FONDAZIONEISTUD

Neuron mirror neuron mirror of we all, are you the way to empower our soul?

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A cura di:

Gaia Vitali

Andrea Bortolotti

Nicoletta Giovine

Alessandra La Forgia

Summary

Abstract

To understand the other,

that is, to imitate his feelings

in ourselves,

we put ourselves in a perspective of

internal imitation

that somehow gives rise,

pours out feelings in us similar

by virtue of an ancient association

between movement and sensation

Nietzsche Aurora

Every human being is able to understand not only the behavior of others, but also their intentions and motivations due to the presence, in various areas of our brain, a specific group of neurons, discovered by G. Rizzolatti and his colleagues at the Department of Neuroscience[1], University of Parma in the mid-90s the mirror neurons.

The primary function of mirror neurons is not imitation[2], as one would think, but it is the understanding of the purpose of the action, the intentions of the other. And it is obvious that more the society in which the individual lives is complex, more the ability to understand the intentions of others becomes a favorable, and then presents an evolutionary advantage. If at first the discovery of mirror neurons was limited only to the neurological scope, now we can say that has unexpected repercussions on the personal and social life of every day.

The aim of our project work is to explain how mirror neurons are a resource to be exploited to empower communication within organizations. Work environment that where empathy is privileged and enhanced, allows you to improve and get better the mission of the individual and of the team.

Through various studies and by reporting examples of important brands that embrace this culture, we observe the construction of an 'organization made up of empathic individuals, who talk and breathe in unison to reach their goals and to ensure their company's success .

1 Science of Communication

“We can have all the means of

communication in the world,

but nothing,

absolutely nothing replaces the look of being human”.

***Paulo Coelho**, Manual of the Warrior of Light, 1997*

1.1 Life Science

Biology (from Greek, βίος, bìos = "life" e λόγος, lògos = "study") is the science that study all that regarding life and the living organisms, describing their form, inquiring about phenomena that happen inside them and finding the way to link all this aspects. Also its purpose is to understand the different models of organism, making a comparison and putting them in relation, highlighting the common features between all the living organisms with the goal of define the concept of “life”.

In this period we had done a lot of progress to understand the processes that are at the base of life and is grew up the consciousness about the deep interactions between the humans and the huge variety of organisms with which we share our life on the earth. As in all the experimental sciences, the aim of biology is reproduce the observed phenomena for understand the mechanisms involved and for verify their universal aspects. In particular, a

feature of modern biology is that living beings follow the same physical and chemical rules that permit to explain the behavior of inanimate matter.
Modern biology seem to be an autonomous science compared to medicine, only since the end of the XVII century, when were discovered lens and microscopes that were able to observe the extremely little.
In the XIX century were formulated new important theories, like the cellular constitution of organisms, the evolution theory and the genetic rules, that give an important empowerment to biology. In XX century the interest of biologists looks at the study of chemicals of living matter and this was helped by the introduction of electron microscope. Nowadays, biology is a booming science that includes sectors even more specifics, like molecular biology or the exobiology and at the same time strongly related with medicine, agriculture, veterinary and with human science like anthropology and psychology.

1.1.1 Cellular Communication

Cellular signaling or cellular communication is defined as the set of processes that permit the dialogue between two or more cells of an organism by responding to a specific signals and includes also the cellular signaling process in response to a signal. The those responsible of the cellular communication generally are extracellular molecules secreted by other cells or by the same cell that could act on the same cell, or, on short or on long distance.
They are, in generally, secreted by a signaling cell with the purpose of transmit a signal to a target cell that is located in a variable distance. These molecules are caught by the receptors, which are, usually, transmembrane proteins located inside the plasmatic membrane with a binding site placed in the extracellular space. Among the molecules that induce a cellular answer, most frequent are the hormones. The binding made by a ligand to a specific receptor unleashes its activation in a wide range of probable mode and the receptor, as well, triggers one or more signaling patterns.
The signaling patterns involve mainly signaling proteins, for example, ionic channels, gene regulatory proteins, enzymes, cytoskeletal structural proteins, intracellular
There are five patterns for the cellular communication: autocrine, contact dependent, paracrine, endocrine and synaptic.

- Autocrine communication: occurs when the target cell is the same cell of signaling. It is a strategy widely used by some cancer cells.
- Contact dependent communication: occurs when the signaling molecules are located on the surface of a cell and they signal to the target cells, binding them, without leave it. It is much used by some types of leukocytes such as lymphocytes.

- Paracrine communication: occurs when the signaling molecule operates at a very short distance on different target cells placed close to the signaling cell.
- Endocrine communication: occurs when the signaling molecule, often carried by the blood, acts on a target cell placed at a great distance. This molecule is often a hormone.
- Synaptic communication: the neurons use a particular type of signaling which consists in the production of action potentials which run along their axons until arriving at specialized structures called synapses, that contain vesicles in which are contained the neurotransmitters; in response to an action potential, some of these vesicles collapses into the presynaptic membrane, releasing neurotransmitters into the inter-synaptic gap and these bind to specific receptors located on the postsynaptic membrane, eventually triggering a further action potential or at least a response on the target cell, or neuron.

The transition from the presynaptic membrane to the postsynaptic is very fast, in the order of a millisecond. The concentration of the neurotransmitters in the inter-synaptic gap is much higher than that of other signaling molecules and may exceed 104 M, on average ten thousand times more of an hormone, although decreases rapidly due to the degradation by specific enzymes.

1.1.2 Neuronal communication

Synapsis is the zone in which the activity is transmitted from a neural cell to another (or from a neuron, called motor-neuron to a muscular fiber. There are two types of synapsis:

- Electrical
- Chemical

Both have as peculiarity the specialization of the membrane's structure in the place where the afferent cell, known as presynaptic cell, is in contact with the efferent cell, or postsynaptic cell.

In the case of chemical synapses, the action potential of the presynaptic cell causes the release of a chemical substance, called neurotransmitter, who diffuses in the extracellular gap changing the postsynaptic cell membrane's potential.

In the case of electrical synapsis instead, a part of the action potential of the presynaptic cell is transmitted directly to the postsynaptic cell for direct contact without the necessity of a chemical mediator.

The majority of synapses of the neuronal system of mammalians are chemicals.

In the chemical synapses, the postsynaptic and presynaptic cell's membrane are placed very close to each other but they remain divided by a little space where we have the extracellular gap also called synaptic gap.

In the case of electrical synapses, instead, the intracellular sections of cells are linked directly with specialized ionic channel, these sections are called tight junctions, through which the

passage of electricity between the cells is permit. When the action potential arrive at the end of the motor-neural axon, it propagates inside a specific structure called synaptic terminal.
The synaptic terminal depolarization causes the release of a chemical messenger kept inside the terminus. In the case of neuromuscular junction of vertebrates, for example, this neurotransmitter is the Acetylcholine (ACh). The Release in the synaptic gap let the ACh modify the ionic permeability of the membrane of the muscular fiber depolarized. The association between the release of Ach contained in some vesicles and the depolarization isn't direct, but is mediated by the entrance, in the synaptic terminus, of the flow of calcium ions.
The vesicles fuse with the membrane at precise points of the membrane that are exactly in front of the postsynaptic motor endplate (release sites).
The synapses in which the neurotransmitter brings the membrane potential of the post-synaptic cell to the level of the threshold for action potential are called excitatory synapses. Not all the synapses between neurons are excitatory: in inhibitory synapses, the neurotransmitter keeps the membrane potential of the post-synaptic cell values more negative than the threshold level, so the post-synaptic cell is inhibited by the release of the inhibitory transmitter.
In the nervous system, neurons receive both excitatory and inhibitory synaptic afferents. If the post-synaptic neuron generates or not an action potential depends only by a factor: if is reached or not the threshold value of the membrane potential. This condition can be evaluated by summing all excitatory and inhibitory potential, so it is the balance of excitatory and inhibitory afferents to determine whether the post-synaptic action potential occurs or not.

1.1.3 Plant's communication

The plants have a rich communication system, consisting of a large variety of molecules (amino acids, sugars, secondary metabolites, volatile substances) with which "dialogue" with their neighboring or with animals. And also in the last few years we're discovering an internal system of information transmission at the level of the roots may be considered somewhat analogous to the nervous system of animals.
The plants do not have neurons, but some plant cells, in particular the cells of the root apex, namely the tip of the root, are able to produce electrical signals in the form of action potentials and send it to neighboring cells.
We remember that Charles Darwin believed that the root apex represented a sort of "diffuse brain" of plants, able to perceive signals from the environment and "make decisions" on the strategies to be followed. Today we know that the roots also possess mechanisms for the processing and transmission of these signals.
Many neurotransmitters in our brain (glutamate, serotonin, dopamine, acetylcholine, etc.) are also present in plants. In this case, we can't call them as neurotransmitter, because they are

not in the brain and because not always their function is known. For some of them it has been shown a key role in the mechanisms of transmission of information. For example, a root has the constant need to know precisely what happens in the environment. This "knowledge" derives from the activity of root apex, each of which is able to "feel", perceive and evaluate, at least 15 different chemical and physical parameters (temperature, salinity, humidity, and so on), which should be integrated and processed to identify the direction of optimal growth. It was discovered that glutamate is essential for this process: if missing or is present in excess, the root behaves as if it had lost all sense of direction and grows abnormally.

The turning point was the discovery that a particular area of the root apex, the transition zone, consumes more oxygen in the nearby areas, a condition that is a sign of strong demand for energy and, therefore, the presence of some intense activity.

Yet, at the beginning the transition zone did not seem to participate in activities with a high energy expenditure, as may be the cellular multiplication.

One of the most obvious reasons to explain why plants have developed something like a neural activity in the apex, lies in the fact that these live underground: the soil, in fact, compared to atmosphere, is a more stable environment for temperature and humidity and is more protected from animal predation and by solar ultraviolet radiation.

The plants then show large intra-and interspecific communication skills, but also learning (and therefore memory) and calculation of costs and benefits. Plants do not remember faces or emotions, but they can remember specific environmental conditions they encountered in the past and the appropriate physiological response to those conditions.

Communication is definitely one of the keywords of plant neurobiology.

The plants are very skilled in communicating with other organisms of the same species or other. The roots, for example, in soil secrete a large amount of substances which constitute real signaling messages, and so do the leaves and flowers, with volatile molecules. In some cases, they are "chemical arms", directed against the surrounding plants with the aim of hindering growth and development, or against predators, to remove them.

Plants do not only communicate within their world, but also with animals. That's right, just think of the visual signals (colors) and olfactory emitting flowers to attract insects and encourage them in this way to provide the service of pollination. And again, many plants, attacked by predators or pathogens, produce substances repulsive towards the enemy, or be able to attract predators of the same enemy (according to the logic known as "the enemy of my enemy is my friend").

1.2 Social Science

Social sciences are that disciplines whose have as point of interest the human and the society where he lives. These disciplines comprehend several subjects like the emotive aspects, as the characteristics of human nature defined by biological and psychological factors like the external aspect linked to the cultural, institutional, social and environmental necessities. The subjects implicated with the social sciences are: history, philosophy, political science, archeology and economy.

1.2.1 Communication between individuals, the bases of society

At the base of the communication process between individuals there is the symbolic interactionism, a current developed about at the end of fifties by Mead (1934).
The fundamentals are:

- Humans approaches things basing on the meaning that things have for their own.
- This meanings are the result of social interaction that evolved inside the human society
- This meanings are modified and manipulated by using an interpretative process done by every singular individual when he get in touch with the signals that he meet.

For some authors the symbolic interactionism is to emphasize the processes by which individuals, reacting to the environment that surrounded them basing on the meaning that emerge during the social interaction, makes the ingredients of social life (Ciacci, 1983).
The interaction is defined symbolic because the individual live immersed in a society in which the stimuli that solicit are full of meanings and values learned through the process of communication and social interaction. But also because the interaction is realized between people through the use of symbols. This is because individuals do not respond directly to the word, but give it a meaning, and respond to that meaning. According to Mead, the soul of socialization is the ability to predict what others expect of us and guide our behavior accordingly.
This ability is acquired through the assumption of a specific role. Mead also argued that socialization is never perfect or complete. He distinguished between the ego, the self, spontaneous, impulsive and not socialized and me, the socialized self, aware of the norms, values and social expectations. For Mead, the self -socialized is able, in most cases, to dominate the me, on the other hand we all have the ability to break the rules and violate social expectations of others.
According to the interactionist perspective, the behavior is not merely a manifestation of inner forces or something determined only by external forces but is the result of a conscious and socially interpretation derived from internal and external stimuli. Although several English and

German schools provided different interpretations of the relationship between the individual and society. Lorenz interpreted the society as a continuous fight with the individual: the purpose of the company was to inhibit those instincts, mostly aggressive, which would characterize the man in the wild. But as aggressive instinct is considered by the German school as an unstoppable instinct (hydraulic model), the solution is found in sports.
On the contrary, Hinde argued that there would be a continuing dialectic between individual and society, and that the operative factor is constituted by relationships. Is referred to the biological basis of society, because the individuals interacting shape society and in turn are shaped. This dialectic would also explain why there is a double standard in society based on gender: female infidelity is blamed, infidels men are appreciated.
This thesis would lead to think that social norms are resulted from this particular dialectic: the crime of honor was canceled only in recent times, when the company reached an evolution that the woman can live and raise their children also without the support of a man. Hinde was then creator of the idea that to understand the relationship between individual and society is needed a psychological (the human mind) and sociological (culture) analysis.

1.2.2 Communication between organization

Communication in organizations has, by its nature, a fundamental role in the planning and control process; communicating coordinates and finalizes the action of operators and managers to achieve results ,help to evaluate a collaborator, to make a shared decision, to solves a conflict. Consider communication as a lever in organizational strategies requires a clear definition of the objectives. Aim for an integrated management of the communication is a goal that can be achieved by following different routes and with different levels of integration and effectiveness.
The first step that an organization must take is to analyze the existing channels of communication, in the second place it is necessary to analyze the perception and evaluation of the different processes of communication for sender, receiver, content, style, effectiveness, appreciation in relation to the means used by the recipient. Just before this first analysis it is possible to diagnose the needs of communication and making an assessment about whether to maintain, modify, integrate the various communication processes.
The organizations are in competition with external communication flows that affect them and reach all of their components conveying messages that may be non-functional for their survival. The press relations, relationships with customers(internal and external) and the needs of the individual are different and you need to manage your own customized reports. The design of a communication designed to achieve the goals of the organization must take into account the multidimensional nature of this multi-directionality of communication flows .

The "products" of the communication must be consistent with the needs of different audiences (customers, employees, stakeholders in various ways), the processes of communication should be simple and decentralized to ensure the dissemination of information and accountability at all levels organization, consistent with the process of "demassification" (or individualization), the processes of communication must be continuous (managed continuously and not so impromptu), the processes and the "products" of the communication must be between them coordinated communication processes and "products" should be the outcome of a careful listening and “sponsored “by those who guide the organization (and that approach given the guiding values).

