Visions for Sustainability

IRIS

Vision without action is useless.
But action without vision
is directionless and feeble.
Vision is absolutely necessary
to guide and motivate.
(Donella Meadows)

Interactions between different logical levels
produce phenomena unseen at either level.
(Gregory Bateson)

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VISIONS FOR SUSTAINABILITY is an indexed scientific journal published in open access by the Interdisciplinary Research Institute on Sustainability (IRIS). The journal promotes a debate on how the concept of sustainability can be addressed and applied in existing and foreseeable societies worldwide. Particular emphasis is placed on facilitating communication between researchers of different disciplines, supporting educational projects and examining the role of contemporary science in dealing with issues related to sustainability. Papers are welcome from researchers and scholars of natural, political, social and other sciences as well as philosophical and humanistic disciplines, and in particular from anyone wishing to make a contribution which combines multiple viewpoints. The aim is to host as wide a range as possible of multidisciplinary, interdisciplinary and transdisciplinary perspectives on sustainability. Discussions or comments on articles which have previously appeared in the journal are also welcome. All submissions will be refereed before publication.

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Visions for Sustainability
The manifesto of our new scientific journal

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***Perspective**: Theoretical vision*

***Fields**: Earth life support systems - Economy and technology - Social processes and structures*

***Issues**: Bio-geological equilibrium and ecological decay - Globalised industrialisation and global products - Art and sustainability*

1. Sustainability research and new visions for humanity's dialogue with itself and nature

New ideas are often like flowers struggling to bloom in adverse conditions. They need places in which to be conceived, discussed and shared, to gradually assert themselves through interaction with dominant existing ideas that tend to intimidate and suffocate creativity, to often wait for years before finally establishing themselves as full participants in humanity's dialogue with itself and nature.

2. Visions give rise to problems … and solutions

Although there is a growing common recognition of the need to work towards a more sustainable modern society in many spheres, the approaches to tackling the problem are numerous and often very diverse. Many disciplines contribute to sustainability science – each one bringing its own methodologies, choices regarding dimensions and other variables, spatial and temporal scales – so that a multitude of scientific narratives and theoretical perspectives are used to study or promote sustainability in fields such as agriculture, bio-urban planning, eco-tourism, industrial ecology, environmental management, sustainability indicators, green chemistry, and many more.

Moreover, each field expresses its own, often implicit, vision of the world, thereby steering the search for solutions in the direction where it already hypothesizes them to be. In some cases, such solutions will lie in the use of innovative technology, whilst for others in rediscovering our contact with nature, a renewed spirituality or artistic creativity. Within the broad spectrum of sustainability research, facts, values, experience and perspectives are inextricably interwoven.

3. Language and visions are interdependent

We all start out from the fundamental vision of the discipline in which we have specialised and subsequently question and explore other disciplines about the concept of sustainability and its many ramifications. This interweaving of perspectives gives rise to an increased awareness of the role of language in shaping ideas, in directing research and in interpreting outcomes. An in-depth reflection on the inextricable and often implicit relationship between signifiers and signifieds in different forms of language (ranging from scientific metaphors to the various descriptions of the world expressed by different cultures) and the underlying representations of reality, can give rise to multiple perspectives and promote a dialogue between experience and knowledge. Often experimenting with contaminated and unconventional language and the free association of ideas, analogies and imagination enable the initial creative phase of each research study to develop. By bringing together different visions of the world new insights can be born (Gagliasso, 2010).

4. Interdisciplinary dialogue and visions in contact

We began working together by bringing into contact our different areas of competence in a multidisciplinary fashion. The ambiguities, misunderstandings and disagreements that accompanied this first phase prompted us to examine more deeply and question the epistemological and methodological assumptions underlying our respective fields of knowledge. Reflecting on our different ways of knowing has allowed us to express our reciprocal perplexities and doubts and allow value judgements to surface that had previously hampered communication. Sharing the different languages of our various disciplines has revealed a more complex reality than hitherto perceived.

