anterior* and *posterior commissures*. Additional refinements will be possible when brain-imaging techniques can more accurately reflect activity (and not general metabolism or blood flow) and when connections between brain regions can be more accurately discerned in spatial terms and on a finer timeline. Nevertheless, it is worthwhile considering what appears to be known up to the present time.

Implicit and explicit experiences are encoded in memory through different pathways, which become functional at different times during development (for a summary, see Schore 2003a). Implicit memories of aversive experiences are encoded in the evolutionarily older amygdala, which is functional at birth, ready to defend the fragile newborn from noxious stimuli. The infant's experiences of fear and pain are not directly available to later conscious recall, yet they form imprints, which will pattern later ways of feeling and responding. Even as adults, situations perceived as dangerous may require rapid action, too rapid to permit conscious perception and reflection. As we mature and forebrain regions grow in size and connections, the automatic responses of the amygdala may be modulated by signals sent from the forebrain, allowing us to take more time before reacting or, conversely, we may consciously assess a situation as a dangerous one and prime ourselves to react. Such rapid reactions to a visual stimulus, mediated by midbrain visual centres such as the superior colliculus, can occur before we are conscious of seeing the object, for example when a soldier in a confrontation shoots a suspected enemy, mistaking a cell phone for a gun. Explicit memory, the images and words that help to create sequential narratives of events, require encoding by the hippocampus, a much more orderly and less reactive system than the amygdala. The later maturation of hippocampal memory mechanisms may explain why early, highly charged affective experiences, including traumata, are not encoded in explicit memory but nevertheless affect an individual's body experience, emotional organization, and self-regulation. These systems operate in parallel but are also integrated in a healthy, mature nervous system via intra- and inter-hemispheric connections, and via feed-forward and feedback neuronal pathways. Active imagination, which always involves movement, real or imagined, facilitates the expression and potential integration of disrupted and unformed connections between these two memory systems.

Early patterns of movement help provide templates for our lifelong patterns of movement in time and in space. Our bodies 'remember' an aversive or traumatic experience through psychosomatic symptoms or 'forget' the experience by blocking or anaesthetizing the conscious experience of our bodies. The memories are not available to conscious narrative, but remain as neural connections in many areas of our brains, in our endocrine glands, autonomic nervous system, skeletal musculature, and in the functioning of the organs of our body. These early patterns influence breath, heart rate, blood pressure, postural muscles, and the experience of skin and touch. They live in posture, gestures, and our sense of ourselves in space and time, our aliveness, our pain. They live in dissociation and dysaethesias (as opposed to synaesthesia). In her book *The Embodied Self*, movement therapist Katya Bloom (2006) beautifully describes her Tavistock-model observations of infants, toddlers, and their carers from a movement perspective. The Israeli therapist Yona Shahar-Levy (2001) takes a slightly different approach, which she calls 'Emotive Movement Systems', which combine dance therapy and psychoanalytic views to address unconsciously stored affective memory systems. She posits that movement may be the only way to access these systems, which may emerge as memories of experience, though not necessarily narrative in nature. Both of these authors develop elaborate methods for quantifying observations of movement. The schemata may be helpful for research, in addition to developing one's powers of observation, if studied in depth.

Embodied memories are enacted in life and in the consulting room. The psychoanalyst Lichtenberg (2001) refers to gaps in the patient's narrative, which we might postulate as deriving from a pathologically embodied template. Those who work with very young children have seen the stories of intense emotional experience, which cannot be verbalized, told through movement. Other children sadly have such disrupted play that no stories can be told, even through movement. Within the analytic process, the patient may be able to express some memories as symbolic (not literal) images through active imagination or creative expression. We also see different qualities, rhythms, pacing, of movement in dreams, not just movement as part of a narrative.

My own clinical observation is that early patterns of action and reaction – which are stored in subcortical brain regions, the autonomic nervous system, and in the organs, muscles and skin – are not only maintained but also actively sought out, perpetuating a familiar but pathological 'homeostasis'. Thus, a person who grew up in a chaotic or overstimulating environment will unconsciously attempt to recreate that environmental quality even though the actual milieu may appear to be quite different.