Technically the most effective solution to achieve continuity, diversification, coordination and simplicity is the development of an organic communication plan. As with any initiative, success is tied to a strong sponsorship. At the organizational level this can be translated into “integrated communication “which is required to ensure the maintenance and development of the corporate image by ensuring a constant and efficient flow of information inside and outside of the company (and vice versa), ensuring the internal and external consent to the policies and actions of the organization; to ensure the listening of customers and the identification of the information needed about the services offered(this mission does not purport to be exhaustive, but indicates some of the primary objectives that could be assigned to position established to oversee the communication).

In the initial stages, the communication unit must be strongly supported to ensure its usefulness and its authority is recognized by the entire organization.

In order for the position responsible of the organizational communication is not an empty box, it is necessary that all elements of the organization listen and wish to communicate with her. The communication has a notable impact on motivation and, consequently, on the quality of services provided. Workers who fully understand the policy that "their" organization follow will be more apt to share it and, in any case, to respect it.

The mission of communication would be: take care of diffusion and comprehension of the company's mission and values, promote a good image of the organization among employees, develop staff involvement through the implementation and maintenance of effective communication flows, promote a positive and participatory through actions aimed at empowerment, involvement and motivation of the people, to ensure consistency of content and instruments of communication with the company communication strategies.

Communication has become faster and has taken on new connotations, has become, in fact, the main activity of the people involved in these systems that exist only because there is communication. One of the objectives of the communication is the creation of corporate identity. To avoid pathological situations communication is essential. In particular, you must create an organizational climate that why people are brought to express their opinions,

discuss, negotiate, protest. Communication, known as the capacity, must therefore be widespread.

1.3 Communication

Communication is “any act by which one person gives to or receives from another person information about that person's needs, desires, perceptions, knowledge, or affective states. Communication may be intentional or unintentional, may involve conventional or unconventional signals, may take linguistic or non-linguistic forms, and may occur through spoken or other modes.”

1.3.1 Verbal, para-verbal and non-verbal Communication

Verbal communication uses oral or written language and is the most widely used in the Occidental world, where it tends to be the favorite instrument for the communication. Verbal communication uses, as the name says, the speaking, and then to communicate effectively it is important that everyone involved in the interaction use the same code of communication. Communicate effectively not only mean “able to express our ideas ," in fact it is extremely important to observe certain rules .

The dialogues must happen regularly in accordance with the alternation of turns: when you are in a lot of talking, the space of speaking must be equally benefited by all, must speak one by one, without interfere and without interrupting anyone who is conducting a discourse. You have to listen and pay interest to what the other person says. We must comply with the argument of which you speak. Let's be clear, there should be no gaps in the speech and even the excesses of the word; do not have to say neither more nor less.

Non-verbal communication is that part of the communication that includes all aspects of a communicative exchange which is not the purely semantic level of the message, which is the literal meaning of words in the message, but which relate to the language of the body, namely the non-spoken communication between people. The common idea tends to consider this type of communication as universally understood, so much that can transcend language barriers. In a face to face communication we use: facial expression, eye contact or gaze, gesticulation, posture, touch and spatial behavior, known as proxemics. Body language is partly innate and partly depends on the processes of socialization. In fact, the mechanisms by which non-verbal communication flows are very similar in all cultures, but each culture tends to elaborate in a different non-verbal messages. This means that forms of non-verbal communication perfectly understandable for people belonging to a particular culture may instead be, for those who have a different cultural heritage, absolutely incomprehensible or even have a meaning opposite to

what it was intended to convey. According to linguists, more than 90 % of our daily communication is in fact non-verbal.

It is therefore a huge contribution to verbal language and, since communication is strictly ambivalent, we can easily understand how big is the risk of not understanding when you are on the phone rather than when talking face to face. A study conducted in 1972 by Albert Mehrabian[3] has shown that what is perceived in a voice message can be divided as follows:

• Body movements (mostly facial expressions) 55%

• Vocal feature (volume, tone, rhythm) 38%

• Verbal feature l (words) 7 %

The effectiveness of a message depends only, minimally, from the literal meaning of what is said, and the way in which the message is perceived is influenced heavily by factors of non-verbal communication.

The para-verbal communication is correct use of voice: timbre, tone, pauses and volume. The timbre is the set of individual characteristics of the guttural voice, nasal, muffled, it is the color of the voice. It depends on what part or parts of the body act as sounding board, that amplify and improve the sound. The timbre of the voice can affect a lot about ourselves and others. Just think of the famous way of saying “raise its voice “or how it is used in communication and art.

The tone is primarily an indicator of the intention and the meaning that is given to communication and can express enthusiasm, disappointment, interest, boredom, involvement, apathy, appreciation or disgust.

The volume concerns the sound intensity, the way to calibrate your voice based on distance from the other person, and based on the importance of the topic.

The time so the pauses, absolute slowness and speed may serve as factors that underline, accentuate or soften the meaning of words.

Para-verbal and non-verbal communication is an integral part of how we relate to others, we use them every day, often at an unconscious level, without realizing it. Without one of these components our communication would be difficult to understand, not fully catch by the receiver. Knowing how to use the right voice can reach more easily an effective communication. Another important function of the para- communication is the expression of emotions and feelings, factors always present in any communication.

1.3.2 Effective Communication

We live in the age of communication. But do we really know what it means to communicate? What is Communication? Most of all, how can we communicate effectively? To communicate means to make others understand our message .

This definition, involves a substantial change in communicative relations, in other words, dump communicative responsibility on one who is talking. According to this definition, we must take on the responsibility of communication sync with our interlocutor. Have you ever wondered why someone, in effect, is clever, witty, funny and very easily able to get the attention and approval by all others, on the contrary, they are boring and aren't good to speaking? Why is there this difference in terms of effectiveness? There are, perhaps, different ways of communicating?

Definitely an extrovert character and the habit of speaking in public can help, and it could be enough for those sporadic occasions of public speaking. Effective communication, assertive, charismatic is a skill, neither more nor less, and as such can be acquired by anyone.

Sure, some people are more able than others to communicate successfully - by virtue of a sort of natural inclination, but personal experience teaches that good communicators.

That's right, anyone who is really motivated to study and apply the techniques of a successful communication (even if only for a few weeks) can achieve great improvements and remove great satisfaction in terms of personal and business.

Listening is very important. When this concerns make on difficult speeches and solve problems in the family or workplace, listening is undoubtedly one of the most important qualities are difficult to sharpen. The interesting thing about it, is that in 99% of cases, people are genuinely convinced they are already perfectly able to listen to your partner. Yet the reality is quite different, and communication problems are pretty much the order of the day for the vast majority of people. Rather than listen, we look forward that the other person have finished his speaking turn to answer back with our point of view, which we had carefully refined just when we thought we were listening carefully. Is advisable to listen very carefully to the point of view of the other, and then answer after thinking carefully about the consequences of your words might have. Is necessary to pay attention to non-verbal language.

Sometimes it can happen that, when a person speaks, his words are not congruent with the tone of voice or body language. In these cases, don't grasp this mismatch can have very negative effects on the quality of the communication. It ' important to maintain eye contact (without overdo it, of course) with your partner as well as develop a greater consciousness of the signals sent by the body language is one of the factors that allow more than any other to improve communication skills.

The gestures, movements, facial expressions and the direction in which we place our body as we speak are all signs that our subconscious picks inevitably. And often be consciously aware of these non-verbal elements makes the difference between a good and a bad communicator.

In all these cases, it is undoubtedly useful to adopt a communication strategy which consists for example in having a facial expression more relaxed, uncross arms crossed, showing the

palms of the hands. Improve the pronunciation and learn to express themselves with standard accent can make in a short time a much more charismatic and effective communicator .

1.3.3 Communication Empowerment

The term empowerment is referred to a process of growth, both of the individual and the group, based on increasing of self-esteem, of self-efficacy and self-determination to bring out latent resources and lead the individual to take possession of his consciously potential. This process leads to a reversal of the perception of their own limits in view of achieving results beyond owns expectations. Empowerment is a multilevel construct that according to the tripartite division of Zimmerman[4] is:

1. Individual-psychological
2. Organization
3. Socio- Political and community.

These three levels are analyzed individually but closely interconnected between them. The individual level refers to the concept of self-empowerment and refers to the process of growth of the individual through paths of different nature (therapeutic, educational, experiential, etc.). Develops new skills and competencies. Zimmerman has dealt with individual psychological empowerment as a path that leads from the learned helplessness (the liabilities learned accompanied by a sense of distrust and discouragement in dealing with everyday problems) to the learned hopefulness (greater self-confidence and learning hope). This construct is decomposed into three components that, taken together, constitute a basic model for the evaluation of empowerment at the individual level of analysis:

1. The intrapersonal component - control (corresponding to control and perceived competence. Includes personality characteristics, cognitive characteristics and motivational aspects) .
2. The interpersonal component - critical awareness - (corresponds to the ability to analyze the socio-political context in which they live in order to understand their environment. It will be implemented in the ability to identify the resources necessary to achieve a goal and the choice of an action plan) .
3. The behavioral component – participation.

The organizational approach is derived by the ambition to overcome the dynamics strictly individual also relevant considering other perspectives such as the links between people, relationship dynamics and structure of organizations. Although this approach refer to multiple contexts and situations, studies have been limited to consider the development of empowerment within the individual groups, organizations and associations, primarily at the corporate level. At the community level, empowerment refers to collective action aimed at improving the quality of life and the connections between the organizations in the community .

Through the empowerment of community is realizes the “competent community “in which citizens have “the skills, motivation and resources to undertake activities aimed at improving the life”. The strategies of empowerment of communities are aimed at encouraging the growth of power in the citizens through their participation in important experiences. In this sense, therefore, these citizens will be a resource for other people.

The empowerment is the process by which the community' develops and strengthens its ability. The communication inside and outside of the community includes roads, electronic devices (telephone, radio, TV, internet), press (newspapers, magazines, books), networks, spoken and understood languages, literacy and ability and availability to communicate (including be tactful, diplomacy, speaking and listening willingness). A community ' is reinforced when it improves its ability' to communicate (in an organizational context refers to communication tools, methods and practices available). If communication is poor the community or the organization is weak.

2 Neuroscience and Mirror Neurons

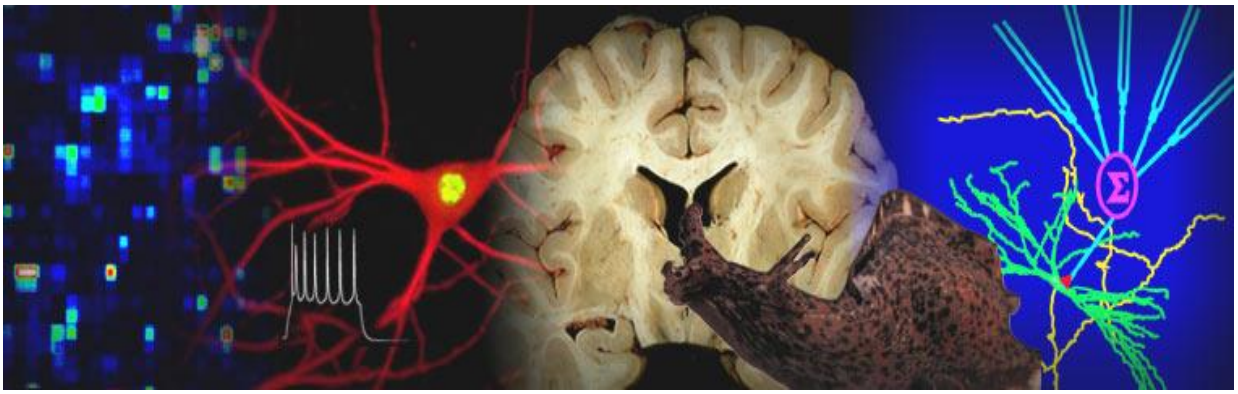


Figure I *University of California, Irvine, Interdepartmental Neuroscience Program.*

"*Mirrors should think longer before they reflect "*

Jean Cocteau*, 1939*

2.1 Old sciences and New Sciences

What the scientific revolution brought in XVII century, neurosciences they did in the days of today, reversing entirely the idea that we had about the nervous system. What has allowed the development of neuroscience has been a more holistic approach, without constraints bounded by the barriers between different disciplines that, before the mid-twentieth century, which were directed to specific sectors of nervous and mental activities without considering different approaches.

This new approach has therefore determined, between the fifties and sixties, the emergence of a new sector, the fact of neuroscience, thanks to the merger and cooperation between the various disciplines such as neuroanatomy, neurophysiology, neuropharmacology, neurochemistry and behavioral studies.

With the term neuroscience mean all studies on the nervous system. The aim of this science has broadened considerably in recent years thanks to different approaches used to study the molecular, cellular, evolutionary, behavioral and medical of the neuron system. The techniques that are now used by neuroscientists to study the brain and nervous system are in particular based on brain imaging.

2.1.1 Evolution of neuroscience

Throughout history, the neuroscience has undergone significant changes and different approaches. The first scholars of the nervous system, were the Egyptians as far back as 1700

B.C. There is evidence of surgical practices about puncture in the brain (drilling) to treat headaches or mental disorders. They had therefore already associated certain diseases with the brain, although mistakenly thought that the seat of thought and intelligence was the heart.
The idea that the heart was the source of consciousness continued until the time of the Greek physician Hippocrates. He believed that the brain was not only involved (sensory organs like eyes, ears and tongue are located in the head), but it was also the center of intelligence. Plato hypothesize that the brain was the seat of the rational soul.
However, persisted the conviction of Aristotle, that the brain was only a regulator instrument of the amount of heat coming from the heart, as the seat of the rational. This belief was so long until Galen, the Roman physician follower of Hippocrates, a medical gladiators, observed that his patients lost their mental faculties when they suffered brain damage.
In 1700 Galvani had laid the foundations for the study of the electrical excitability of muscles and neurons (but only towards to the end of the nineteenth century was proved the electrical excitation of neurons). There were no significant changes in the neurosciences until, in 1872, Darwin led to a great revolution, that introduced the concept of emotional expressions in the reigns of the humans and the animal, and how these expression were involved in the evolution of the species and in their social relationship. However, studies on the brain became more effective after the onset of the microscope and the development of a staining procedure by C. Golgi towards the end of 1890, was used to unravel the complex structure of the neuron. In the 1906 Golgi and Cajal won the Nobel in medicine thanks to their accurate and comprehensive description and the categorization about neurons in the brain. Subsequently, around at 1950, Hodgkin had introduced a mathematical model about the transmission of the electrical signals on the neurons, and at the same time Gastatu and Bert, had advanced the mu rhythm theory[5].

