

## **THE POSITION OF MIRROR NEURONS IN LINKING APPLIED PSYCHOLOGY AND APPLIED PEDAGOGY**

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### **Summary:**

An overview is given upon the status of research concerning the mirror neuron system in the human brain. From the very start of finding motor imitation activities in the brain of macaques (merely by chance) to the state of art experiments that seem to prove that the mns in the human brain is very well capable of not only imitating moves but as well to identify intentions and emotions the impact on education and learning is discussed.

**Keywords:** Learning, Imitation, Motor Vocabulary, Empathy

When we carefully observe the motion of somebody else, carrying out a specific task in sports, arts or in everyday life, our organism will absolutely imitate the full scale neural control mechanism. That means that by just observing a move we will imitate the activity down to micro-moves in our muscles in the end.

This “Carpenter-effect” was detected and published before the end of the 19<sup>th</sup> century but it took more than 100 years until the source of this effect was found.

A team of the University of Parma, led by G. RIZZOLATTI was doing research on the neural control of simple reaching moves of macaque monkeys when they found out that the same neurons in the F5 region of the monkey did not only fire when the monkey reached out for food but as well when the monkey observed somebody else reaching for food.

A series of very cautious and sophisticated tests followed before the group was absolutely positive that they somehow had detected the origin of imitation.

Maria UMILTA stated that the monkeys were not only able to copy moves that they saw in total but they could also copy and finish moves when they had only seen the starting sequence. The key point was that they had to have information about the set up.

Funny enough the ability of imitation was limited by the specific knowledge of the operation: monkeys could not imitate pick up moves by using some tools which corresponds with the findings of Gordon GALLUP who proved that monkeys failed in identifying themselves in a mirror if they had no pre-experience with the function of a mirror.

With that RIZZOLATTI, GALLESE and IACOBONI turned to the research of the mirror neuron system in human beings. Supported by image giving procedures like the fMRT and the PET and by using TMS they found out that human were able not only to identify and copy the move but also the intention behind the move as long as this move belonged to the motor vocabulary of the respective person.

This famous “tea-cup-experiment” was published in 2005 stating that chains of mirror neurons do in fact rebuild the intentions of the move observed.

This was achieved by presenting different video clips showing an action, a specific context and the intention of a move.

RIZZOLATTI stated by this that “*The bigger part of the neurons does not code single moves but motor acts.*” (Rizzolatti/Sinigaglia 2008, 37).

Backed up by the researches of RAMACHANDRAN, KEYSERS et al. and FOGASSI the concept of the human mirror neuron system was extended largely.

Not only moves and intentions but feelings, emotions and empathy as well are transferred by the mirror neuron system.

The following statements: “*Mirror neurons lead us to identify the intentions of others.*”

(Iacoboni 2011, 43) – “*Mirror neurons of human are capable of cope not only the target of the motor act but as well the timing of the single moves of which it is composed.*”

(Rizzolatti/Sinigaglia 2008, 125) as well as the identification of specific sounds following

KEYSERS - “*It seems that our only chance to identify this noise is to simulate the action*

*producing this sound or to imitate it internally.*” (Iacoboni 2011, 46) summed up do lead us to a general concept of an implicit kind of understanding thus rejecting the traditional old concept of understanding by reflecting.

The scheme

**Reception**  $\Longrightarrow$  **Cognition**  $\Longrightarrow$  **Movement**

has to be substituted by the system of **direct matching**.

“*Our brain is capable of giving sense to acts of others and by this to understand them directly without cognitions, just based upon personal motor abilities.*” (Rizzolatti/Sinigaglia 2008, 14).

### **What does this mean to the concepts of education in general and in the education of coaches and referees in particular?**

For education in general it just underlines the fact that “*education is the living demonstration of a certain set of values*” (Pollany 2006, 2) in principle. Therefore the demand on the personality and the competence of the leader is pretty high. A key factor in this relationship is the issue of authority. Authority is a bilateral system based upon acceptance without pressure.

