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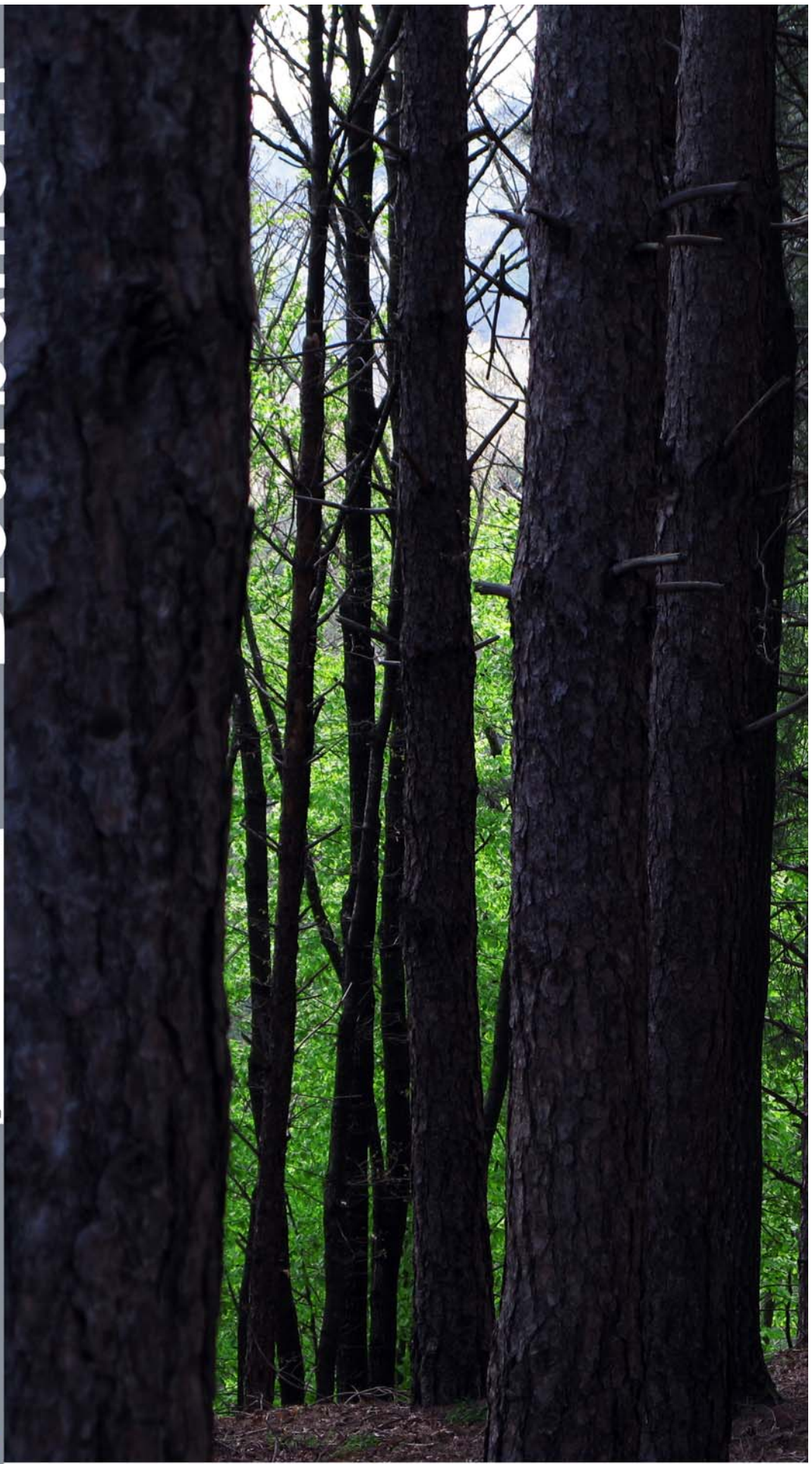

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Biophilia and Gaia: Two Hypotheses for an Affective Ecology

