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**Mirror Neurons? What Do They Have To Do With
Early Childhood Development and Education?**

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Introduction

Children see, Children do! This re-wording of a common phrase refers to the copying behavior that humans (as well as primates) engage in. Parents and teachers of young children are well aware of how much children imitate them - for better or for worse!

I vividly remember one nap time in a Toddler Room in a parent cooperative child care center. All the children were on their cots. One of my co-teachers was "stuck" back in a corner between several children, with one little boy who was having a hard time settling down. He wanted his stuffed bear, which was in his locker. The teacher asked me to get it, which I did. In an effort to not disturb the children who were already drifting off to sleep, I tossed the bear to my co-teacher. The moment she caught it, my heart sank with the realization of what I had just done! The little boy was still awake! His eyes were open! He saw me throw the bear to the other teacher! Guess what he did with the bear? He lay on his cot and threw the bear up in the air and caught it - over and over again! I had modeled that behavior to him - and then gave him the stuffed bear! What else could I expect him to do? I learned a lot that day. What I didn't know at the time, though, was that "mirror neurons" were involved heavily in that incident.

What are Mirror Neurons?

Mirror neurons are a subset of cells in the brain that do a variety of functions. Mirror neurons are organized into vast and complex networks. They hold templates or patterns for specific actions, and we can then recall

these actions at a later time and perform them. Mirror neuron networks give us a fast and intuitive idea of what is going on. When a baby sees his/her mother begin to uncover her breast, the baby knows that food is coming! Mirror neurons allow us to anticipate other's actions. When mirror neurons are functioning, you don't have to do much thinking.

Humans have multiple mirror neuron systems.¹ These systems allow us to copy actions that we see, but they also allow us to understand:

- The actions of others (such as, he or she is throwing a ball)
- Their intentions (they are throwing the ball in my direction)
- The social meaning of their behavior (I'm included in the game; or, I'm a living target about to be hit!)
- Their emotions (they like me; or, I'm on the opposing team and am thus the "enemy")

Now, most neurons are highly specialized. For example, there are neurons specialized to detect horizontal or vertical lines, a single sound frequency, or the direction of a movement. Some neurons are in groups and these groups detect more complex features, such as faces, hands, expressive body language, or they plan out movements or get into postures that are complex.²

Mirror neurons, however, are arranged in even more complex networks of neurons that allow us to do such things as:

- Read movements of others
- Understand goals of other's behavior
- Read and understand another's intentions
- Feel other's emotions, as if they are our own
- Understand language
- Absorb culture directly through
 - Social sharing
 - Imitation
 - Observation³

¹ Blakeslee, Sandra. "Cells That Read Minds." The New York Times, January 10, 2006. (<http://www.nytimes.com/2006/01/10/science>)

² Ibid.

³ Ibid.

This list describes abilities that are highly developed in humans, humans within a social context. Mirror neuron systems which are involved in the human capacity for language and empathy, for example, are *only* activated in social contexts. Brain science work on mirror neurons gives neurological support to Lev Vygotsky's essential premise that "all knowledge is co-constructed" through interaction with others or talking to our self.

Now, other animals have "rudimentary mirror neurons" however "humans, with their huge working memory," can "carry out far more sophisticated imitations." (Think about dancers learning long choreographed pieces.)⁴ Human children are "hard wired" to imitate through mirror neuron networks that are in place at birth. Mirror neurons are involved in observing what other people do (such as, use a fork, or type on a computer), and then practicing doing these same things. It is no wonder that the areas in the brain for *observing* and the areas of the brain for *doing* are very close to each other physically. When we observe, we prime (ready) ourselves for copying.⁵

Who figured this out?

Researchers in psychology have studied imitation in newborn babies for more than half a century, but didn't fully understand what was going on. People (including researchers) have observed situations where a parent sticks out his tongue at his newborn baby, and if the baby is paying attention to him, the baby will imitate the gesture.

How do babies know how to stick out their tongue, when they don't know where their mouth is? The answer to this came with the discovery of mirror neuron networks.

"In the early 1990s, a group of neuroscientists at the University of Parma, Italy, identified, for the first time, so called "mirror neurons" in the brains of monkeys. The researchers located neurons that fired when monkeys performed an action, such as grasping a cup.