By this we are referring to a critical and contemplative process employing methods involving the diverse forms of input by a wide range of people, an approach capable of spanning complex systems. Interdisciplinary research allows us to take note of the "short-sightedness" of the visions arising from individual disciplines; it prompts us to think the unthinkable and to ask questions that are usually neglected – and the importance of which is greatly undervalued as a result of our ignorance (Sardar, 2010).

Why and to what extent do some consider incompatible quantitative and qualitative forms of research? What makes it difficult to accept the idea that first-person research can also be a valid instrument for investigating the relationships between ourselves and natural systems? How can we incorporate into our thinking the idea that scientific knowledge may have lost the capacity to give certain answers and provide reliable predictions in a world increasingly characterised by complexity and contradiction?

As we debate about different ways of knowing and forms of knowledge, a number of significant and productive examples of interdisciplinary collaboration have developed. Different approaches to measuring the anthropic burden on different spatial scales have been compared and, and as far as possible, integrated (for example, the relationship between ecological, water and carbon footprints). Material flow analyses at regional level are now employed when working together to analyse environmental policies. In global terms these data are compared with those that show the correlation between international trade and the scale of human appropriation of the net primary production of global chlorophyllian photosynthesis.

The complexity that characterises our world requires that we also investigate the causes and the directions of material flows, together with the ways of appropriation and distribution of net primary production. The role of every individual becomes evident and the responsibilities held by communities become ineluctable. Such a vision makes clear the ever-greater need for collaboration between natural and social and human sciences.

5. Beyond disciplines, a space in which to enact new visions

A pathway that we believe enables us to better address many of the questions posed and open up new horizons of study is that of transdisciplinary research. There is increasing awareness of the ingenuity gap that exists between our need for new solutions and our ability to invent and innovate (Westley et al., 2011). Bridging this gap requires new epistemologies capable of generating new knowledge, new methodologies for experimenting and building that knowledge, new languages that permit those epistemologies and methodologies to come into being. New visions derive from the interactions between what Bateson called different logical levels out of which emerge phenomena we are unable to see from the perspective of one single level (Bateson, 1979; Bateson, 2000).

Our research lies within various intersecting perspectives: the perspective of a post-normal science, based on "the insight … that in the sorts of issue-driven science relating to environmental debates, typically facts are uncertain, values in dispute, stakes high, and decisions urgent. Some might say that such problems should not be called 'science'; but the answer could be that such problems are everywhere, and when science is (as it must be) applied to them, the conditions are anything but "normal"(Funtowicz and Ravetz, 1999, 2013); the perspective of a hermeneutics that "sees the relations between various discourses as those of strands in a possible conversation (…) which presupposes no disciplinary matrix which

unites the speakers" (Rorty, 1976: 318); the perspective of an awareness that "new forms of knowledge integration and generation that support planetary stewardship are required, capable of integrating a much richer diversity of ideas and viewpoints and of bringing action and research into closer proximity" (Westley et al., 2011: 776).

Such perspectives require a shift from interdisciplinary to transdisciplinary visions. An interdisciplinary approach is based on a dialogue between the epistemologies, methodologies and languages of different disciplines that enriches the processes and products of each of them. In this sense, interdisciplinary approaches are collaborative, in that the disciplines and their practitioners offer each other mutual support in addressing particular questions and problems that arise. A transdisciplinary approach aims to build new epistemologies, methodologies and languages that go beyond those of the individual disciplines in order to address new and common problems. Transdisciplinary approaches are thus cooperative, in that the disciplines and their practitioners unite in order to generate the new constructs that are their very reason for being.

6. Opposing views of human approaches

The concept of sustainability in itself implies awareness of the acceleration of change occurring in our world and the relentless increase in the scale of anthropic transformations. However, the directions proposed to overcome the difficulties are numerous, often divergent, and sometimes contradictory. The prevailing vision concerning environmental issues is confidence that technoscientific innovation will lead human beings to solve current problems. This is based on the modern ideal of progress, which asserts that the expansion of scientific knowledge and the accelerating use of technological applications will bring ever greater social well-being (Benessia and Funtowicz, 2013, p. 56). Such a vision has, however, repeatedly been questioned as a result of the increasing non-intentional consequences of the application of such technologies, both within the environmental and the ethical spheres. High potency models that feature technoscientific innovation propose the idea that problems are mono-causal and transitory (Ravetz, 2006), and consider uncertainty as a quantifiable risk that can be objectively managed. Problems are faceable by experts, responsible for manufacturing and shooting 'silver bullets' powered by huge, centrally-driven fluxes of energy and matter. By contrast, low potency models place particular emphasis on saving balances at local as well as global levels of biogeochemical patterns and cycles, and are based on decentralising and localising legislative and technological intervention. Low potency action acknowledges the complexity of each and every socio-environmental context and requires caution and humility in human approaches to natural systems (Jasanoff, 2003).

