



**ORIGINAL ARTICLES
AND REVIEWS**

New epistemological foundations for cultural psychology: from an atomistic to a self-organizing view of living systems

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Abstract

An epistemological foundation for *cultural psychology* is essential to neuro- and behavioural sciences for the challenge psychological sciences must currently face: searching for an explanation of how a brain can become a mind and how individuals assign a sense to the world and their life. Biological systems are very likely determined by physical and chemical laws of spontaneous self-organization and endogenous constraints but, even if the major result of the Darwinian revolution is “the discovery that living species are their story”, the modern synthesis of the evolution theory adopted only continuist and gradualist hypotheses. This nourished the analogy between the theory of natural selection and the theory of operant conditioning, thereby supporting empiricist associationism and the methodological positivism of behavioural and “classical” cognitive psychologists. Current scientific contributions provide evidence to the need for psychotherapy and psychopathology of a new epistemological approach in order to connect research stemming from animal models, up to the most abstract levels of personal meaning. The complex system oriented approach, here described, called “*post-rationalism*”, shaped by a change initiated by evolutionary epistemology. The regulation of emotions initially develops within interpersonal relationships and evolves during both phylogeny and ontogeny, according to complex self-organization processes, leading to the acquisition of Self-organizing abilities and the construction of personal meaning. Endorsing the epistemological similarities of neo-Darwinism and behaviourism, and differentiating from this, the above mentioned approach, emphasises the fact that clinical and psycho-therapeutical practice must be founded on the laws of biological organisation: the ongoing activity of neurobiological systems, including the more abstract domains of thought and language.

Key words

- cognitivism
- complexity
- evolutionary psychology
- personal meaning
- post-rationalism

INTRODUCTION

In *Origins of stories* [1], Jerome Bruner claims that “...an event cannot, by definition, be inferred from a deterministic law. History overcomes necessity. And every story implies events that might never have happened...” With his thinking Jerome Bruner [2] laid the epistemological foundations for a *cultural psychology* essential to behavioural sciences and neurosciences, its main focus of investigation being the study of processes by which individuals assign a sense to the world and to their own life. The primary scope of human psychology is the “search for meaning”. In this way Bruner paves the way for a cultural or interpretative psychology, where the mind is the link between the individual and the external world. Cultural psychology is meant to investigate how people, can create their own reality through narration, *i.e.* communicating and sharing with others what is “filtered” by each personal vision of reality. Accord-

ing to Bruner, culture is shaped by narration and self narrating. In the mentioned book, G. Bocchi and M. Ceruti provide a rich report of the contingent and unpredictable changes that occurred during the evolution of culture and the physical universe. They discuss what in their – and my opinion – is the major result of Darwinian revolution: “the discovery that living species are their story” (the very same way we can state today that *knowledge is a biological phenomenon*), to conclude that the universe or mankind, rather than being at the end of a predetermined path, predictable or already known, are in the middle of a story. Through the study of fossils – spread throughout the entire planet - Darwin came to a new vision of life: during the course of evolution, any living phenomenon or being has a story that can be expressed as a process with a beginning and an end, a way of narrating and being narrated.

The principal aim of this essay is to stress how the

post-rationalist perspective, considering a human knowing system as any other biological system with the same laws and processes, is also centred on the personal processes of narration and self-narrating, for the comprehension of the individual story.

DARWINISM AND NEO-DARWINISM: THE INTEREST FOR EVOLUTION

Differently, empiricist associationism and the methodological positivism of behavioural and “classical” cognitive psychologists, is supported by the continuist and gradualist hypotheses adopted by the modern synthesis of Darwinian evolution theory. These rationalist cognitivists often call “non scientific”, new epistemological approaches based on an evolutionary perspective and on the emerging studies in the field of behaviour and change of complex systems. Thus, biological systems are very likely determined by physical and chemical laws of spontaneous self-organisation, while changes in evolutionary and learning processes are guided by exogenous factors as well as internal and endogenous constraints. In order to fully understand the post-rationalist approach and the extent to which it is supported by current scientific debates, let’s move forward along the critical line drawn by M. Piattelli Palmarini and J. Fodor who denounced the lack of mutual knowledge and communication between evolutionary biologists and psychologists. The two authors firmly believe in the analogy between the theory of natural selection and that of operant conditioning, in addition to the idea that change in evolutionary and learning processes is guided by exogenous factors as well as by internal and endogenous constraints, probably determined by auto-organisational, physical and chemical laws!