Surprisingly, the same neurons also turned on when a monkey merely watched another monkey closing his hands around the cup, suggesting

⁴ Ibid.

⁵Vedantam, Shankar. "How Brains' 'Mirrors' Aid Our Social Understanding." washingtonpost.com, September 25, 2006. (<http://www.washingtonpost.com>)

that these neurons also played a role in mirroring the actions of others. Later, this Italian team and other scientists searched for and found areas of the human brain with the ability to mirror movement."⁶

So, when I stick my tongue out at the newborn baby, the cells in the baby's brain that perceive my tongue AND perceive the baby's own tongue- get stimulated, and the baby sticks out his tongue! In this small act, we are witnessing motor mirror neurons in action.

Why is about more than "simply learning" how to do things?

To start with, mirror neuron systems explain how imitation (or observational learning) works. Albert Bandura was the first psychologist to study the process of observational learning, which occurs when a person's own behavior is influenced by watching another person, called a model, or role model.

Children learn a great deal by watching adults, older children, and peers. I remember the first time a preschooler in my class played "teacher" and was "reading" a story to some other children. I saw myself - in how the child sat, how she held the book, and how she kept control of the group! At the time, I viewed this as a simple case of imitation of my behavior. What I didn't know then, was that she was "feeling" my behavior when she watched me.

Mirror neuron systems make us "mind readers"

"Mirror neurons allow us to grasp the minds of others, not through conceptual reasoning, but through direct simulation. By feeling, not by thinking."⁷ When a child (boy or girl) is mimicking shaving while his or her father actually shaves, the child is "feeling" what it's like to shave by watching the father. Because the child "feels" it, he or she is able to mimic or perform the behavior.

For another example, suppose you see a friend returning a piece of merchandise that was defective. You watch your friend be assertive in

⁶Eisenstadt, Leah. "Empathy on the Brain." Triplepoint.
(<http://www.bu.edu/sjmag/scimag2005/features/mirrorneurons.htm>)

⁷ Blakeslee, op. cit., 1.

getting her money back. Her success influences you to behave more assertively the next time you try to return something you've bought.

Mirror neurons help explain why you did this. By watching your friend's approach being successful (or rewarded) in terms of getting her money back, your mirror neurons responded as though it was YOU who had the success and was rewarded. You felt what she was feeling. Our brains, according to Gallese, "appear to have developed a basic functional mechanism... which gives us an experiential insight of others' minds."⁸

"With mirror neurons, we do not have to pretend, we practically are in another person's mind."⁹ Think about preschoolers' dramatic play. When a child pretends to be the bus driver, she IS the bus driver, especially if that child rides the bus frequently and has frequent opportunity to watch the driver! The more she gets to observe, the more she can "feel" what the driver is doing.

On the other hand, researchers now believe that various conditions in people that are characterized by a lack of empathy or "mind-reading" are caused by mirror neurons gone awry. This would include people who have autism, schizophrenia, and people with strongly anti-social behavior, which includes hurting others. (This is not to imply that these 3 conditions are in any other way related.)

Daniel Goleman, in his book, Social Intelligence: the New Science of Human Relationships¹⁰, tells us that the very design of the brain makes us sociable, and much of this design is the work of multiple mirror neuron systems. When we interact with others, we form an "intimate brain-to-brain linkup".¹¹ "During these neural linkups, our brains engage in an emotional tango, a dance of feelings."¹²

⁸ Ibid.

⁹ Iacoboni in Than, Ker, "Scientists Say Everyone Can Read Minds." Health Sci Tech, April 27, 2005.

¹⁰ Goleman, Daniel. Social Intelligence: The New Science of Human Relationships. New York: Bantam, 2006.

¹¹ Ibid., 4.

¹² Ibid., 5.

