

# Phantoms in the brain: A neuroscience view of social self repair using the psychodramatic method

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**Abstract:** Use of mirrors with people with phantom limbs reveals that extraordinary and immediate changes in felt experience can occur when an internal schema in the brain is projected out and then perceived as external. This opens up a fascinating new area of work for group psychotherapy given the discovery of the neurologically embedded social self. Examination of a psychodramatic production of an individual's internally held social self suggests similar mechanisms are in operation for the updating of the social self schema. It appears that the interpersonal field is a primary factor in the formation of the self and that the corresponding neurobiological structures can be further modified with mirroring of the cognitive, affective and relational aspects of the social self. Understanding these mechanisms will enhance the different techniques of interpersonal mirroring that already occur in most group modalities. Progress will be made as we reflect on the results of putting these new insights and ideas into practice.

**Keywords:** interpersonal neurobiology; mirror therapy; mirroring; neurosignature; phantom limbs; psychodrama; social brain; social self; social neuroscience.

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## **Amputation of the phantom limb**

Lord Nelson could feel the fingers of his right hand digging into his palm – but he did not have a right arm – he lost it in the attack on Santa Cruz de Tenerife. He believed his pain was proof of the existence of the spirit. Philip Martinez had a phantom limb with spirit too; he suffered pain in his phantom limb, terrible pain. In 1985, his left arm was amputated after a motorcycle accident. For ten years his phantom arm was fixed in one awkward position. When he woke up in extreme pain from his phantom, he would will the paralysed phantom limb to move and straighten up hoping that that would relieve the pain; but he never got any movement – not until he entered the office of Dr. V. S. Ramachandran (1998). What then occurred is remarkable. Remarkable because the paralysed phantom was instantly unhinged through the use of a simple mirror. Remarkable because up to then phantom limbs had been an untreatable mystery to medical science; no amount of will, creative visualization or surgery of neuromas had had any dependable healing effect. Neuromas are the injured nerve endings formed at the stump site that were hypothesized to be carrying residual memories of the arm stump. While neuromas have been shown to fire abnormally and have a modulation effect on phantom limb pain (Bitter et al, 2005), surgical removal has not cured the phantom pain. Severing the sensory nerves that go into the spinal cord, cutting the back of the spinal cord and even chasing it up into the brain and burning out bits of the thalamus relay station have had no consistent desirable effect on the phantom limb pain (Ramachandran & Blakeslee, 1998).

Wilder Penfield (1950) discovered that a map of the entire body surface exists in the brain in an area which is now called the Penfield homunculus. Stimulation in a particular place in the body results in stimulation in a specific place in the Penfield homunculus. In the neighbouring motor cortex, another map was found that receives the intention to move a particular part of the body. Two wonderfully named English neurologists, Lord Russell Brain and Henry Head, came up with the term *body image* for these maps.

In one investigation of body image, Dr. Tim Pons (1991) surgically removed the arms of monkeys. He found that the area of the homunculus corresponding to the amputated hand had got connected up to the face. Sensations from the face were not only feeding the facial area of

the homunculus, but also feeding the hand area of the homunculus. Ramachandran wondered if that would be true of people with phantom limbs. Could the sensations from the face be fooling the brain into experiencing that the phantom hand was still there? He blindfolded a phantom limb patient, and using a Q-tip touched different points on the patient's face. The patient not only felt their face, but also their phantom hand as well. Moving around the face, a phantom hand was uncovered. Functional MRI studies (Cruz et al, 2003) reveal that motor cortical remapping occurs in almost all amputees. For example, there is a downward shift of the hand area of the cortex onto the area of face representation. That is, the Penfold homunculus has it that input from the face is from the hand.