BOX 1 "*The mirror mechanism and mu rhythm in social development*"

Ross E.Vanderwer, Nathan A.Fox, Pier F. Ferrari

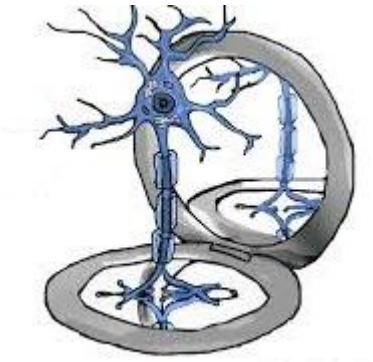
In humans this has been studied extensively by examining mu activity during actions observed by specialists and non-specialists. For example, studies contrasting dancers versus non-dancers observing dance movements show greater desynchronization in the dancers familiar with the dance movement [60]. Moreover, evidence shows that activation of the action observation/execution matching system improves athletes' ability to understand the outcome of their sport related actions sooner and more accurately than non-athletes [1]. These studies parallel those obtained with Fmri investigations showing that th e MN areas are more active during the observation of a movement that has been specifically learned during one's own professional training, such as in dancing [10,11]. Together, these findings suggest that motor experience modifies internal motor representations and the related neural networks involved in processing sensorimotor control. The assumption that the mu rhythm reflects activation of the MN system has been further supported by studies using both EEG and functional MRI [2]. The results clearly showed that during action observation mu desynchronization correlated with activity in the IPL and other areas associated with the MN system [37],such as the supplementary motor area and the dorsal premotor area. These data suggest that the mu rhythm could be considered a

neural signature of the MN system. The use of these noninvasive methods has provided converging evidence for a human MN system. They also offer an opportunity to measure MN activity in different populations and under different conditions to begin to better understand the role of MNs in typical and atypical development as well as more complex social behaviors such as imitation and empathy.

In the recent past, it was thought that the motor system was solely responsible for the movement and the interpretation of the signals[6]. This until a team of Italian researchers at the University of Parma discovered mirror neurons, a class of neurons involved also in the behavior.

This discovery has greatly changed the perception that existed until then, that the main system of the movement was only motor neuronal one. There are significant ongoing studies on the ability of these neurons to modulate the action and the emotions understanding, which have opened a vast world about the relational component and how we can predict the behavior of others as a means of using these neurons[7].

2.2 Mirror neurons



2.2.1 What are mirror neurons

Mirror neurons[8] are a class of neurons, originally discovered in the premotor cortex of monkeys, that discharge both when individuals perform a given motor act and when they observe others perform that same motor act[9]. Ample evidence demonstrates the existence of a cortical network with the properties of mirror neurons (mirror system) in humans. The human mirror system[10] is involved in understanding others actions and their intentions behind them, and it underlies mechanisms of observational learning[11]. Herein, we will discuss the clinical implications of the mirror system[12]. A mirror neurons are multimodal association neurons that increase their activity during the execution of certain actions and while hearing or seeing corresponding actions performed by others[13].

2.2.2 The great discovery

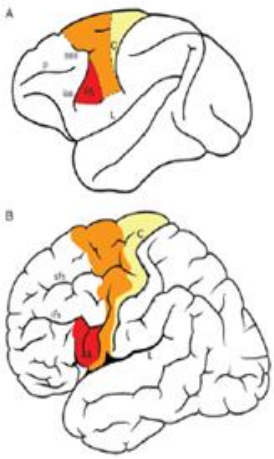
In the 80s and 90s of last century the group of researchers at the University of Parma coordinated by G. Rizzolatti and composed by L. Fadiga, L. Fogassi, V. Gallese and J. Pellegrino[14] was devoted to the study of the premotor cortex. they had placed electrodes in the

inferior frontal cortex of a macaque monkey to study neurons specialized in the control of hand movements, such as grasp or handle objects. During each experiment was recorded the behavior of individual neurons in the brain of the monkey while it was allowed the access to the fragment of food, in order to measure the neuronal response to specific movements. Like many other remarkable discoveries, that of mirror neurons was due to chance. The anecdotal reports that while an experimenter took a banana in a fruit basket prepared for the experiments, some neurons in the monkey that was watching the scene had reacted. How could this have happened, if the monkey had not moved?

These neurons are activated only for the motor functions? At first, investigators thought it was a defect in the measurements or a fault in the equipment, but everything turned out okay and the reactions were repeated as soon as he repeated the action of grasping[15]. Since then, this work has been published, with the update on the discovery of mirror neurons located in both the inferior frontal parietal regions of the brain. In 1995, Rizzolatti[16] and his team demonstrate for the first time the existence in humans of a system similar to that found in the monkeys. Using trans cranial magnetic stimulation were discovered in fact that the human motor cortex is facilitated by the observation of others' actions and movements.

More recently, other evidence obtained through fMRI, TMS, EEG and behavioral tests have confirmed that similar systems exist in the human brain and that is highly developed. Have been identified with precision the regions that respond to the action/observation. Given the genetic similarity between primates, it is not surprising at all that these brain regions are closely similar to each other[17].

2.2.3 Mirror neurons from monkeys to humans



The first animal in which mirror neurons have been identified and specifically studied was the macaque. In this monkey mirror neurons were localized in the inferior frontal gyrus (called region F5) and inferior parietal lobe. Experiments[18] have shown that mirror neurons serve as mediators for the understanding of the behavior of others. For example, a mirror neuron that is activated when the monkey rips a piece of paper, it is also activated when the

Figure II *Lateral view of the macaque (A) and human (B) cerebral cortex showing homologue cortical regions (colored areas). The yellow and orange, in both the monkey and human brain, indicate the primary motor and the premotor cortex, respectively. The red colored region indicates the hypothesized homologue cortical motor areas related to communication and language (monkey area F5 and human area 44, or Broca's area).*

same monkey sees another (or other primate) do the same gesture, or even if it only hear the sound of torn paper without visual information. These properties have led researchers to believe that mirror neurons encode abstract concepts to actions such as "ripping paper", even when the action is performed directly and when it comes the information that is made by others.

The function of mirror neurons in macaques is not well understood, since the adult individuals do not seem to be able to learn by imitation, while the infant monkeys are capable of learning by imitation. Recent experiments[19] show that baby macaque can mimic facial movements of humans only when they are babies and only during a limited time window[20].

However, it is still unknown if mirror neurons are connected to types of behavior "fine" like this. We know for certain, however, that in adult monkeys, mirror neurons allow them to understand what another monkey is doing, to recognize the specific action. Direct observation of mirror neurons is more difficult in humans than in monkeys. While the latter it can be observed an individual neurons, in humans can be observed the neural activations only through changes in blood flow due to them.

The first experiments with humans, conducted with images of actions (grab, etc.) produced graphically on the computer, gave disappointing results. The repetition of the same actions performed experiments and observed between a group of volunteers gave more concrete results. By refining the survey techniques (fMRI) and brain imaging was performed precise location of mirror neurons in human.[21]

BOX 3 ***"Social Neuroscience: Mirror Neurons Recorded in Humans"***

Christian Keysers and Valeria Gazzolal

Researchers associate mirror neurons with two brain regions: the ventral premotor (vPM) cortex and the inferior parietal lobule (IPL). The fact that mirror neurons were originally reported in these two regions in the monkey [1–3] somehow led to an irrational double standard. On the one hand, rather than critically examining whether visual activity in these regions truly overlapped with activity during motor execution of similar tasks [10], most enthusiastically attribute any activity in these regions to mirror neurons — even though, in the monkey, 90% of neurons in these regions are not mirror neurons [1,2]. On the other hand, glucose uptake [11], fMRI [12–14], transcranial magnetic stimulation [15] and magnetoencephalographic [16] experiments suggesting that the primary somatosensory cortex, the supplementary motor area (SMA) or the temporal lobe could also contain mirror neurons encounter skepticism and are ignored in most reviews on the mirror neuron system. Mukamel et al. [9], however, could not choose where to look for mirror neurons. The position of their electrodes in humans was dictated by clinical considerations. Patients had electrodes in the medial wall (cingulate cortex, SMA and pre-SMA) and the medial temporal lobe (amygdala, hippocampus, parahippocampal gyrus and entorhinal cortex) — none of which is classically associated with mirror neurons. In accordance with what fMRI experiments suggested [6,12,13], mirror neurons were found in many of these areas: the SMA, the hippocampus and parahippocampal gyrus and the entorhinal cortex. These results suggest we should stop considering certain brain regions as intrinsically 'mirror neuron regions': mirror neurons are a minoriy, but exist in many brain regions.

Experiments[22] conducted by J. Buccino and others researchers in 2001 showed that in humans the activation of Broca's area and other areas in the presence of complex actions (grasping to eat, kick a ball, take items) is connected to another language in a system of "resonance" more complex than the system of the monkey. The main difference is that the human system of mirror neurons coding motor acts transitive and intransitive, and it's able to encode both the type of action and the sequence of movements of which it is composed. In humans, it is not necessary an effective interaction with objects: our mirror neurons are activated even when the action is simply mimed. Although their primary role is to understand the others' actions, the human context is obviously more complex.

Recent electrophysiological evidence (via microelectrode recordings of neuronal discharges), showed the presence of the mirror system in humans, in the parietal and frontal space.

In the same study, it was also found the presence of mirror neurons in non-motor areas such as the hippocampus and the temporal cortex. This goes to show how mirror neurons are diffuse in a several brain areas, and constitute a real mirror system that is involved in both the understanding of the actions, in mimic actions[23].

2.2.4 Mirror system: the deep meaning"

The great physicist, mathematician and epistemologist H. Poincaré argued that the spatial coordinates around our body and therefore our relationship with objects and people around us,

involving the fundamental keys of our nervous system, for which coordination with the our "outside" would not be an achievement of the individual but of the species.

There were a lots of research[24] about that system and with its link with the language development[25], because in the humans the mirror neurons were localized near Broca's area, an area that is involved in the language elaboration[26]. This led to the conviction (for someone the proof) that human language evolved through the information transmitted with the gestural performance and finally the mirror system has been able to understand and encode/decode. It is now certain that this system has all the potential to provide a mechanism of action understanding and learning through imitation and the simulation of the behavior of others. In this sense, it should be emphasized that the recognition does not occur only at motor's level, but with the real recognition of the action as an event biophysical. As with many theories on the evolution of the language, even in this case there is still an open discussion due the lack of obvious demonstrations. The research[27] linking the system of mirror neurons also to the understanding of the behavior of an intention not manifested but inclined to future performance (prediction of behavior immediately to come). Fogassi[28] and others, have recorded the activity of 41 mirror neurons in the inferior parietal lobule (IPL) of two rhesus macaques (the IPL is recognized as part of the cortex dedicated to the association and integration of sensory information).

The monkeys watched an experimenter either grab an apple and bring it to his mouth, and pick up an item and place it in a cup; 15 mirror neurons were activated vigorously by observing the action "grasping to eat", while there is no recorded neuronal activity in 'observe the action "pick and introduce". For four other mirror neurons the opposite had proved to be "true": the neurons were activated in response to the action of the experimenter who had inserted an apple into the cup without eating it. In this case the activity of mirror neurons was determined only by the type of action and not from the motor response of manipulating objects in a behavioral model.[29]

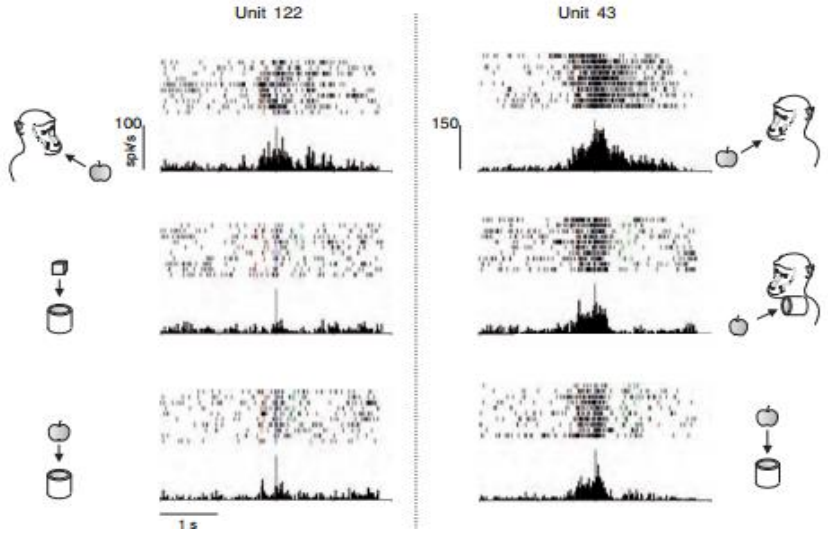


Figure III

Discharge of two IPL neurons during active grasping. Unit 122 strongly discharges when the monkey grasps a piece of food to eat (top), whereas it does not respond when the monkey grasps an object (center) or a piece of food (bottom) to place. Unit 43 strongly discharges when the monkey grasps a piece of food to eat (top), whereas the discharge is significantly weaker (12) when the monkey grasps a piece of food to place into a container positioned near the mouth (center) or near the grasped object location (bottom).

Significantly, the neurons were "discharged" before the monkey could observe the human model while was starting the second part of the motor act: to bring the object to the mouth or put it in the cup. Therefore, IPL neurons "code the same act (grasping) in a different way depending on the final goal of the action in which the act is contextual". In other words, they can provide a neural basis for predicting, in another individual, the subsequent actions to a given behavior and intention that is at the origin. The observation in monkeys and humans also leads to consequent studies on the possible evolution of their mirror system. In humans, for example, there is a complex system of expression of the emotions that is absent in all other species, so the research also extends to the field of knowledge of social mechanisms, with evidence that the concept of "individual" is very relative.

2.2.5 How does mirror neurons work?

"The function of mirror neurons is different from that of the motor neurons that are activated every time you move a muscle while you are performing an action. The ns are activated not because you are acting, but because you are thinking about act" G. Rizzolatti.

It is generally assumed that the main functional role of parieto-frontal mirror neurons is to understand motor acts performed by others in an automatic way, by matching them to the subject's own motor repertoire[30]. Evidence in favor of this hypothesis came from experiments that showed that F5[31] mirror neurons also fire when monkeys cannot see the triggering feature of a motor act but have sufficient clues to understand its goal, or when monkeys recognize an action from its sound only.

BOX 4 ***"Hearing sounds, understanding actions: action representation in mirror neurons"***

Kohler E, Keysers C, Umilta MA, Fogassi L, Gallese V, Rizzolatti G

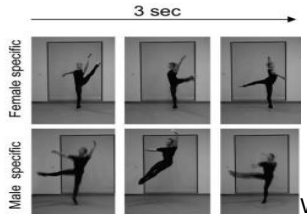
In the monkey ventral premotor cortex (area F5) there are neurons that discharge both when the monkey performs a specific action and when it observes another individual performing a similar action (mirror neurons). We investigated whether there are neurons in F5 that discharge when the monkey performs a specific hand action and also when it hears the corresponding actionrelated sounds. The experiments were carried out in three awake macaque monkeys (Macaca nemestrina) (4). In total, 497 neurons were recorded and their motor and visual properties were assessed (1–3). In an initial group of neurons (n 211), we studied auditory properties by using sounds produced by the experimenter's actions and non–action-related sounds; in another group (n 286), we used digitized action-related sounds (4). Sixty-three neurons (13%) discharged both when the monkey performed a hand action and when it heard the action-related sound (5). An example of such a neuron is shown in Fig. 1B (neuron 1). This neuron responded to the vision and sound of a tearing action(paper ripping; VS). The sound of the same action performed out of the monkey's sight was equally effective (S). Sounds that were non–action-related (white noise, monkey calls) did not evoke any excitatory response (control sounds: CS1, CS2). As a matter of fact, as often occurs in F5 neurons during strong arousal, a decrease in firing rate was observed.