7. Democracy and nonviolence are prerequisites for defining visions of sustainability

Even the most accurate and rigorous scientific dialogue cannot give rise to transformations in behaviours and life-styles if it does not stimulate motivation and belief in the possibility of change (Langer 2012). And such motivation and belief can only flourish in a democratic and non-violent environment, in which we recognise the importance of careful decision-making processes that respect all legitimate perspectives in order to explore the sustainability of individual and group choices. In this respect, we should bear in mind two boundaries within which each human action must occur. One of these is the ceiling, which represents the limit of the planet's biophysical renewability, and for which numerous thresholds have been identified

that, if exceeded, would trigger irreversible and uncontrollable transformations of global eco-social systems (Rockstrom et al., 2009). The second is the floor, which represents socio-economic equity, since the question of the limits of the availability of resources and natural services are recognised as inextricably linked to the issue of their distribution (Raworth, 2013).

Of equal importance is the need to give more attention to the question of military defence and war, the single most significant cause of the environmental and social unsustainability of modern society (AA.VV., 2013).

There is apparently little correlation between forms of government and environmental impact. Certainly governmental policies within so-called liberal democracies are no guarantee of a more limited ecological footprint. At the same time, there are kinds of democratic participation that question the high potency model and are capable of initiating new directions in dealing with environmental issues. Principals of ecological democracy emphasize the importance of local initiatives in sustainability practices, based on social interactions with the environment and on the rights of scientific citizenship built on access to information and the development of responsibility, participation and belief (Liberatore and Funtowicz, 2003).

8. Embodied experience in the world directs visions and actions

There is growing interest in the relationship between our physical selves (experienced, organic and mental), as explained by life sciences, and the set of values we assume as a result of our embodiment both within physical environment and the relationships we live in. Our mental lives are not encompassed solely within our brains, but rather extend throughout both our bodies and our technological protheses and into the environment in which we live. A vital contribution to sustainability research comes from the dialogue between experimental neurosciences and the phenomenological investigations of subjective experience. Awareness is a self-sustaining flow inexorably directed towards the future and driven by the affective valency we attribute to the world we inhabit (Thompson, 2007).

9. Educate to stimulate new visions

The issue of sustainability in education is of crucial importance. In many schools and universities, the dominant idea is still that of 'transmitting' knowledge, conveying concepts elaborated within disciplines and broken down into 'subjects' or 'courses'. Students are asked to learn without the opportunity to engage in discussion or bring personal experience to bear. Likewise in society, where the public is, at most, required to 'learn' about sustainable behaviour from scientific bulletins, television programmes and newspaper and magazine articles. Our epistemological and methodological premises are based on the belief that the educational process, which has the power to promote sustainability, requires the involvement of all members of society, including students during their educational experience. All students must have the opportunity to build knowledge, formulate ideas and express themselves as autonomous, aware and critical individuals about the topics that regard their own lives and, by the same token, those of all other living beings on our planet. Educators whose work takes them to the heart of the problems of equity and justice, of global citizenship and sustainability, can help young people to question the directions in which contemporary society is heading and propose alternatives for the future (Hicks, 2012).