Movement, observation and empathy

Simple experiments recording the subthreshold electrical activity of skeletal muscle fibres can monitor subliminal, unconscious responses. Using this technique, it has been shown that when we watch someone move, our own muscles respond in a way that mirrors the other person's movement. We might think of this as a kind of priming of our own movement patterns, or as a subliminal felt-response. As early as 1903, Lipps (1903–6) suggested we involuntarily imitate others' facial expressions to understand their feelings. Electromyogram (EMG) studies in the 1980s showed that observing emotional facial expressions results in increased activity in the same facial muscles, occurring as early as 300 milliseconds, long before conscious awareness (Dimberg *et al.* 2000). From these experiments, we might conclude that our muscles make an immediate, subliminal felt-image of the movement that we observe. But it is not that simple.

First, experience and training modulate mirroring. Studies by Daniel Glaser and his colleagues have shown that when a dancer watches a film of another dancer, the response in the corresponding muscle fibres is stronger than when an untrained person watches the dance (Glaser *et al.* 2003). It is also stronger when a ballet dancer watches a film of another ballet dancer as compared to a dancer from a different tradition – though the ballet dancer will still respond more strongly than a person without any dance training. In a way this is common sense, but note that this does not refer to the ability of the dancer to describe verbally or form a visual image of the dance film but rather to the response of the dancer's muscle fibres, a response that takes place before the dancer is aware of seeing the movement and long before cognitive analysis and reflection upon how the movement is made. Recordings of the electrical activity in muscles (EMGs) show that experience can change one's response to the observed behaviour of others, even without making a conscious decision or being aware of the change. For example, in a simple experiment, a person watched another person move a finger but was asked to move a different finger while watching. Then the person again watched the other person move the same finger, but the observer's EMG in the finger that he previously moved himself was larger than in the finger that he watched being moved (Catmur *et al.* 2007).

Second, context modulates mirroring. If we are able to become conscious of another's movement, we can place it within the current context and compare it with our history with this person, which may include images and the imagined meaning of the movement; we may name it, and also consider our voluntary response, if any (Niedenthal *et al.* 2005; Leiberg and Anders 2006).

Third, the discovery of mirror neurons should be considered.

Mirror neurons: 'Monkey see, monkey do'

The term 'mirror neurons' is applied to cells involved in the imitation of observed movement, which were originally identified in the associative premotor cortex (F5) of two Macaque monkeys (Gallese *et al.* 1996). In one monkey, the neurons were studied in both hemispheres and in the other, in the left hemisphere only. The monkeys were trained to reach not only for objects such as raisins and sunflower seeds, but also for non-food objects. Out of a total of 532 neurons studied, 92 were categorized as mirror neurons: they were active before a movement actually occurred (the monkey could not observe its own movement), *and* they were also active when the same movement was observed. Individual mirror neurons tended to respond to specific kinds of hand movements, such as grasping, placing, or moving an object or food. This work had been preceded by research that showed that an action was facilitated, in other words had a lower threshold, if a subject was also observing the action (Fadiga *et al.* 1995), a result consistent with studies of subliminal mirroring recorded in muscle fibres.

Some mirror neurons have spatially sensitive responses. Researchers using monkeys have identified spatially sensitive subsets of mirror neurons. One class distinguishes between observed actions carried out within hand's reach; another responds to actions beyond the animal's personal space; and a third does not make this discrimination. Peter Thier at Tübingen University, in collaboration with Giacomo Rizzolatti at Parma University and others, identified a group of mirror neurons by recording single nerve cell activity from electrodes when a monkey gripped different objects and when the monkey watched a person grasp the same objects, both nearby and further away. About half of the nerve cells that were active when the monkey picked up the objects also became active when a person did the same thing. About half of identified mirror neurons were active only when the monkey was watching activity within its personal space, defined as within reaching distance; smaller numbers responded only to actions performed in a place outside the monkey's grasp or were not spatially sensitive. Thier suggests that proximity-specific activity in mirror neurons may play a role when we monitor what goes on around us, or serve as the basis for inferring the intentions of others and for cooperative behaviour: 'These neurons might encode actions of others that the observers might directly influence, or with which he or she can interact' (Thier 2007: 2).

