Adolescent mind and neurosciences

Gianluigi Monniello, Lauro Quadrana

Abstract

Adolescent Mind Transformation and Neurosciences. We have lately been observing a great development both in neurophysiologic and in neuropsychological research aiming to explain and integrate, on behalf of some scientists, how scientific breakthroughs may be of utility in confirming the basics of the psychoanalytic theory. Neurosciences have lately been defining the structure and functions of the brain systems processing the information about the relationship with the caregiver and underlying the subjectuality and intersubjectivity mechanisms. Thanks to *brain imaging* we can nowadays observe the progressive maturation of the brain in adolescence, especially the complete development of the frontal lobe which, from the philogenetic point of view, consists in that surplus that makes the difference between human beings and the other animal species.

Key words: adolescence, neurodevelopment, subjectuality, incarnate simulation; mirroring.

Several researches dealing with brain development show how different types of precocious relational experience have a positive or negative impact on the evolving psychic structure.
In particular, neurosciences are currently defining structures and functions of the brain systems which process the information regarding the relationship with the *caregiver*, mediate affection and involve mechanisms of subjectuality and intersubjectivity.
Can psychoanalytical conceptions of the psychic apparatus be consonant with what is currently proved to work in nature?
Can the theoretic psychoanalytical model include both the psychic function and the biological structure?
Nowadays, thanks to the use of *brain imaging* it is possible to observe the brain development during adolescence and, in particular, the fulfilment of the frontal lobe development, which represents that surplus distinguishing the human beings from other animal species.
Our experience of reality is built on activity patterns of neuronal groups inside the brain which give rise to functional units able to represent our experiences in different forms, as images and sounds, words and sensations, abstract ideas or perceptions. The ways we assemble particular neural activations, autonomously or while interacting

with other people, determine the nature of our experience of reality. Communications based within human relations rely, at least partly, on sharing these representations, and the patterns of communication which are established in the course of more precocious relations directly affect the mind development.
Elaborating the activity and the nature of neuronal connections, experiences shape the circuits they are based upon, such as processes connected to memory, emotions or self-consciousness. Understanding the impact experiences have on the mind helps us also understand how the past keeps affecting significantly the present and the decisions for the future.

Brain development in adolescence

Until the 80's little consideration was given not only to the role of experience on the development of brain structures but also to the active role of the child on his/her own brain development through the interaction with the environment (Shore 1997).
At the birth, children have the entire neuronal pool necessary in life. (*National Cleringhouse on Child Abuse and Neglected Information 2001*).
During the foetal development neurons migrate to spawn the different brain regions (Edelman 1988), thus creating the basic brain structure.
In the following years, and until death, the brain will keep on evolving, but changes will not be as relevant and dramatic as those occurring soon after the birth. The first brain areas reaching the complete development are the brain stem and the mid-brain. They regulate the essential body functions for survival (breathing, digestion, excretion, thermoregulation), the so called autonomic functions. The last developing areas are the limbic system, in which the emotional regulation takes place, and the cerebral cortex, that enables the abstract thought.
As the brain develops, it increases in volume and plasticity. The growth of every brain region largely depends on the stimulus they receive and, thus, on the possibility to create new synapses, or new connections between neurons (LeDoux 2002). The neural connections are the cornerstone of the brain development.
The number and type of synaptic connections that will be formed depend only on experience. At the age of three, in the brain of the child there are about 1000 trillions synapses, which are much more than he/she will need. Some of those will get stronger and remain intact, others will be lost (Edelman 1987).
As an adolescent, the child has lost about half of these synapses and during his/her life relatively few join compared to the remaining 500 trillions (Shore 2005).
Thus, a first strong message coming from the neurodevelopmental studies is that in the adolescent brain many things happen in a relative short time; the other important message is: the different changing brain components develop according to different schedules.
On the one hand, certain emotional motivational and behavioural changes, "hooked" to the pubertal event and connected to the development of limbic structures, seem to start more precociously; on the other hand the growth of neurocognition and autoregulative abilities is much slower.