10. One journal for a multitude of voices

In launching this journal we hope that our commitment and our enthusiasm will stimulate others to join us in an attempt to make a contribution to reducing the

'cosmological void' that has led us so close to unsustainability (Panikkar, 2008). We believe that without an underlying cosmology we will find no adequate 'space' within which we can place both our scientific and our subjective human knowledge. "Vision without action is useless. But action without vision is directionless and feeble. Vision is absolutely necessary to guide and motivate" (Meadows et al., 2004). Sustainability research is constantly seeking new visions. These visions may come from approaches that re-think traditional sciences in a post-normal, inter- or transdisciplinary framework or that re-discover the value of largely ignored existing knowledge (such as that of indigenous peoples), approaches that are normally excluded by science (such as art or meditation) or that are beginning to gradually emerge from their position as yet on the margins of the mainstream. Visions for Sustainability wishes to give space and voice to as many of them as possible.

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Language, its technologies and sustainability

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Abstract. This paper argues that there is a crucial link between language and sustainability and explores in particular how the evolution of certain characteristics and functions of human language are related to it. The emphasis is on how the principal technologies of language - speech and writing - are related to our ways of being and doing, reflecting on and acting in the world and the consequences of this relationship in terms of the sustainability of our existence. The emergence of writing and its correlation with nominal language are seen as particularly significant developments in how we represent reality and thereby risk following unsustainable pathways.

Keywords: Natural language systems and technologies, representation, reflection and action, sustainability

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***Perspective**: Theoretical vision*

***Fields**: Human sciences*

***Issues**: Sustainable language and knowledge – Educational processes*

Introduction

Language is an essential condition of life based on sensory stimuli received and re-elaborated in various ways by all living creatures in order to dialogue with the environment that sustains them and of which they are a part. The sustainability of life itself depends on this dialogue and therefore on the language which permits it. Life and language have evolved together over millions of years and necessarily continue to do so. Human, or *natural*, language made a very recent appearance within the vast spectrum of life's immense multilingual diversity around 220,000 years ago. Natural language is *natural* because its phylogenesis is the result of long and complex processes of biological and cultural evolution. This paper aims to raise some theoretical questions and indicate some directions for research concerning the relationship between language and sustainability and how this is vital for humanity's dialogue with nature and itself.

1. Language as being and doing

Like all forms of language, natural language can be considered from the point of view of what it is - its essence, or its characteristics - and of what it does - its uses, or its functions. Within the ongoing process of the evolution of language, both characteristics and functions are interdependent – in that they define each other - and dynamic – in that they are constantly subject to change. I would like to explore the relationship of what natural language is and how it changes, what it does and how this changes, from the point of view of its basic technologies - those of speech and writing.

Natural language is not the only kind of language that human beings use. In this sense, all human beings are multilingual, and personal multilingualism, the various ways in which people use a multiplicity of types of language, is a feature of daily life. Body language (physical contact, distance and proximity, posture, movements, gestures, facial expressions ...), visual language (lines, shapes, sizes, colours, symbols, pictograms, images ...), sound language (noises, sounds, timbres, rhythms, melodies ...) and natural language (phonemes, graphemes, words, speech and writing, texts of various kinds ...) interact and feed into and out of each other continuously, interweaving and merging in multimedia compositions that are by no means only a recent phenomenon, but which have witnessed a considerable acceleration through technological developments in the past few decades.

Natural language is in fact not a type of language totally distinct from the others, but rather only a particular combination of specific elements of sound language (based on a range of sounds that make up the phonemes used to form the words of speech) and visual language (based on a range of symbols that represent the graphemes used to form the same words in writing). Moreover, sign languages, formed by particular combinations of elements of body language, are also natural languages in the full sense of the term while also being visual languages, since the gestures that are the signifiers of sign language would be of no significance if they could not be seen.

Language is not something that exists outside the person who is born, a phenomenon that is in the world around us, that we must learn through experience or through study. Nor is it a kind of blueprint or expression of a set of innate and universal cognitive structures waiting to be activated and declined on the basis of the accident of birth in one part of the world as opposed to another. Language develops naturally as a constituent element of experience and subsequent learning in human beings, on the basis of many contextual variables.

Learning is a process of adapting to experience, a lasting change that is the outcome of that experience. Language plays a dual role in this process, because it mediates both the experience and the subsequent adaptation. Language permits the flow and the sharing of information between the individual and his environment, the dialogue and communication between individuals and inside individuals, which are the very essence of life. Language is thus above all a way of being in the world, a human semiosis that enables us to make sense of the world, a means with which to build an idea of a reality in which we live and act according to that idea. In other words, the self of each one of us is born and constructed linguistically. "We human beings exist and operate as human beings as we operate in language: languaging is our manner of living as human beings" (Maturana 2002, p. 27).