Studies using neuroimaging techniques in humans do not have the precision of the single-cell recording research in primates. Brain areas, not single cells, are identified, and the time frame is much cruder by a couple of orders of magnitude (a fraction of a millisecond versus several hundred milliseconds). It is also known from the primate research that mirror neurons are not clumped exclusively together in a brain region, so one is monitoring the activity of many types of neurons with a variety of inputs. While one must interpret these studies with some caution, they suggest that more subtle and complex processing, not just simple mirroring, is at work.

What happens when you also perform an action yourself while observing the movement of another person? Cognitive interference and conscious resistance affect mirroring. Multiple cortical areas are involved when one actively tries *not* to imitate a facial expression. Different areas are activated with a cognitively interfering task (Lee *et al.* 2008).

There is also cross-modal activation of mirror neurons. While mirror neurons were first studied in relation to watching a movement, and in fact involved imitation rather than actual mirroring, it has now been found that sound, smell, vision, tactile sensation, and proprioception also activate mirror neurons (Umiltà *et al.* 2001; Rizzolatti and Craighero 2004). One cortical area, the insula, is involved in both viewing a primary affect (disgust) and *feeling* it (Wicker *et al.* 2003). All these modalities inform our sense of embodiment. As noted earlier, their coordination depends upon being able to move and actively engage with our environment, and for our actions to be responded to by others (Noë 2004; Catmur *et al.* 2007). Patterns of symbolic play and memory representation reflect this cross-modal experience (Lichtenberg 2001).

Auditory mirror neurons in monkeys respond while they perform hand or mouth actions *and* when the monkeys listen to sounds made by these actions (Kohler *et al.* 2002; Keysers *et al.* 2004; Galati *et al.* 2008). In humans, fMRI techniques have identified brain areas that respond to both actions and listening to actions. The neural circuit that is activated is in the *left* hemisphere temporo-parieto-premotor areas. Individuals who scored higher on an empathy scale have stronger responses in this circuit (Gazzola *et al.* 2006). Unlike monkeys, human mirror neurons can respond to the anticipated trajectory of a movement (Iacoboni *et al.* 1999, 2005; Urgesi *et al.* 2006).

Issues concerning mirror neurons and semantic memory may be raised. Are there mirror neurons that map seen or heard actions onto motor representations of the same actions at an *abstract* level? This is necessary for *understanding* the actions of others. Neurons have been identified in the left inferior frontal and posterior temporal regions that selectively respond to action sounds but not according to body-mapping. Their activity was influenced by *semantic* congruency, not body location. Human mirror neurons can represent the meaning of *actions* (but not of other events) (a) at an abstract, semantic level, (b) independently of the effector, and (c) independently of conscious awareness (Gazzola *et al.* 2006; Galati *et al.* 2008).

Do mirror neurons play a role in empathy? Mirror neurons have been posited as playing a role in our capacity for empathy (Carr *et al.* 2003; Parr *et al.* 2005; Iacoboni and Dapretto 2006; Iacoboni 2009). Carr *et al.* (2003) identified a circuit that connected imitative areas to the limbic system, a term applied to a number of brain areas that integrate environmental and interoceptive stimuli. Drawing upon mirror neuron research, Parr *et al.* (2005) suggest that this type of awareness is mostly unconscious, occurring as a basic form of empathy which results simply from watching others' behaviour. They go so far as to say that empathy is based on pre-motoric representation of action and expression. Mirror-touch synaesthesia is also linked with empathy. Watching another person being touched activates a similar neural circuit to actual touch and, for some people, it can produce a felt tactile sensation on their own body (Keysers *et al.* 2004). The existence of this type of synaesthesia correlates with heightened empathic ability, which is consistent with the notion that we empathize with others through a process of simulation (Lipps 1903; Banissy and Ward 2007).

