The Neurological, Social, and Emotional Importance of Mirror Neurons and Dance/Movement Therapy with Autism Spectrum Disorder

Rachael Collins
Naropa University
PSYS 657, Fall 2012
Abstract

This paper examines current research regarding mirror neurons and their role in human relationships. It also reviews research linking mirror neurons to autism spectrum disorder; making connections for possible reasons for the emotional and social deficiencies those with autism live with. There is a discussion of the field of dance/movement therapy, explaining how the field uses interventions to access many of the social and emotional deficits in those with autism. Concluding with a hypothesis that there is a connection between the field of dance/movement therapy, mirror neurons, and autism, and a need for further research.
The Neurological, Social, and Emotional Importance of Mirror Neurons and Dance/Movement Therapy with Autism Spectrum Disorder


Winnicott proposed that a baby first starts to understand that he or she exists by the mother reflecting their actions back with heightened affect. (Tortora, 2011) By seeing themselves in another being, they are able to start to differentiate between themselves and another. In 2010, Stern and colleagues looked into the ways humans implicitly know how to be with one another and claimed that the immediate communication between beings occurs on a non-conscious level through “body-to-body dialogue” (Tortora, 2011, p. 7). A healthy individual instinctually knows how to be in relationship with another being. As Siegel puts it, there is an energy that passes back and forth between individuals and it is that force that allows us to be in relation with one another. (Siegel, 2012) From birth, humans have an instinctual reflexive imitation capacity called echolalia. (Cozolino, 2006) It is this ability that lays the foundation for learning by observation, embodying empathy, and the ability to have a theory of mind, or in other words the ability to see others’ intentions as different from one’s own.

The following reviews emerging research regarding mirror neurons and their connection to the innate ability of humans to connect with one another. It also goes on to review current research linking mirror neurons to autism, making connections for possible reasons for the emotional and social deficiencies those with autism carry. Finally ending with a discussion of the field of dance/movement therapy, hypothesizing that there is a connection between the field, mirror neurons, and autism that should provoke further research on the topic.
Mirror Neurons

Mirror neurons, as defined by Siegel are “a set of neurons that is distributed in various regions of the brain that has both motor and perceptual functions” (Siegel, 2012, p. A1-52). They are thought to be located in area F5, the ventral premotor cortex, Brodmann area 44, the inferior parietal lobule and the superior temporal sulcus, and are found to fire when an action is performed, seen, or heard. (Wan, Demaine, Zipse, Norton, & Schlaug, 2010) There is growing evidence that there are two neural circuits for social cognition. The gap between physical self and others is activated by embodied motor simulation through the frontoparietal mirror neuron system, while self-other processing at an evaluative level is engaged through the cortical midline structures and temporal-parietal junction. (Pineda & Hecht, 2009)

Gallese, Rizzolatti & Craighero state that the neurophysiological foundation for empathy, love and human interaction is provided by mirror neurons. (Homann, 2010) The mirror neuron system has also been called an “observation-execution matching system” because of its role in understanding the action and intention of others (Dapretto et al., 2006, p. 28). The brain, by means of mirror neurons, literally makes an image of the mind of another before it can understand it intellectually. (Siegel, 2012) The awareness that others have intentions and beliefs that are different from oneself is considered the ‘theory of mind’. (Bernier & Dawson, 2009) It is thought that mirror neurons are a key component in the theory of mind, however a non-invasive procedure to directly measure this in humans has yet to be developed. (Pineda & Hecht, 2009)

The ‘direct matching hypothesis’ put forward by Rizzolatti et al. (2001), suggests that we understand actions and intentions by mapping the auditory/visual representation of the observed action onto our motor representation of the same action. Thus, once the actions
of another individual are represented and understood in terms of one’s own actions, it is possible to predict the mental state of the observed individual, leading to a ‘theory of mind’ (Oberman et al., 2005, 2006, 2008; Oberman & Ramachadran, 2007; Pineda, 2005; Rizzolatti et al., 2001). (Le Bel, Pineda, & Sharma, 2009)

There is also evidence from Koelewijn et al. that shows another potential function of mirror neurons being the ability to evaluate the correctness of actions of others. (Pineda & Hecht, 2009) In a study done by Pineda & Hecht, it is shown that mirror neuron activity is more relevant when individuals are making “social-perceptual judgments about emotional facial expressions” than during “social-cognitive tasks” that call on beliefs (Pineda & Hecht, 2009, p. 310). Which would suggest that the function of mirror neurons is directly involved in the relationship between an individual and another, rather than that of the individual alone.