2. Language as phylogenesis, ontogenesis and microgenesis

The essence of a language is primarily determined by its material basis and how this enters into a relationship with the user of that language. The user, a living being who exists within an environment, receives sensory stimuli in the form of the physical or chemical phenomena that are the components of language. While animal languages (and, presumably, prior versions of human language) also make a wide use of chemical stimuli, natural human language has developed a particular way of re-elaborating specific physical stimuli. For example, when using natural language in receptive way, through listening or reading, we capture sound waves or light waves that become the particular acoustic or luminous stimuli we recognize as constituent elements of that language. The development of human language is based on biological and neurological systems dedicated to particular functions that correspond to the physical characteristics of language itself and adapt and change through experience and the sensory stimulation it provides. The ear translates sound waves received into electrical impulses, which are transmitted to the brain through the fibres of the auditory nerve. Similarly, the light waves captured by photoreceptors in the retina are translated into impulses sent to the brain by the optic nerve. A neural architecture is built through the information furnished by experience and social interaction as both the basis of developing and using language.

This biophysical process of language development can be analyzed at three intersecting levels: the phylogenetic, the ontogenetic and the microgenetic. The phylogenetic level concerns the evolution of different types of language and technologies for their production and reception. For natural language, examples can be the development of language families such as the Indo-European or the Austrolasian, individual linguistic systems, or technologies of language as speech and writing.

The ontogenetic level concerns the linguistic development of individual human beings: the emergence of different types of language and their technologies, the transition from protolanguage to language, from using one to a number of language systems, the importance of the encounter with speech, writing and texts.

The microgenetic level is that at which daily communicative events and individual language acts occur and cumulatively contribute to both phylogenetic and ontogenetic developments over varying time spans. At one time these developments could be calculated in terms of tens of thousands of years, but now they can be measured in terms of centuries or even decades, as a result of the increasing acceleration of change. Significant examples for analysing the relationship between language and sustainability are the interactions between scientists or between scientists and politicians or the public at large, or the interactions between teachers

and learners or between learners, can be analyzed as a set of microgenetic acts which influence the development and the role of language and languages in scientific and political, research and learning processes.

The phylogenesis and the ontogenesis of natural language are both characterized by the use we make of it in thinking and doing, in reflecting on the world and acting in the world. These functions are the two complementary faces of every human semiosis (Halliday 1978). Reflection enables us to gather experiences, understand and represent sensory data and perceptions, elaborate cognitions, build and rebuild knowledge, construct the mental schemata that form the reality in which we live, interpret what is happening around and inside us. Action, through which we also interact with others, enables us to communicate, share information, thoughts, memories and desires, seek to influence and regulate, solve problems, and so on. Once again, our capacity for reflection and action both depend on the quantity and the quality of the input received and the characteristics of language system that mediates it.

3. Language as system

A language is a system, in the sense that it is a series of interrelated elements that show particular connections and interactions necessary for the operation of the system itself. Moreover, natural language, and every single language that is an example, is an open and dynamic system that evolves and is metastable, because, like all such systems, it can continue to exist only through a constant process of change based on reciprocal exchanges with the environment to which it belongs.

The building blocks of any language system are the signifiers that allow its users to exploit its potential for the construction of meanings, within the limits prescribed by the characteristics of the system. As we have seen, the types of signifiers used depend on the biophysical characteristics of the language in question. In the case of natural language, the signifiers are words formed by particular combinations of phonic or graphic elements. At the base of the system is the dynamic relationship between signifiers (words that make up the system itself) and signifieds, which together form signs, the basis of the sense-making processes that enable us to give meaning to the world we inhabit.