In the final section of the *Origin of species* [3] Charles Darwin refines his definition of evolution: the production of a huge phenotypical diversity by the uniform and unceasing action of *natural selection*. Although other naturalists before him had posited the idea – with more or less detailed explanations – of living organisms continuously transforming in time, Darwin is unanimously considered the founder of evolutionism: a slow and continuous process of natural selection leads to changes among populations, *i.e.* evolution. Thomas Henry Huxley [4] was the first author to express some doubts on Darwin’s views: in a letter to Darwin, he raised some objections against the pre-evolutionist principle *natura non facit saltus* (nature does not make leaps), according to which any gap or missing link in evolution can be solely ascribed to gaps in our knowledge. As G.L. Bocchi and M. Ceruti emphasize, Huxley’s suggestion was only marginally received: the germs of pluralism continued to be constrained by a strongly continuist conception of the time of evolution. In his article *Evolution: the modern synthesis* (1942), Huxley coined the definitions of “evolutionary synthesis” and “modern synthesis” [5-8]. The 1960’s gave way to the development of a neo-Darwinist gene-centred theory according to which the relation among different areas of research was interpreted in a very restrictive way, thereby accentuating continuist and gradualist hypotheses, increasingly focusing on the micro-evolutionary processes that can

be observed in a laboratory, yet neglecting macro-evolutionary phenomena, considered to be deducible at a micro level [4-6, 9-14].

More recently, along the same line of reasoning of both *What Darwin got wrong* and neo-Darwinism, M. Piattelli Palmarini and J. Fodor [15] underlined “the important analogy between the account of the fixation of phenotypes that Darwin offered and the “learning theoretic” account of the acquisition of “behavioural repertoires” promoted by H.B.F. Skinner, a father of behaviourism”. Interestingly enough - and accordingly with the point of view here proposed - the above mentioned authors maintain that the two theories are identical. In their opinion, in the attempt to explain how learnt behaviours can be acquired, Skinner formulated and supported a theory where the associationism of British empiricists (“learning is the formation of habits”) merges with the methodological positivism of some psychologists like Watson [16] and philosophers like Dewey [17] (“scientific explanations should avoid dealing with unobservable phenomena such as mental states and processes). According to this type of psychology the organism must be treated as a “black box” and learning as the result of “stimulus-response” associations: this path leads us to the critical remarks on classic cognitivism [18, 19, 21] and to their implications for the epistemological tenets of psychotherapies and of the theories of mind and knowledge.

Assuming only a single continuous and univocal correspondence between gene configurations and overall fitness of the organism means to neglect the complexity of developmental trajectories as one of the many sources of internal constraints, such as the role of the *genomic imprinting* [25] and of the epigenetic factors [26] or the impact of the “noise of development”. This is a definition used by Lewontin [24] to refer to the microscopic random events that occur at all levels, from single cells to tissues (making even identical twins not exactly identical [27-29]) and to point to the existence of internal fluctuations, influencing the course of phenotypic evolution both before the effects of ecological variables and independently of the latter. It is interesting to see how these phenomena are fully coherent with a post-rationalist view of personal knowledge, which can be considered as any other living system. They are recognised in an occurring and shared approach in terms of the theories of complexity [30] as organisationally closed, in that they tend to privilege the maintenance of their organisation (identity) over their adaptation to the environment.

Stephen Jay Gould suggests going back to Darwin and re-focusing on the organism as a whole: “Too often, the adaptationist programme gave us an evolutionary biology of parts and genes, but not of organisms (the same way behaviourism and classic cognitivism offer fragmented simplifications of the human mind)” [31]. According to Gould and Lewontin the adaptationist programme was wrong in its attempt to classify an organism on the basis of some “characters” that must be proved as ideal. Such an approach is far too reductionist and is at risk of losing sight of what really matters: the organism in its environment and in its constrained

historical evolution. From the basic gene level, Gould's attention is then shifted to the organism's intermediate level, focusing on other "constraints" by using architectural metaphors, in an analogy with Venice's San Marco Cathedral's decorative *spandrels*⁽¹⁾ on the constrictions that make evolution limited and no longer omnipotent, historically determined by contingencies and not free to float in the randomness of variations towards optimality. In 1997 Gould publishes two more significant articles: *Darwinian fundamentalism* and *Evolution: the pleasures of pluralism*. His ideas are appreciable also when he states that adaptationism must be replaced by a pluralistic approach, emphasising Darwin's statement that "natural selection was the major, but not single cause of all modifications" [3, 33].