The adolescent brain

The adolescent brain is definitely still developing: millions of nervous connection branch as much, or even more, are cut, neurotransmitters flood and finish it off, giving it new connotations. It is still a brain in progress.
Recent researches by Giedd (1999), have shown how the process of brain growth happens continuously in numerous crucial areas of the adolescents' cerebral cortex, among which the parietal lobes, regions connected to the logical and spatial reasoning, and the temporal lobes, connected to language. The most important datum revealed by Giedd is that frontal lobes keep on developing. Their development reaches the highest peak more or less at the age of eleven for girls and twelve for boys.
After getting larger dimensions than adults gray matter starts to regress quickly; scanning the children's brain repeatedly, Giedd has found out that the frontal lobes, which allow the adolescents to act properly, are probably developed and finished only after twenty years of age.
Giedd's researches have also revealed that neural connections don't decrease from the prepubertal age on. In fact, near puberty, the brain frontal lobe quickly increases.
Giedd claims that if the adolescent brain is still engaged in deep changes, we cannot help wonder what kind of experience is desirable for a brain in full development.
What can we expect from adolescents since that wonderful inhibitory mechanism, their prefrontal cortex, is not completely attuned yet?
The dynamic condition of remodeling and reorganizing this structure could contribute to give sense to the well known impulsive and uninhibited behaviour.

Greenough (1986) developed a system to determine what is the kind of experience that affects the brain synapses in the adolescence. Some synaptic changes seem to be induced by the genes. It is what he calls *experience-expectant*. It is a change that should occur or it is expected it occurs in every individual of a given species in a normal environment, such as the development of sight, hearing and some components of language. If it is exposed to common images and sounds, a normal brain modulates the exuberant excess of synapses, creating properly interconnected neural networks. This way, it manages to respond to fundamental stimuli such as love calls or language. If it is not exposed to similar essential experiences, such as the mother's voice or the shape of a tree it may not manage to respond properly to stimuli.

There is another kind of *experience-expectant* changes. It is the synaptic growth depending above all on the kind of experience an individual makes, on the kind of development that makes a brain unique and allows it to adapt wherever it is.
Giedd showed that even the cerebellum keeps changing during adolescence. It seems that it is the last brain structure to develop. In many cases it finishes restructuring – an initial growth followed by pruning the brain connections – after the frontal lobes.

Then, the adolescent brain growth implies an overproduction, an excess of nerve branches and brain synapses, as well as a regress on a large scale of these branches. It may mean that adolescence is a "critical" period in which the environment or the adolescent's activities can "direct" the scheme of brain growth. If the synaptic exuberance really occurs before puberty, as Giedd suggests, how does it affect the adolescent's development and behaviour?

By accurately checked laboratory experiments, neuroscientists are beginning to identify what the effects of the pruning process in the developing adolescent mind are. By simply observing the regions where this event occurs, they understood it is connected to the harmonization of important cerebral functions, among which the control of mechanisms of inhibition and working memory, i.e. the ability to remember by heart some pieces of information when too many clash with each other.

A recent study seems to have found evidence of what we could call "adolescent mental confusion". McGivern (2002) found out that when children get to puberty, at about eleven or twelve, they speed with which they can identify emotions decreases by 20 percent. For a few years the reactions speeds remains slow. It normalizes at the age of eighteen.

This discovery could reflect the «relative inefficiency of the frontal neural circuits» of the adolescent brain during the process of remodelling, suddenly growing and pruning the synapses.

Finally, there is the most recent point: the development of new neurons. One of the main dogmas of neurosciences was shaken some years ago by reports according to which the adult brain, also including the adolescent's, keeps producing a regular flow of new neurons at least in the hippocampus and maybe in other areas.

One of the most relevant changes occurs in the frontal and prefrontal cortex (Giedd e Thompson, (2000). In these zones occur the impulses control, the emotions regulation, the knowledge of the consequences of one's actions and the decisional, logical and rational processes. These so called executive functions reach a full development only at the beginning of the adult age.

As shown by Yurgelun-Todd's studies (2006), adolescents mainly use amygdale to spot emotions instead of the frontal cortex like young adults. This suggests that adolescents are prepared to provide instinctive behavioural response to emotional stimuli, whereas when they grow up they are able to modulate the response or even inhibit it in case of necessity as a function of social context in which they are.