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ABSTRACT

Affective Ecology is a new branch of ecology concerned with emotional relationships between human beings and the rest of the living world. The basic instinct that guides the evolution and maturation of a well-tuned relationship with the living world seems to be biophilia, our innate tendency to focus upon life and life-like forms and, in some instances, to affiliate with them emotionally (*The Biophilia Hypothesis*). Our feeling of a deep connection to Nature, our sensation of being a child of Mother Earth, of Gaia, is probably an instinct and it is present in all human cultures, including those more technologically advanced, where a scientific understanding of the planet's living nature has been developing to an ever more advanced level (*The Gaia Hypothesis*). Nevertheless, within our artificial society, now distant from the natural world, we are running the risk that our biophilia is not becoming adequately stimulated in order for it to flourish as naturalist intelligence, the ability to take care of and subtly interact with living creatures. On a brighter note, we are discovering that Gaia continues to affect us on a deep psychological level, activating our involuntary attention (fascination) and favouring the restoration of our attentional capacity. We can all learn to respond to the call of Gaia and the natural world, to refine our senses and our mental capacities through the practice of active silence (mindfulness meditation); an engagement that seems to be particularly efficient in re-establishing our personal connections with Gaia and the living world.

Keywords: Active Silence Training (AST); Affiliation; Attention Restoration Theory (ART); Directed Attention; Empathy; Fascination; Mindfulness Meditation; Open Attention.

The environmental crisis is an outward manifestation of a crisis of mind and spirit. There could be greater misconception of its meaning than to believe it concerned only with endangered wildlife, human-made-ugliness, and pollution. These are part of it, but more importantly, the crisis is concerned with the kind of creatures we are and what we must become in order to survive.

(Lynton K. Caldwell)

AFFECTIVE ECOLOGY

The urgency posed by the big environmental issues requires a global reaction from humanity that is both rapid and adequate to defend the natural world (Stern 2007; IPCC 2007; Rockstrom et al. 2009). Nevertheless, despite our ever increasing knowledge of the global ecology, only a minority are truly motivated to modify their behaviours in order to face the environmental challenges. We are talking about well-informed moral people, for whom the knowledge about such problems is motivation enough to drive them to take action for ethical outcomes (Schultz 2001). For the majority of people, on the other hand, an exclusively rational and cognitive approach to the big problems regarding the environment is often insufficient to motivate them to take preventative or remedial action. Of consequence, various authors have warned of the necessity to bring emotive and affective associations into discussions about conservation (Saunders 2003), environmental education (Wilson 2006) and sustainability (Colucci Gray et al. 2006; Camino, Barbiero & Marchetti 2009).

To consider emotive and affective connections between human beings and the rest of the living world opens up a vast field of interdisciplinary research that teeters on the boundary that lies between biology and psychology. Indeed, these types of connections to which we refer have their phylogenetic roots in the evolutional history of humanity and can therefore be the subject of biologists, or reflect the ontogenesis of the human psyche and therefore be the subject of psychologists. Epistemological, linguistical and methodological differences exist between biology and psychology that cannot be underestimated. Nevertheless, understanding how a connection between a human being and an animal, a plant or a natural environment is established, developed and consolidated is of fundamental importance for environmental education that aims to permanently modify the behaviour of people. *Affective ecology* is focussed upon this area of research (Barbiero et al. 2007b; Barbiero 2009): it is '*affective*' because the capacity of the human species *to bond with* is only in part genetically programmed, and instead depends to a large degree upon the development of psychological potentials that themselves depend more upon cultural than genetic contexts (Bell, Richerson & McElreath 2009); and '*ecology*' because ecology is the science of phylogenetically determined connections. Affective ecology is proposed as a complementary tool to cognitive ecology that conveys knowledge via rational reasoning, exploring new channels of comprehension about (and of communication with) the living world – that knows how to make wise use of the affective and emotional competences of people. To form a more precise intellectual framework of affective ecology, I want to unit two scientific hypotheses that could constitute its scientific base: the biophilia hypothesis, proposed by Edward O. Wilson (1984), and the Gaia hypothesis, created by James Lovelock (1979). Two scientific hypotheses that presume a strong affective component – explicit in the biophilia hypothesis and implicit in the Gaia hypothesis – and it is just this characteristic that makes their combination particularly interesting to us.