In line with the same considerations, in the mid '90s, starting from words like "evolution" and "development" (processes intended as the two faces of the same medal), the expression "evo-devo" is coined to indicate a true revolution [34, 35]. This emphasises how the filters (constraints) internal to development – which neo-Darwinism tried so obstinately to stay away from – are at the centre of evolution, that is essentially the evolution of the vector that links genes with phenotypes: evolution is the evolution of ontogeny! The whole process of development, from the fertilized egg to the adult individual, modulates the phenotypical effects of geno-typical changes, therefore "filtering" the phenotypical options among which ecological variables have any chance to make a selection. All this is very close to the phenomenon of self-organisation, (crucial to the post-rationalist definition of *personal meaning organization*) a notion that describes how living systems organise themselves and operate to preserve their systemic identity/integrity, as a result of basic evolutionary constraints [19, 36]. According to the evo-devo approach, a mono-dimensional theory of evolution is not appropriate: there are multiple levels of regulations that influence the expression of genes at different stages of development. The scope of this article does not include an exhaustive dissertation on these positions, which are still very controversial and not fully endorsed by most scientists. We suggest a further consultation of Piattelli Palmarini and Fodor's work who keep the debate alive and recommend not taking the neo-Darwinian explanation of evolution for granted.

THE EMERGING STUDIES IN THE FIELD OF BEHAVIOUR AND CHANGE OF COMPLEX SYSTEMS

What really matters to us here is to observe how modern biology, on which our psychological perspective is based, has fully embraced the notions of non-linearity, multiple biological sources and levels of internal con-

straints on possible phenotypes; the generally accepted idea is that the evolved phenotypes incorporate information on the ecological systems, in which they have developed, together with information on the internal organisation of the carrier organisms, just as a human knowing system incorporates its story and creates a vision of itself and the world, from the very first moments of its life.

Over the last twenty years a new theoretical and clinical approach to medicine is being developed, which may be conducive to a synthesis, taking an evolutionary or Darwinian perspective as the general reference framework, as the "principle unifying the study of living beings, including diseases and human health". To say it with Corbellini [37-39]: "The evolutionary standpoint implies that any clinician should raise at least two questions «Why does one get sick?» and «Why has this person become sick right now and why in this way?», thus shifting attention from the immediate causes that are experimentally studied to the remote ones, and to the fact that the patient's individuality is an irreducible evidence; it is essential to keep into account the historical constraints that influence the risk of getting sick both on a phylo- and ontogenetical level. "The causes of diseases are harmful not in themselves, but because of the incongruence between the body's physiology and the surrounding context: this dissonance or mismatch is manifested by the interactions between the individual genetic/epigenetic constitution and the contingent environmental factors [40]. It is with great interest and enthusiasm that we report such a theoretical novelty that comes to characterise medical thinking and that leads us to observe medicine from an historical perspective. The standpoint of Darwinian or evolutionary medicine entails a paradigm shift in the approach toward different domains of medical sciences: this may have some major repercussions on teaching practices and may contribute to the training of a new breed of physicians that are capable of a broader understanding of epistemology and psychology. We are heading for an increasingly tailor-made health care, in the belief that each one of us is the carrier on an individual genome, with a personal evolutionary history and moving towards a social and epigenetic trajectory that emphasises the uniqueness of each individual. The doctor-patient relationship must also be framed, understood and revised in light of evolutionistic considerations [40]". All this in my opinion cannot be separated from any current psychological theory on change and from any clinical and psycho-therapeutic practice, the latter in particular being inextricably related to biological phenomena, including those that pertain to development and knowledge as well as to the more abstract domains of thought and language.

⁽¹⁾...You decide to build a church by mounting a circular dome on four rounded arches that meet at right angles. I'll accept that as an analog of adaptation; that's an engineering design that works. But once you do that, you have four tapering triangular spaces where any two arches meet at right angles. The spaces are called spandrels. They're spaces left over... No one can claim that the spandrels under the dome are adaptations for anything. I suppose it's a good idea to put some plaster there - otherwise the rainwater is going to come in - but the fact that they're tapering triangular spaces is a side consequence of the adaptive decision to mount the dome on four arches. It's space left over. It's a side consequence; it isn't an adaptation in itself." [32]..... just as with the human brain: most of what the brain does are probably spandrels - that is, the brain got big by natural selection for a small set of reasons having to do with what is good about brains on the African savannas. But by virtue of that computational power, the brain can do thousands of things that have nothing to do with why natural selection made it big in the first place, and those are its spandrels [32].