Mirror neurons are now being studied intensively, and research has focused upon their evolutionary development; functioning in autistic and in schizophrenic individuals (Arbib and Mundhenk 2005; Caggiano *et al.* 2009); applications to the treatment of stroke patients, where mental imagery of movement facilitates recovery of the movement itself (Fourkas *et al.* 2006); and relationship to theories of empathy, self, and mind (Rizzolatti and Craighero 2004; Leiberg and Anders 2006; Caggiano *et al.* 2009). This is a developing area of inquiry, and refinements can be expected. The capacity for empathy may involve pre-motoric representations, as suggested by Parr *et al.* (2005), but it is also clear that true empathy (rather than simply mirroring the emotional state of another) is a complex process that requires frontal cortical mechanisms and the integration of information from many parts of the nervous system (Leiberg and Anders 2006).

Might the nature of mirror neurons need to be reinterpreted? All published studies concerning humans have recorded responses of brain regions measured by blood flow or magnetic resonance techniques, not the activity of single neurons. In a review article, Iacoboni (2009) referred to human single-cell recordings from mirror neurons during surgery for epilepsy (Mukamel *et al.*, unpublished observations). Iacoboni writes:

> We found human neurons with mirror properties in the frontal lobe as well as in the medial temporal cortex. Although the discharge of these cells during action execution and action observation seems to imply a common representational format for perception and action implemented at single-cell level, it is also true that lesions in the frontal lobe are more often associated with motor deficits, and lesions in the medial temporal lobe are more often associated with perceptual deficits. Perception and action, which are united at the level of single cells, seem to be more easily separated at the system level. In principle, the discharge during action

> execution and during action observation of frontal and medial temporal neurons may represent in neural terms the 'vertical links' posited by the associative sequence learning model between a sensory unit (the medial temporal neuron) and a motor unit (the frontal neuron) that fire together as a result of associative learning.
>
> (Iacoboni 2009: 666)

Here we have a question of whether individual mirror neurons integrate information from the senses and also participate in the organization of movement patterns (as implied by the way they have been defined and then identified in subsequent studies), *or* whether they are one part of distributed neuronal networks, linking, for example, temporal lobe, association cortex, motor cortex, and frontal cortex. Such a fundamentally different conception of mirror neuron functioning could potentially revise the interpretation of much of the literature to date.

Closing reflections

Other relevant anatomical features of the brain include the von Economo neurons. In 1925, the Greek-born Austrian psychiatrist, neuroanatomist and enthusiastic aviator Constantin von Economo published a paper describing large, spindle-shaped neurons in the human forebrain, specifically in the anterior cingulate and fronto-insular cortex. It was thought that they were found only in great apes, but they have recently been identified in cetaceans (whales, dolphins) and in elephants (Coghlan 2006; Hof and van der Gucht 2007; Hakeem *et al.* 2009). Their location in brain regions that receive a wide variety of inputs and their very large axons suggest that von Economo neurons can rapidly integrate information that would otherwise remain subliminal or require active integration over a longer time span. It is speculated that von Economo neurons play a role in conscious emotional and behavioural processing, intuition, and higher-order social cognition (Allman *et al.* 2002, 2005). This notion is consistent with findings that self-conscious emotions are linked to the anterior cingulate cortex, where von Economo neurons are found. They are also found in the fronto-insular cortex (F1) (von Economo and Koskinas 1925, cited in Triarhou 2006). Both the anterior cingulate and the fronto-insular cortex are involved in the conscious awareness of visceral activity. In humans, von Economo neurons are also found in the prefrontal cortex and are more prevalent on the right side of the brain.