THE BIOPHILIA HYPOTHESIS

Biophilia Framework

According to Edward O. Wilson, biophilia is «our innate tendency to focus upon life and life-like forms and, in some instances, to affiliate with them emotionally» (Wilson 2002, p. 134). Humanity, over the course of our evolution, would have developed a set of phylogenetically adaptive learning rules that mould our relationships with the natural world, even today (Wilson 1993). If this hypothesis is correct, the biophilic instinct would find its expression in a) *attention* – the capacity to let oneself be fascinated by natural stimuli, and b) *empathy* – the capacity to emotively affiliate with the different forms of life, or, as more precisely suggested by Silvia Bonino when referring to one-way empathetic engagement with non human life, *differentiated participation*. Thus, attention and empathy would constitute the two central constructs of biophilia and, at the same time, the two mental faculties that characterise the human instinct to love and care for Nature, faculties that should therefore be adequately cultivated.

Attention

Psychologists generally agree that attention can be defined as the process by which some elements of sensory information are encoded and elaborated whilst other aspects of the sensory reality are neglected (Valenza & Simion 2002). Our senses continually receive an enormous mass of stimuli and information about the external and internal environments that is elaborated by the subcortical centres without us being aware. Only a small part of this information reaches the cerebral cortex and engages with the consciousness, and thus gaining our attention. Attention focuses on only some aspects of the world that for some reason appear to be important. Our faculties – i.e. memory, deduction, risk evaluation, etc. – concentrate and attend towards the origin of the stimulus. Attention is phylogenetically adaptive and has evolved in man in response to the needs of basic survival, developing configurations of characteristic neural networks, corresponding to the diverse modalities with which attention manifests (see e.g. Parasuranam & Davies, 1984; Parasuranam, 1998). Here, we will consider two types of attention: directed attention and open attention.

Directed attention is the capacity to activate a state of alertness or to consciously direct ones attention towards the object that provoked it. It is a type of functional attention which serves that that we are doing and that requires mental effort to be maintained with time. It is the form of attention that one needs to carry out tasks or to finish a job. It is the form of attention that we can define as passive and subordinate because it responds to external stimuli, it is attracted to them and it can become prisoner of them (Pensa 2002).

Open attention, on the other hand, is a state of vigilant consciousness, active because it is attention in itself, free and independent of external stimuli. A form of attention that takes care of "here and now", that attends new insights, as in the sense of the Buddhist *yoniso-manasikāra* which implies exactly this type of attention, where *yoni* indicates the maternal womb (Pensa 2002): a form of attention that generates new awareness, and becomes a permanent mental state.

Directed and open forms of attention are not coextensive mental states: directed attention limits open attention. However, directed attention is important for establishing open attention. For example, suppose you were to take up a new sport that you had never done before; the movements do not come easily, they are awkward and you feel cumbersome performing them. We therefore apply our will to focus our directed attention on the exact execution of each movement until, with practice and patience, the movement comes naturally. This liberates the need for directed attention, leaving space for open attention, that Simone Weil calls "true" attention (Weil 1966). Thus open attention has a systemic nature: the athlete does not pay attention to the sequence of necessary movements anymore (directed attention), but to how these movements equilibrate between themselves.

Affiliation

According to Ursula Goodenough, the phylogenetic origin of the sentiment 'to affiliate with' resides within the neuronal networks involved in the contemplation of our profound genetic affinity with creatures of other species. It seems that these neuronal networks evolved via the exaptation route from networks that guided our maternal and paternal instincts, networks that also generated emotions like love, care and the instinct to protect. The root of altruism and of responsibility, in the literal sense of the term *to marry (sponsum) things (res)*, has its origin in «our capacity to experience empathy with other creatures and respond to their concerns as our own» (Goodenough 1998, p. 127).

The sentiment 'to affiliate with' seems, from this perspective, like a particular manifestation of empathy, here intended as the capacity to feel, to understand and to share thoughts and emotions with another. From an ontogenetic point of view, empathy evolved with the psychological development of the child. Around 3-4 years of age, a child experiences his/her first form of *empathy for participatory sharing* that will accompany him/her for all of childhood. In adolescence, with the development of an ever more sophisticated cognitive capacity, the ability to feel and share the thoughts and emotions of others extends to the comprehension of entire social groups *(empathy for general conditions*; LoCoco, Tani, & Bonino 1998) and (in an extended form) to participate in the "emotions" and expressivity of animals and the sacrality of vegetable life (Hill 2000) and certain natural landscapes (Naess 1976). Thus empathy transforms in this way into *differentiated participation* or *asymmetric empathy* of the different forms of life and natural objects (Barbiero 2007a). We talk about differentiated participation (or asymmetric empathy) because the real sense of empathy, by definition, can only exist between human beings that reciprocally divide the capacity to understand and share *human* emotions. The relationship that is established between a human being and an animal cannot therefore be of empathetic form because, even when a non-human living being is able to perceive and correctly tune to the emotive state of a human being, it is not able to share the experience. Indeed, many animals perceive human emotions, but they experience them in a completely different way. The reverse is also true: even though it can be useful in certain contexts (with children and the elderly), human beings should avoid the psychologically regressive confusion of projecting human sentiments onto a non human living being.