THE BRAIN-MIND RELATION

Today the long-standing issue of the brain-mind relation can be investigated with very sophisticated technology: the mind is “the supreme property, conquest of the living matter” [41]. Throughout the course of development of almost all species, the brain has gone through a progressive increase in volume, “but even more important for achieving functional performance was the surface extension operated by the cortical layer’s folding into the creases known as gyri... in *Homo sapiens*, the most advanced of primates, other factors have come into play, amplifying enormously the brain mantle’s performance. The cultural heritage has been added to the genetic make-up. The huge power of these two forces is at the base of the *human* phenomenon bound to open infinite spaces in the material field of the universe and in the abstract and equally infinite domain of thought” [42].

H. Maturana begins his article on the Biology of cognition [36] stating that “Man knows and his capacity to know depends on his biological integrity; he knows that he knows”. Later on A. Damasio [43] wrote that even an amoeba knows, but before coming to know that it knows, we have to proceed along the whole phylogenetic scale, the whole human evolution”. In E. Boncinelli [44] we read: “With the human species, biological evolution has gone beyond itself and has reached a sort of paradox...we can consider ourselves released from the conditionings of our biology, but we should not forget that the freedom we enjoy is a conquest and a nice gift of our own genes, a gift that has not been given to squids nor to frogs”. Several authors clearly underline how the growing complexity of the brain progressively required higher and higher levels of organisation: emotion, the first feelings or knowing (*i.e.* the first link or relation between an organism and the environment) is the basis of the most elementary cognition or knowledge. Consciousness -a self-reflective ability reserved to humans- is nothing but the highest form of further self-organisation and ordering, essential to an organism’s survival. “Consciousness begins when the brain acquires the power... to tell a wordless story that goes on within the body’s boundaries...and I suspect that what made consciousness prevail through evolution was that the knowledge of the feelings caused by emotions, is essential for the art of living...so that we could know life” [43].

W. James [45] defined consciousness as a skill that is developed when the nervous system becomes too complex to regulate itself. In other words, consciousness is like an emerging brain’s property that takes control of the nervous system. “The interaction of consciousness with brain mechanisms seems to be bi-directional: consciousness stands at the top of the hierarchical ladder made of sub-atomic particles, atoms, molecules, cells and brain circuits and is in charge of performing the organising function and directing the activity of all the sub-cellular, cellular and supra-cellular entities that make up the brain... The world, the way we perceive it with its colours, smells and sounds, is a fruit of our brain” [42].

In order to not waste a wealth of information existing between the proximate genotypic level and the ultimate phenotypic level of an organism, we advocate a foundational view that focuses on similarities in brain, be-

haviour, and various basic psychological features across mammalian species. In agreement with Panksepp [46, 47], we embrace an approach that suggests the potential to link the emerging discipline of evolutionary psychology to *its parent scientific discipline* like biochemistry, physiology, molecular genetics, developmental biology and the neuro-scientific analysis of animal behaviour, to stress that the biological organisation is the ongoing activity of neurobiological systems [48]. The contribution of neuro-sciences has spread out to areas such as affects regulation, mentalisation, development of the Self, consciousness and language, thus providing evidence to theories that in the past were confined to philosophy. Today we are beginning to see more clearly the once mysterious mechanisms that organise and give sense to all the information about the external world and the events occurring in it. Let’s take the case of brain plasticity: different studies focusing on neural connections showed that the afferent cells, after being damaged, are able to generate new connections based on a process known as synaptic re-organization [49, 50]. Alleva and Francia [51] studied neuro-trophins like the NGF (nerve growth factor) and the BDNF (brain-derived neurotrophic factor) implied in neurogenesis, differentiation, growth and maintenance of selected central and peripheral neuron populations during development and adulthood. Neurotrophins, together with the HPA (hypothalamic-pituitary-adrenal axis), play a relevant role in modulating brain plasticity and coping behaviours, particularly during the critical stages of ontogenesis, *i.e.* when the brain is very sensitive to external stimulation: early life events, such as psycho-physical stress, influence the NGF and BDNF levels and cause a dis-regulation of the HPA axis. Early life experiences can therefore affect brain development and contribute to inducing differences from individual vulnerability to stress, up to causing psychiatric illnesses. A break in the mother-offspring relation generates neuroendocrine, neurochemical and behavioural alterations in the adult organism, but we are still unable to fully understand the basic mechanisms underlying these changes [52]. Fluctuations in the levels of neurotrophic factors during the critical stages of development may cause long term changes in brain plasticity and an increased vulnerability to aging and psychopathology [53-57].