Emotional Mirrors

Vittorio Gallese, one of the original researchers at the University of Parma, states that "emotions constitute one of the earliest ways available to the individual to acquire knowledge about its situation."¹³ Mirror neuron systems, according to the Parma group, "allow us to read emotions in others" and understand their intentions.¹⁴



Mother and infant smiling at each other Harry Cutting Photography

Newborn babies cannot understand language, but they can understand us! We smile at them, which causes them to smile back, and then we continue to smile and coo at the baby, with both of us feeling happy. These brain-to-brain linkups are essential for us to bond with the baby and for the baby to become securely attached to us. When these linkups are pleasurable, the baby is motivated to engage with us more and to copy all of our behaviors, including language.

¹³ Ibid.

¹⁴ Rizzolatti, Giacomo; Fogassi, Leonardo; Gallese, Vittorio, "Mirrors in the Mind." Scientific American, Nov. 2006, Vol. 295, Issue 5, 54-61.

Goleman states that "the more strongly connected we are with someone emotionally, the greater the mutual force. Our most potent exchanges occur with those people with whom we spend the greatest amount of time day in and day out, year after year - particularly those we care about the most."¹⁵

Feelings are contagious

Whenever we connect with someone else, says Goleman, "our social brains interlock. Our social interactions even play a role in reshaping our brain, through 'neuroplasticity',...our key relationships can gradually mold certain neurocircuitry."¹⁶ "Because of mirror neurons, we feel with the other. Empathy, then, includes attuning to our own feelings in order to better sense what's going on with the other person."¹⁷

Since empathy requires us to be aware of our own feelings, then children need to learn about and be able to talk about their own feelings. Teacher-caregivers and parents must be prepared to help children identify their emotions when they are being expressed and must also model empathy to the child. And, the parents and teacher-caregivers must be aware that their own feelings are "contagious".

Goleman reminds us that the brain-to-brain link is a "double-edged sword: nourishing relationships have a beneficial impact on our health, while toxic ones can act like slow poison in our bodies."¹⁸ During interactions, "we create one another...and the social brain represents the only biological system in our bodies that continually attunes us to, and in turn becomes influenced by, the internal state of [the] people we're with."¹⁹

We "catch" each others feelings, kind of like we catch a virus, by being exposed to them. "When someone dumps their toxic feelings on us," says Goleman, when he or she "explodes in anger or threats, shows disgust or

¹⁵ Goleman, op. cit., 5.

¹⁶ Ibid., 11.

¹⁷ Salzberg, Sharon. "I Feel Your Brain: An Interview with Daniel Goleman." Tricycle: The Buddhist Review, Nov. 6, 2006.

¹⁸ Goleman, op. cit., 5.

¹⁹ Ibid., 10.

contempt - they activate in us circuitry for those same distressing emotions."²⁰

Implications of this information for early childhood educator/caregivers and programs

The National Association for the Education of Young Children has a Code of Ethical Conduct for teachers of young children. The first and most primary of all the principles is "Do No Harm". With the information we now have on how the mirror neuron systems work, "harm" may come to children through the passing on of "toxic" feelings.

This brings us to some of the challenges that we continue to face in our field of early childhood education and care. We operate programs for young children, whose young parents are typically in the lowest earning period of their lives. Our programs are primarily financed by the parents' ability to pay for the total cost of the services, since there are few subsidized programs (whether private or public). The subsidies that do exist are for parents who have a very low income, however the payments do not equal the cost of care.

This has resulted in a situation where the typical teacher-caregivers make low wages, have few, if any, benefits, and little formal education. We have a high turnover rate in ECE programs, of about 30%. Since the programs that do provide higher wages, benefits, and healthy and appropriate work environments (and here I mean both physical environments and psycho-social environments) -since those programs experience very low turnover in teacher-caregivers, other programs must have extremely high turnover rates. Some children, therefore, may have three or more different teacher-caregivers within one year in a classroom where the child spends almost $\frac{1}{2}$ of each 24 hour day, five days a week. Relationships in these situations are fleeting at best.

Teacher-caregivers of young children - in full or part-day programs, in centers or in homes - whose working conditions make them upset or angry, will "send" these emotions to the children, even if they try to repress them. When teacher-caregivers work in classrooms that are lacking in age-

²⁰ Ibid., 13.

appropriate equipment and toys, or that have only the minimum required amount of space per child, they will become stressed by trying to keep control of overcrowded and under-stimulated children. The children will pick up on the stress that the teacher is feeling, which in the long term contributes negatively to their health - for both the children and the teacher-caregiver.