These data[32] indicate that premotor mirror neurons discharge whenever the someone builds up an internal representation of a motor act made by another agent, even if the subject does

not see it. These findings indicate that action-constrained parietal mirror neurons do not only encode the observed motor act (e.g. grasping), but also the aim of the observed action. It has been hypothesized that this organization provides a neural substrate for understanding the goal of the entire observed action before it is concluded. Activation of the mirror system is also related to the observer's motor experience of a given action.

BOX 5 ***"Action Observation and Acquired Motor Skills: An fMRI Study with Expert Dancers"***

B. Calvo-Merino 1, D.E. Glaser 2, J. Grèzes 3, R.E. Passingham 4 and P. Haggard



When we observe someone performing an action, do our brains simulate making that action? Acquired motor skills offer a unique way to test this question, since people differ widely in the actions they have learned to perform. We used functional magnetic resonance imaging to study differences in brain activity between watching an action that one has learned to do and an action that one has not, in order to assess whether the brain processes of action observation are modulated by the expertise and motor repertoire of the observer. Experts in classical ballet, experts in capoeira and inexpert control subjects viewed videos of ballet or capoeira actions. Comparing the brain activity when dancers watched their own dance style versus the other style therefore reveals the influence of motor expertise on action observation. We found greater bilateral activations in premotor cortex and intraparietal sulcus, right superior parietal lobe and left posterior superior temporal sulcus when expert dancers viewed movements that they had been trained to perform compared to movements they had not. Our results show that this 'mirror system' integrates observed actions of others with an individual's personal motor repertoire, and suggest that the human brain understands actions by motor simulation

In the process of inferring intentions, the frontal node of the mirror system in the right hemisphere was recruited. In a second study, the right mirror system was found to be sensitive to the outcome of an action, such as opening or closing a box, independent of the means to achieve this outcome.

BOX 6 ***"Action outcomes are represented in human inferior fronto -parietal cortex"***

Hamilton AF, Grafton ST

We report evidence of suppressed responses in right inferior parietal and right inferior frontal cortex when participants saw repeated movies showing the same action outcome, but these regions did not distinguish the kinematic parameters by which the action was accomplished. Thus these brain areas encode the physical outcomes of human actions in the world. These results are compatible with a hierarchical model of human action understanding in which a cascade

of specialized processes from occipital to parietal and frontal regions allow humans to understand the physical consequences of actions in the world and the intentions underlying those actions.

2.3 Communicating Mirrors

Figure IV *Nana's Magic Mirror, Charlotte Madison*

In the mid-nineties a group of researchers[33] has discovered that there were neurons that were activated not only during the execution of an action, but also when the same action was only observed from the subject under consideration. With this discovery, it was realized that our body is able to communicate with others thanks to the para-verbal language, creating a real connection bridge.

2.3.1 Communication through mirror neurons

Between the motor region and the area perceptual, for the same action, occurs a phenomenon of "mirroring" between certain nerve cells, then defined by the term mirror neurons. To be considered as such, a neuron must have a double pattern of activation, perceptual and motor, even if not all neurons with these properties are considered neurons with properties of mirroring. The actions that trigger a mirror neuron are very specific, are intentional acts that have purpose and foreseeable consequences.

According to M. Iacoboni[34], in fact, in the human brain mirror neurons located in the frontal and parietal cortical regions works closely with the superior temporal neurons, creating a neural representation of the intentional state of the person observed. Thus creating a non-verbal link between the observer and the sender.

A classic example of this phenomenon, for example, was demonstrated by experiments with infant monkeys, which were able to reproduce the facial movements after they have been observed by the investigator. In adult monkeys it was noted instead, that it is the goal of the

action to activate the neurons, but only after the guinea pig had seen performing the action. For example, if a monkey see a hand move forward without any goal, the mirror system is not activated, whereas if it moves forward to grasp an object, even if the object is covered by a screen (prior vision of complete action), then the mirror neurons will be activated because it includes the goal of the action.

There is also a theory, called simulation theory[35], which holds that the mirror neuron system[36] learns from experience. Experiments[37] have been made with classical and capoeira dancers. When students have observed their masters, it was noted that the experience of dance has allowed a better learning than when you were trying to imitate the other style of dance, as the classical dancers have learned most of what was shown by their teachers and vice versa.

2.3.2 How I became we

The activation of mirror neurons and related neural areas produces an image of the mental state of the other individual, then, the perception of predictable actions of another person is used to create an image of his mind. Regarding the mechanisms of internal simulation, a hypothesis is that mirror neurons and cortical related areas influence through the insula the activation status of lower subcortical regions (limbic areas and brainstem).

Another notion is that the mirror neuron system allows us to imagine empathetically what is going on in another individual. It is believed that the internal simulation-processes in which we absorb and enter into resonance with the internal states of others, represents the first step of empathy about "feeling with" another person who clearly depends both on past experiences from both the current situation. The observations of scientific studies showed that our brain is able to identify the internal states of others[38] through their actions and then to respond by changing our behaviors and internal states. The way in which we can understand others is directly related to the awareness[39] of our inner states, the way we understand "who we are “is shaped by the interactions we had with others.

The prefrontal region is involved in the evaluation process (to stimuli that give meaning and emotional value), in affective regulation (the brain's ability to modulate our psychophysiological states), in social cognition (the complex mechanisms that allow us to have mind sight and receiving the mental states of others) and in the consciousness of ethical autonomy (the ability to travel mentally in time)[40].

The areas of the brain that are responsible for emotional mechanisms, such as the orbitofrontal cortex, the anterior cingulate and amygdala, are also involved in other processes, including the emotional memory, empathy and basic emotions. It is also assumed that the medial part of this region has an atypical structure in the most serious disturbance of cognitive

functions social autism. The prefrontal areas have a central role in the processes that determine the "flexible response".

As demonstrated in some experiments[41] of visual stimulation, parts of these cortical regions mediate alterations or reversals of stimulus-response associations and these are involved at the interface between the default automatic operations of the central nervous system and mental processes that allow flexible adaptation to changes as a result of contexts and perspectives.

The flexibility of response mediated by the prefrontal regions may therefore involve the coordination of processes involving sensory mechanisms of perception and evaluation that determine the ability to develop new responses new responses significantly subjective. We can say then that this function allows us to make decisions or to manage our relationships with others in the light of considerations about our past, present and future, this integration can be seen as a process that plays a crucial role in the development, in the subjective experiences and in the interpersonal relationships[42] of an individual. Emotions are an indispensable component of attachment relationships.

During the first years of life, the earliest forms of communication are based on the sharing of emotional states and play a crucial role in determining how an individual will subsequently be connected emotionally with others. Basically the idea is that an integrated communication leads to the growth of integrative fibers in the brain.

2.4 Senses and mirror neurons

Aristotle deals with the theme of synesthesia as interdependence of the senses, distinguishing between “own sensitive sense” and “share sensitive sense“. For “own sensitive sense” Aristotle means for example the view for the color, the hearing for the sound and taste for the flavor, while an example of a “share sensitive sense“ it is the movement. This concept evolved to the concept of synesthesia as co-feeling, as a sensory shared[43]. At the biological level the mirror system is responsible for the sharing of experiences, in fact its activation depends not only by the view, but also from the other senses.

What happens to people who are blind from birth when they realize that someone close to them is performing an action?

When a blind man hear the sounds of familiar actions, he activate the same areas that are activated in sighted people, both while listening that during the observation of actions, showing that the mirror neuron system also exists in people who have never seen the execution of actions in their life experience. So the mirror system can develop in the absence of view and is able to process information related to the action perceived. The visual information is only one

of several clues that allow you to perceive the actions performed by others. Another important clues, is the olfaction, the odors.

The effects of odors on the perception of the action or the evoking of the idea of action, has been the subject of an interesting experiment[44] of trans cranial magnetic stimulation. S. Rossi and co-workers have made to smell foods with different smells. Only smells "good" whet appetite and provoke the desire to grab the food[45].

2.4.1 Touch

Figure V *Detail from "The Creation of Adam", Michelangelo*

The connection between mirror neurons and tact, known as experience of mirror touch synesthesia[46], and this experience leads us to touch us when we look at another one that touches himself or is touched by another one.[47] Some researcher[48] adapted the experimental paradigm of the 'enfacement illusion' to quantify the changes in self-face recognition as a result of synesthetic touch. MTS and control participants observed the face of an unfamiliar person being touched or not, without delivering touch on the participant's face.

Changes in self-representation were quantified with a self-face recognition task, using 'morphed' images containing varying proportions of the participant's face and the face of the unfamiliar other. This task was administered before and after the exposure to the other face. While self-recognition performance for both groups was similar during pre-test, MTS individuals showed a significant change in self-recognition performance following the observation of touch delivered to the other face. Specifically, the images that participants had initially perceived as containing equal quantities of self and other became more likely to be recognized as the self after viewing the other being touched. These results suggest that observing touch on others not only elicits a conscious experience of touch in MTS, but also elicits a change in the mental representation of the self, blurring self-other boundaries. This is consistent with a multisensory account of the self, whereby integrated multisensory experiences maintain or update self-representations.

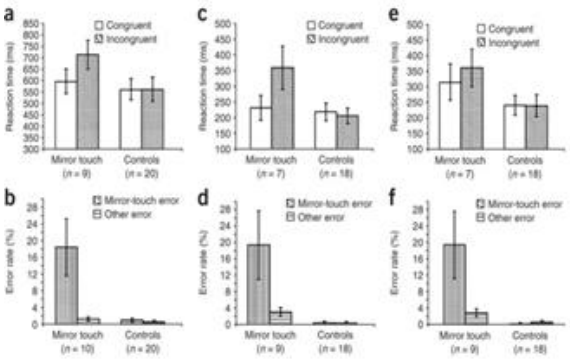


Figure VI (a,b) *Faces experiment. Reaction-time performance was compared using 2 (congruency) times 2 (group) mixed ANOVA. Participants performed faster overall on congruent than on incongruent trials (F = 10.69, P = 0.003). A significant interaction was observed (F = 10.37, P = 0.003), and this was a result of synesthetes performing slower on incongruent trials (t = -2.69, P = 0.028). Mirror-touch synesthetes had a higher percentage of mirror-touch errors compared with controls (t = 2.54, P = 0.032), but showed no differences in other error types. (c–f) Hands experiment. A 2 (congruency) times 2 (group) times 2 (perspective) mixed ANOVA conducted on reaction times revealed a significant congruency times group interaction (F = 18.93, P < 0.001), which was a result of synesthetes performing slower on incongruent trials (t = -3.08, P = 0.022).*

2.4.2 Olfaction

Figure VII *The Bitter Potion (ca. 1630-40), Adriaen Brouwer*

While “mirror neurons” were originally found in the pre-motor and motor cortex part of the brain, many researchers have found mirror neuron properties in neurons that control for functions other than motor function.

One example of this can be seen in the research done by C. Keysers, PhD and his associates[49] who have discovered that this “mirror neuron” firing pattern applies to feelings and perceptions[50]. In one study, Keysers[51] and his team tested the neural signals of men who were subjected to the smell of rotten butter, and compared them to neural signals from another group of men who simply watched as other men encountered such smells.

In both groups of men, the olfactory area of of the brain lit up thereby signifying that the concept of mirror neurons is not limited to actions but can be extrapolated to emotions and perceptions as well. Since then, many such experiments have been organized, testing different senses and emotions such as disgust. The general consensus of these experiments is that mirror neurons are very versatile and that they do fire for many different emotions and perceptions.[52] Thus far, mirror neurons properties seem to exist in the post-central gyrus.

2.4.3 Hearing

Figure VIII *Young women talking (Confidences) Renoir*

It was identified a mirror neurons system at the hearing level[53]. These mirror neurons respond both while monkeys perform hand or mouth actions and while they listen to sounds of similar actions[54]. Preliminary evidence suggests that a similar system may exist in humans. Several data[55] was found using fMRI, for example left hemispheric temporo-parieto-premotor circuit is activated in both cases, providing evidence for a human auditory mirror system. In the left premotor cortex, a somatotopic pattern of activation was also observed: A dorsal cluster was more involved during listening and execution of hand actions, and a ventral cluster was more involved during listening and execution of mouth actions. In conclusion, area F5 contains a population of neurons—audio-visual mirror neurons—that discharge not just to the execution or observation of a specific action but also when this action can only be heard. Multimodal neurons have been described in several cortical areas and subcortical centers, including the superior temporal sulcus region, the ventral premotor cortex, and the superior colliculus. These neurons, however, responded to specific stimulus locations or directions of movement. The difference with the neurons described here is that they do not code space, or some spatial characteristics of stimuli, but actions when they are only heard.[56]

BOX 7 ***"Empathy and the Somatotopic Auditory Mirror System in Humans"***

Valeria Gazzola, Lisa Aziz-Zadeh,Christian Keysers

A critical feature of the mirror system is the selective mapping of specific heard or seen actions onto the motor programs for executing the same actions. Showing the existence of a mirror area that is more activated by hand sounds than by mouth sounds and that has the same preference during execution, as well as the existence of an area with a complementary preference for mouth actions, could help establish such specificity in humans. So far, some studies have shown that the vision [28–30] (or sound [31]) of hand actions activates different sectors of the premotor cortex than the vision (or sound) of mouth actions, and other studies have shown that the execution of hand actions activates different sectors of the premotor cortex than the execution of mouth actions [30, 32–34]. However, none of these studies has compared the execution and perception of the actions from these two effectors (hand versus mouth) in the same subjects…

…Studies on pianists yield corroborating evidence for the effect of learning [8, 50]: Compared to novices, expert pianists show significantly stronger activations to the sound/sight of piano playing in their premotor cortex. Together, these data indicate that the mirror system is not restricted to genetically preprogrammed actions; rather, it is plastic and also responds to learned actions, in agreement with the idea that mirror neurons could result from hebbian learning [5] .

2.4.4 Sight

Figure IX *Facial expressions, Bowen*

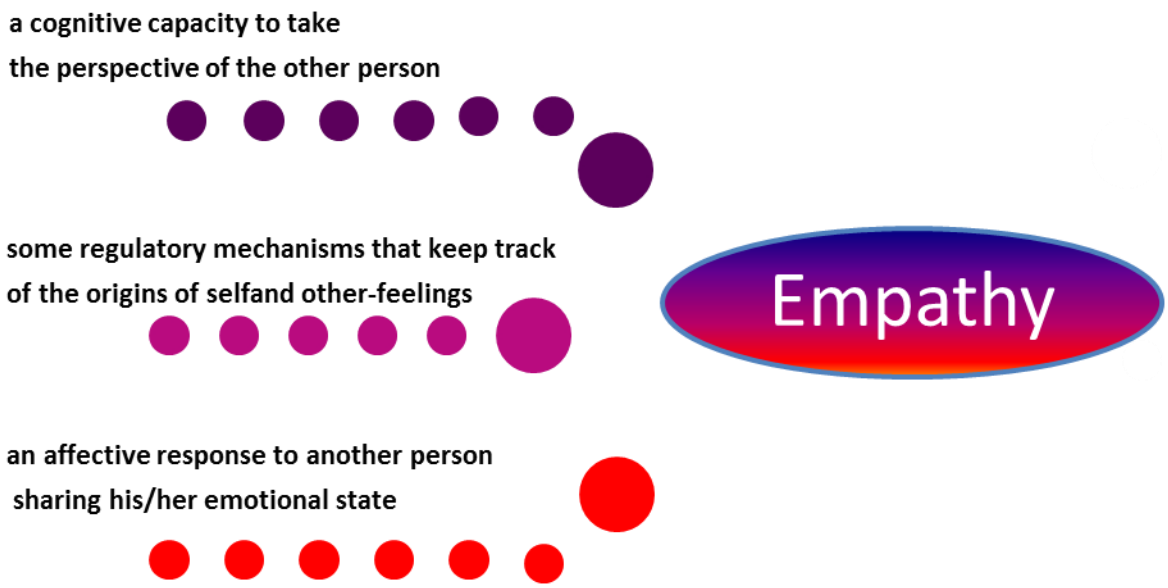
The view[57] was the most studied way because the discovery of these studies took place when certain brain areas were activated not only during the execution of a motor act but also when the action was observed[58] while it was performed by another individual[59]. The activation of the inner motor skills, can take place in the visual and auditory ways, because the observer knows the results of the action and is directly involved in the understanding of the goal of those who is performing the action: imitation, understanding empathy.