To say it with Siegel [58] and Feinberg’s words [59, 60], the human mind seems to emerge from the activities of the brain, whose structures and functions are directly influenced by interpersonal experiences, and by the processes that modulate energy and information flows inside the brain and between different brains, within the interactions between internal neuro-physiological processes and environmental phenomena. The development of brain structures and functions depends on how experiences – particularly those related to increasingly frequent and complex interpersonal relations – influence and shape the genetically determined maturation processes of the nervous system throughout phylogenetic evolution: the human “connections/relations” shape the development of the nervous circuitry that is the foundation of the mind.

THE “COGNITIVE REVOLUTION” AND THE POST-RATIONALIST APPROACH

Today the major challenge facing neurosciences and all the psychological disciplines seems to be the attempt to understand how brain structures can generate the consciousness of the Self, how the brain is able to perform an abstract function, starting from a concrete activity. Starting from speculations that have been widely debated from the very dawn of philosophical thinking, Denton [61] makes an assumption that appears to be very close to the post-rationalist view focused on complex systemic processes: consciousness seems to have progressively manifested throughout animal evolution in the form of “primal emotions” such as hunger, thirst, need for air, sexual drive (and perhaps later certain motivational systems such as playing, cooperation and all those activities matching and specialising interactive skills and needs), *i.e.* all those pressing forms of activation-arousal that are highly functional to the survival of an organism and that push it to act. Denton’s assumption that primal emotions are the first emergence of primary consciousness leads him to a deeper consideration of Damasio’s idea [43] that “emotion and the experience of emotion are the direct expressions of the highest level of bio-regulation in complex organisms”; emotions and the development of their regulation processes drive the Self towards increasingly complex systemic functional states [55, 62, 63].

The post-rationalist approach mainly takes shape with the work of V.F. Guidano [63-65], with the expansion of the traditional epistemological associationist empiricist perspective and the elaboration of a *psychology of the self* that embraces cybernetics, systems theory, and artificial intelligence (*i.e.* the forefront of the “cognitive revolution” burst in the 70’s and 80’s in the Anglo-saxon world). Guidano was one of the major theoreticians and spokesmen of the epistemological change that occurs making *knowledge from the point of view of he who possesses it* a method for psychotherapy and a conceptual model to explore individual development and knowledge. The “post-rationalist” attribute introduced by Guidano himself at the end of the 80’s hinted at a new way to intend psychology, based on the recognition of individuals’ irreducible characteristic of constructing meanings. He pointed to an approach rooted in the so called cognitive revolution, viewing epistemology as the founding discipline of the clinical theory and practice of a new scientific psychology. Instead of empiristically considering cognition as a system of hierarchically ordered beliefs that guide people’s actions and emotions, Guidano and Mahoney [65, 66] regarded cognition as a process corresponding to the “interiority” of individuals and explored the active role that each subject plays in the construction of his reality. For a scientific investigation of the mind (that does not neglect the study of interiority), knowledge had to be intended as an active, adaptive and historical process, conducive to the creation of certain structures – or theories – that living beings generate during the course of their interaction with the environment.

Evolutionary epistemology [67, 68] based itself on a vision of man intended as an organism able to actively

order his reality through the production of theories whose conservation or elimination is ruled by natural selection. In his vision of the individual, Campbell [67] emphasised the feature of interior self-regulation that is intrinsic to the internalisation of theory selection and conservation processes, in the same way that Darwin had done with genes. Yet Campbell’s analysis of personal autonomy was still strongly dependent on the neo-Darwinian view of the organism/environment relation: a subject that traditionally was approached by considering natural selection as a specifier of structural changes in the organism, regarding evolution as the optimisation of adaptation to the environment (continuist/gradualist hypotheses). The shift from structuralist cognitivism to post-rationalist psychology was shaped by a change initiated by evolutionary epistemology. This point of view was totally overturned in the early 80’s by two Chilean biologists, Humberto Maturana and Francisco Varela [36, 69], who pushed the evolutionary interpretation into the internal dynamics of animal groups and into the history of structural transformations and environmental changes. The founding notion is that an organism and its environment, change in an interdependent fashion: unit-environment relations can therefore be maintained only if the autonomous unit – the system – is able to generate, within its own organisational constraints, levels of reference that are suitable to coping with environmental change.