This raises the question, 'Brain before mind?' In his important book, *The Developing Mind*, Daniel Siegel (2001: 1) expresses a dominant contemporary viewpoint when he begins: 'The mind emerges from the activity of the brain, whose structure and function are directly shaped by interpersonal experience.' In contrast, Roger Shepard (1990), a pioneer in the study of mental imagery, made a philosophical application informed by his interest in the capacity to mentally rotate an object. He and his colleague, Pier Hut of Princeton, addressed 'the hard problem':

> Instead of speaking of conscious experience as arising in a brain, we prefer to speak of a brain as arising in conscious experience. From an epistemological standpoint, starting from direct experiences strikes us as more justified. As a first option, we reconsider the 'hard problem' of the relation between conscious experience and the physical world by thus turning that problem upside down. We also consider a second option: turning the hard problem sideways. Rather than starting with the third-person approach used in physics, or the first-person approach of starting with individual conscious experience, we consider starting from an I-and-you basis, centered around the second person.
>
> (Hut and Shepard 1996: 313)

In other words, how can we have a mind (which can then develop the idea of a brain) without a relationship to another human being?

Even if we consider the mind as an emergent property of the brain, like Siegel, we can also recognize that science is much better at reductionism than at synthesis. For example, it is not possible to predict or describe the qualities of a substance, *as experienced by the senses*, based upon its chemistry alone; as much as we know about physics and chemistry, synthetic chemistry (the laboratory synthesis of complex molecules found in nature) is still an extraordinarily difficult, practically alchemical undertaking. To give another example, knowledge of chemistry may help to explain biological phenomena, but it cannot predict the existence of life or the variety of its forms. Likewise, neurobiology cannot predict what living beings are capable of experiencing, and at times its findings (always subject to revision as new theories and techniques emerge) have limited what we consider valid in our own experience or have seemed to confirm unfounded prejudices.

Jung realized that the reality of the psyche is paramount, not what the limited findings of science tell us is possible. It may be tempting to over-interpret and over-extend the 'hard evidence', comprised of findings based on still crude neuroimaging techniques and recordings from monkey neurons, into a whole theory of the nature of mind. This might be comparable to believing that one cell type or one area causes an experience, just as we once hoped that a single gene might make the difference between health and disease. Should we and our new, high-status relations/hard science allies forget that our primary focus in psychology is the exploration of psyche itself, we run the risk of naively becoming a monstrous amalgam of brain-psyche, just as Kamudha in *The Flowering Tree* became part tree, part human. Nevertheless, might we eagerly await the next wave of studies in neurobiology, which no doubt will challenge our minds and stimulate our creative imaginations, perhaps even informing our clinical practices?

Note

1 In April 2009, the Fourth International Conference of Analytical Psychology & Chinese Culture, held at Fudan University in Shanghai, had as its topic: 'The image in Jungian analysis: active imagination as a transformative function in culture and psychotherapy'. The following month, the *Journal of Analytical Psychology* sponsored an international conference in San Francisco, entitled, 'The transcendent function today: imagination and psychic transformation in analysis'.

References

Allman, J.M., Hakeem, A.Y. and Watson, K.K. (2002) 'Two phylogenetic specializations in the human brain', *The Neuroscientist* 8: 335–46.

Allman, J.M., Watson, K.K., Tetreault, N.A. and Hakeem, A.Y. (2005) 'Intuition and autism: a possible role for von Economo neurons', *Trends in Cognitive Sciences* 9: 367–73.

Anderson, M. (2003) 'Embodied cognition: a field guide', *Artificial Intelligence* 149: 91–130.

—— (2008) 'Evolution, embodiment and the nature of the mind', in B. Hardy-Vallee and N. Payette (eds) *Beyond the Brain*. Cambridge: Cambridge Scholars Press.

Arbib, M.A. and Mundhenk, T.N. (2005) 'Schizophrenia and the mirror neuron system: an essay', *Neuropsychologia* 43: 268–80.