BOX 8 ***"Motion, emotion and empathy in esthetic experience"***

David Freedberg1, Vittorio Gallese

The mirror neuron system in monkeys and humans. **(a)** Activation of the area F5 mirror neuron during motor-act observation. **(b)** Activation of the area F5 mirror neuron during action execution. For both conditions, six consecutive rasters (spike recordings) during six consecutive trials are shown. The arrows indicate the onset of observed and executed grasping. (a) and (b) modified, with permission, from Ref. [60]. **(c)** Somatotopy of premotor and parietal cortices as revealed by fMRI during action observation. Activation foci are projected on the lateral surface of a standard brain (MNI). Red, activation during the observation of mouth grasping; green, activation during the observation of hand grasping; blue, activation during the observation of foot kicking. Overlap of colors indicates activation foci present during observation of actions made by different effectors. (c) modified, with permission, from Ref. [61].

2.5 Empathy



There are various ways in which someone can understand actions, intentions and emotions of others[60]. However there is only one way that others can understand "from within"[61]. This pathway is based on the activation of the mirror mechanism[62]. When an individual sees an action done by another individual, mirror neurons are activated[63]. This activation triggers a complex motor's network that turns the information into a motor copy of the observed action[64]. This action is similar to what is being aroused endogenously during motor execution or during certain emotions provoked by natural stimuli[65]. An important aspect of emotions, is their social function, because the emotions are the way of communication that allow us to perceive the mental states of others. The ability to "feel" mind's elements represents an essential dimension of human experience[66].

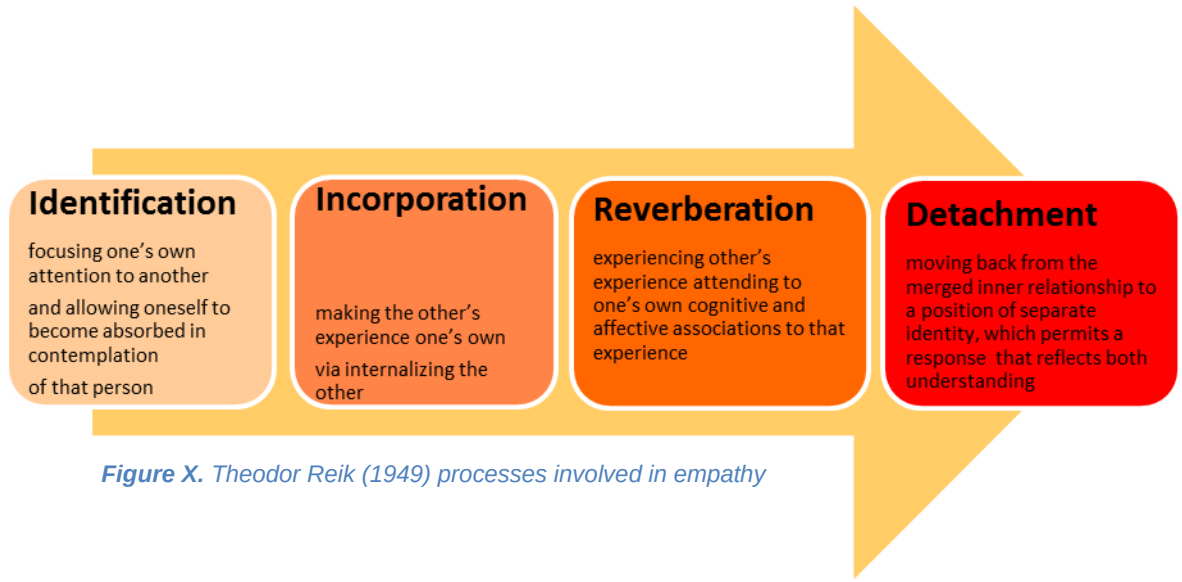


Figure X. *Theodor Reik (1949) processes involved in empathy*

The emotions are influenced by the perception of gaze and facial expressions through processes inscribed in our brains permanently. The somatic aspects of emotional processes are not easily translatable into words, non-verbal signals (facial expressions, tone of voice, body movements) in this sense can be effective communication tools.

BOX 9 "***The Functional Architecture of Human Empathy***"

Jean Decety, Philip L. Jackson, University of Washington

One of the main components of empathy is based on a mental simulation of the subjectivity of others, whichcan be initiated in two ways: automatically or intentionally.The idea of an unconscious and automatic simulation is far from new. For instance, Lipps suggested that an involuntary, instinctual, "kinesthetic" imitation of the observed vital activity of another occurs in empathy. When empathy produces this "physical mimicry" in the spectator, the intentional focus does not remain on the spectator's body but is projected into the other. Later, Ax suggested that empathy might be thought of "as an autonomic nervous system state, which tends to simulate that of another person". In psychoanalysis, Basch speculated that because their respective autonomic nervous systems are genetically programmed to respond in like fashion, a given affective expression by a member of a particular species tends to recruit a similar response in other members of that species. This is done through the promotion of an unconscious autonomic imitation of the sender's bodily state and facial expression by the receiver. This generates in the receiver the autonomic response associated with that bodily state and facial expression, which is to say, the receiver experiences an affect identical with that of the sender. This view was further developed by Levenson and Ruef who found evidence that a perceiver's accuracy in inferring a target's negative emotional states was related to the degree of physiological synchrony between the perceiver and the target. In other words, when two people feel similar emotions, they more accurately perceive each other's intentions and motivations. The idea that the knowledge about emotions expressed by others relies on a simulation of how the emotion would feel in the perceiver was also proposed by Damasio. The presumed mechanism for such a simulation involves an internal brain simulation that consists of rapid modification of ongoing body maps. The discovery that the somatosensory cortex is involved in the recognition of emotions provided the first direct evidence in favor of such an unconscious simulation process.Recently, Goldman and Sripada have provided several detailed cognitive models for a simulational approach toface-based emotion recognition marshaling neurological evidence for paired deficits between emotion production and emotion perception.

3 Broken mirrors

“Our language, our emotions, how to behave,

goals, hopes take them from our parents,

by teachers, by friends, by other.

We live in our community

like the child in the womb of the mother,

outside there is the desert, the exile:

to be among people who you don’t know

and who doesn’t know you

who you doesn’t love and who doesn’t love you,

to which you do not know what to say

and

who has nothing to say to you”.

***F. Alberoni**, Corriere della sera, 1 nov. 2010*

3.1 Poor and weak interpersonal relationships

In trade relations, it frequently happens that the protagonists of the various types of communication experience difficulties in communicating with others and that their exchange ends with an argument, an angry silence, a passive adaptation, and with feelings of anger, frustration, sadness, guilt. In the communication process something is not working, generating ineffective communication. The ineffectiveness in the communication between two (or more) persons may occur as a consequence of, for example, a period of stress. In any case, it is an exchange failed, in which communication is still occurred, but the expectations(conscious or unconscious) of the people involved in the process have been disappointed or frustrated. Both, the sender and the listener, involved in the communicative exchange, can express themselves or answer in an inefficient manner, contributing, to greater or lesser extent, to the failure of communication. The sender gave an inefficient message when he prefers an implicit communication rather than explicit, and it is not clear, nor authentic nor assertive. The listener helps to make or maintain communication ineffective when he is not listening the message of another, nor take in regard his experience, and answers:

• moralizing, judging according to their own value system as heard instead of accepting the system of values of the other and trying to put himself in his shoes.

• generalizing, that is communicating in an abstract way and on the basis of information that do not take in regard the concrete experience of the other, instead of answering by focusing on the real explained situation.

• investigating, and doing a lot of probing questions, direct and frequent, that can be perceived as intrusive by the issuer, instead of respecting the time and space of the other.

• judging and criticizing the others situation, instead of listening without prejudice and possibly answer with comments or constructive criticism .

• advising and giving directives, offering advice and tips prematurely, even when not required, instead of responding to the real needs of the other.

Communication is a necessary process, spontaneous and inevitable for human beings, and is possible to learn and consolidate new forms, styles and communication skills that allow the person to communicate more effectively, contributing to the development of healthy and satisfying relationships.

Most of us spend a considerable part of our life, to work for at least five days a week. Most of this time we spend working with other people, with some of whom we have common interests and activities out of context and we are also working closely linked by a relationship of friendship. The statistics on the social relations tell us that less than a quarter of the people we consider friends are people we work with and that half of us do not have any friends in the workplace. On the other hand the relations in the work environment could represents a

sources of great discomfort and dissatisfaction if they are characterized by the presence of conflicts. The contrasts in the work are not a rarity, dissenting opinion and different point of views are inevitable in most aspects of the workplace, even if some conflicts can also be productive, there are some cases which the differences and contrasts leads to severe discomfort then they can also cause stress and unhappiness.

Typical cases are the boss who unfairly criticizes our work or a colleague who abuses his authority or a customer that makes us lose time. It ' important to recognize the following cases:

• You are responsible for everything. If you try to face the problem, but failed because the other person refuses to cooperate, you have to acknowledge that you had done everything possible .

• If the conflict is not resolved, take alternative measures. Among the alternative measures are the possibility of a formal complaint of the situation or attempting to internal transfer to another office as an extreme choice. There are many factors that contribute to the stress of our working live, but all can be traced to the following classification :

• Factors that depend on the nature of employment, for example, too much work or not so much work ;

• Factors that depend on their role within the organization, such as the level of responsibility;

• Factors intrinsic to the structure of the organization, for example the lack of consultation between colleagues ;

• Factors related to the career, for example, the frustration of his ambitions ;

• Factors that affect the nature of the relationship with superiors, subordinates, colleagues, customers .

The negative effects of interpersonal conflicts in the workplace occur both on a personal level and at the corporate level. On the individual level, the negative effects of stress and conflict are mainly manifest through psychological, physical and behavioral symptoms. On a psychological level the typical reactions are: the inability to concentrate and think clearly, increased irritability and difficulty in relaxation. The most common physical symptoms are headache, insomnia and difficulty of digestion. The most common are behavioral signals the break up with the relationships that have caused conflict, abuse of alcohol, cigarettes and tranquilizers making an attempt to break the tension.

3.1.1 Liquid relationships

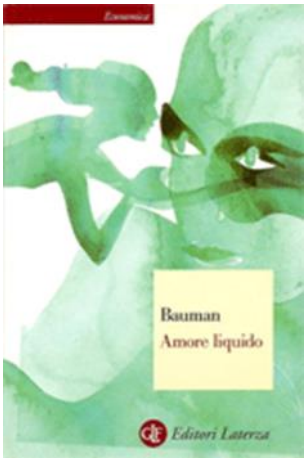


Figure XI. *Theodor Reik (1949) processes involved in empathy*

Z. Bauman is considered the greatest contemporary sociologist, his success comes from a metaphor with which he photographed the actual society: that of liquidity. Basically, he believes that today's man has no more certainties nor stable reference points. And everything became more fluid, liquid. Much of the recent research of Bauman examines the gradual disappearance of the great opposition that characterized our social life. The relationships are now all more liquid and watered down, also because of new digital technologies that have introduced a new "division" between the online and offline[67]. Bauman, theorist of liquid society said: "Just think of the change in the value of the word "friend" that took place between yesterday and today, thanks to the internet, to understand how the relationships have become easy and superficial "he speaks opposing the concept of pure relationship to a liquid one, with no restrictions, which aims at passing satisfaction, with no obligation, but thereby creating anxiety and frustration.

The concept described by Bauman in his book: "Consuming Life", perfectly applies to new relationships that resemble more and more to the relationship we have with things in a consumer society where everything is disposable". The relationships live of a monologue and not of a dialogue, them are created and deleted by a click of the mouse, accepted as a time of freedom in respect to all occasions that life and the world we offer. In fact, the lack of commitment and the selection of persons as merchandise in a store are only an encouragement for mutual unhappiness.

A relationship, especially if is love, is an occasion of happiness but should never be based on convenience, which reduces the relationship to something superficial and frustrating, preventing us from reaching those real things that each of us continues to desire". For the author when the relationships between a couple, parent-child or friendship turn into subject-object relations, a process facilitated by the Web, "arise serious moral problems and insecurity

instill everywhere, creating permanent anxiety". And so thanks to the internet the private becomes public, we carry on working while on vacation, we think we are always in touch with our "friends" online (but can we really define "friends" all the contacts we have on Facebook?).How Bauman explains in his latest essay published in Italy: "Collateral Damage: Social Inequalities in a Global Age", the migration of our life online is not always translates into an effective reinforcement. Often we find ourselves in the paradoxical situation of not knowing the best use of the new conquered freedom .

M. Konnikova[68] explains in an excellent review published recently in the New Yorker, how several studies on the effects of the web and social media argue that the Internet does not make us not nearly happier. Indeed, as shown by a meta-analysis summarizing the results of more than 40 research on the subject, spend a lot of time online may have a slight negative effect on our well-being. For example, the use of Facebook can contribute to unpleasant feelings. But, as always emphasizes the New Yorker, there are also many researches in the opposite direction: a 2009 study argues that Facebook makes us happier and increases trust in others .

Or, again, that some online activity can reduce the sense of suffering. In short, the effects of social media may seem contradictory, because everyone uses them in different ways and it is not easy to generalize.

To get out of this contradiction, the New Yorker cites an interesting study of 2010 made by the Carnegie Mellon[69], its say that when we interact online in an active way the social ties grow. However, when you behave in a passive manner, social networks can have the opposite effect: they let's to our relationships make us weaker and more alone. So, the sense of loneliness emerged from various studies would not be a direct effect of Facebook, but of the way we use it. And also, the New Yorker always stresses, it is increasingly difficult to be active online, even for constant overload to which we are subjected. And so, more the incentives to make online networking are numerous and more we have a passive position, in which we struggle to strengthen social ties: there is a study that proves that users spend on average more time passively. In short, as noted by Bauman the real causes are never found in the mediums we use: "It all depends on what we are looking for: technological devices are limited to make, more or less realistic our desires and more or less quickly and effectively our research".

But liquidity is also found in romantic relationships. While not so long ago long-term relationships were considered "natural instincts "are now perceived as oppressive: "The pledge with another person, in particular, an unconditional bond and a certain kind of engagement "till death do us part", in good times and in bad, for richer, for poorer, looks increasingly like a trap to avoid at all costs".