In the early 80’s a discrepancy was becoming increasingly evident between the logic “linearity” of descriptive psychiatry and the multifaceted “complexity” of human experience that would be encountered in clinical practice; while cognitivists and relational therapists were working at an integration of the developmental hypotheses focused on the interface between family and individual processes. The interdisciplinary convergence that leads to the approaches in terms of complexity [30, 63] embraced 2nd cybernetics, irreversible thermodynamics, evolutionary pluralism, cognitive science, evolutionary or natural epistemology, etc., radically transforming the traditional relation between observer and observed. This made it possible to elaborate a constructivist epistemology: rather than as the active and autonomous construction of a system that progressively models its internal order, starting from a flow of variable and unpredictable stimuli, while defining its specific individuality and identity “...this gradually takes shape in the course of individual development, and...each one of us, though living in an ‘objectively’ shareable social reality, actively constructs ‘from inside’ at very articulated levels of individual perceptive order, his absolutely unique and exclusively subjective point of view” [63]. The metaphor of a man-scientist, who generates theories – followed by Popper’s disciples –, is then followed by that of the observer, who by means of observational processes, constructs an order of reality, that reflects his own perceptive organisation (self-reference): *Everything said, is said by someone* [70].

The studies on self-organized systems support the introduction of a new methodological perspective in cognitive sciences, such as the one described. Even if the concept of self-organisation, common in biological

systems, is differently considered among the scientific debate, is here considered as a simple spontaneous process that occurs in complex systems. In order to explain how an organism generates a certain meaning, a new epistemological framework consists in the construction of a mechanism that is able to produce a given behaviour, resulting from the internal coherence of its operations, *i.e.* a specific mental state. This approach – that can be defined “constructivist” – is different from the predictive model of physical sciences (rationalist behavioural and cognitive), mainly founded on anticipation and prediction according to rational principles. Hence, the definition of post-rationalism, to indicate the rejection and overcoming of any linear determinism, of any trust in a single and absolute scientific truth, which is the same for everyone, in favour of a pluralistic and multiple interpretation of every perspective. In our clinical practice, rather than accurately predicting the person’s cognition in that specific instant, as indicated by a prediction-based approach, it could be more useful and explicative to reconstruct the internal dynamic of an individual that is able to give meaning to a set of events according to his personal coherence.

This is how Guidano arrives at the formulation of the notion of *personal identity*, intended as a hierarchical organisation of knowledge, emotions, perceptions and memory, a true structural theory of the Self and of the conscious world, where past, present and future events are connected in a sort of continuum going from normality to psychopathology. Infancy, childhood, adulthood and senescence are the different stages of the irreversible development of individual life, characterised by their organisational, biological, affective and cognitive peculiarities that participate in the construction, maintenance and change of personal meanings. During the course of individual development, cognitive processes are articulated in an ordered set of sub-systems of reactions and meanings that make up identity, in a specific self-referential process of construction of self identity. According to the approach described thus far and in line with the consequent epistemological interpretation, current experimental evidence seems to support the possibility to bridge the gap between clinical and biological psychology and the related animal models; the evolutionary role of the processes of emotional self-regulation is underlined in light of the shared recognition of human species’ interactive nature, and of the role of biological regulators played by the early relational processes experienced during individual development, as proven by multi-disciplinary studies [51, 62, 71].

THE PRIMACY OF EMOTIONS AND THEIR REGULATION

In agreement with post-rationalist cognitivism, which emphasises – differently from classical cognitivisms – the primacy of emotions over cognition, emotions are the central processes of brain activity. Moreover, the individual’s abilities to organise them (these abilities derive at least in part from the early experiences of attachment/separation) directly influence how the mind integrates different experiences and reacts to subsequent stressful situations. The mind is a complex system able

to coordinate and organise its activities according to different mechanisms that are its self-regulation processes, in turn strictly related to the modulation of emotions. This process provides for the regulation of energy and information flows by the modulation of arousal states and the attribution of meaning to the cognitive representations derived from experience. The regulation of emotions initially developed in the framework of interpersonal relationships and evolved during phylogeny in a complex process of self-organisation that lead to the acquisition of Self-organising abilities [72]. By recognising the interactive nature of the human species, we can confirm the evolutionary role that emotional self-regulation processes and biological regulators play in the relational processes throughout individual development. Reciprocity is perceived as a key and ordering element for development, as emerged from the vast research conducted on groups of anthropomorphic primates [54, 62, 73-75].