Llinas (2000) points out how the adolescent brain constantly monitors its inner state, scanning itself. It is not true that the brain loosk at the outside world. It looks at the emotional contents created inside on and on. In a certain way the brain constantly dreams and sometimes it is disturbed by external events.

The brain, continues the Author, is a closed world inside, a subsystem that constantly reworks its contents, as it happens in the psychological experience of the dream, where contents are a subjective and interpreted reflex of a series of really happened external facts.

Emotions and affections in neurosciences

What are the great contributions of neurosciences and their resonance for psychoanalysis? Neurosciences placed emotions at the centre of the psychic life and the mechanisms of cerebral functioning.

Affection and emotion have became, in just a decade, the crucial point of intersection of the neuroscience subjects and the psychological theories.

The works of LeDoux, Damasio, Panksepp e Watt, on one hand, the research on the problem of the attachment, the study on alexithymia and the consequent attention on the affective regulation, the focus of the psychoanalytical thought on the emotional experience of meeting - from Stern to Fonagy – suggest dialogue and propose points of convergence to relaunch their search fields.

Damasio introduced the concept of somatic marker as a central element of the emotional learning that records and keeps track of the emotional reactions to certain situations. He maintains that the mind essentially moves from the soma and that the processes we experience as mental are just representations of the body in the brain.

According to Damasio the essence of what we are mirrors the patterns of interconnectivity between brain neurons, and all the brain does consists in the synaptic transmission between neurons and in retrieving the information codified by a former synaptic transmission. Like Damasio, LeDoux points out the human prerogative to have feelings, which activates high cortical circuits, and on the defence reactions coming along with emotions.

The core of Panksepp's point is the description of a series of prototypical emotional states, emotional networks, preordained circuits, common to all mammals, which are responsible for the fundamental emotional affections.

According to Pankseep, the "sense" of emotions, peculiar of our world of affections and mood, is organized in a very different way from sensorial modalities directed towards the outside.

Emotions reflect those changes of our body that are communicated to the somatic monitoring structures of our brain, not only through specific channels of information processing, but also through less sophisticated mechanisms of chemical transport of the blood and cerebrospinal fluid circulation stream.

The emotional feelings, in conclusion, seem to reflect old cerebral functions. The apparent psychic power of these functions appears to decrease with the high cortico-cognitive growth, especially among the most intellectualized and autistic members of our species. Maybe, for many people the emotional arousal becomes part of their dynamic unconscious because they have learnt to rely on their own cognitive resources (Panksepp 2005).

Lieberman *et al.* (2007) observed, in persons subject to fRMI, that the verbalization of their own emotions and sensations sets up cerebral changes. In particular, the amygdale arousal decreases and the prefrontal region of the right brain is activated. Lieberman *et al.* (2007) write: "The same way one presses on the brake as soon as the yellow light is on, so one puts a brake to one's own emotive responses translating emotions in words".

Mirror neurons, incarnate simulation and change in psychotherapy

What percentage does a developing adolescent brain change with experience, and how? Is it all predestined by the tiny strand of DNA or the destiny of the synapses and the adolescent's behaviour can be really modulated by significant and long-lasting interactions such as the psychotherapeutic experience?

By longitudinal studies on twins Giedd (1999) found evidence that reveals which developing cerebral regions are susceptible to changes due to external stimuli. Some researches appear to show that «the least heritable» part of the brain, the one that shows the main differences between identical twins as they were interacting with the surrounding environment, is the cerebellum.

The cerebellum continues to change during adolescence. In fact, it seems that this is the last cerebral structure to develop and in many cases it finishes its restructuring project after the frontal lobes.

Mentalizing, i.e. having a *theory of mind*, implies the ability to recognize that the other's mind is different from ours (Dennett, 1978; Fonagy e Target 1993-2000; Fonagy 2001; Fonagy et al. 2002). This also implies the ability to infer what occurs in someone else's mind through their facial expression, the tone of voice and other non verbal communications. In substance, it is the ability to understand one's own and the others' behaviours in terms of mental states such as beliefs, sensations and motivations (Fonagy e Target 1997).

By a constant work of tuning, the adolescent looks for a new way to communicate with themselves and with others, through the developmental ability to experiment and express emotions.