Bauman argues that love is an event very similar to death: ”You can’t learn to love, just as you can’t learn to die. Nor can learn the art of not remain snared and away from love.
Because the death that love pounce and capture the victim off guard.”
The magazines are full of pages devoted to the “post of the heart", in which the expert on turn recommended to those who have emotional problems how to behave. But, according to the sociologist, in love you do not learn from previous experiences. You can learn how to perform a task only when there are a fixed set of rules and stable scenario, and it is certainly not the case. To love means to surrender to a mysterious future. Love is the realm of uncertainty and, consequently, the men find themselves living in a paradoxical situation. On one hand, in a relationship tend to look for a comfort that makes them move away from the nagging sense of fragility that warn when they are alone. But once paired off, the man does not come to contentment emotional hoped, on the contrary, “Having a relationship “means a heap of trouble, but mostly live in perpetual uncertainty. The promises of fidelity to the relationship, once this has been established, are “meaningless”.
In these circumstances, people today prefer not to risk too much and tends to establish new types of relationships, less demanding and no promises: cohabitation, virtual relationships, open couples. These new sentimental forms are easy to create and just as easy to stop if you find a new object of desire. In other words, the philosophy that is the basis of modern “links" is that of consumerism: disposable .
The partners are like consumer goods in shop windows when we see a new object, which has thousands of quality, do not hesitate to replace it with the ones we bought earlier. Similarly, even in love we open the door to new experiences that could be “the most satisfying and rewarding”. Bauman 's theses have been criticized for pessimism, he says that the society in which we live is not the best, but closed his remarks with a hope: "Our consolation [..] is the fact that “the story still exists and can still be done “.

3.2 Why and how killing mirror neurons?

"You're bored, you are doing nothing, do you think consistent and believe to be right? You're killing them. Your neurons are committing suicide and the fault is not of the age". A. Bertirotti stated in a lecture titled "The mind in the Net", addressing the problem of the relations and virtual communication, or more exactly of that future digital that can transform an extraordinary potential in a dangerous comedy: "every man tells lies, but give him a mask and he will tell the truth," cit. Oscar Wilde. From social to media, insisted Bertirotti, it is important not to forget that the truth is somewhere else, and that to communicate we needs the reality of the body, the suggestion of a look.

It has been shown by several studies about daily exercise of our neurons, mirror and not, allows them to stay active. Were suggested a series of exercises to keep you in business these neurons, for example, trains memory weekly, keep anxiety at bay and the comparison with others, especially with those who do not think like us (the Zen theory says to embrace the shadow). Also it is always useful to think positive because our mirrors reflect to others our mental state (whatever it is). The killing of mirror neurons may also have a pathological implication because many of these seems to be involved in social interactions and dysfunction of this neural system may explain some of the primary symptoms of certain diseases, including autism, such as the isolation and the absence of empathy. Studies of people with autism[70] show a lack of activity of mirror neurons in different regions of the brain. It 'been Ramachandran[71], a neurologist Indian, speaking of broken mirrors, a broken mirror neuron system that turn out to be insufficient in autism. An autistic child is suffering from a dissociation: cognitively understand what does a person, but it is not able to understand it in an experiential way because inside of them fail to recreate the motor process of that action. Furthermore, is added their inability to feel emotions. Ramachandran and Iacoboni[72] argue that autistic people are unable to create the appropriate motor programs because of the lack of mirror neurons that does not guarantee him then an appropriate "normality". Without an efficiently endowment of mirror neurons, our normality is broken because that system is the base of social life.

3.3 Mirror without reflection

Fig XII *Invisible mirror, Laura Williams*

3.3.1 History of social network

The history of the social network began in 1997 when an American named "Ellison" launches site SixDegrees.com, the goal of the first social network was to create relationships between people. After this first attempt in 2003, again in USA, is coined the term "Social Network" thanks to a new social network that was very fashionable: Friendster, which was the forerunner of a series of social networks. And well known that the Social network was a great success from the outset, in fact Friendster was not prepared to cope with the number of users and requests coming, and pages, consequently, it were very slow in loading. And it is precisely at this time that many users from Friendster were moved to another social network: MySpace, born from C. De Wolfe and T. Anderson with a specific purpose: to give young people a space where they can do what they wanted.

In May 2003, R. Hoffman and some members of Paypal and Socialnet.com have launched LinkedIN, social network oriented to world of work where the profile becomes the curriculum vitae and the relationships that develop are professional in order to create reports useful to their careers. On 4 February 2004, born "The Facebook", created by nineteen year old Mark Zuckerberg. The young Mark had the idea of an exclusive social network that was based on real profiles: a system for keeping in touch with people you've met, it is so popular because it has a lot of functions and the ability to transform into a social platform capable of hosting third-party applications. After two years on 15 July 2006, was born Twitter, that allows you to send short messages to small groups. In recent years there have been two other Social Network to establish itself as Google+, the social network Google, launched in 2011 and Pinterest, born in 2012.

Social networks are the environments in which you can enter into a relationship with other people and are characterized by four main features: persistence, searchability, replicability, invisible audience. The social network itself (until internet's arrival), had the function of a

connecting physically any group of individuals, united by various social ties such as casual acquaintance, work relationships, family ties, for example, a community of workers, sportsmen, the brotherhoods, religious, etc. A social network can also be based on a common educational approach as in Scouting.

Nowadays, a social network service consists of a structure that manages the Web-based networks of social relations. The structure is identified, for example, by means of the reference website of the social network. This simple shift in meaning, however, has led to important changes.

3.3.2 The loneliness of social network

We live in an era where it is increasingly difficult to relate effectively with others that we are frequenting and talking in "real life". It seems that the use that is made of Facebook (or any social network) reflects precisely this increasing difficulty. Some find it easier to talk about their problems and their worries, writing on FB, rather than calling someone who trust yourself, or leave the house to go find one of your friends. Writing on social networks is, in a sense, a little 'how to speak aloud through mirror, looking at yourself. Maybe talking through the mirror, fades a bit the deep sense of loneliness in which one is immersed. In the era of the media through which all are connected in a network, in one way or another, everyone feels deeply lonely and have no one to be able to say, "Today, it was a bad day and terrible things have happened. I need to stay with someone, do a walk together?" Rather we use a computer or a chat as a tool to not feel alone, to tell our loneliness and sadness of a day gone bad. However, the function any other social network is purely illusory. In the end, we remain deeply alone, exactly as it was before starting our own confessions and our outbursts. Indeed, the more we get used to this mode of relating illusory, the less we will be able to carry on an intimate relationship, in the sense of the ability to convey emotions and to speak of himself as well as to confront directly on any matter. In this way, the loneliness of individual are growing up, while decreasing social skills. Everyone thinks that social networks are a mirror of the times, a reflection of what is happening in the world. But the model is not a mirror, social networks are not a reflection of society, but are a reduced short-sighted scale model where you are trap into, because you can’t read or see things a comprehensive manner, that leaves barriers and loneliness. There is a sort of exhibitionism, for instance, what causes people to photograph moments of everyday life, people or things and post them on the network in real time.

There are many scholars who have raised some issues about social networks. Bauman spoke about the issue of virtual friendships that are born and are deleted with a single click, and we are not sure that will improve our lives. Serra instead writes about the new generation of journalists who spend most of their time on social networks, which takes away the mental

space to verification, verification in the field. Finally, the NY Times[73], talks about how there are families in which there is no longer the relationship between family members because they are struggling with this virtual labyrinth.

3.3.3 The mirror does not reflect the lack of empathy

We know that mirror neurons through the mirroring, that is, through the simulation in our brain of experiences happened to other people, allow us to fully understand what they are feeling. This phenomenon allows you to get a great empathic attunement with others, thanks to the understanding of their internal states (basic interpersonal relationships).

Since the mirroring process is immediate you cannot speak of imitation, but of direct understanding of inner experience that translates into action without the mediation of logic abstract. This finding could explain the phenomenon of empathy, revealing the biological basis, since the neural structures involved (mirror neurons) appear to be the same ones that are activated as when we feel certain feelings and emotions and as when we look someone else feel the "same "feelings and emotions, allowing us to capture the experience of others. If so, mirror neurons play an "empathetic" rule and their malfunction could explain and justify the so-called broken mirrors, namely the lack of effective communication in relationships, or even some diseases such as autism.

A form of empathy, for example, is the one that is established between the parents and the son from the earliest years of his life. Mother and father also learn to be empathetic individuals, primarily through the sensitivity and not punishment. They should educate the values of 'altruism, openness towards others, so that the child could learn to understand and share the point of view of others.

We talk about tuning. However, when the parents are not in tune with their children, the situation causes them anxiety, worry and discomfort. When a parent never show any empathy with a particular range of the emotions (joy, tears, needs to be rocked), the child begin to avoid expressing them his feelings. In that way many emotions begin to be deleted from the register of intimate relationships. empathy has no age. There are cases such as the study of children who have empathize with their mother, mirroring her feelings.

Another example is that of the relationship between teacher and student, where it is very important to the sharing with the others kids, because if a student had taken all the attention for its merits or demerits, him enters a state of uneasiness and dissatisfaction that diminish its academic performance. Empathy is also a key factor in a couple's relationship, where the man does not give material things, but gives himself. There is a desire to merge with another being, understanding it fully, so the empathy facilitates the involvement of growth within the couple with its positive effects, and ruined it with its negative effects. Lack of empathy can be a source

of diseases, such as autism. Tests were done for this pathology, and clearly show that the disorder that affects children with autism is not about motor system, but essentially procedural. It is, in short, to an higher cognitive and neurological level. A further test through which you and tried to measure the anticipatory skills of individuals with autism, showed that the deficit is involved in the procedural sense.

The results therefore give scientific value to the considerations already exposed by autism's previous scholars and pave the way for a serious and well-founded correlation between autism and mirror system malfunction.

4 Reflecting mirrors

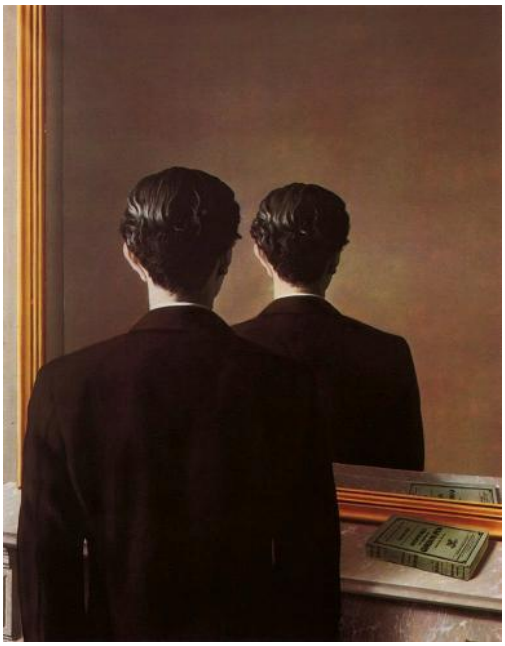


Figure XII *Dialogo allo Specchio, Magritte*

"The art is to make others feel what we feel,

in delivering them from themselves,

by offering them our personality

as a special release"

Fernando Pessoa*, The Book of Disquiet*

4.1 Emotions and Art: Neuro-aesthetic

Emotion is to look at an artwork as if you were inside it, experience the same feelings of his characters, evoking the movements made by the hands of the artist, to share his mood. The skill of a painter coincides with his ability, often unconscious, to evoke an emotion in the observer's brain, says V. Gallese[74]. There is a science that explains the relationship between the brain and artworks: neuroaestethic[75]. Gallese suggests that the emotions inspired by an artwork through the muscle tension and facial expressions of his characters are reflected in the cerebral cortex of the observers.

The motor areas that correspond to the muscles are activated by looking at the giants "Prisons" by Michelangelo, who is trying to wriggle out of the stone.

The circuits of the pain are activated, looking at the victims of the "Disasters of War" by Goya. Seeing St. Thomas the observer feel the sensation of putting his finger in the wounds of Christ.

This feeling of supporting the efforts of Prisons, to pierce the canvas does not mean actually make the same gestures". The neurons discharge as if they were to pierce the canvas - explains Gallese - but not give the order to the muscles".

Figure XII *sx: Disaster of the war, Goya; dx: Incredulity of St.Thomas, Caravaggio*

Plato spoke of "mimesis "referring also to artistic creation, for which the theory of identification in order to explain the emotion in the face of art is certainly not new". But the observation of this phenomenon in the light of modern scientific knowledge is new ". It is the empathy that allows us to excite us in front of a work of art, speculate Gallese and D. Freedberg[76] (from Columbia University).

In fact, recently there have been studies on the importance of the mirror neuron system in the aesthetic experience of both the visual arts, since such a system is also activated in the presence of images, depictions, that the performing arts .

It has been suggested that artworks can activate mechanisms embodied, universal in nature, which can simulate actions, emotions and bodily sensations. As well as for the pictures, the same effect can create sculptures.

Working with some images of classical sculptures, Greek and Renaissance, and just changing their golden proportion, it was interesting to note that the activation of visual cortical areas persisted, but that the emotional structure of the insula was missing. This means that genes such as Praxiteles or Donatello, were able to trigger in us a real biological reaction .

This process would be essential for understanding the effects of artistic images, and more generally to those produced by the mass media. The two researcher had published a study on "Motion, emotion and empathy in aesthetic experience "in the journal "Trends in Cognitive Sciences"[77]. To test our hypotheses to the end, we are carrying out tests on a group of volunteers, watching their reactions trans-cranial brain by magnetic resonance imaging", explains Gallese. Another contribution was offered by Professor S. Zeki in the conference "Neurobiology of Beauty"[78], where he tells how the brain behaves in the presence of beauty: "When I saw the picture a slight feeling of pleasure ignited in me".

As Zeki says “there is a common definition of beauty, it is in the medial orbitofrontal cortex, that is involved in the aesthetic experience. It would seem in fact that this is correlated with visual experiences pleasant or, more simply, with the perception of what each of us considers beautiful, irrespective of the characteristics of the object itself, thus becoming active in the presence of stimuli that fall under the concept of beauty, desire love as an integral part of the system of joy and gratification. When our eyes meet an artwork we create a visual process, we are able to generate in us the sensations of pleasure and beauty which the artworks are able to give. Beauty Is In the eye of the beholder".

Before to perceive a picture is necessary to involve not only the visual system but also the complex system of knowledge, emotions and values. Zeki argues that even the beauty and pleasure arise from the integration of the concepts in our brains, and creations expectations are strongly influenced by culture, then subject to individual and cultural differences.

4.2 Neuroscience between literature and creativity

When Leopardi spoke of the moon, he knew what he was talking about, "wrote I. Calvino in “Memos ", reminding us that the poet from Recanati would be interested about sciences for a lifetime hundreds of pages of his admirable “Zibaldone“. Bonnefoy writes about him also: “Leopardi is a great poet because he understood with special intensity, that poetry is to rely on the intelligence of the words“. It's just the intensity of the poetic word that makes the neural circuits stronger and deeper. And there is the knowledge from neuroscience that shows how a common brain is different from poetic brain, the poetry acts on our neurons, through the words, in addition to rhythm, rhyme, musicality, to make a difference. With the sparkle of these verses in our brain, something has changed and has activated.