If knowledge is seen as a self-organising process, the marked propensity to structure an intense emotional reciprocity with care givers appears as the *ontological constraint* at the root of any possible ordering of experience, thus underlining *the organisational and regulatory* role played by emotional and affective processes – primarily those of attachment and detachment – during the course of individual development. The attachment system is biologically pre-programmed to enable the survival of animal species at growing levels of complexity and duration up to human beings: the functions of attachment are not confined to childhood, but rather characterise the affective styles in adulthood and accompany humans throughout their entire life [76, 77]. Guidano distinguished some different categories of attachment styles that are shaped throughout individual development; his idea was that the maintenance of the organisational attachment patterns ensures, on one hand, the continuity of one’s internal coherence and on the other, an increasingly articulated self-referentiality of cognitive processes. Starting from the earliest phases of development, the quality of interaction is integrated with the biological features and abilities emerging through the different phases of development. From an emotional standpoint, the child begins to know and recognize himself starting from the earliest basic sensations [63]. During the course of neuronal development, such basic sensations must be specifically connected to perceptions so that actions can be perceived as early individual emotional experiences. An emotion is a complex process that implies the integration of many biological and experiential components and that orients the quality of cognitive development, which in turn will continue to influence the emotion in a complex interactive process running through one’s entire life.

MEANING IS THE OVERALL SELF-ORGANIZING ABILITY

If the ordering of the world cannot be separated from our being there, then to exist means to know: meaning is the way existence can be experienced and evaluated. Meaning is part and parcel of the overall self-organising ability. In the stream of the evolutionary process, the

flow of one's affective and psycho-physiological modulations is perceived as a sort of recursivity, recognised and assessed in a coherent fashion as unitary and continuous in time, through the structuring of basic ordering categories, able to produce (in an autopoietic and self-referential fashion [36]) and to assimilate consistent experiences [78] on which one's own sense of identity can be built. The qualitative aspects of this search for coherence depend on the interactive structure of human experience, where the sense of Self is linked to the experience of being part of others' consciousness (self-esteem). Apparently, with the emergence of abstract-reflexive abilities, primates' tendency to fight for high social ranking has evolved into a matching level of more abstract self-referentiality, *i.e.* the need to preserve self-esteem. During the course of the evolutionary process, the construction of the organisation of Personal Identity, *i.e.* of the set of personal meaning systems, depends on the role played by the interactions with significant others (attachment-separation processes).

Parallel to the emotional processes, attention has been focused on the study of cognitive processes that are secondary to the emotions they are rooted and built upon [79]. "In the field of evolutionary psychology and psychopathology, emotions and their modulations are considered as tightly intertwined processes: emotions are regulated while at the same time they perform regulatory functions... any processing of information is based on emotion, meaning that emotion is the energy that directs, organizes, amplifies and modulates the cognitive activity while constructing its experience and expression" [80]. In accordance with Siegel, we can consider emotion as a system of meaning evaluation and the brain as a complex system consisting of neural circuits that "must possess some mechanisms making it possible to determine which excitation profile can be useful or neutral or harmful; in order to coordinate its functions, the system must be able to attribute values and meanings [58]. The idea of complexity is applied to the study of evolutionary paths in an effective synthesis between attachment theories and those of Piaget's school on cognitive development, up to the current contribution of cognitive sciences, the first among others being those of P. Fonagy *et al.* [81-83] on the development of meta-cognition skills, (*i.e.* the ability to "observe" events and phenomena from the point of view of others). This ability is founded on the development of mentalisation skills (self-reflexive and interpersonal), *i.e.* the process through which children learn to understand others' minds as well as their own; as a consequence, the affective quality of the child's relationship with the care giver determines the individual sense of Self and the ability to discriminate between internal and external reality. The ability to modulate affective states is equally strictly related to mentalisation: it thus appears reasonable to assume that the ultimate goal of attachment is to produce a representational system that evolved as an aid to survival, in that it ensures the development of the brain structures useful for social cognition and to provide the individual with the necessary tools to cooperate with others. Attachment seems to work as one of the main organisers of brain and human mind development [70, 84-86]. Damasio makes a dis-

inction between "nuclear consciousness", the simplest form that gives the organism a momentary sense of Self in the here and now, and "extended consciousness", a biologically more complex phenomenon characterised by different levels of organisation that evolves throughout the whole lifespan of the organism, participating in the continuity that preserves and maintains the personal sense of identity. The reader will recognise an assonance with what W. James, followed by V.F. Guidano and his post-rationalist approach, described on the flow of consciousness as the continuous reciprocity between "I and Me", *i.e.* the immediacy of experience and one's unceasing explanation [64, 87].

A human cognitive system should therefore be intended as a form of self-referentially organised complexity, whose primary attribute is its very self-organising ability. Human experience is nothing but the product of this self-organisation process that in evolutionary terms has gone on for millions of years. The capacity to regulate emotions and their relevant activation states, through so called "processes of affective regulation", plays a crucial role in the internal activities of an individual: many psychiatric conditions can be seen as disorders of these regulatory processes... this is the reason why some therapeutic approaches aimed at different levels of brain and mind activity can be used to help patients to acquire more balanced and functional forms of self-regulation; the patient-therapist relationship can provide "external constraints" (in addition to biological modifications [88] that contribute to modifying personal self-organising skills and abilities). The ordering of reality is a principle that is inherent to the dynamics of life itself, which has taken on growing forms of complexity and self-organisation as humans have proceeded along the evolutionary ladder up to the acquisition of self-determination and plasticity of individual human processes. Reality – like the qualities and features of self-organisation – is the product of the relation that the system establishes with its environment: it pertains not only to the biological characteristics, but also to their interaction [72].