Ramachandran speculated that there was a kind of learned paralysis with phantom limbs. The intent to move the limb is in the motor cortex map and there is some kinesthetic input coming in (from the face) but there is not any visual input (the limb simply was not there) and so the brain cannot update that there is no limb and it cannot get any experience of it moving either. Even if surgeons took out the face, Ramachandran speculated, who was to say that the sensory inputs from the face would not get mapped onto another area in the Penfield homunculus and there would then be a phantom face containing a phantom arm? Ramachandran speculated that perhaps the brain concludes that the command to move the arm creates the paralysis. Perhaps the memory of paralysis is carried over and not updated. When there is an intent to move the amputated limb, the motor command sends a message to the limb and parietal lobe containing the body image but the visual feedback informs that it is not moving and the proprioceptive feedback doesn't come back either. The typical habit of checking an area of the body (a hand, a foot, a knee) by clenching, bending or twiddling could accelerate into extreme action, with no dampening.

If it was a learned paralysis, thought Ramachandran, then it could be unlearned. As he was pondering how that might be achieved – particularly what was the role of vision – he had a patient who reported that he could move his phantom arm and reach out for things. Ramachandran played a trick. He asked the patient to reach out for a cup sitting on the table with his phantom and then, waiting a moment, he suddenly yanked the cup away. The patient yelled out with pain as though the cup had been ripped from his grasp. Ramachandran also

knew that the body image can be profoundly modified with just a few simple tricks. Ramachandran and Blakeslee (1998) describe how in 30 seconds most people can have a convincing felt experience on someone else's nose as one's own. They also outline how an inanimate object can be experienced as one's hand. These involve aligning a felt experience with a visual trick. Ramachandran wondered what would happen if a patient actually saw his phantom. He constructed a box with a vertical mirror to try out his idea. The next patient in was Philip Martinez.

Ramachandran told Philip to put both his arms into the box – the left arm stump and his real right arm – and to arrange himself until the right arm image was also imposed upon the left arm so it looked like he had two arms. He then instructed Philip to move both his arms together synchronized like conducting an orchestra. Here is Ramachandran's report of what occurred:

'Oh, my God! Oh, my God, doctor! This is unbelievable. It's mind-boggling!' He was jumping up and down like a kid. 'My left arm is plugged in again. It's as if I'm in the past. All these memories from so many years ago are flooding back into my mind. I can move my arm again. I can feel my elbow moving, my wrist moving. It's all moving again.' (p. 47)

However, when Philip closed his eyes, the phantom froze up again. Then when he opened his eyes and saw the limb in the mirror, it was 'plugged in' again. Ramachandran saw this as the visual feedback competing with the phantom. Philip took the contraption home and kept playing with it. Suddenly, after four weeks, his phantom limb and the associated pain disappeared.

This unlocking of an internal schema through the experience of seeing an external representation opens up a fascinating potential for the emerging fields of *interpersonal neurobiology* (Badenoch & Cox, 2010; Siegel, 2010) and *social neuroscience*. It appears that in recent evolutionary moves, certain areas of the human brain have expanded to be a home for the socially-constructed self. "The social brain contains our implicit and procedural memories of our early interpersonal learning history... The social brain edits our experience, interpreting the ongoing stream of social information in light of implicit memories." (Cozolino, 2002, p. 183). The neural structures are organized into schemas or networks that "are implicit procedural memories of sensory, motor, affective

and cognitive memories of others...These memory networks become evoked in subsequent interpersonal experiences throughout life." Mirror neurons are the best known example of the social nature of perception, action and intention (Schermer, 2010). We are hard-wired for attachment. We are hard-wired for groups (Flores, 2010).

It appears our initial relationships shape the structure of our brain (Badenoch & Cox, 2010). The neurological structures of this social self are set up after birth and in response to the first set of human relationships the newborn enters (Siegal, 1999). This social self is "an awareness of the body and its relation to extrapersonal space" (Cozolino, 2002, p.146). It is a template of the different social situations, mapping the nuances of interpersonal language, gesture, gaze and posture which inform social experience. There is the growing realization that our brain is social. "It appears that mutual recognition and identification are the progenitors of reason, self-consciousness, and culture rather than vice-versa. This understanding overturns the cherished assumption that social behavior results mainly from a learning process mediated by a formal language" (Schermer, 2010, p. 492). The mutually impacting relationship between the inherited 'neurosignature' and the neural plasticity in response to environmental influences is discussed later in a consideration of the mind-body-spirit interfaces and interactions.