Banissy, M.J. and Ward, J. (2007) 'Mirror-touch synesthesia is linked with empathy', *Nature Neuroscience* 10: 815–16.

Bloom, K. (2006) *The Embodied Self*. London: Karnac.

Bowlby, J. (1969) *Attachment*. New York: Basic Books.

Caggiano, V., Fogassi, L., Rizzolatti, G., Thier, P. and Casile, A. (2009) 'Mirror neurons differentially encode the peripersonal and extrapersonal space of monkeys', *Science* 324(5925): 403–6.

Carr, L., Iacoboni, M., Dubeau, M.C., Mazziotta, J.C. and Lenzi, G.L. (2003) 'Neural mechanisms of empathy in humans: a relay from neural systems for imitation to limbic areas', *Proceedings of National Academy of Science USA* 100: 5497–502.

Catmur, C., Walsh, V. and Heyes, C. (2007) 'Sensorimotor learning configures the human mirror system', *Current Biology* 17: 1527–31.

Chodorow, J. (ed.) (1997) *Encountering Jung*. Princeton, NJ: Princeton University Press.

Coghlan, A. (2006) 'Whales boast the brain cells that "make us human"', *New Scientist*, 27 November.

Corrigall, J., Payne, H. and Wilkinson, H. (eds) (2006) *About a Body: Working with the Embodied Mind in Psychotherapy*. London: Routledge.

Cosolino, L. (2002) *The Neuroscience of Psychotherapy*. New York: Norton.

—— (2006) *The Neuroscience of Human Relationships*. New York: Norton.

Damasio, A. (2000) *The Feeling of What Happens*. New York: Harvest.

Dimberg, U., Thunberg, M. and Elmehed, K. (2000) 'Unconscious facial reactions to emotional facial expressions', *Psychological Science* 11: 86–9.

Dunbar, R.I.M. and Schultz, S. (2007) 'Evolution in the social brain', *Science* 317(5843): 1344–7.

Economo, C. and Koskinas, G.N. (1925) *Die Cytoarchitektonik der Hirnrinde des erwachsenen Menschen*. Vienna: Springer.

Ekman, P. (1998) 'Introduction, commentary, and afterword', in C. Darwin, *The Expression of Emotions in Man and Animals*. Oxford: Oxford University Press.

Ekman, P. and Rosenberg, E. (eds) (1997) *What the Face Reveals*. Oxford: Oxford University Press.

Elkins, J. (1999) *What Painting Is*. London: Routledge.

Fadiga, L., Fogassi, L., Pavesi, G. and Rizzolatti, G. (1995) 'Motor facilitation during action observation: a magnetic stimulation study', *Journal of Neurophysiology* 73: 2608–11.

Fogassi, L. and Ferrari, P.F. (2007) 'Mirror neurons and the evolution of embodied language', *Current Directions in Psychological Science* 16: 136–41.

Fonagy, P., Gergely, G., Jurist, E. and Target, M. (2001) *Affect Regulation, Mentalization, and the Development of the Self*. New York: Other Press.

Fourkas, A.D., Avenanti, A., Urgesi, C. and Aglioti, S.M. (2006) 'Corticospinal facilitation during first and third person imagery', *Experimental Brain Research* 168: 143–51.

Fraiberg, S.H. (1969) 'Libidinal constancy and mental representation', *Psychoanalytic Study of the Child* 24: 9–47.

Galati, G., Committeri, G., Spitoni, G., Aprile, T., Di Russo, F., Pitzalis, S. and Pizzamiglio, L. (2008) 'A selective representation of the meaning of actions in the auditory mirror system', *Neuroimage* 40: 1274–86.

Gallagher, S. (2005) *How the Body Shapes the Mind*. Oxford: Oxford University Press.

Gallese, V., Fadiga, L., Fogassi, L. and Rizzolatti, G. (1996) 'Action recognition in the premotor cortex', *Brain* 119(2): 593–609.

Gazzola, V., Aziz-Zadeh, L. and Keysers, C. (2006) 'Empathy and the somatotopic auditory mirror system in humans', *Current Biology* 16: 1824–9.