Bilateral means that authority must be given by the addressed person thus stating the fact that education needs cooperation of the addressed as a basic requirement.

Without the readiness for cooperation by the pupil, student or athlete the whole process cannot be started due to a certain procedure in our limbic system.

There is a direct connection between the mirror neuron system and the limbic system via an area of the brain that is called **insula**.

This connection has been proved by IACOBONI in his experiment with portraits of people showing expressions of different emotions thus leading to the “Facial-Feedback-Hypothesis”. But this connection at the same time does work the other way around as well. Our limbic system, namely the Hippocampus checks the incoming information whether it is of interest or not. And only in case of rating the information worth while the mirror neuron system will be activated.

That means that in the end all information has to be presented in a way evoking interest – a challenge for all lecturers, teachers and coaches. If this is not the case, the attention of the audience will turn to something else rated more interesting by their system.

Moving on to language and verbal teaching we start on the grounds of LIBERMAN’s motor theory of language perception. This theoretical concept has been backed up by researchers FADIGA, WILSON and MEISTER and summed up in this statement: *“In order to understand the words of somebody else it is in fact necessary to mirror them.”* (Iacoboni 2011, 115)

But this means that the presenter has to use a language which the students are in command of. Therefore it is very difficult to transfer the knowledge that someone has gained from university lectures to kids in primary schools. The same applies in sports with the transfer of top level concepts to athletes of less experience and class.

### **With this we have already switched to particular challenges in the education of coaches and referees/delegates.**

Talking about coaches they have to adjust their presentations and demonstrations to the level of their respective players. This gives a massive problem in case a top coach decides to work with a low level team. Even if he/she tries very hard every now and then overload of the players is more or less inevitable. A lot of patience and mutual understanding is necessary to avoid conflict. And just one player tackling the authority of the coach can cause the collapse of the whole system.

It is not clear yet to what extent verbal explanations can evoke motor knowledge due to the mass of mirror neurons in the BROCA-region. Rizzolatti’s statement *“If understanding is possible on different grounds....., mirror neurons are able to cope the ... action without any optic stimulus.”* (Rizzolatti/Sinigaglia 2008, 112) connected with the theory of LIBERMAN mentioned above has borne the impression that excellent verbal description might be sufficient in many cases.

In terms of the education of referees/delegates I do have massive doubts.

There will be a huge number of situations during a game that cannot be defined verbally to the extent. Also there are situations that one can call correctly only knowing the situation from the experience as a player or having a different context to find it in the personal motor vocabulary.

Looking at the present situation with the education of the referees/delegates most of them are forced to start their career quite young. That means that they never had the chance to gain a motor vocabulary in handball that will match with the one of a top player or an experienced coach who had been a player of good class before.

So they do lack of the chance to detect and understand intentions and actions of players in crucial situations because they do not have a copy of the situation in their vocabulary available.

The ultimate effect is the statement that they do know all the rules by heart but they do not know the game and therefore their calls are disastrous.

But using the mirror neuron system we do have a direct and easy way to give them the necessary information for their motor vocabulary.

A quick and straight way is to do a huge lot of short video clips showing crucial situations from different angles in real time. This should be repeated 3 times, followed by one slow motion and another presentation in real time. It is necessary to show the start of the action, the full sequence and the outcome including consequences.

These clips might be summed up with headlines and collected in a few DVDs.

This is the first part of the concept.

The second part is to organize a seminar for the referees/delegates focusing on the watching and the uptake of the material – the learning technique for adjusting the information into the vocabulary by means of the mirror neuron system.

This teaching concept shall be started from all sides:

All our lecturers shall be familiar with the concept of learning by the mirror neuron system.

It has to be part of the top referee seminars, the mini courses and the young referee program.

At the same time it has to be presented to the chiefs of referees and implemented in the courses of national education of referees/delegates.

I want to point out that the instrument is not new but the application of the teaching tools will be much different from the past. We have to say farewell to the over aged idea of only calling what you see. The ultimate target is to call what you see, feel and know.

Wop, September 2011

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