Teacher-caregivers who are overwhelmed due to their working conditions and/or their lack of specific early childhood training may not "link up" with children in their care. They may only be able to survive the day. The children in these classrooms will miss out on the opportunity to benefit from an adult who is "exquisitely attuned" to their unique personality and learning style. They will miss out on the support and "scaffolding" from adults that they need to grow.

Changes in the infra-structure of full and part-day early childhood programs are sorely needed if we want our children who are enrolled in them to find an adult with whom they can have a deep, authentic relationship.

We must make decisions that are in the best interests of children

Even in the best of physical circumstances, the adults who care for children outside of their homes must have the psychological maturity to form and maintain intense, and healthy, relationships with others. Goleman reminds us that "every interaction has an emotional subtext."²¹ We can make each other feel better or feel worse when we interact. He speaks of how we each have an "emotional economy" - which refers to the net "inner" gains and losses that we get from our interactions with others. "By evening," Goleman says, "the net balance of feelings we have exchanged largely determines what kind of day - 'good' or 'bad' we feel we've had."²² We are capable of changing another's moods and they are capable of changing ours.

When teacher-caregivers are working with children who have challenging behaviors, these daily interactions can be very stressful. If the teacher does not have a firm knowledge of guidance and communication techniques nor support from experts or an additional aide in the classroom, she or he

²¹ Ibid., 14.

²² Ibid.

will be in a constant struggle with the child. This may potentially bring up many negative emotions in the teacher and in all the children in the class. "Like second-hand smoke, the leakage of emotions can make a bystander an innocent casualty of someone else's toxic state" says Goleman. This is the "downside of emotional contagion."²³

Now, in some programs, the child with the challenging behaviors would be "kicked out"! This, of course, is unethical in our field. To protect everyone in the room and to "do no harm", structural adjustments must be made to both support the teacher and to keep the child in the program. Adjustments can include: reducing the total number of children in the class, getting outside help for the teacher-caregiver from an expert, and/or adding an additional, experienced, and *mature* adult to the classroom.

A further down-side of our social brains

In classrooms where the children are "out of control" - which can be seen in a variety of settings for a number of reasons, we set up a spiral of reactions that can put adults and children into a state of depressed immune function. When we confront anger from someone (adult or child), our brain (specifically the amygdala) goes into "hypervigilance." It is looking for other signs of danger as we experience the fight-flight-flee or freeze response of extreme stress. The emotion of "fear" really sets it off. When we are hypervigilant, we are more susceptible to someone else's emotions, and our ability to learn is suppressed.

From the adult's point-of-view, if we DO allow ourselves to emotionally connect with others, couldn't we get overwhelmed by the input? Goleman states that "the dilemma is that the social brain continually makes emotions contagious, which means our empathy also makes us vulnerable to catching distress. The archetype of such empathy distress is *compassion burnout* in helping professions like nursing or social work [or, I add, early childhood education]. That occurs when people are constantly confronting human pain and distress but have too few inner emotional resources or too little emotional support in their workplace to contain those feelings - they get swamped."²⁴ In ECE programs, especially full day programs, we may have

²³ Ibid.

²⁴ Salzberg, op.cit.

upset children who cry all day, or parents who “unload” their problems and worries on us when they come to pick up their child. The high turnover in this field is also a product of emotional burn-out!

What resources must be in place to reduce the stress of working with young children and their families?

Teacher-caregivers must be well schooled in using and teaching problem solving, and avoid getting into power struggles with children. We can reduce conflict through thoughtful arrangement of the physical environments and the use of prevention in our guidance and supervision of children. Teacher-caregivers must be comfortable interacting with both children and adults. I periodically encounter students who want to work with young children, because they DO NOT like to work with adults!! This means they are only half-way there. We must be able to establish healthy relationships with adults as peers and as the parents of the children in our care.