BIOPHILIA AND NATURALIST INTELLIGENCE

Naturalistic intelligence is the eighth manifestation of human intelligence according to the classification posed by Howard Gardner in his *Multiple Intelligence Theory*. It is defined as the ability to connect, on a profound level, with non human living beings and to appreciate the effect that such relationships have upon us and our external environment (Gardner 1999). This form of intelligence requires a developed sensory ability with which to perceive living organisms, the capacity of logical reasoning that allows us to distinguish and classify living organisms on the basis of certain logical parameters, a particular emotive sensitivity toward all that is "natural" and, finally, a certain existential knowledge that allows us to link all these qualities together on the basis of experience of a spiritual nature (Gardner 1999). If biophilia, as stated above, is a set of phylogenetically adaptive learning rules, it could constitute the physiological basis and the psychological potential from which naturalistic intelligence emerges.

However, as observed by Richard Louv, if children are not allowed to have the opportunity to develop an adequate relationship with nature, biophilia is not stimulated and naturalistic intelligence atrophies, causing damage to both the physical and psychological development of the child, which Louv defines, on the whole, as "nature deficit disorder" (Louv 2005; Charles & Louv 2009). Thus, it is necessary that the pedagogy of naturalist intelligence reverts to its original vocation, educating people to recognise the peculiarities of the living state of the various forms of matter (Buiatti & Buiatti 2001) in its manifestations of autopoiesis (Maturana & Varela 1980), negentropy (Schroedinger, 1942) and mental processes (Bateson, 1980). Life is a natural phenomenon, different and unique with respect to all the rest (Capra 1996; Buiatti & Buiatti 2008).

Who is able to recognise – intuitively or intellectually (by which, it is not important) – the peculiar harmony of each living organism cannot fail to experience a profound sentiment of marvel and of reverence for the mystery of matter that is able to transform itself into something living; and the fact that each organism – even a clone! – is actually unique and unrepeatable. Life, in this sense, is truly sacred (Bateson & Bateson 1987; Goodenough 1998). Thus, a theoretical framework is needed that can account for each element and that makes sense, not only of the living taxonomy, for example, but also of the great biogeochemical cycles and the sentiments of affiliation that we feel «for our Sister, Mother Earth» (Francis of Assisi). A theoretical framework is needed that meets the scientific standards of the XXI century, and that excites and inspires. Gaia, Mother Earth, a universal myth, yet also a contemporary scientific hypothesis, provides the answer. An efficacious pedagogy of naturalistic intelligence cannot but start here.

THE GAIA HYPOTHESIS

The Gaia Framework

The rocks, the minerals, the water, the air, the earth and its visible inhabitants, the fungi, the plants, the animals: each creature, living or not, can speak to us, can help us feel at ease within our common home, the Habitable Earth (*Gê oikouméne*). We are all children of Gea

(Γῆ), or Gaia (Γαια), children of a very long and uninterrupted evolutionary history. We feel that we belong, not only to the human race, but also to the biosphere itself, and we can empathise deeply with the sacredness of each living form (Goodenough 1998). Little by little we re-discover our ecological selves, being part of our deepest self (Naess 1976). We do not need to put excessive demands upon our linguistical/verbal or logical/mathematical intelligence with discussions about environmental education or diagrams of the greenhouse effect because it is the *locus naturae* that educates our naturalistic intelligence (Hill 2000). And it will be our naturalistic intelligence that stimulates the manifestations of our other forms of intelligence, in all their shades, day after day more cognitive and affective (Goleman 2009) to become aware of our responsibility towards ourselves and to all creatures, a responsibility that derives from being the species that knows the other species (Volk 1998).