**Autism Spectrum Disorder**

Individuals with autism spectrum disorder (ASD) are characterized by social and emotional deficits, which are believed to be in part caused by a functionally impaired mirror neuron system. (Pineda & Hecht, 2009) The fundamental impairment of autism however is considered to be in the social area with challenges with facial expressions, peer relationships, and eye contact. (Bernier & Dawson, 2009) Individuals on the autism spectrum “often feel misunderstood and are not able to express their needs effectively” (Tortora, 2011, p. 11). Essentially they experience dysregulation emotionally or physiologically, which may make them appear distant and self-occupied. (Tortora, 2011) With difficulty in imitation, it is hard for those living with the disorder to understand intentions of others or have empathy. (Cozolino, 2006)
What would it be like for you if the objects around you began to make sounds, interacted with each other, and approached you in unpredictable and frightening ways? For those with autism, human behavior is the stuff of nightmares. (Cozolino, 2006, p. 283)

There are two essential components of empathy: recognition of affect and expression, and attention to others’ affect. Both of which have been found to be impaired in those with autism. In a study developed by Yirmiya, Sigman, Kasari, & Mundy (1992) it was found that children with autism had difficulty in labeling both emotions displayed by children telling stories on videotape and their own emotional response to the tape. Additionally, in an empathy test developed by Corona, Dissanayake, Arbelle, Welington, & Sigman (1998) to measure physiological responses such as heart rate, children with autism showed no response when viewing another distressed person as a healthy individual would in the same situation. (Bernier & Dawson, 2009)

In 1972 DeMeyer and colleagues were the first to report that imitation was impaired in those with autism, yet motor actions were intact. This conclusion has been supported by 18 other studies as well. (Bernier & Dawson, 2009) Since the mirror neuron system is implicated in imitation learning, studies in recent years have worked to examine the development of the mirror neuron system in children with ASD. (Le Bel et al., 2009) The first to propose that mirror neuron dysfunction was the cause of imitation impairments in autism was Williams et al. (2001). (Bernier & Dawson, 2009) “The mirror neuron theory of autism simply proposes that dysfunction of the execution/ observation matching system does not allow for the internal representation of others’ observed behavior, expressions, movements, and emotions” (Bernier & Dawson, 2009, p. 277).
In a study done to evaluate the mirror neuron activity in high-functioning individuals with autism when imitating and observing facial emotions, it was found that they showed no activity in the mirror neuron area in the pars opercularis even though they did in fact use motor skills in order to imitate the facial expressions. A similar lack of mirror neuron activity in the pars opercularis occurred when observing facial emotions as well. In the same study it was also found that there is a negative correlation between the children’s scores on the social subscales of the Autism Diagnostic Observation Schedule- Generic (ADOS-G) and Autism Diagnostic Observation Interview- Revised (ADI-R) and the activity in the pars opercularis. This meaning that the less mirror neuron activity the children had in that particular area of the brain, the more severe their score on both autism diagnostic indexes. (Dapretto et al., 2006)

**Plasticity in Mirror Neurons: The Use of Music and Rhythm**

Wan et al. suggest that plasticity is possible in the mirror neuron system, similarly to how plasticity is possible in other parts of the brain following sensorimotor skills training. Making music involves auditory, motoric, somatosensory, and visual information, and therefore it is thought that the act of making music may use similar parts of the brain that contain mirror neurons. (Wan et al., 2010) Because of the plasticity of the mirror neuron system, it’s possible that creating music could assist in developing the system in those with developmental disorders such as autism. Similarly, imitation has also been shown to increase social interaction over gross motor activity in those with autism. (Wan et al., 2010) Wan et al. propose that more research be done to learn the effects of multi-sensory engagement in those with autism. It is hypothesized that learning would improve with or without the engagement of the mirror neuron system, and in order to determine if the system was in use or not a control group would be necessary in the
research showing exercises without the use of imitation, as imitation is the differentiating factor. (Wan et al., 2010)