Glaser, D.E., Grezes, J.S., Calvo, B., Passingham, R.E. and Haggard, P. (2003) 'Functional imaging of motor experience and expertise during action observation', *Society for Neuroscience* (Abstract for Poster Presentation: December 2004 online edition of *Cerebral Cortex*).

Golden, A.J., Neshat-Doost, H.T. and Dalgleish, T. (2008) 'Reduced autobiographical memory specificity following self-regulation depletion'. Paper presented at the Sixth Special Interest Meeting on Autobiographical Memory and Psychopathology: The Exploration of New Research Directions, Hotel Arena, Amsterdam, The Netherlands, 13–15 January 2008.

Goswami, U. (2008) *Cognitive Development*. Hove: Psychology Press.

Hakeem, A.Y., Sherwood, C.C., Bonar, C.J., Butti, C., Hof, P.R. and Allman, J.M. (2009) 'Von Economo neurons in the elephant brain', *Anatomical Record* 292: 242–8.

Held, R. and Hein, R. (1963) 'Movement-produced stimulation in the development of visually guided behaviour', *Journal of Comparative and Physiological Psychology* 56: 872–6.

Henderson, J.L. and Sherwood, D.N. (2003) *Transformation of the Psyche: The Symbolic Alchemy of the Splendor Solis*. London: Routledge.

Hof, P.R. and van der Gucht, E. (2007) 'Structure of the cerebral cortex of the humpback whale *Megaptera novaeangliae* (*Cetacea, Mysticeti, Balaenopteridae*)', *Anatomical Record* 290: 1–31.

Hrdy, S.B. (2009) *Mothers and Others: The Evolutionary Origins of Mutual Understanding*. Cambridge, MA: Harvard University Press.

Hut, P. and Shepard, R. (1996) 'Turning "The Hard Problem" Upside Down & Sideways', *Journal of Consciousness Studies* 3: 313–29.

Iacoboni, M. (2009) 'Imitation, empathy, and mirror neurons', *Annual Review of Psychology* 60: 653–70.

Iacoboni, M., Woods, R.P., Brass, M., Bekkering, H., Mazziotta, J.C. and Rizzolatti, G. (1999) 'Cortical mechanisms of human imitation', *Science* 286: 2526–8.

Iacoboni, M., Molnar-Szakacs, I., Gallese, V., Buccino, G., Mazziotta, J.C. and Rizzolatti, G. (2005) 'Grasping the intentions of others with one's own mirror neuron system', *PLoS Biology* 3: e79.

Jung, C.G.: Unless otherwise stated: *The Collected Works of C.G. Jung* (CW). London: Routledge & Kegan Paul.

—— (1928) 'The relations between the ego and the unconscious' (CW 7).

—— (1946) 'Psychology of the transference' (CW 16).

—— (1996) *The Psychology of Kundalini Yoga: Notes of the Seminar Given in 1932* (Shamdasani, S., ed.). Princeton, NJ: Princeton University Press.

Kazdin, A.E. (2008) 'Evidence-based treatment and practice: new opportunities to bridge clinical research and practice, enhance the knowledge base, and improve patient care', *American Psychologist* 63: 146–59.

Keysers, C., Wicker, B., Gazzola, V., Anton, J., Fogassi, L. and Galles, V. (2004) 'A touching sight SII/PV activation during the observation and experience of touch', *Neuron* 42: 335–46.

Kohler, E., Keysers, C., Umiltà, M.A., Fogassi, L., Gallese, V. and Rizzolatti, G. (2002) 'Hearing sounds, understanding actions: action representation in mirror neurons', *Science* 297: 846–8.

Lee, T-W., Dolan, R.J. and Critchley, H.D. (2008) 'Controlling emotional expression: behavioral and neural correlates of nonimitative emotional responses', *Cerebral Cortex* 18: 104–13.