Like the body image, the social self is fed by frontal cortex executive commands, memory imprints, and visual, auditory and kinesthetic sensations. The social self also suffers paralysis and learned helplessness from experiences of deprivation and trauma. Could we then expect that an experience of the social self externalized will result in the release and expansion of a person's interpersonal functioning? This will be examined through considering psychodramatic work which explicitly uses other group members to enact a client's internal social self. This enactment is not just mirroring of the visual and physical aspects, but also mirroring of the affective and relational aspects of the psyche. An illustrative psychodramatic enactment is described as material for examination and discussion.

## **The psychodramatic enactment**

J. L. Moreno (1972, 1983, 1985) drew on dramatic methods and a theology of spontaneity and encounter to formulate the psychodramatic method of groupwork. Psychodramatic theory and practice have been built on and refined over one hundred years with various schools and different fields of endeavour continuing to develop around the world. Psychodrama conceptualizes personality as a dynamic set of roles internalized from interactions with significant others (Max Clayton, 1991, 1992, 1993). The dramatic stage and its methods are used by group members to enact the internal world of the protagonist. The enactment can be set in a particular time and place, a critical event, or, it may be of the different motivations and forces impacting on the protagonist.

The emphasis is placed on the application of role theory such that human beings develop a deeper feeling and appreciation of one another. The point of view taken is that role theory may be applied so that incisive analysis is infused with feeling and so contributes to the development of a humane culture. (Clayton, 1994, p. 121).

See Williams (1989) for useful illustrations of ‘classic’ psychodramatic work. We will use a summary of Carter’s (2011) psychodramatic work to look at the psychodramatic use of mirroring.

### **Mark**

The protagonist, Mark, identifies he wants to explore a significant event in his life that he believes is a key to his offending (done under the command of a dominatrix). He remembers a living room. He is invited to go into the living room and lay out what is there. There is a wood burner. He enacts the wood burner. He is giving out heat and is emotionally independent. An auxiliary takes up the functioning of the wood burner. Mark takes a shoe to be a truck he is playing with. There is no rush in the enactment, there is no orientation in the psychodramatist that there is anything wrong or needing to be fixed. The psychodramatist appreciates the boy’s world and experience. The boy is being very quiet. He tells the psychodramatist he must not disturb his mother and her boyfriend in the bedroom. The psychodramatist invites Mark to choose group

members to be these two other people. Mark enacts these two people. Mark, as his mother's boyfriend, puts an ultimatum to the mother that it is either him or the boy. If she wants him, then the boy must go. The psychodramatist invites Mark to be the mother and the auxiliary takes up the functioning of the boyfriend and makes the ultimatum. Mark as mother decides that the boy will go. There are various role reversals and challenges to the mother; however, she remains resolute. Mark says this is what happened but the real awful thing is still to happen. The home scene is moved to the side of the stage and a new scene is laid out by the protagonist – the dormitory of a boy's home.

Mark is invited to go into the living room. This evokes a strong affective experience in which significant details are recalled. The initial scene is visceral. Mark enters into the consciousness of his younger self in a felt way. The psychodramatist is fine tuned to these movements and experience. Early, pre-autobiographical events are not experienced as normal memories – “we do not experience the sensation of remembering, but instead the perceptions feel like they are just the way things are” (Badenoch & Cox, 2010, p. 466). Each 'role' (wood burner, mother, boyfriend) is first enacted by the protagonist. After role reversal, the auxiliary takes up the functioning as given by the protagonist and the protagonist then responds to that from his new position or role. The group members as auxiliaries become intimately involved in Mark's world. When Mark enacts his internal mother, he is being her. The protagonist is not assuming an external role as is done in role play, but instead is giving external form to his internal world. It is not so much that the protagonist chooses someone to *represent* their mother but *to be* their mother. This is not role play or *acting as if*, this is an actual life situation: the world of the protagonist as he experiences it. The psychodramatic enactment aims to be an embodied mirroring of the social self. Mark becomes immersed in a living experience of his world. With each role reversal there is a new image in the three dimensional mirror of his world. The mirroring is both continuous and in every place he looks. He sees himself in the other roles being reflected back. The protagonist is saturated in a living experience of the mirror of his self.