The signifier and the signified define each other reciprocally and neither can exist without the other. In this way, a sign is the result of various types of relationships: between signifier and signified, between different signifiers and between different signifieds. In all cases, signifiers and signifieds are defined negatively in terms of how they distinguish themselves from other signifiers and signifieds. A signified is what it is by virtue of how it differs from other signifieds. Paradoxical as it may seem, it is defined in terms of what it is not. In other words, the processes of signification are distinctions of distinctions of distinctions of distinctions, and so on. Thus they are a potentially infinite process of definition and redefinition of signs, of construction, deconstruction and reconstruction of meanings.

In a metastable system elements combine, separate and recombine to create new organisation with each new combination. Signifiers and signifieds cannot become permanently combined in the same way. In an open system this would be the kind of equilibrium that is equivalent to death, without the constant flow of information and rielaboration on which the system depends in order to maintain and develop itself (Prigogine and Stengers, 1984). Signifiers and signifieds must remain flexible to facilitate the processes of signification in which given and new experience, familiar and different contexts, habitual and emerging

needs, come into contact. In this way, structural couplings are created capable forming neural and cognitive architectures and giving rise to new mental structures.

4. Language and representation

While reflection and action may arguably be considered two universal functions of human language, the relationship between characteristics of different families and individual language systems and the mental structures they mediate are of potentially infinite diversity. Within the Indo-European family that contains the dominant colonial languages including, obviously, the English language that has come to exert great vitality and influence (and therefore be of corresponding importance for the relationship between language and sustainability), two mental structures typical of the ways of representing and living reality have developed. One of these structures is based on the idea of the world as a concrete place where things happen, a world made up of agents, events, outcomes, a subjective and dynamic world of processes. The other structure is based on the idea of an abstract world in which there is evidence and facts, without agents, events, outcomes, an objective and synoptic world of products. These two structures are closely related to developments in the technologies of natural language and the characteristics of the linguistic systems that depend on them.

The technologies of natural language are always related to its biophysical basis and its principal channels: the phonic and the graphic. Language has been developing in its oral form throughout the roughly 220,000 years of its phylogenesis. Speech has always been a very powerful technology at the service of researching, discovering and building knowledge, experimenting and consolidating various types of operations such as harvesting, hunting, using tools and socializing. These are uses of language typical of all human beings but which occur exclusively through speech in a society of hunters and gatherers where nomadism, moving constantly from place to place, is the main feature of life, and as yet no compromising limits of the intrinsically provisional and temporary nature of oral language have emerged. In this type of society people live in small, mobile groups. The social structure is already relatively complex, but the functioning of social institutions and the sharing of cultural constructs do not require a permanent form of language and speech therefore still perfectly fulfils the purposes for which it was developed. Language and society demonstrate high levels of sustainability within a way of living based on processes - on events in which things happen and on agents who are responsible for what they do - all mediated by a shared language without exclusive forms or registers.

A radical change occurred when humans began to write, in a still very recent past that dates back to roughly 5-6000 years ago. Writing developed and spread everywhere as the result of a desire to give up a nomadic life and create some form of stable community. The development of an agro-pastoral and sedentary society, based on a constantly increasing availability of food, involves a major transformation of socio-cultural characteristics, a considerable growth in population, the division of labour, the formation of power structures, the creation, distribution and inheritance of wealth, the development of a regulated system of goods and services produced and exchanged. This type of society, characterized by stability, required the development of a form of language for a range of purposes for which speech was no longer adequate. Writing provided precisely the kind of permanence in the texts constructed as was required by such social, economic and cultural developments. Writing allows human beings and the communities of which they are members to record and make permanent experience and knowledge so that they are available and can be accessed when needed.

For tens of thousands of years human beings had produced visual images and thus switching to graphic representations of speech was relatively simple. Writing developed to perform new functions such as labelling and creating inventories of property, billing goods and services traded, collecting and registering taxes, encoding laws, recording measurements of territories, calendars and astronomical data. At the same time, by virtue of its very existence, writing began to take on some functions - religious, oratorical, literary - previously performed by the speech. Sacred texts, lyrical and epic poems begin to be transcribed and gradually composed as written texts, stories are told, ideas are developed and philosophies elaborated. Education began to take place through the written medium and so the foundations were laid of the educational systems to be developed in the following millennia. Language became increasingly an instrument of power exercised by elites through new exclusive forms and registers.