In Guidano's work [63, 64] we find one of the most promising applications of the notion of self-organisation in cognitive and clinical psychology: the interdependence between self-knowing and self-ordering implies that the generation and the assimilation of any information are regulated by the personal identity patterns that have been structured up to that moment, thus making a unitary and coherent dimension of experience possible. Moreover, Guidano emphasises how self-organisation also means that any pressure for change, emerging in a subject from the continuous integration of experience, is subordinated to the preservation of the "experiential order" (personal meaning) as the basis of the continuity and coherence with which one's Self is perceived. Attention is increasingly focused on a type of active interiority that is alive and builds its world through a ceaseless effort of interpretation, enabling an inter-subjective negotiation of the meanings assigned to events and behaviours. The narrating mind [87], which conceals a continuously evolving specific Self, is in charge of narrating and signifying all experiences that are exceptional, out of the ordinary, not known and shared [89].

FINAL CONSIDERATIONS

Today, we have to accept that the study of the mind and its disorders must be related to human suffering, but also to the new data emerging from neurosciences applied to laboratory research. This way of looking at the human system as at a fragmented structure, paying no attention to connections and processes is the same problem that scientists have to face when they work at different levels of analysis, or from a different new daring standpoint to generate the genetic foundations of many psychiatric conditions and illnesses [31]. The issue here is not “what” we study or observe to know, but “how” we assemble the data coming from different experimental domains [90-91]. What appears to be necessary at this point of the discussion and in current scientific debates, is a shared epistemological approach built around notions such as development, process, self-organisation, self-regulation and complexity. Any observable behaviour is in fact the ultimate result of a sequence of processes that are structurally alike for the species, but imply different interactions and relations for the individual: although we live in similar conditions, each one of us produces a wide range of variable behaviours that can be explained only by observing our own evolutionary history and the meaning that each one attributes to his or her specific experience and to the relations established over an individual's lifespan.

Based on what was stated above, neo-Darwinism still employs a reductionist-associationist methodology that characterises behaviourism. Instead, animal models seem to be used differently in post-Darwinism: although these studies are based on micro-evolutionary observations, they appear to be suitable to isolate some specific aspects and to explore their effects, but paying great attention to macro-evolution and to the processes that determine the self-organising meaning of any phenomenon as experienced by a human subject. Following the evolutionary history and adaptive significance of behavioural responses, could allow us to design experimental protocols that value data quality, as well as their explanation. A multilevel approach that considers factors ranging from the genetic set up to psychological experience, could lead to a more holistic and effective

investigation of mechanisms underlying brain function [92-94]. This work aims to contribute to the construction of an approach in clinical studies that may provide new strategies to more precisely investigate psychopathology and psychotherapeutic interventions.

A non-classic cognitivist approach, such as the post-rationalist one, could offer a theoretical framework for this multilevel approach, in addition to a noteworthy contribution to not only a descriptive, but an explicative psychopathology. Last but not least, focusing on the relevance of self-referring narration and personal stories in both cognitive and biological development, gives way to effective suggestions for a cultural psychology. With these considerations in mind, a proposal can be made, aiming to launch a much broader debate on the proposed issues, so as to gather enough experimental evidence to bridge the gap between concrete scientific work and abstract elaborations, without neglecting the uniqueness and complexity of living and human systems. In other words, participating in the current scientific debate on non-linearity, developmental discontinuity, self-organisation and self-regulation of biological systems is of great interest for the author of this article, in order to avoid the simplification and parcelisation of complex living systems, and even more so of knowing human systems. Behavioural classic cognitivists usually label the post-rationalist approach as “non-scientific”, given its interest in personal meaning. Reacting to such criticism nowadays means to take on the challenge launched by modern theories of complexity, which inevitably introduce the observer in the observed system and accept a degree of uncertainty, having the courage to renounce unrealistic “faith” in absolutely exact measures and in deterministic predictabilities that belong to a science that has become obsolete.

Conflict of interest statement

There are no potential conflicts of interest or any financial or personal relationships with other people or organizations that could inappropriately bias conduct and findings of this study.

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