Mark sets out many beds and boys. A matron (enacted by the protagonist) is hanging the protagonist's bed sheet out the window and telling the world what a disgusting little boy he is – he has peed his bed. The psychodramatist challenges the matron; however, the matron

persists. The protagonist is role reversed back to being himself as a boy and the auxiliary takes up the role of the matron. The boy collapses, shamed and alone. Despite encouragement from the psychodramatist, he cannot and will not rise up to the matron.

Through the mirroring within the enactment, Mark's learned helplessness ('paralysis') is presented to conscious, lived, autobiographical memory. This seems very similar to the mirror of the phantom limb where it becomes 'plugged in'.

There are many production possibilities all with potential benefits. Another auxiliary could take up the functioning of Mark as a boy and Mark could come to the edge of the action area and witness a reenactment. Mark could be invited to role reverse with another of the boys in the dorm. However, in this case, the psychodramatist invites Mark to go and be his mother. The psychodramatist does not know what the mother will do. Mark as mother immediately comes to her son and says this was not what she wanted and she takes him away, her arm around his shoulder. Mark is role reversed into being himself the boy. He takes in his mother's love. This attachment is sustained for some time.

This was not done when Mark was a boy. This is no longer recall but is what psychodramatists call surplus reality.

A threat to this is perceived. The psychodramatist invites Mark to become the boyfriend. Will the boyfriend persist with his ultimatum? Mark as boyfriend immediately comes beside the boy, on the other side to the mother and puts his arm around the boy's shoulder. The protagonist is role reversed into being himself (the boy) and is invited to walk around and really take in the experience. After a while the three of them come to face the matron. Mark tells her there is no place for her in his life and he walks away with no backward glance. There is an enactment of a park and the protagonist has a sustained experience of playing in the park. The co-leader of the group takes up the role of a dominatrix and tries various seductions – shame, command, promise of thrill – but none of them work, Mark continues his new life. He is happy. He looks full of life and satisfaction.

In the play of surplus reality, there is the evocation of the here and now potential, the urge to take up what the present offers and do something new. Perhaps, we can also see this as the living into Winnicott's *potential space of the child*; the evocative space between inner and outer realities, as the child emerges from fusion with the nurturer

out into the larger social matrix. Throughout the enactment, there is a lot of play and in the play, there is therapeutic effect. We saw that with Philip Martinez: his phantom limb was amputated after he had taken the mirror home and played with it.

Psychodramatists consider a catharsis of integration occurs when affect, cognition and action are present in a new and enlarged social constellation. A new experience of attachment which is sustained like this, blended into autobiographical memory, is highly likely to be integrated into the social self neurologically (Flores, 2010). The psychodramatist is keen for the positive experiences to be sustained for as long as possible. Entry into play is given great importance. "Attachment is more than the re-establishment of security after a dysregulating experience and a stressful negative state: it is also the interactive amplification of positive affects, as in play states" (Schoore, 2003, p. 34).

There are three in-session role tests of the strength of the attachment and new functioning: the role reversal into boyfriend to see if he would continue his ultimatum, the facing of the matron, and then the challenge from the dominatrix. In response, Mark sustains connection with himself and his caregivers. He is propelled into expanded and sustained movement of his self in relation to people he cares about. If other things occur in his life, then one can expect this new functioning to become integrated into other aspects of his personality over time.

It requires a group to create the living enactment of Mark's world. There is reciprocal benefit. Group members can be impacted on strongly. Enacting a role as an auxiliary offers multiple experiences. It is very intimate living into the world of another. Perhaps the auxiliary will get to do something they would never do in their life: they have to tell someone they love them with full feeling; they have to get fully embodied in fury; they have to forgive themselves. Just as there is for the protagonist, so for the auxiliary there is movement in the psychic distance between being in self and being in an interpersonal context. This provides opportunities for building mindfulness and spaciousness around emotional events. Being an auxiliary can be very precise training for individuation. The auxiliary must be one role fully and congruently, at the same time as being alert to the functioning of the protagonist in the other role: a role reversal could be imminent.