In the processes of developmental changes, new emotional patterns regulate the new connections that are created during adolescence, as well as continuous emotive signals regulate the connections with new experiences. From the first years every individual, during their lifelong development, acquires a sense of continuity through an individualized and lasting pattern of affective monitoring.

Since emotions and affections in adolescence are connected to specific relational experiences happened in the past, their new arousal in similar circumstances is facilitated. This proposes the idea of emotional patterns of the self in relation to others (Bucci 1997).

Another fundamental aspect is that the Self is connected to the repeated experiences made with other significant individuals. They are interiorized during the first years of life. This line of thought is linked to that of some psychoanalysis theorists who point out the importance of emotive representations, structured in the first years of life, regarding the Self and the others (Stern 1985; Kernberg 1990).

It is important to remember that any conception of affective nucleus has to be referred to multiple interactive processes, not to a single generic process.

Thus, adolescence can be thought as a process of neurosubjectivation in which the adolescent is engaged in a work of *consilience*, i.e. in the attempt to put together in a

harmonic and integrated way the multiple experiences experimented within their process of subjetualization and subjectivation (biological and psychic).
The adolescent's condition is to put to the test–subjectivate their *salience,* i.e. the ability to recognize an important situation and take action, carry out acts of passage. The acts of passage imply an intentional movement of the subject towards the object. Every intentional relation can be seen as a relation between subject and object.
The intentional movement of the adolescent towards the object implies *per se* the ability to recognize and understand the other's movement. He/she is engaged in a reorganization of the affection rooted in the processes of mirroring and imitation. Mirroring mainly consists in the fact that the plain observation of another person's actions induces an arousal of the motor cortex that is somatotopic with respect to the part of the body watched doing the action, even without any movement by the subject observing. Mirror neurons have the characteristic to respond both when the subject does something specific and when that something specific is seen to be done by someone else.
In other words, mirror neurons are not activated only to imitate the watched movement but also to understand the complexity and the aim of the entire motor sequence: they are able to read the other's intentions.
"In our brain there are neural mechanisms (mirror mechanisms) allowing us to understand the meaning of others' actions and emotions replicating them to our internal (simulating them) without any explicit reflexive mediation. The novelty of our approach consists in giving for the first time a neurophysiological description of the exponential dimension of the understanding of others' actions and emotions" (Gallese 2004).
Meltzoff's recent researches (2002), have shown that just few hours from their birth babies are able to reproduce mouth and face movements of the adults who are looking at them.
The child's body perfectly simulates the adult's, not as a given reflex arc but through visual information turned into motor information, with a mechanism that has been called *active intermodal mapping* (Meltzoff e Moore 1998). It defines a *supramodal actual space* (Meltzoff 2002) not linked to a single interaction mode, be it visual, auditory or motor.
This intersubjective mode, that keeps on expanding in the course of life, could underlie the maternal mirroring (Winnicott 1967) and also the concept of affective attunement (Stern 1985).
Recent studies seem to clarify a more articulated mechanism that implies the role of mirroring even of logically related neurons.
Besides classically described *mirror neuron* downloading both during the performance and during the observation of a certain motor act, there are also neurons activated by the visual stimulus of a certain motor act downloading during the performance not of the same motor act but of another one functionally related to the one observed (Iacobini 2005).
Besides giving a functional role to these logically related mirror neurons, the results