Teacher-caregivers must be confident and “congruent” in their language and responses to children and their parents. Our brains are wired with an “early warning system for insincerity” - they are “specialized for suspicion.” These characteristics are just as important to us as humans as our “capacity for trust and cooperation.”²⁵ For example, if our body language (especially our facial expression) does not match what our words say, the listener’s brain activates “a site specializing in vigilance for social threats or conflicting information.” It makes us “dislike” that person.²⁶

Children, in care outside of their homes, need mature adults who are confident in their ability to form and maintain healthy relationships with them and their parents. Relationships are EVERYTHING. The ability to form healthy relationships with each child in our classroom, in our care, IS the most essential quality for effective teaching and caregiving. But the relationships must be authentic, and include brain-to-brain link ups. Children can detect a fake.

²⁵ Goleman, op.cit. 22.

²⁶ Ibid.

Children are strongly influenced by the quality of their relationships

In the interpersonal flow of emotion, one person tends to make a "larger emotional shift to converge with the other"²⁷ and that is the person who has less power in the relationship. In our situations, that would most often be the child. If we exude "toxic" emotions, or even indifference, children in our care will work to match their feeling to ours. Says Goleman, "when we attune ourselves to someone, we can't help but feel along with them, if only subtly. We resonate so similarly that their emotions enter us - even when we don't want them to."²⁸

But if we exude healthy, supportive, confident, fun-loving, creative feelings as teacher-caregivers; if we are authentically happy to see each child arrive each day, then the children will "catch" these feelings! Teacher-caregivers who feel supported in their work, who feel respected for the enormously important job they do, will most likely be enthusiastic in the morning when the parents and children start arriving. When we share positive feelings, "which are evoked largely through tone of voice and facial expression"²⁹ we help establish rapport.

But, even in the best of worlds

Say we have teachers who *are* emotionally mature and are capable of making and maintaining healthy, authentic relationships. Their ability to "connect" with each child in their class **can still be compromised**, if one or more of the following situation exists.

1. They are in charge of too many children (how many is "too many" depends on the age, abilities, and developmental level of the children in the group). When there are too many children, some children will be left without connecting. Often these are the children who are "shy" or are the ones "capable" of doing things by themselves.
2. The teacher-caregiver is preoccupied with other duties or concern: this could be a health concern (especially if they have no insurance), a problem at

²⁷ Ibid.

²⁸ Ibid., 26.

²⁹ Ibid., 30.

home, unrealistic record keeping, or even having to answer the phone! When teacher-caregivers have to multi-task or are chronically distracted, they do not connect with children as frequently. "When our attention is split, we tune out a bit, missing crucial details - especially emotional ones."³⁰ Maintaining mutual attention with children through eye contact "opens a pathway for empathy."

3. The teacher-caregivers work with children for a number of hours that goes BEYOND their capacity to connect. Many experts in the field estimate that most teacher-caregivers exceed our capacity to be "present" with children when we go past 6 consecutive hours. These constraints on "connecting" with children are indicative of a need for a coordinated, system-wide, multi-disciplinary, problem solving approach to meeting the needs of children and teacher-caregivers in early childhood programs.

What can teachers of young children do?

Teaching is both an "art" and a "science". The "art" of teaching is in the relationship - the dance we have with each child - the brain-to-brain link. The "science" of teaching is in our knowledge of child development, and now, brain development. The science meets the art when we apply this knowledge, when we are engaged in the dance! When the art and science come together, children flourish. They are challenged, respected, supported, nurtured, and understood! This is how they learn best. Our creativity can flourish as we develop responses, curriculum, and/or learning opportunities for children who we know well.

The broad field of early childhood education (including parent involvement and early intervention for children with special needs) has to be addressed in light of what we are learning, but that does not mean that we, as individuals, cannot create some of the necessary change right now.

As teacher-caregivers of young children, we can use our knowledge of child development, including brain development, to the child's benefit. Since we've been exploring mirror neurons, let's look at how we can use this particular information to support the development of each child's own mirror neuron system.

³⁰ Ibid.

Use body language that matches your words - be congruent

Mirror neuron systems are present in the infant prior to the acquisition of language. Thus, the younger the child, the more they rely on reading body language as opposed to the words that the adult is saying. As caregivers, we need to make sure that our bodies, faces, behavior, and words are coordinated, particularly in our work with infants and toddlers.