## **Areas for investigation**

What are the indications for the production of the different elements in a traumatic event? With Mark, we see that the original event was reproduced and he experienced distress but not a re-traumatizing. Progressive elements in his world were present on the stage and creative facilities had been activated and engaged before the traumatic event of the Matron shaming him. Mark was involved in laying out the environment, choosing people to be roles, becoming the stove, playing with the toy truck. Through the use of dramatic methods, Mark could be moved crisply through the system. What elements of the traumatic situation need be produced on the psychodramatic stage will be informed by several factors: the clinical approach being taken, the nature of the relationship between the psychodramatist and the protagonist, the group history, the clinical purpose, the warm-up to memory or theme (Clayton & Carter, 2004).

New attachment experiences were generated from existing relationships in Mark's social self. Even with protagonists who have had no apparent caregivers, there is inevitably something embryonic, even if only imaginary, to which attachment experiences can be nurtured. For example, the perfect mother can be invited to be present. The accuracy to the actual mother is irrelevant for the immediate purpose. It is the accuracy to the protagonist's imagination containing his projected wishes and longings that is the target.

What are the indications for role reversal? In Australia and New Zealand, heavily influenced by Max Clayton, there has been a strong imperative to keep the production tight to the experience of the protagonist, to follow the protagonist's script. If the protagonist introduces new content or a question in a role, then there is a role reversal. The auxiliary cannot know what the protagonist's response will be, what new unexpected excuse, resistance, fear or subtle opening or softening might be evoked in the protagonist. If the auxiliary does take up the response, then at best it can only be an educated and felt guess. The protagonist will then be making adjustments to fit in with others' responses. This will bring the protagonist out of immersion in his/her world and into the greater world of the group. This has its own advantages. For example, when Mark was walking around with his caregivers, auxiliaries took up their aspects of the world that Mark

was encountering. At this point in the dramatic work, there is no contamination of his script.

The psychodramatist was an active participant in the enactment. He was not part of Mark's original family, yet he is active in the drama, challenging the mother, getting curious with the boy. His *interviewing for role* assisted the protagonist to be the role and bring to conscious expression certain beliefs, attitudes and decisions of that role. The psychodramatist interviews and perhaps challenges the roles not so much because he thinks certain things should happen but more for investigating the system and provoking expression of things that may not normally be expressed. Precision in following the warm-up, metaphors, and script of the protagonist is crucial to the production of the protagonist's inner world on the stage. The psychodramatist trains to be involved as a real person and alert to reactive or emotional entanglement. A good sense of the type of training and ongoing supervision required can be got by studying the detailed commentary given by Clayton and Carter (2004) on a three day training event for trainee psychodramatists.

## **The group and the nature of the psyche**

There is a solid history of seeing the self as social in psychotherapy, for example Lewin's (1951) electromagnetic group field and the socially defined selfhood of Foulkes' (1964) group matrix. In group psychotherapy, we can see that mirroring of the social self is occurring almost continuously. Group psychotherapy uses the group as the treatment means (Yalom & Lesczc, 2005). The group dynamics and interactions are explicitly used to bring about new and expanded functioning for group members. Group members are active participants with each other in a real life social interaction (Schermer, 2010) and as such, the group sessions offer multiple opportunities for mirroring. The graded motor imagery work of Moseley (2004) suggests that this type of mirroring is evoking new neurologically embedded behavior.

Moseley identifies a 'smudging' in response to an injury, where more cells are assigned in the brain to the painful body part. The areas in the brain looking after that area of the body will expand and spread. One way to change the neural representation of the affected limb is to

get the body going normally and then the brain cells will change. As a first step, they have the client watch others moving the affected limb. A final step is the mirror work of the unaffected limb to the affected one.