The technology of writing is certainly one of the most significant developments - perhaps the most significant of all - in the phylogenesis of natural language and of the human beings who use it. It furnished cognitive processes with an instrument for greatly expanding mental activity, for the empowerment of mind (Bruner 1985), freeing the mind from the limitations of memory and creating a potentially limitless store of increasing amounts of information which is permanent and thereby enabling recovery and reflection (re - flectere = fold, turn back to, go over again) on what has been accumulated, adding to it and at the same time further promoting the ability to do so. Moreover, in the transition from speech to writing, as well as allowing these developments at the level of reflection and action, natural language transforms himself from something that happens into something that exists, from process into product (Halliday 1989).

5. Language as speech and writing

The evolution of two channels for the reception and production of language and the growing range of uses of each one create a complementary relationship between them. An oral text is personal. It is produced in a given time and place and by specific interlocutors. In this sense, it is unique and only valid for that situation. A written text, on the other hand, is impersonal and often produced for a variety of situations and people.

Because of the very nature of its sound-based channel, speech is more immediate and is constructed temporally here and now. This permits us to produce it in real time but also creates the need to process it just as quickly. The grammar of speech is a grammar of process characterized by the production and comprehension not of sentences but of units of information that correspond to tone units. The speaker elaborates what s/he wants to say and how to say it at the same time. Often the interlocutor is present or able to interact and thus the speed, duration, turn taking and meaning constructed are negotiated together. Many paralinguistic and extra-linguistic elements, such as intonation, rhythm, speed, volume of voice, the use of pauses, proxemics, gestures and expressions on the face of the speaker, are important, or even decisive, for the communication that takes place.

Speech is also more concrete and dynamic, based on a narrative way of telling a reality made up of people, actions and outcomes, that is, of processes. Speech tends to rely on parataxis, coordinating units of information in a flexible manner. It may seem messy, imprecise, even vague. There is more omission, but also of repetition, of elements and frequent use of routines and formulae.

On the other hand, the graphic channel renders a written text a static object organized in space. Writing is more abstract and synoptic. The abstraction arises from its

symbolic representation of sounds. The interlocutor, or the imagined interlocutors, are absent. Therefore, the meaning must be constructed exclusively through the resources of the lexico-grammatical resources of the language system. Features such as spacing and punctuation cannot express as much the great variety of paralinguistic and extra-linguistic features of speech. This implies a greater textual density and a possible consequent difficulty of understanding. Rather than the narrative mode typical of speech and experience as process, the written text tends to favour a paradigmatic mode of representing a world of phenomena, facts, knowledge, products (Bruner 1985),. It projects a synoptic perspective on a reality that it represents as object and reformulates lived experience as a series of linguistic elements and steps frequently based on hypotaxis.

Recent decades have seen the emergence of a new example of a very significant factor for the phylogenesis of language. The innovation of digital texts has already had, and will certainly continue to have, a very powerful effect on the technology of natural language and thus on its overall evolution, perhaps by changing totally or substantially lessening many of the differences between the spoken and the written. Digital text is much more immediate, malleable and flexible than the written text on paper. It speeds up the technological processes and in both the reception and the production is much closer to the real time of speech. Both the reader who interacts with the text and the writer who produces it can skim, modify, edit and reproduce parts of the text with great ease. People can participate in virtual communities and become much more interactive than writing has hitherto permitted. It is possible to create more complex multimedia and multilingual texts (with a variety of types of language and examples of single languages) and generate new types of text.

6. Language as verbal and nominal representation

The development of two complementary and alternative ways of representing reality - as a process and as a product - present in the two main technologies of natural language - is also manifest through the two main categories of words in Indo-European languages, on the one hand, verbs and adverbs, and on the other, nouns and adjectives. The first category was created as a set of words related to actions and events, and develops at increasing levels of diversification and increasing complexity, while still maintaining the essential character of something happening and therefore the world as process. The second category came into being as a set of words directly referring to tangible things such as objects and tools. At a later point, however, appears a tendency toward the reification of phenomena, concepts and ideas. To the concrete noun is added the abstract noun through nominalization.