**Dance/ Movement Therapy’s Role in Building Empathy and Imitation**

In dance/ movement therapy, the therapist follows the client’s lead as they “mirror and attune to the mover’s nonverbal style” (Tortora, 2011, p. 8). The awareness in order to be attuned to another’s movement comes from observing shifts in eye contact, posture, voice changes, and breath patterns. (Homann, 2010) “We listen, attune, and respond to the tones, rhythms, and multi-layered textures of our patient’s expressions both nonverbally and verbally” (Tortora, 2011, p. 7). By embodying the movement of a client, the therapist is able to create movement interventions in order to aid in expanding the client’s movement and therefore ability to be emotionally expressive. (Tortora, 2011) Siegel states that “attunement builds on itself” and becoming more attuned to one’s personal inner experience can actually increase their ability to be sensitive to the inner experience of others (Siegel, 2012, p. 23-1). By joining in movement with the therapist, mutual attunement occurs and the client is potentially able to increase their capacity to understand themselves in relationship.

The interventions used in dance/ movement therapy are both psychologically metaphoric and physical, and provide a way for the client to engage in relationship, exploring both the self and other. (Tortora, 2011) They incorporate somatic, perceptual, and emotional processes. Conscious tracking of sensations one body part at a time, tracking the rhythm of breath, and yielding into gravity are all ways of initially bringing awareness to the body. (Homann, 2010) Suzi Tortora often works in three stages with various clients including those with autism; the first includes working towards self-regulating senses in the individual, then she integrates
intersubjective functioning engaging verbal and nonverbal exchanges, and finally begins to work on the client’s ability to be in relationship with others. (Tortora, 2011)

The discovery of mirror neurons has attracted a lot of attention from dance/movement therapists because the function of the neurons provide an explanation for dance/movement therapists’ ability to resonate with clients. (Tortora, 2011) This discovery shows the neurological explanation for an individual’s ability to attune their senses in order to be in a nonverbal relationship through movement.

As we come to know ourselves, being in touch with our subcortical states, we open the gateway through this mirror neuron-insula-body-insula-middle prefrontal flow that then enables us to also know someone else. We come to resonate in ourselves with what we sense in others, enabling separate selves to become a part of a functional whole. (Siegel, 2012, p. 23-3)

Based off various dance/movement therapists’ description of the field, it would appear that the mirror neuron system is actively engaged during dance/movement therapy activities. More research in this area is needed however in order to scientifically identify the connection between mirror neurons and the field of dance/movement therapy. It is however proven that various dance/movement therapy techniques have been successful in those with autism under certain circumstances by attempting to stimulate and support neuronal development. In a clinical study by Fields, Sanders, & Nadel (2001) it was found that “children with autism who had been intentionally mirrored by adults demonstrated increased socialized behavior and engaged in much more reciprocal play with adults than those who had not been mirrored” (Homann, 2010, p. 90). Also, teaching imitative skills as an early intervention in those with autism has shown to
be effective in teaching the ability, which in turn allows for other forms of social communication and learning. (Bernier & Dawson, 2009)

**Discussion**

It appears that there is a connection between the mirror neuron system, autism, and the field of dance/ movement therapy, however more research is needed in order to prove the extent to which they are intertwined. Dysfunction in the mirror neuron system is thought to be a possible cause for the social impairments found in those with autism. There is evidence to suggest that the mirror neuron system has plasticity and can be molded, and dance/ movement therapy targets the imitation, and empathetic functions of the mirror neuron system with its various interventions. The two functions of the mirror neuron system that dance/ movement therapy targets are the social impairments those with autism often embody. It is hypothesized that if mirror neurons are in fact malleable, targeting the system with an embodied approach such as dance/ movement therapy would increase the ability of those with autism to be in relationship with others.
References