Similarly, in group psychotherapy sessions, a participant may experience another group member reflecting back some new appreciation of them. Or, perhaps they witness an interaction between two other group members that is new to them. Group members are explicitly being exposed to expanded and progressive functioning with the group leader having a keen eye to having that land and taken in and sustained.

Are these new experiences neurologically embedded into the social self? Experience with phantom limbs suggests that there are both inherited maps and new remapping. The nose exercise outlined in the first section reveals remapping can occur within a minute. Ramachandran and Blakesle (1998) report a client born without arms yet having phantoms (p. 41) which suggests some kind of inherent felt body map. A whole body energy field has been suggested in the neuromatrix model which appears to be the most popular model so far to explain phantom limbs (Giummarra et al, 2007). A whole body energy field could make some sense out of what happened when Ramachandran pulled an object away from the grasp of phantom limb and the person experienced pain. Perhaps, such a field is also what is at work for fingertip regeneration in young children (Illingworth, 1974).

The neuromatrix theory proposes an inborn, genetically specified body image termed a neurosignature. The neurosignature is a genetically predetermined conscious awareness of self, emergent from the sensory, limbic, and neural systems but extending beyond the body schema into an extensive network. The exact makeup of that network or how it may be connected with the brain is not clear.

What is the relationship of one neurosignature to another? Is it a web of interconnectedness that we see in the social self? Moreno (1953) saw the psyche is both inside and outside the body. Perhaps, one could imagine such an ethereal form tethered to the body, felt across space, and so see it as just another name for soul or spirit. Perhaps these agglutinate into Jung's collective unconscious. We are in the realm of gross speculation but can we rule it out? In the first sentence of *The Neuroscience of Psychotherapy*, Louis Cozolino (2010) releases his fundamental attitude which also dominates a wide diversity of fields:

“How does the brain give rise to the mind?” Yet, can we say that with any more surety than we can say: How does the mind give rise to the brain? From whatever end we come, we are moving into a relational truth – each now affects each other. As we put our ideas into practice and reflect on the results, we are gaining greater clarity and finer precision of the workings that arise from the ongoing dynamics of the relationship between mind, brain, body and the interpersonal.

Psychodramatic enactment might also inform work with phantom limbs and pain. Contextual elements could be produced around the traumatic event. What effect would laying out the interpersonal situation pre- and post-event have on the person’s experience of their phantom limb? Investigations could be done on producing and modulating auditory, olfactory, and kinesthetic experiences to assess whether they operate similar to the visual pathways.

The empty stage and dramatic methods reward the psychodrama clinician with an almost unlimited scope to what can be adjusted in interpersonal interactions: isolated, added, slowed down, paused and replayed. The part can be isolated within the whole and introduced back into the whole. Interpersonal interactions, sensory input, and language can be regulated using dramatic methods. Almost all the complexities of interpersonal behaviour can be presented within a semi-controllable environment. Additional instruments could be introduced into the psychodramatic enactment to measure and record behaviour.

Investigations could be made in the dramatic production of the social self of a protagonist without disclosure of content, names, or thoughts. Perhaps desirable results could be obtained with minimal role reversal and objects could be used to be the different roles. A mirroring ‘technique’ that was independent of a psychodramatic context might well be formulated to be deliverable within different group modalities.

## **Summary**

Group psychotherapy is one of the great living laboratories where we have to try out our new ideas and to see what actually builds individuation, reciprocity and cooperative working relationships. With all the multifarious factors that impact, forever unique to each new group situation, it is difficult to imagine group psychotherapy being

served by a scientific approach in the 19<sup>th</sup> Century positivist sense; yet if we are highly creative, we may find ways to deliver *demonstrations* of therapeutic effect and change.