If I am showing concern for a child who has just bumped his or her head, I should try to mirror the emotion the child is feeling to demonstrate empathy and understanding. I might make a sad face as I say something like, "Ow! You hit your head! That must hurt! Come here and let me look at it."

If, however, a toddler falls and begins to cry, and the adult's response is to laugh, the child becomes confused at an emotional level. This experience is happening at a subcortical level in the brain, meaning that the emotional confusion remains but is not available to the child at a conscious level. The feelings remain but are not available for reflection.

On the other hand, say a toddler is peeking at me from behind a chair, and I respond by smiling, pulling my shoulders up, and pretending to "peek back". In this case, the child does NOT experience emotional confusion. Instead, he or she feels emotionally understood, and acknowledged.

Story telling and reading poems

One of the major ways that we use and train the mirror neuron networks is through story telling. Leah Eisenstadt explains that "we experience emotions second-hand through story telling, whether it's the sadness of loss... or the joy of a long awaited reunion. Throughout history, people have shared the storytelling tradition around the campfire, on stage, on the big screen, and now through reality television"! Art and literature "exploit" mirror neurons. "Experiments show that when you read a novel, you memorize positions of objects from the narrator's point of view."³¹

Reading to preschool aged children from books designed for slightly older children, (such as Winnie-the-Pooh or Stuart Little) or reading poems allows children to "feel" other's emotions or observations without the aid of

³¹ Blakeslee, op.cit.

pictures, only from the words. When I was in grade school, one of my teachers, who had a gift for reading aloud, read us the book, Charlotte's Web. Let me tell you, when Charlotte, the spider, died, EVERYONE in my class, boys and girls alike and even the teacher, CRIED!

Spoken words can evoke creative and vivid images in our minds, if we are connected brain-to-brain. Here is the first section of a poem (by Rosalie Moore) which I used to read to preschoolers. It is entitled "Catalogue". If you have ever lived with a cat, you will relate to this even more strongly.

Cats sleep fat and walk thin.
Cats, when they sleep, slump; When they walk, pull in--
And where the plump's been, there's skin.
Cats walk thin.

Picture books are wonderful for young children, but reading aloud, without pictures, must not be ignored! Literature uses imagery and metaphor. Mirror neurons may be involved when people understand metaphors. So reading to children, from great literature, helps develop children's capacity for empathy and forming relationships.

Reflect cultural diversity

A second way to support children's development from the perspective of mirror neurons is to reflect the cultural diversity of the children and families in your classroom. "Cultural diversity is what defines us as a species," says neuroscientist, V.S. Ramachandran.³² Our big memory systems and mirror neurons support the development of unique ways of living, adapting to our circumstances, and communicating, or in other words, making culture. Each group makes a unique culture based on our tendencies to mirror each other and connect with each other.

Our mirror neuron systems also support our ability to acknowledge, accept and celebrate our cultural differences. According to Ramachandran, "mirror neurons... dissolve the barrier between self and other." He calls them 'empathy neurons'.

³² Ramachandran, V.S. "Mirror Neurons and the Brain in the Vat." Edge: The Third Culture. Jan. 10, 2006. http://www.edge.org/3rd_culture/ramachandran06/ramachandran06_index.html

Having a bulletin board on which you put photos of the children and their families celebrates differences. You can even have the children make a frame for their photo. Or you could have a photo album of family and school pictures. Children go back to these pictures all year long.

Singing together

And finally, singing together is a way to get in synch with each other. When we sing together, we share a "visceral pleasure, and the larger the group the better." The wiring for such mass synchronization and resonance is built into our nervous system. "Getting in synch creates an emotional match."³³

Teachers should not be afraid to sing with children. You do not have to be a professional or accomplished singer! Whole group, (or whole center) singing will promote good will and pro-social attitudes. Songs with positive messages model "getting along" and seeing others as potential friends. Singing together makes us all feel good.

Try this one to any tune you like:

You're my friend, you're my friend,
You're my friend, you're my friend.
Friends, friends, one-two-three,
All my friends are here with me!
All my friends are here with me!

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³³ Goleman, op.cit., 32-3.