of these studies also allows to speculate that they can be part of the neuronal chain which codifies the intensions of others' actions.
The traditional way to see the understanding of intention is that the description of an action and the interpretation of why that action is performed largely depend on different mechanisms.
According to this hypothesis it is possible to come to a direct experiential understanding of others' actions, modelling the behaviour of others as an intentional action on the basis of a motor equivalence between what the others do and what the observer does. The mirror neurons system is likely the neural correlate of this mechanism that we can describe in functional terms as *incarnate simulation*. With the incarnate simulation we do not witness just an action, emotion or sensation. At the same time, the observer's mind creates inner representations of body states related to those same actions, emotions and sensations, "as if" he/she were performing a similar action or trying a similar emotion or sensation.
When we observe another person's facial expression, and this perception leads us to identify a particular affective state in the other, his/her emotion is reconstructed, experienced and directly understood through an incarnate simulation that produces a body state shared by the observer. This body state involves the activation of viscero-motor neurovegetative mechanisms, like in the case of studies by fMRI (Functional Magnetic Resonance) related to the experience of disgust or facial muscles involved in the expression of the observed emotion (Dimberg 1982; Dimberg and Thunberg 1998; Dimberg et al. 2000; Lundqvist e Dimberg 1995). It is therefore the activation of a neural mechanism shared by the observer and the observed that allows the direct experiential understanding of a given basic emotion.
Freud (1912), stated that the analyst "must turn his own unconscious like a receptive organ towards the transmitting unconscious", recognizing the role of unconscious communication between analyst and patient. But he could not explain how this communication could occur (Freud, 1921a, 1921b, 1925, 1932): the neural connections were not observable.
So, how does the unconscious communication happen? A possible explanation may lie in the incarnate simulation: patient and analyst could unconsciously catch, in a constant and reciprocal way, the other's subtle stimuli activating shared neural pattern.
Otherness is also substantiated by the different neural circuits that come into play and/or by their different level of activation when we are the ones who perform or experience emotions and sensations compared to when the others do it.
Many of the changes that occur during the analytical process have to do not only or mainly with internalization and insight and therefore with the interpretation (related to the declarative memory), but rather with the unconscious elaboration that develops in significant moments of meetings between the therapist and the patient: these are moments of human authentic spontaneous and direct meeting everyone of us well remembers in the course of our analysis (Stern 2005).

The declarative knowledge is gained or obtained by verbal interpretations that change the adolescent's intrapsychic understanding in the context of the psychoanalytical relation and transference, whereas the implicit relational knowledge is carried out through intersubjective interactive processes that change the relational field in the context of the shared implicit relation.
As interpretation is the therapeutic event that rearrange the patient's conscious declarative knowledge, so the moments of meetings represent the event that reorganizes the implicit relational knowledge fro the patient and the analyst.
Of course, a moment of meeting implies a condition of learning identification (Guillaumin 1976), an availability to emotive and cognitive reappraisal, and a specific emotional harmony. These conditions describe what occurs in the domain of the shared implicit relationship, i.e. a new specific dyadic state of the participants is being created.
Transference and countertransference are just the background frame of a *moment of meeting*. What is at stake is the personality of the two interacting people relatively stripped of any role-induction (Stern 1998).
The analytical work with the adolescent suggests with particular emphasis the value of such moments of meeting. This form of intersubjective meeting allows the adolescent and the analyst to experiment again disturbing emotive styles and attitudes, i.e. some unconscious categories of affect. Such an involvement represents the deepest and sometimes more painful way we know to experience our Self in the presence of another person.
Over time, the psychotherapist happens to propose a new relational model to internalize. This way the neural networks related to the old representations of the object and the Self will weaken gradually, while new associative links will be formed and be strengthened with the exposure and interaction between analyst and patient. "Therefore, the old neural networks don't disappear but are relatively weakened while the new neural networks containing new object relations of the therapy will be reinforced" (Gabbard 2008).

Conclusions

The expansion of psychological knowledge of child development enables us to recognize the crucial role played by empathy, responsiveness, visual exchanges, affective attunement, environmental response contingency and the subjectualizing value of being agents of one's own change. These different and complex relational processes move from the original emotional experiences of reflection and resonance, biologically oriented. These experiences revive the intersubjective exchange, favour the growing awareness of the importance of the Other – possible mirroring and exchange source – and contribute to the making of stable representations of such an awareness.
Knowing that some brain areas activate, as it has been observed in some experiments related to the theory of mind, doesn't help *per se* the psychotherapist when they are in

front of a person suffering from a borderline personality organization. Notwithstanding, the theory of mind is helpful to fully consider how the mind is neither more nor less the brain activity. Coming to a confident belief to have a mind of their own and a subjective inner world is to recognize others have inner worlds different from ours.