And creativity? It is possible that exist one or more areas of creativity and that is more developed in creative people. Establish a neurobiology of creativity, the many states of mind and emotion is still difficult.

You can, however, speak of synesthesia (from Greek = sin together and aistanestai = perceive) as a process of extraordinary associations into a single image of nouns and adjectives belong to different sensory spheres. A form of synesthesia is that which exists between color and sound, so that a person hearing a sound or note, perceives and ascribes a color even though this is not really present in the auditory and / or visual stimulus. Mozart and Kandinsky for example, were suffering of this intimate correspondence between sounds and colors that will surely contributed to their artistic creativity. For Kandinsky the synesthesia was the starting point for artistic inspiration: in his compositions, “symphonic “become a means of sound that vibrates and resounds. But Hippocrates had already realized that feelings,

perceptions and creativity were related with the mind, especially with the brain. It is interesting how synesthesia is associated with creativity, and creativity to the brain.

4.3 Musical-brain

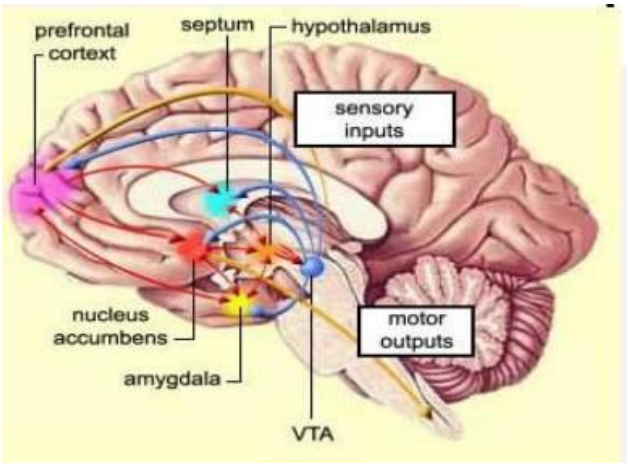
"The man that hath no music in himself,

nor is not moved with concord of sweet sounds,

is fit for treasons, stratagems, and spoils "

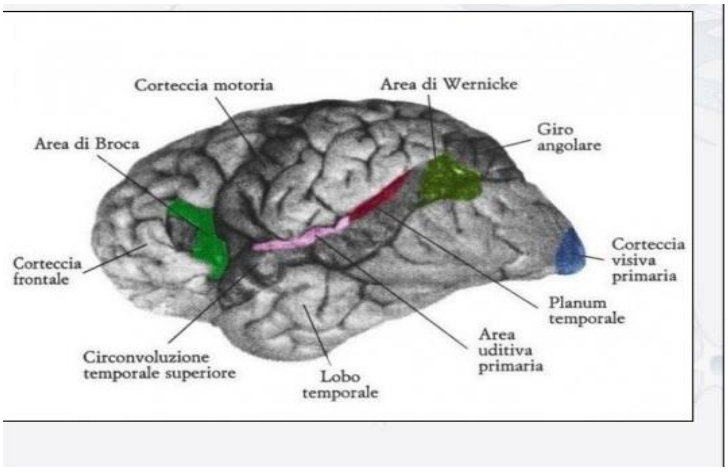
***W. Shakespeare**, The Merchant of Venice*

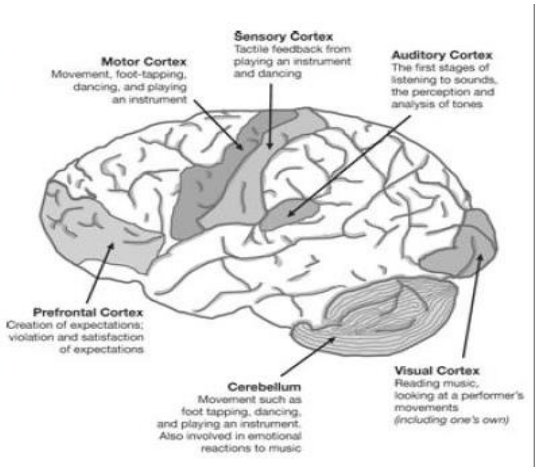
The music and singing have deep effects on each one of us, independently by styles and types. What is make the music interesting, is how music can reach the listener and evoke certain emotions. Music is the science of the voice and sound's production, but it is also the art of expressing feelings through the sounds, the melody and the harmony. The music's beauty is the harmony out of chaos. Requires the activity of many parts of the brain, all the evidence, and the thought that involves emotion[79].



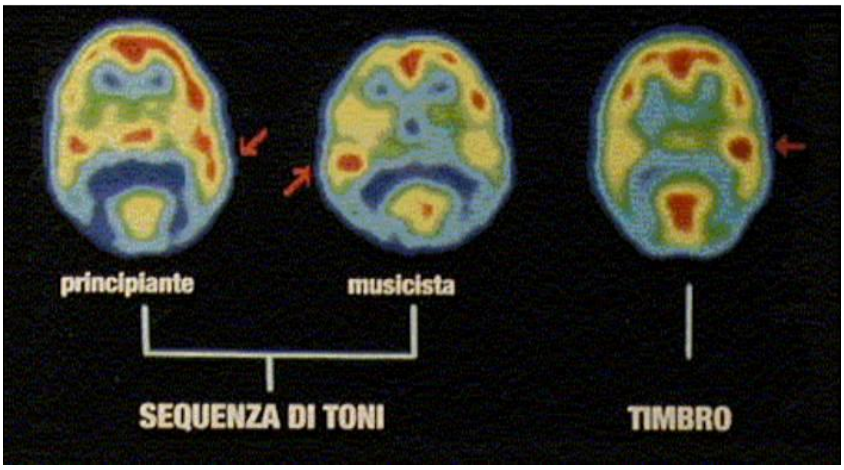
- Are the components of the limbic and mesolimbic vegetative system that are involved to analysis of emotions the pursuit of musical pleasure.

According to some experimental studies about the localization of sounds, there was a dominance of the right ear for the music and melodic messages, while the left hemisphere was involved for verbal messages and. It is possible to identify different areas of the brain involved in different aspects of music perception: the right temporal lobe is essential to recognize and enforce the melodies, the left temporal lobe which depends the development of musical language, writing, composing and performing music ; inferior





frontal cortices in recognition of the harmony, the bark right in the auditory perception of time below the music, the left auditory cortex in the perception of rhythm, cerebellum and basal ganglia in the synchronization of musical rhythms and coordination of movements.
In inexperienced listeners, the listening stimulates the right side of the brain, the most intuitive (visible in red), while in the most active musicians rational, is left side.
Schalaug[80] demonstrated a magnification of specific areas of the brain after a year of musical training. Music has the power of multi-modal systems, and can simultaneously stimulate the auditory, visual, sensory, motor and limbic, ensuring a unique integration of its kind.
As is well known the musical skills are developed from early childhood, using the music was possible to evaluate the electrophysiological responses of children. The studies done showing



how learning and cognitive development begin already in the womb and as the music, among many stimuli to which the child is exposed, can promote these learnings. One of the biggest advantages of music is its multimodality, listening the music we activates our auditory areas - the sound reaches the ear and is transmitted to the primary auditory cortex and processed in associative areas. The musician plays and moves and he give to us useful signals for the interpretation of the songs, both tactile that motor.
The techniques of music therapy represent the set of essentially non-verbal interventions that use mediators "artistic" in order to promote and expand the modes of communication and expression .The term music in this context, it is used as a synonym for sound.
The music therapy, in a modular arrangement of the central nervous system, is able to act on neuronal circuits capable of stimulating neuronal plasticity. The music with its action on maturation imprinting, with its facilitative action of pleasure and, at times, the restorative regression, is able to promote thought and behavior in both healthy and pathological conditions.
In Neuroscience is consolidating the principle that sensory input is able to facilitate, through the structures of the temporal lobe, the processes of attention, observation and learning

managed by the frontal lobe. In other words, music-therapy stimulation is able to act on anatomical structures delegated to attention, learning, thinking and behavior.
Historically, we can distinguish two types of music therapy :

- active music therapy in which the interaction between music therapist and the patient is by the direct production of sounds using voice, musical instruments or simple objects.
- receptive music therapy based on listening to music with the help of players, in which the patient is given a certain activity in perception, imagination and elaboration of proposals music.

Listening joyful or sentimental music, exciting or relaxing music, there are some changes in the autonomic nervous system that regulates blood pressure, heart rate, respiration, perspiration and other physiological responses (the vegetative nervous system). Music such as dance or marches for orchestra provoke responses especially of motor's system: those facts that lead us, almost in spite of ourselves, to keep time with your foot or with the rocking of the shoulders. (Motor System). Because music is a form of structured communication, with its own language, much of its decoding takes place in the left hemisphere, responsible for logical processes, while the right captures the emotional processes (Cognitive and Behavioral System).

5 Mirrors at work

"When people in an organization develop a shared and intuitive vibe for what's going on in the world, they're able to see new opportunities faster than their competitors, long before that information becomes explicit enough to read about in the Wall Street Journal. They have the courage of their convictions to take a risk on something new. And they have the gut-level intuition to see how their actions impact the people who matter most: the folks who buy their products, interact with their brand, and ultimately fund their 401(k) plans. That intuition transcends what's traditionally referred to as market research. A widespread sense of empathy starts to influence the culture of a place, giving it a sense of clarity and mission. People spend less time arguing about things that ultimately don't matter. Empathy can even start to ensure more ethical behavior in a way that no policies and procedures manual ever could".

***Dev Patnaik with Peter Mortensen**,*

Wired to Care,How Companies Prosper When They Create Widespread Empathy

5.1 Work and crisis

5.1.1 Crisis

It's not possible to give a precise and general definition of a crisis, just as it's not possible to predict with exact certainty when a crisis will occur, how it will occur and why. However, does exist a guiding definition of a major crisis. First, a major crisis affects, or has the potential to affect the whole of an organization.

If it is an event that will affect only a small, isolated part of the organization, it may not be a major crisis. A major crisis will also exact a major toll on human lives, property, financial

earnings and the reputation and/or general health and well-being of the organization. Often these effects occur simultaneously. As a result, a major crisis cannot be completely contained within the organization's boundaries. And some major crises, such as the one suffered by Barron's Bank several years ago, will actually destroy the organization.

Particularly the financial crisis of 2007–2008, also known as the Global Financial Crisis and 2008 financial crisis, is considered by many economists the worst financial crisis since the Great Depression of the 1930s. It resulted in the threat of total collapse of large financial institutions, the bailout of banks by national governments, and downturns in stock markets around the world. In many areas, the housing market also suffered, resulting in evictions, foreclosures and prolonged unemployment. The crisis played a significant role in the failure of key businesses, declines in consumer wealth estimated in trillions of U.S. dollars, and a downturn in economic activity leading to the 2008–2012 global recession and contributing to the European sovereign-debt crisis. The active phase of the crisis, can be dated from August 9, 2007, when BNP Paribas terminated withdrawals from three hedge funds citing "a complete evaporation of liquidity", and a year later in the 15 September 2008, when the Lehman Brothers bank firm filed for Chapter 11 bankruptcy protection, following the massive exodus of most of its clients, drastic losses in its stock, and devaluation of its assets by credit rating agencies. Lehman's bankruptcy filing is the largest in US history, and is thought to have played a major role in the unfolding of the late-2000s global financial crisis.

In our day the consequences of this global crisis are continuing and we have to learn to face it and manage it to avoid the collapse of the organizations.

5.1.2 Crisis management

Most executives and organizations, unfortunately, are prepared for only a small number of worst-case scenarios. Moreover a crisis leadership is also necessary for the existential, emotional and spiritual bottom line. No person, business, organization, institution or society can survive for very long without crisis leadership[81]. There are several potential challenges that all organizations need to face and overcome if they are to survive today's threats:

- Right heart: crisis extract tremendous emotional costs. Crisis demand exceptional emotional capabilities.
- Right thinking: crisis demand high creative and positive skills.
- Right technical skills: crisis demand that we know different thinks and that we do things differently.
- Right social and political skills: crisis management requires a special type of political and social skills.
- Right soul: crisis management requires special type of inner of spiritual growth.

- Right integration: crisis management requires that we integrate previous forms of capabilities
- Right transfer: new skill are needed
- Right signal detection: mechanisms that are able to pick up the dangerous signal and amplify it. Then we have to transferred it to the right people in the right method.
- Right stakeholders: all the internal and external parties who cooperate, share crisis plan and participate in the training and development of your company.

These points can help every organization to anticipate, plan for and survive the crises that are an inevitable part of life.

Is very important in situations like that where we are today, to try to better manage the crisis, and to prepare organizations in these difficult moments. This preparation is obtainable only by a great effort of these organizations and of all their members, because they have to change their point of view about the problem and see the company under another perspective.

5.1.3 Empathy in work environment

In previous points, there are some that are independent from a single individual, some others that have an hidden common factor: the empathy. When we are talking of trust, right integration, right heart, right thinking, right soul, we are talking indirectly of empathy[82]. The concept of that word, in the work environment, is fundamental. There are a lot of cases of how the crisis can be induced by a lack of empathy and can lead to a lack of empathy. In both case we are not able to communicate each other and we don't understand the people around us, that are part of the same organization. This can led in a bad work environment that led itself a really uncomfortable situation. It is, nowadays, common talk about discomfort occupational (or stress). The experience of change itself, particularly where individuals feel a lack of control or involvement and the uncertainty of the workplace, can result in various situations of occupational discomfort. The occupational stress has a lot of variants:

Mobbing: repeated and unprovoked behavior against an employee or group of employees, that creates a risk to health and safety. This lead the worker to auto firing itself.

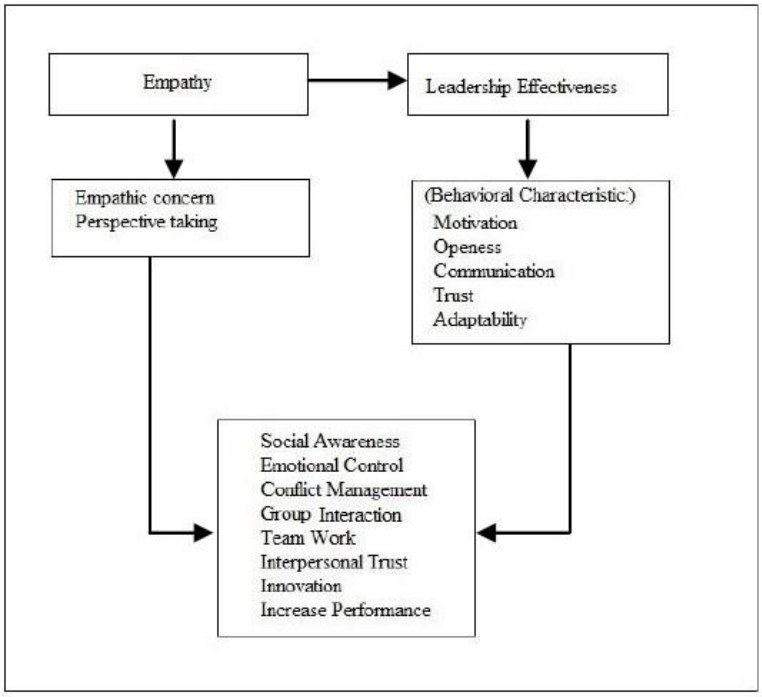
Burnout: process in which the stress becomes a defense mechanism and a response strategy to the voltage, resulting in behavior and emotional detachment, avoidance of emotional exhaustion, depersonalization and reduced work capacity.