Legrand, D., Brozzoli, C., Rossetti, Y. and Farne, A. (2007) 'Close to me: multisensory space representations for action and pre-reflexive consciousness of oneself-in-the-world', *Consciousness and Cognition* 16: 687–99.

Leiberg, S. and Anders, S. (2006) 'The multiple facets of empathy: a survey of theory and evidence', *Progress in Brain Research* 156: 419–40.

Lichtenberg, J.D. (2001) 'Motivational systems and model scenes with special references to bodily experience', *Psychoanalytic Inquiry* 21: 430–47.

Lipps, T. (1903–6) *Ästhetik*. Leipzig: Verlag.

Narayan, K. (2008) 'Showers of flowers: A.K. Ramanujan and an Indian folktale', *Jung Journal* 2: 5–22.

Niedenthal, P.M., Barsalou, L.W., Winkielman, P., Krauth-Gruber, S. and Ric, F. (2005) 'Embodiment in attitudes, social perception, and emotion', *Personality and Social Psychology Review* 9: 184–211.

Noë, A. (2004) *Action in Perception*. Cambridge, MA: MIT Press.

Parr, L.A., Waller, B.M. and Fugate, J. (2005) 'Emotional communication in primates: implications for neurobiology', *Current Opinion in Neurobiology* 15: 716–20.

Ramanujan, A.K. (ed.) (1997) *A Flowering Tree and Other Oral Tales from India*. Berkeley, CA: University of California Press.

Rizzolatti, G. and Craighero, L. (2004) The mirror-neuron system, *Annual Review of Neuroscience* 27: 169–92.

Schore, A. (1994) *Affect Regulation and the Origin of the Self.* Hillsdale, NJ: Lawrence Erlbaum.

—— (2003a) *Affect Disregulation and Disorders of the Self.* New York: Norton.

—— (2003b) *Affect Regulation and the Repair of the Self.* New York: Norton.

—— (2005) 'Attachment, affect regulation, and the developing right brain: linking developmental neuroscience to pediatrics', *Pediatrics in Review* 26: 204–17.

Shahar-Levy, Y. (2001) 'The function of the human motor system in processes of storing and retrieving preverbal, primal experience', *Psychoanalytic Inquiry* 21: 378–93.

Shepard, R.N. (1990) *Mind Sights.* New York: W.H. Freeman.

Sherwood, D.N. (2006) 'Alchemical images, implicit communication, and transitional states', *Spring* 74: 233–62.

Siegel, D. (2001) *The Developing Mind.* New York: Guilford.

Stern, D. (1985) *The Interpersonal World of the Infant.* New York: Basic Books.

—— (2004) *The Present Moment in Psychotherapy and Everyday Life.* New York: Norton.

Thier, P. (2007) 'Mirror, mirror in the brain: mirror neurons, self-understanding and autism research', *Society for Neuroscience*, 7 November (online).

Thomas, L.E. and Lleras, A. (2007) 'Moving eyes and moving thought: on the spatial compatibility between eye movements and cognition', *Psychonomic Bulletin & Review* 14: 663–8.

Triarhou, L.C. (2006) 'The signalling contributions of Constantin von Economo to basic clinical and evolutionary neuroscience', *Brain Research Bulletin* 69: 223–43.

Umiltà, M.A., Kohler, E., Gallese V., Fogassi, L. and Fadiga, L. (2001) 'I know what you are doing: a neurophysiological study', *Neuron* 31: 155–65.

Urgesi, C., Valentina Moro, V., Candidi, M. and Aglioti, S.M. (2006) 'Mapping implied body actions in the human motor system', *Journal of Neuroscience* 26: 7942–9.

Wicker, B., Keysers, C., Plailly, J., Royet, J-P., Gallese,V. and Rizzolatti, G. (2003) 'Both of us disgusted in *my* insula: the common neural basis of seeing and feeling disgust', *Neuron* 40: 655–64.

Wilkinson, M. (2006) *Coming into Mind.* London: Routledge.