The analytical work tends to make the subject gradually aware of the fantasy nature of scenarios he/she imagines and his/her wrong belief to catch reality in its entirety from such a narrow view. Then the goal is to free the subject from the only possible view. Loosening the constraints of recurrent fantasies, the psychoanalytic path should allow the subject to look at reality from new points of view and pass from the compulsion of the unconscious inner reality, offering the already experienced, to learn from experience through real openness to the Other. Experience recording is already its translation which places, in fact, a first distance from the experience. It may occur thanks to mechanisms of brain plasticity. It is in this field that the freedom of the subject is at stake. It is just this transcription that offers a mobility space, the potentiality to transform, the ability to modify both oneself and the processes of subjectivation of the outer reality, being author and actor of a becoming which is different from the one, up to that moment, set by the impediments. The neural plasticity is therefore condition of the possible plasticity of one's becoming. Plasticity is, ultimately, what allows the subject, thanks to appropriate relational experiences, to relieve from the coaction of a fantasy, crystallized, formerly built scenario.

Isn't such a definition of neural plasticity evocative of what in the psychoanalytical language is described as unconscious pervasiveness»?

REFERENCES

BUCCI, W. (1997). *Psicoanalisi e scienza cognitiva*. Roma: Fioriti Editore, 1999.

DAMASIO, A. (1994). *L'errore di Cartesio*. Milano: Adelphi.

DENNETT, D. (1978). Beliefs about Beliefs. *Behavioral e Brain Sciences*. 1, 4, 568-570.

DIMBERG, U. (1982). Facial reactions to facial expressions. *Psychophysiology*. 19, 643-647.

DIMBERG, U., THUNBERG M. (1998). Rapid facial reactions to emotion facial expressions. *Scandinavian Journal of Psychology*. 39, 1, 39-46.

DIMBERG, U., THUNBERG. M., ELMEHED K. (2000). *Unconscious* facial reactions to emotional facial expressions. *Psychological Science*. 11, 1, 86-89.

EDELMAN, G. (1987). *Darwinismo neurale*. Torino: Einaudi.

EDELMAN, G. (1988) *Topobiologia. Introduzione all'embriologia molecolare*. Torino: Boringhieri.

FONAGY, P., TARGET, M. (1993-2000). *Attaccamento e funzione riflessiva*. Milano: Raffaello Cortina, 2001.

FONAGY, P., TARGET M. (1997). Attachment and reflective function: Their role in self organization. *Development and Psychopathology*. 9, 679-700.
FONAGY, P. (2001). *Psicoanalisi e teoria dell'attaccamento*. Milano: Raffaello Cortina, 2002.
FONAGY, P., GERGELY G., JURIST E.L., TARGET M. (2002). *Regolazione affettiva, mentalizzazione e sviluppo del Sé*. Milano: Raffaello Cortina, 2004.
FREUD, S. (1912). Consigli al medico nel trattamento psicoanalitico. *OSF*. Vol. 6. Torino: Boringhieri, 1974.
FREUD, S. (1921a). Sogno e telepatia. *OSF*. Vol. 9. Torino: Boringhieri, 1977.
FREUD, S. (1921b). Psicologia delle masse e analisi dell'Io. *OSF*. Vol. 9. Torino: Boringhieri, 1977
FREUD, S. (1925). Inibizione, sintomo e angoscia. *OSF*. Vol. 10. Torino: Boringhieri, 1978.
FREUD, S (1932). Introduzione alla psicoanalisi. Nuova serie di lezioni. *OSF*. Vol. 11. Torino: Boringhieri, 1976-1980.
GABBARD, G. (2008). L'azione terapeutica nella psicoterapia psicoanalitica nel disturbo di personalità borderline. Serata Scientifica, D.S.N.P.R.E.E, Sapienza Università di Roma.
GALLESE, V., KEYSERS C., RIZZOLATTI G. (2004). A unifying view of the basis of social cognition. *Trends Cognitive Science*. 8, 396-403.
GIEDD, J., BLUMENTHAL J., JEFFRIES O., (1999). Brain development during childhood and adolescence: a longitudinal MRI study. *Nature Neuroscience*. 2,10, 861-863.
GREENOUGH, W.T. (1986). What's special about development? Thoughts on the bases of experience sensitive synaptic plasticity.*Developmental neuropsychobiology*, 387-408.
GUILLAUMIN, J. (1976). L'énergie et les structures dans l'expérience dépressive. Le role du préconscient. *Rev. franç. Psychanal*., 5-6, 1059-1072.
IACOBONI, M., MOLNAR-SZAKACS I., GALLESE V., BUCCINO G., MAZZIOTTA J., (2005). Grasping the intentions of others with one's own mirror neuron system. *PLoS Biol*. 3, 3, 79.
KERNBERG, O. F. (1990) *New Perspectives in Psychoanalytic Affect Theory*. New York: The Academic Press.
LEDOUX, J. (2002). Il Sé sinaptico. Milano: Raffaello Cortina.
LIEBERMAN, M. D., EISENBERGER, N.I., CROCKETT M.J., TOM, S. M., PFEIFER, J.H., BALDWIN, M.W. (2007). Putting Feeling Into Words. *Psychological Science*, 18, 5, 421-428.
LINAS, R. (2000). *I of the Vortex*. Cambridge: MIT Press.
LUNDQVIST, L., DIMBERG U. (1995). Facial expressions are contagious. *Journal of Psychophysiology*. 9, 203-211.
MCGIVERN, R. F., ANDERSEN J., BYRD, D., MUTTER, K.L., REILLY, J. (2002). Cognitive efficiency on a match to sample task decreases at the onset of puberty in children. *Brain and Cognition*. 50, 1, 73-89.