## References

- Badenoch, B. & Cox, P. (2010) Intergrating interpersonal neurobiology with group psychotherapy. *International Journal of Group Psychotherapy*, 60, 4, 463-481
- Bitter, R. G., Otero, S., Carter, H. & Aziz, T. Z. (2005) Deep brain stimulation for phantom limb pain. *Journal of Clinical Neuroscience*, 12, 4, 399-404
- Carter, P. D. (2011) The dramatic heart of the psychodramatic method. *The Arts in Psychotherapy*, 38, 290-297
- Clayton, G. M. (1991) *Directing psychodrama: A training companion*. Caulfield, Victoria: ICA Press
- Clayton, G. M. (1992) *Enhancing life & relationships: A role training manual*. Caulfield, Victoria: ICA Press
- Clayton, G. M. (1993) *Living pictures of the self: Applications of role theory in professional practice and daily life*. Caulfield, Victoria: ICA Press
- Clayton, G. M. (1994) Role theory and its application in clinical practice. in P. Holmes, M. Karp & M. Watson (Eds.) *Psychodrama since Moreno: Innovations in theory and practice*. London: Routledge (pp. 121-144)
- Clayton, G. M. & Carter, P. D. (2004) *The living spirit of the psychodramatic method*. Auckland, New Zealand: Resource Books
- Cozolino, L. J. (2002) *The neuroscience of psychotherapy: Building and rebuilding the human brain*. New York: W. W. Norton
- Cozolino, L. J. (2010) *The neuroscience of psychotherapy: Healing the social brain*. New York: W. W. Norton
- Cruz, V. T., Nunes, B., Reis, A. M. & Pereira, J. R. (2005) Cortical remapping in amputees and dysmelic patients: A functional MRI study. *NeuroRehabilitation*, 18, 1, 299-305
- Flores, P. J. (2010) Group psychotherapy & neuro-plasticity: An attachment theory perspective. *International Journal of Group Psychotherapy*, 60, 4, 543-566
- Foulkes, S. H. (1964) *Therapeutic group analysis*. London: Karnac
- Giummarra, M. J., Gibson, S. J., Georgiou-Karistianis, N. & Bradshaw, J. L. (2007) Central mechanisms in phantom limb perception: The past, present

- and future. *Brain Research Reviews*, 54, 219-232
- Lewin, K. (1951) *Field theory in social science*. New York, NY: Harper & Row
- Moreno, J. L. (1953) *Who shall survive?* New York, NY: Beacon House
- Moreno, J. L. (1983) *The theatre of spontaneity*. New York, NY: Beacon House (Original work published 1924)
- Moreno, J. L. (1985) *Psychodrama* (Vol. 1; 4<sup>th</sup> Ed.). New York, NY: Beacon House (Original work published 1946)
- Moseley, G. L. (2004) Graded motor imagery is effective for long-standing complex regional pain syndrome: a randomised controlled trial. *Pain*, 108, 192–198
- Penfield, W. & Rasmussen, T. (1950) *The cerebral cortex of man: A clinical study of localization of function*. New York, NY: MacMillan
- Pons, T. P., Preston, E. & Garraghty, A. K. (1991) Massive cortical reorganization after sensory deafferentation in adult macaques. *Science*, 252, 1857-1869
- Ramachandran, V. S. & Blakeslee, S. (1998) *Phantoms in the brain: Probing the mysteries of the human mind*. New York, NY: William Morrow
- Schermer, V. L. (2010) Mirror neurons: Their implications for group psychotherapy. *International Journal of Group Psychotherapy*, 60, 4, 487-513
- Schore, A. N. (2003) The human unconscious: the development of the right brain and its role in early emotional life. in V. Green (Ed.) *Emotional development in psychoanalysis, attachment theory and neuroscience*. New York, NY: Brunner-Routledge (pp. 23-54)
- Siegel, D. J. (1999) *The developing mind: How relationships and the brain interact to shape who we are*. New York, NY: Guilford
- Siegel, D. J. (2010) Reflections on mind, brain, and relationships in group psychotherapy. *International Journal of Group Psychotherapy*, 60, 4, 483-485
- Williams, A. (1989) *The passionate technique: Strategic psychodrama with individuals, families and groups*. London: Tavistock/Routledge
- Yalom, I. D. & Lesczc, M. (2005) *The theory and practice of group psychotherapy*. New York, NY: Basic Books