Gaia as a universal myth

Myths are timeless and they express with their archetypal contents some fundamental themes of humanity with universal validity that cannot be conveyed using rationality alone. Mother Earth is without doubt an archetype deeply rooted into our psyche. The concept of the Earth as a Mother is present in virtually all cultures and dates back to the Neolithic age: the idea is that the Earth is a sort of womb for life (Gimbutas 1989). In ancient Greek mythology, for example, Gaia is the starter of life: the Olympic Gods and all living creatures descended from Gaia (Koreny 1958). She is also the Roman *Mater Tellus* (Koreny 1958) and *Hel* in Norse mythology (Monaghan 1981). She is a mother Goddess that renews with each season (she is always a virgin and always fertile) and she knows the mysteries of life and death: she is a Goddess of knowledge. Over the course of the centuries, this Goddess has tended to be personified into ever more distinguished female figures, each one of which conserves an attribute of the original Goddess. For the ancient Greeks, the Goddess that best assumes the form of Gaia is Demeter, and her name (Δημήτηρ) again converts back to Mother Earth. Demeter, together with her other identities, Persephone and Kore, is at the centre of the Eleusinian Mysteries, the ancient religious rites that celebrated the cyclic seasons of life: Persephone's Winter, Persephone being the wife of Ade and Queen of the Underworld, and the awaking of Kore in the Spring, Kore being the fertile Goddess of vegetation (Koreny 1958). It is possible to retrace the same myth structure to the Celts, with the epic deeds of Eire and Fodhla (Monaghan 1981), and even in the patriarchal Christian world, where the virgin and mother "Goddess" incarnates into the historical figure of Myriam of Nazareth who, starting from the Third Ecumenical Council of Ephesus in 431, became to be known as *Theotókos*, the Virgin Mother of God.

Gaia as a scientific hypothesis

The myth of Gaia was borrowed by James Lovelock (1979) to illustrate a scientific hypothesis that describes the dynamics that make the Earth a peculiar place to host life. The Gaia hypothesis was for a long time a controversial argument, in part because experimental verification was difficult to obtain (Kirchner 1989) and in part because the more orthodox academic culture does not like such a merger of science and myth (Margulis 1998). However, it is now commonly accepted that the Earth is a system characterised by the phenomenon of emergence (Schenider 2001). This presumes that life has a significant effect upon the

environment (*influential Gaia*), at least upon the Earth's surfaces and the atmosphere (Kirchner 1989; Kirchner 2002). In turn, the environment exerts its influence by limiting the evolution of the biosphere via Darwinian processes (Lenton 1998).

It is more difficult, however, to establish whether the biosphere influences the abiotic world in a stabilising way. If it were so, negative feedback loops should prevail in the dominant connections between biota and the physical world (*optimizing Gaia*). Life, in other words, would not only condition some chemical-physical variables in such a way that they adapted to life (for example, mean atmospheric pressure at 1 bar and the average surface temperature between 0° e 100° C, parameters that allow water to be conserved in the liquid state), but it should also be able to cope with oscillations of these variables such that it always returns to the reference values after a global perturbation. Overall, what one observes in reality is behaviour of Gaia that is both homeostatic, where negative feedback loops effectively prevail, and homeorhetic, where positive feedback loops prevail (Barbiero 2005).

The biogeochemical cycles of our planet seem to be fundamentally homeostatic: the feedback loops have a negative sign, that is, they tend to inhibit the perturbations from altering the overall structure of the system. In principle, however, it is possible that one or more positive feedback loop is established within the cycle; loops where the product of a reaction amplifies rather than inhibits the sequence of successive reactions, triggering a cascade process. A cascade process by nature tends to modify the equilibria consolidated in an irreversible manner and the system becomes unstable, remaining as such until a new point of equilibrium is attained (homeorhesis). The history of the Earth is constellated with episodes that have upset long-standing homeostatic equilibria, such that these points of discontinuity are used by academics to divide the history of the Earth up into geological eras. From the Proterozoic eon onwards, the protagonists of many of these points of discontinuity are diverse forms of life that inhabited the planet (Schwartzman 1999). One example is the transformation of the terrestrial atmosphere from a reducing to an oxidising one caused by photosynthesising organisms. This, not only contributed to changing the planet's climate, by cooling it down, but they started to release molecular oxygen into the atmosphere that revealed to be lethal for life on Earth. For some time, the planet managed to absorb the oxygen, mostly via the easily oxidised minerals contained within the rocks, but once these deposits were saturated, the free oxygen in the atmosphere destroyed the layer of anaerobic organisms that covered the Earth (Schwartzman 1999). Following this ecological disaster, the terrestrial atmosphere never again favoured anaerobic life, although the new equilibrium attained permitted the evolution of eukaryotic cells (Volk 1998; Margulis 1998).