MELTZOFF, A. N., & MOORE, M. K. (1998). Object representation, identity, and the paradox of early permanence: Steps toward a new framework. *Infant Behavior and Development*. 21, 201-235.
MELTZOFF, A. N. (2002). *Imitation as a mechanism of social cognition: Origins of empathy, theory of mind, and the representation of action.* In U. Goswami, Handbook of childhood cognitive development, Oxford: Blackwell Publishers.
NATIONAL CLERINGHOUSE ON CHILD ABUSE AND NEGLECTED (2001). *Understanding the effects of maltreatment on early brain development.*
PANKSEPP, J. (1998). *Affective Neuroscience: The Foundations of Human and Animal Emotions.* New York, Oxford University Press.
PANKSEPP, J. (2005). Affective consciousness: Core emotional feelings in animals and humans. *Consciousness and Cognition*. 14, 30–80.
SHORE, R. (1997). *Rethinking the brain*. New York: Families and the Work Institute.
SHORE, R. (2005). *La regolazione degli affetti e la riparazione del sé*. Roma: Astrolabio.
STERN, D. (1985). *The interpersonal world of the infant*. Basic Books, New York.
STERN, D.N (1998). Non-Interpretive Mechanisms in Psychoanalytical Therapy. *Int. J. Psycho-Anal*, 79, 903.
STERN, D.N. (2005). *Il momento presente in psicoterapia e nella vita quotidiana*. Milano: Raffaello Cortina.
THOMPSON, P., GIEDD J., WOODS R., MACDONALD D., EVANS A., TOGA A. (2000). Growth Patterns in the Developing Brain Detected By Using Continuum-Mechanical Tensor Maps. *Nature*. 404, 190-193.
WATT, D. F. (1998) Affect and the limbic system: some hard problems. *J. Neuropsychiatry Clin Neurosc.* 10, 113-6.

Authors

Gianluigi Monniello, Child Psychiatrist, SPI and IPA Psychoanalyst. Scientific Secretary of the Psychoanalytic Center of Rome (CPdR). Associate Member of the Italian Psychoanalytic Society (SPI). Professor at the Faculty of Medicine and Surgery, "Sapienza" University of Rome; responsible for Day-care adolescents of UOC A Child and Adolescent Neuropsychiatry of Azienda Policlinico Umberto I in Rome. Editor of the journal *AeP Adolescence and Psychoanalysis*. Teacher of the four-year course ARPAd (Rome Association for the adolescence and young adults Psycotherapy). ISAPP Vice President (International Society for Adolescent Psychiatry and Psychology).
Mail address: gianluigi.monniello@uniroma1.it

Lauro Quadrana, Specialist in Psychotherapies, expert in Psychodiagnostic, works as a Manager at Day-care Adolescents UOC A Child and Adolescent Neuropsychiatry of Azienda Policlinico Umberto I in Rome; besides the clinical activity he is referent of the UOC A psychodiagnostic section. His main interests

regard neuroscience studies and psychopathology in adolescence, in particular in the relation between the psychotherapeutic process, neural development and mental disorders.
Mail address: lauro.quadrana@uniroma1.it

Translated by Giulia Lampis