Occupational stress: occurs when there is a substantial imbalance between the demands coming from the working environment and the response capacity of the worker to deal with them or control them.

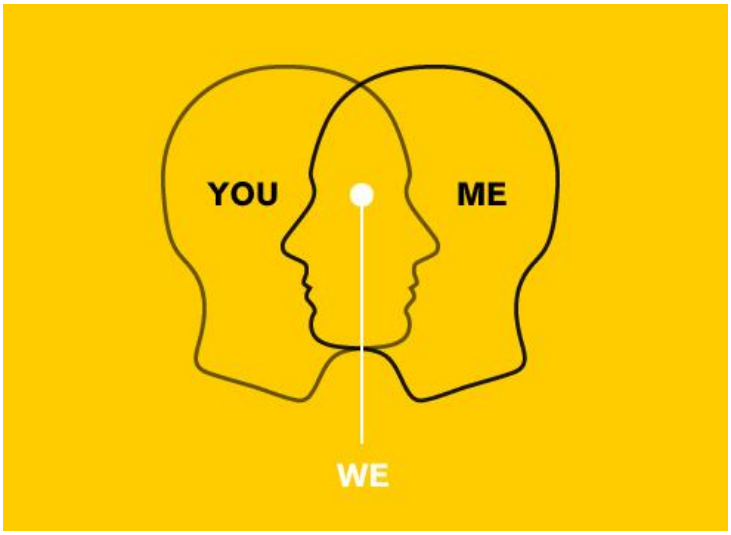
Harassment: any act or unwanted behavior that offends the dignity and freedom of the person who suffers.

Alienations: pervasive sense of meaninglessness and lack of professional self often resulting from demotion.

The occupational stress usually occurs through a particular mood, somatic and behavioral reactions. There are some assessment indicators, as the slowness, the aggression, the resentment towards the organization etc. According to the European Agency for Safety and Health at Work, the factors predisposing the onset of occupational stress are mainly related to the particular conditions of employment status (job insecurity, role ambiguity, poor pay, excessive demands).The use of the empathy and the mirror neurons as instruments to avoid this bad situation, should be a really low cost solutions, that would be applicable to everyone, because everyone of us has mirror neurons.



5.2 Empathic Organization



5.2.1 Empathetic negotiation can save the companies

There are countless cases where take an empathetic attitude has fostered relationships within an organization, or even, in extreme cases, has improved the fortunes. Among these we mention the case of C. Vlachoutsicos[83], who recounts his experience to the Harvard Business Review. His trading companies had ordered a large quantity of electrical fixtures from an Indian supplier for resale to their customers. They had offered a good price and had received plenty of orders. Few days later, the Indian supplier informed them that the price of each fixture would have to be almost 40% higher than originally quoted, otherwise they could not execute the order. In the course of a long phone dialogue with the R&D Manager of the Indian company his Managing Director lost his temper. It was clear to him that the situation threatened to get bogged down in name-calling and blaming, which was only making a bad situation worse. Achieving this kind of empathy after such a rocky start wasn't something to be done by telephone and e-mail, so he suggested that his Managing Director and he go to India together.

They spent several days in Mumbai and they began by simply asking, without heat or indignation and, most importantly, in a face saving manner, why they had so abruptly changed the terms of the deal. Their best way forward, therefore, was to show to the suppliers that while the price increase would save them losses, it would also have very negative consequences for them because there was a strong likelihood that their company would be shut out of the Greek market. In other words, they could think of this project as an investment in growth rather than as a short-term profitable deal. After extensive discussions they were finally able to agree on a price only 10% above the initial offer. What really made the difference?

Their arguments for reducing the price back to where it had been were not based on their interests but rather on an objective analysis of the risks and opportunities that the supplier faced. Finally, the connection they had forged with the supplier proved a strong foundation for many profitable and successful deals in the years that followed.

5.2.2 Emphatic Brands

The success of many brands depends largely on the company's culture, what makes the difference between a successful company and one that has none, nowadays, it depends on so-called Corporate Empathy. A recent article by Gizmodo journalist Sam Biddle pointed out the emphasis on empathy in the training of Apple's Genius staff[84]. The business strategist, D. Patnaik in his book Wired to Care describes the human brain as an apple. In that theory at the center is a hard core linked with our biological survival (hunger, our sex drive and fear). On the outer core is the neo-cortex which manages our higher-level thinking. In mammals like mice, this part is thin but humans it's up to 80% grey matter, which is what makes us smart. The "sweetest part of the apple" is the limbic system, which draws together all the parts of the brain to handle emotional information. This part is responsible for our capacity for empathy allowing us to communicate and sense emotional cues, which are fundamental to what makes us social and caring. It's in fact triggered by face to face interaction. In this age of hyper-connectivity, we're seeing now that business is becoming very personal. We're seeing the people behind the corporate veil. he fact is corporations are now a pervasive part of our lives. Today, 59% out of the world's 150 most powerful economic entities are corporations, not countries. As Craig Davis said: "Companies are massively powerful, many of them have more economic muscle than entire countries and exercise massive influence on the world. Comfortable or not, companies have to put themselves in other people's shoes”.

The best example given is by TOMs Shoes founder B. Mycoskie is a shining example. His 'One for One' movement - one shoe given away to a child in need for every one sold - has proven to be enormously profitable whilst improving the lives of many in the developing world. It's also given the company generous amounts of social capital.

5.3 Crisis and the healthcare organizations

5.3.1 Crisis and Spending review

Following the economic crisis that has affected our country in recent years, and in general the world, in the autumn of 2012 the new government led by Prime Minister Monti has implemented a financial reform called "spending review", for the containment of public spending by rationalizing targeted costs and better utilization of available resources.

Through the measures adopted by Monti government, the funding of the Italian NHS will contract 6.8 billion euro to be carried out in the period 2012-2015. In particular, these reductions will be primarily aimed at buying conditions in the supply of goods and services, in addition to costs for drugs, medical devices, biomedical and health services external to purchase. This maneuver appears to be a logical point of view at least, necessary, since for the most highly industrialized countries, health spending should be a growing voice in public budgets. In fact in the UK they want to bring the health budget from £96 bilion to £110 bilion whitin the 2015-16 and capital spending will rise to £4.7 billion. Since new medical treatments and an ageing population means the demand for NHS services is rising, it’s inescapable to implement several reforms. The reform useful especially for aged people is to link the activity of NHS with the Social care, in fact by 2015-16, over £3 billion will be spent on services that are commissioned jointly and seamlessly by the local NHS and local councils working together.

Also Obama is acting a review of the healthcare, called Obama care, even if it is the subject of numerous controversies as it goes to revolutionize the system of private insurance on which the American health care is based.

One possible solution, which is independent of the vision of problems from another point of view, is empathize. Indeed workplaces covered by a culture empathic survive the crisis better and so patients with which the doctor establishes a relationship of empathy takes less time to recover.

5.3.2 Empathy in Healthcare

Several data seem to demonstrate that empathy could be useful in the relation with the patient[85]. Study as "Practitioner empathy and the duration of the common cold[86]," show that patients who rated clinicians as having "perfect" empathy during medical visits had shorter, less severe colds and greater activation of the immune system[87]. The cold duration in the perfect-score group of 84 patients was 7.10 days versus 8.01 for the 264 patients who rated their clinician's empathy as less than perfect. In a recent study where oncologists were video-recorded speaking with their patients, oncologists only responded to 22% of moments thought to be an empathic opportunity. Another more recent study involving oncologists and lung cancer patients showed the physicians responding to only 11% of empathic opportunities.
There is new evidence indicating that empathy is an important medical tool and it can be acquired and taught in medical school". If you aren't establishing a rapport with your patients, they may be less likely to adhere to your recommendations to change their lifestyles and lose weight," says Kimberly A. Gudzune, M.D., M.P.H., an assistant professor in the Division of General Internal Medicine at the Johns Hopkins University School of Medicine and leader of the study published online in the journal Obesity.

5.3.3 Mirror neuron therapy

Since empathy has been linked to the activity of mirror neurons, we can speak of mirror therapy, as the activation of mirror neurons induces a noticeable improvement in patients. This aspect has been treated in a thesis entitled "Study of the system of mirror neurons to rehabilitation theory for the recovery of the upper in hemiplegic patients" by G. Venuto[88]. In this paper we discuss how to motor imitation attempts to facilitate a recovery of neuronal circuits and motors compromised, thereby promoting brain plasticity through the use of multiple sensory afferents(visual, auditory and proprioceptive), trying to wake the system using a variety of input. According to statistical analysis data there is a statistically significant difference between the results obtained from the mean difference between T1- T0, between the traditional and the treatment of our experimental protocol (t = 3.74, P -value = 0.0135) .For the three patients at follow-up (T2 -T1) has not shown a significant improvement (t = 2.48, P -value = 0.132) .Analyzing the data expressed by the Wolf Motor Function Test is found :when it relates to a significant increase in the mean difference between the phase T1 -T0 of patients in our treatment (t = 6.6, P -value = 0.0027) .As for the three patients then underwent follow-up (T2 -T1 = 1.67), the increase is not significant (t = 3.78, P -value = 0.063).

5.3.4 Broken Mirror and Autism

Mirror neurons seem involved in social interactions, disruption of this neural system may explain some of the primary symptoms of autism, including the isolation and lack of empathy. Studies of people with autism show a lack of activity of mirror neurons in different regions of the brain. Ramachandran, a neurologist Indian, speaks of broken mirror, as the bad working of mirror neurons in autism. Why someone is autistic? These children, are highly intelligent ,but they suffer from a dissociation They are able to cognitively understand what a person is doing, but they are not able to understand it in an experiential way .

For example, they look at an individual who grabs a glass, but they are not able to recreate the formula motor of that gesture. Added to this is their inability to feel emotions that it is an huge inability. Now you must find a way to make them understand what are the emotions. So as you can imagine a therapy?

There are scholars such as Ramachandran and Iacoboni who claim that autism is a disorder of the primary mirror neurons, that these children are not able to create the appropriate motor programs and that, not having them, also have difficulties to create the mirror neuron ; Children often get stuck and fail to act. Without an efficient allocation of mirror neurons, therefore, our "normality" falls apart since this system is the basis of social life.

5.3.5 The Impact of Empathy on Leadership Effectiveness

Global markets and global crisis have increased the challenges faced by organizations causing them to manage their employees across varying cultures, different time zones, and complex organizational structures. Thus, more effective leadership skills are required to enhance business survival and continuity[89]. Empathy is a pivotal leadership tool in today's global market. The leaders with higher empathy appear to be more effective. The clear implication is that multinational organizations need to develop leaders with high empathy skills, this allow them to relate effectively to diverse groups of employees, and achieve the desired results. Empathy skills allow leaders to understand better other peoples' perspectives and opinions, making the work environment more enjoyable and productive. Goleman state that empathy is a must-have virtue for leaders because it can inspire, motivate, envision, and lead others to greater effectiveness. The empathy has an important role in leadership because empathy enables leaders to connect with their people. Empathy ensures that connections occur between people so that everybody is included and no employee feels left out, and as such, an empathic leader is perceived as an effective leader. An effective leader increases employee optimism, motivation, and commitment, as well as organizational vision.

According to McCuddy and Cavin[90], in the rapidly growing global market there are more leaders working across borders, distances, and cultural boundaries.

These leaders need to adapt to multicultural differences, have exceptional knowledge of business operations, have effective time management skills, and be able to act and think beyond traditional boundaries.

By placing themselves in the same position as their employees, leaders are using empathy to help motivate their employees by earning their trust. Goleman note that empathy helps leaders to increase their capacity and willingness to understand situations, and accept proposed changes and opinions of others. Empathy enables leaders to be sensitive towards others so that they can create an atmosphere of openness, making these leaders more flexible and open to new ideas and perspectives that lead to effective leadership. Empathy has become increasingly important to the success of leadership because empathic leaders are more likely to have an appropriate degree of openness about diversity and the differences between cultures. According to Martinovski, Traum, and Marsella[91], empathy also plays an important role in developing trust in leader-employee relationships.

Leaders can also use positive emotions to earn trust from their employees and create bonding through their ability to understand others. Tager[92] stated that empathy also allows leaders to be more aware of changing environments and be willing to adapt and do things differently. Adaptability provides leaders an advantage in cross-cultural situations and prevents them from crisis and offending employees. According to Mahsud, Yukl, and Prussia[93], empathy enables leaders to have a better understanding of new social surroundings, and helps them quickly learn and adapt to new environments. In the same vein, empathy skills also help leaders have a positive attitude towards adapting to new environments and trends which create a collaborative atmosphere. Leader requires the ability to take the perspective of others, further notes that the ability to take the perspective of others means that leaders should be able to see the world through others' eyes. Thus, leaders must acquire empathy to promote behaviors that are necessary for effective global leadership.

In research on transformational leadership, low job turnover, leadership effectiveness, and individual advancement were related to leaders who had a high degree of empathy, openness, and communication.[94]

Empathy has also been regarded as a powerful tool in developing leadership skills that are instrumental in the development of trustworthy and motivated employees. Thus, empathy strengthens leader-employee relationships and eliminates shortcomings or mistakes. A recent study has been done on how empathy is a powerful means to improve business performance, comparing some multinationals from U.S versus some multinationals from Malaysia[95]. This study supports previous research and provides significant evidence that high levels of empathy skills are pivotal to achieve leadership effectiveness. The study expands the growing body of

knowledge on how empathy positively impacts leadership effectiveness and organizational performance to face the new challenges from the markets and to face the crisis itself.

Conclusion

" Mirror neurons will be for psychology what DNA was for biology ".

This famous quote of Vilayanur S. Ramachandran could sum up the importance of mirror neurons in that the discoverers have termed “empathic participation“. Mirror neurons have been a real innovation, a "revolution" for the neuronal communication and bio- social, which influenced the actions, behaviors and language of man and has directed its inter- individual. Is curious then as well as mirror neurons are involved in what is called organizational and corporate welfare. No coincidence that nowadays, it is being discussed their involvement in the political and economic system. This application is called neuro-marketing, which is the set of techniques belonging to the field of neuroscience aimed at marketing, studying the effects of advertising and communication routes in the human brain with the intention of arriving in predicting consumer behavior. Another important field where we can use mirror neurons and empathy to improve our social relationship is in the work environment. In an organizational context, it results fundamental both to increase the productivity and the performance of the organization and to face the financial crisis that is occurring in these years. Dean Rusk, former U.S. Secretary of State, state: "One of the best means to persuade and understand others is through your ears starting to listen to them, let's talking about emotions. We have to link us to each other through the feelings and the emotions”.

Suddenly empathy becomes no longer a technique or strategy that was built, but a real resource for ourselves and the company we work.

The empathy, therefore, is no longer considered a predisposition irrelevant but will be the new skill of the future.

Thanks

We wish to thank all those who have allowed us to deepen our knowledge about mirror neurons and that made possible the execution of this work. A special thanks to the researchers and the expert in the field of neuroscience for have provided us with important data, essential for the performance of our work.

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