Whatever the true nature of Gaia may be – influential or optimising –, the hypothesis formulated by Lovelock gave rise to a rich and heuristic field of study: Geophysiology, which considers the biosphere and its matrices (atmosphere, geosphere, hydrosphere) as a single super-organism *sui generis* (Kump, Kasting & Crane, 2004).

GAIA FASCINATION RESTORES HUMAN BIOPHILIA

Gaia is not only a legend and a scientific hypothesis; Gaia is an essential element of our lives. We are discovering that Gaia affects us on a deep psychological level – as only a true mother would – activating our involuntary attention, fascinating our senses and favouring the

restoration of our attentional capacity. If this is true, we stand before a crucial issue that needs to be addressed in its entirety: here, Gaia is the *active* subject, while humanity receives physical and *psychological* nourishment. Modern man is used to considering himself to be at the centre of the Universe. He tends to believe that he is the sole driving force, for better or for worse, of his own destiny. Here, we are dealing with a totally new perspective, which is much more humble: we depend upon the integrity of Gaia: as stated by Francis of Assisi in his *Laudes Creaturarum* (1224), Mother Earth really sustains and manages us, not only physically («et produce diversi fructi»), but also on the psychological («con coloriti flori et herba») level.

The Attention Restoration Theory

The primary question of my research is thus: why and in what way is attention influenced by certain natural environments? In the quest to answer this question, I have become greatly interested in the Attention Restoration Theory developed by Stephen Kaplan, psychologist at University of Michigan, particularly about the restorative power of fascination (Kaplan 1995) and mindfulness meditation (Kaplan 2001).

Fascination

Kaplan distinguishes two forms of attention: directed attention and involuntary attention, or fascination. The first form, we have already discussed above. To Kaplan, directed attention, in its essence, can be defined as the capacity to inhibit concurrent or distracting stimuli while carrying out a task (Kaplan 1995). When directed attention is subject to intense and prolonged use, it becomes exhausted and mental fatigue occurs: the subject is more easily distracted his/her behaviour becomes more frequently impulsive and hostile.
Involuntary attention (James 1892), or fascination, is a form of effortless attention, resistant to fatigue (Kaplan 1995). It permits directed attention to rest and regenerate until it returns to normal efficiency levels. Fascination can trigger open attention inasmuch as it emerges from the performance of processes (for example, from play, but also from listening to or telling stories, or problem solving) or by simply surrounding oneself with into wild natural environments perceived as reassuring and regenerating (*wilderness Gaia*).

Mindfulness

Mindfulness meditation is a psychological practice with its roots in the spiritual traditions of Buddhism (Siegel, 2007), and from which various methods used in stress reduction (Kabat Zinn; 2005) and diverse psychological therapies have been derived (for a recent review, see Horowitz, 2010). In its essential form, mindfulness meditation offers the opportunity to experience suspended individual moments in time from the multiple auditory and visual stimuli received and to enter into relationship with one's interior space (Freire, 2007). Mindfulness meditation requires the practitioner to empty his/her mind of the flow of thoughts that tend to activate directed attention, creating in this way the right conditions such that open attention can manifest (Pensa 2002).

Kaplan retains that a person, even with modest training in meditation, could obtain great benefits in his/her capacity to regenerate directed attention from practicing mediation, even if the environmental context has little or no regenerative properties (Kaplan 2001). In some way, mindfulness meditation may have a substitutive role to that of fascination of the natural world.

Kaplan's hypothesis (known as the 6th hypothesis) opens up new perspectives: if fascination of Gaia regenerates directed attention, establishing in this way a point of contact with the human psyche, symmetrically the human psyche, via mindfulness meditation could establish a point of contact with Gaia, or at least with some of her epiphanies. Indeed, *wilderness Gaia* and *mindfulness meditation* require the human subject to "let go" of directed attention and to predispose oneself to open attention.

Active Silence Training

On these bases, Dinajara Doju Freire, Maria Ferrando and I developed *Active Silence Training* (AST), an educational scheme designed specifically for primary school children (Barbiero et al 2007b). The AST is constituted of fascinating games that aim to stimulate biophilia in children, enhancing properties of both attention and empathy. For this reason, the AST is divided into two modules: *Cooperative Play* (Bello, Bo & Ferrando 2002) and *Mindful Silence* (Freire, 2007). The *Cooperative Play* module is constituted of games that encourage the children to cooperative between themselves in order to stimulate their sense of empathy (Jelfs, 1982; Bonino, 1987). The *Mindful Silence* module is constituted of games that introduce mindfulness meditation to the children, thus stimulating their faculty of attention (Kaplan 2001; MacLean et al. 2010).

Experimental data

To enable biophilia to flourish in each child, we need to stimulate his attention and his sense of empathy. The AST is the instrument that we have created to attain this objective in children that pass a large part of their time in urban environments with poor regenerative powers. Although the AST was performed in many primary schools in North and Central Italy, all the experimental observations reported here were taken at the Istituto San Giovanni Bosco delle Figlie di Maria Ausiliatrice, a primary school in Aosta (Italy), in order to present a socially homogenous group of children and to follow them over the course of their five primary school years.

Both physiological and psychological parameters were taken into consideration in the study. Regarding the former, heart rate and arterial blood pressure were assessed – indicators of the state of relax of the children (Barnes et al. 2004; Black, Milam & Sussman 2009), and for the latter, the *Continuous Performance Test* (CPT, Cornoldi, 1996) was primarily used to evaluate the regenerative capacities of attention in the children. This version of the CPT is a paper and pencil test that measures sustained attention. The subject is required to spot a triplet of the same repeated letter within a very long string of letters. The CPT is a brief and conceptually simple test, but nevertheless somewhat tiring for primary school children. It is a validated measure of sustained attention (see e.g. Corkun 2008). The CPT measures

sustained-directed attention as well as the capacity to inhibit or block out other stimuli. In our CPT, a triplet of letters was presented to the subjects for three test-trials whereby the order in which the same letters appear changes for each trial as does the size of the letters and the spacing between them. No cognitive function is involved whilst performing the test as the order of the letter string is casual and without sense; however, the subject is required to maintain directed attention. The CPT allows us to measure four variables: the number of correct replies, the number of incorrect replies, the number of times no reply is given, and the time to complete the test. In this way we have been able to assess to what extent and after how much time children are able to regenerate directed attention by means of *active silence* (Barbiero et al. 2007b).

In a first phase, we compared the regenerative capacity of the AST with that of the children's habitual recreational break between lessons (playtime); we obtained evidence that the AST is much more efficient than their usual playtime in regenerating attention in the children at school (Barbiero et al. 2007b). Next, we compared the two modules of the AST, the Cooperative Play and the Mindful Silence modules; we discovered that the Cooperative Play module produces immediate but transient regenerative properties of attention, while the practicing of Mindful Silence regenerates directed attention more slowly but the effects are longer-lasting (Berto & Barbiero, manuscript submitted). Finally, we compared the AST in class with the fascination of nature. We took the children on an explorative nature trail within the woods, incorporating story-telling and song such that the children could fully immerge themselves into this environment with absolute serenity. We were not surprised to observe that following this experience of nature their assessed performances of directed attention were comparable or better to those achieved after performing the *active silence* exercises in the classroom (unpublished data); this result was also confirmed by the outcome of the children's version of the Perceived Restorativeness Scale (Pasini et al. 2009), a test for assessing how the regenerative potential of an environment is perceived.

Evocative Suggestions

If our observations are confirmed, we can conclude that:

1) Some natural environments are able to stimulate fascination in children in such a way that enables directed attention to rest and regenerate.

2) Biophilia could exert an evolutionistic influence that goes beyond the memory of our past in the savannah (Balling & Falk 1982), affecting both directed attention and concentration. Thus, biophilia could represent a relevant evolutionistic advantage (Barbiero 2010).

3) If the capacity to regenerate depends on certain natural contexts, one might expect that the destruction of the Earth's wildernesses, in addition to the more obvious serious consequences, would have a detrimental effect upon the ability of our future generations to mentally regenerate in a full and complete manner. In particular, the studies of environmental amnesia come to mind (Kahn, 2007).

4) If, of the various natural contexts, those of intense natural beauty are not other than the epiphany of Gaia, then, in one sense, it is Gaia that regenerates our ability to attend. Thus, the veneration of the ancient populations for Mother Earth (Gimbutas 1989) should not be considered a naïve rite, but as an act of gratitude for that that is the power to regenerate.

5) Finally, I turn to definition of biophilia, «our innate tendency [...] in some instances, to affiliate with [life forms] emotionally» (Wilson 2002, p. 134). Wilson uses – and I believe not by chance – the verb "to affiliate". The etymology of the word "affiliate" is Latin (*ad filius*) and means "son of", thus implicitly indicates a relationship with a "mother". If Gaia is the scientific epiphany of Mother Earth, then Gaia is "mother" and humans are literally her "sons". It is clear that of all the empathic relationships, that existing between mother and child is one of the most profound and special. What is more, could the mother-child model of an empathic relationship be that that best encapsulates the empathic relationship between Gaia and mankind? Even though there are many scales that measure mother-child empathy, we have not been able to identify one yet that could be used together with the AST, but the investigational road ahead is without doubt promising.

AFFECTIVE ECOLOGY AND HUMAN SPACES

Over recent years, biophilia has more frequently been taken into consideration in studies, hypotheses and practical proposals regarding the designing of human spaces in order to optimise human welfare, performance, etc. (see e.g.: Kellert 2005; Tai et al. 2007; Kellert, Heerwagen, & Mador 2008; Salingaros et al. 2009). Though being a good starting point, biophilia is, however, only a quality of the human mind that requires an adequate relational context and Gaia to be expressed, or, better still, one of her innumerable epiphanies can provide the right partner to enable biophilia to flourish.

Regarding affective ecology, I propose the following food for thought:

1) Biophilia is a collection of learning rules which depend upon the mental faculties, attention and empathy. A Biophilic project should consider i) fascinating environmental contexts to diminish the use of directed attention and favour open attention, and ii) the most appropriate spaces for human interactions to favour empathetic contact between human beings and between human beings and the natural world (Zammit et al. 2010).

2) Fascination is a relational process where man is the passive actor and the various epiphanies of Gaia react directly upon the human psyche. However, fascination is limited by the experience that each person has of the natural world. A biophilic design should dedicate space for manifestations of wilderness Gaia that are compatible with a real experience of wilderness for the user (Kaplan 2001).

3) Open attention can connect the human psyche to wilderness Gaia. A biophilic design should, therefore, provide spaces for retreat and solitude where the perception of the world's beauty merges with one's more intimate spirituality (Ouellette, Kaplan & Kaplan, 2005).

CONCLUDING REMARKS

Like many conceptual instruments of the life sciences, the biophilia hypothesis and the Gaia hypothesis do not possess the status of 'theory' in the strict sense of the word: that is, they do not possess a predictive power derived from their logical-deductive structure. However, many lines of evidence support their real consistence, insomuch as that today the biophilia hypothesis and the Gaia hypothesis together can be considered as a collection of inductive models with great heuristic value for the environmental sciences. In their flexibility, the Gaia and biophilia models conserve all the complexity of the living world (Capra 1996), with networks of connections never completely closed and boundaries never completely defined, as is life (Camino & Barbiero 2005). The Gaia hypothesis and the biophilia hypothesis offer to the scientific community a new way of contemplating the living world, where experimental observation becomes a tool for dialogue between different perspectives (Benessia, Barbiero & Camino 2006) and where a verbal language is favoured that is better adapted for describing the dynamicity of the processes than a nominal language that tends to crystallise in definitions that for their nature are in continual evolution (Dodman, Camino, & Barbiero 2008).

If ecology is the science of the relationships between living organisms and their environment, the relationships between human beings and the rest of the living world should receive particular attention. Here, affective ecology emerges: the study of the affective *and* cognitive relationships that human beings establish with the living and non living world. It addresses emotions that become sentiments, and intuitions that become knowledge. Sentiments and knowledge are not juxtaposed, they interchange however and collaborate. Read Nature with an open heart, listen to Nature with a ready mind: this is the correct nourishment for the healthy growth of naturalistic intelligence.

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