Verbal language is, however, a priori, both at the phylogenetic and ontogenetic levels. Children are born and grow up spontaneously perceiving and verbalizing a world based on what happens, but even adults, when they interact in an everyday and spontaneous way choose a verbal language. Without Kineo, and also repeated examples of that event, there can be no kinesis. The switch to nominal language excludes the experiential information, the prior processes of signification are taken for granted, attention is focused on the textual information and the lexical density of the text increases.

It is no accident that nominalization emerges in Ancient Greek, a language that has exerted a major influence in the development of Western thought. It has a very precise reflexive function, because it creates a synoptic view of reality represented in the sense that it encompasses and synthesizes inside words a kind of meaning that cannot be conveyed through verbalization. The noun

describes the product, wholeness, permanence, fact, objective knowledge, while the verb describes the process, something unfinished and temporary, subjective and as yet not elevated to the same status.

A comparison between Greek and Latin reveals a difference of great importance for the phylogenesis of all linguistic systems in Europe, together with the thought and the knowledge building processes dependent on them, the disciplines that evolve as a consequence and thus most of the intended learning processes and outcomes of education in the Western world. Ancient Greek manifests a widespread use of nouns with articles, the nominalization characteristic of abstract thought, while in Latin the article is absent and consequently thought is expressed in a more concrete and verbal mode. While the Greek philosopher elaborated abstract concepts such good and evil, Latin describes what is good and what is bad. The subsequent evolution of all modern European languages demonstrates specific ways in which verbal and nominal language intersect and the same development of the relationship between both is manifested in the ontogenesis of every learner and user of language.

The development of nominal language has had a very clear function in the evolution of the idea of the existence of an objective reality, typical of science in the western world until the twentieth century and still dominant. Scientific texts that reflect this vision tend, for example, to refer to phenomena like thermal excursion or to knowledge based on experimental evidence, while a vision based on lived experience, much more accessible and understandable to most people, would talk of temperatures that rise and fall a lot or scientists who have carried out experiments and found that … , i.e., in everyday, verbal language which is concrete and subjective. In nominal language there is no longer the agent, the action or the specific outcome. Everything is rendered an abstraction through the use of an objective language far from the reality of everyday experience.

7. Language as nominalisation and lexical density

Nominalization is by no means limited to scientific texts. Over time it has become a feature of most sources of dissemination of information, also in the form of titles, captions and articles typical of journalism. Consider the following example:

Climate change will displace hundreds of millions of people by the end of this century, increasing the risk of violent conflict and wiping trillions of dollars off the global economy, a forthcoming UN report will warn.

The second of three publications by the UN's Intergovernmental Panel on Climate Change, due to be made public at the end of this month, is the most comprehensive investigation into the impact of climate change ever undertaken. A draft of the final version seen by The Independent says the warming climate will place the world under enormous strain, forcing mass migration, especially in Asia, and increasing the risk of violent conflict.

Based on thousands of peer-reviewed studies and put together by hundreds of respected scientists, the report predicts that climate change will reduce median crop yields by 2 per cent per decade for the rest of the century – at a time of rapidly growing demand for food. This will in turn push up malnutrition in children by about a fifth, it predicts. (Independent, 2014)

A text like this can be analysed from a number of different perspectives, including those of the index of lexical density and the index of nominalisation. The index of lexical density is the calculation of the proportion of lexical words - the nouns, verbs, adjectives and adverbs that express meaning - compared to grammatical words - non-lexical

adverbs, pronouns, prepositions and conjunctions - that indicate syntactic relationships between lexical items. In general, in a written text there are at least twice as many lexical words as grammatical. The index of lexical density is thus 0.66 or more. In everyday speech, the same index typically stands around 0.3-0.4. The written text has a kind of density that renders its understanding a question of adapting ones mental schemata to an accepted praxis within the scientific disciplines involved and to the ways of reasoning and expression accepted by the culture that produces it.

Subsequently, taking into account only the lexical words, we can calculate the index of nominalisation in terms of the proportion of nominal words - nouns and adjectives compared to verbal words - verbs and lexical adverbs. In the above example, we constantly find values similar to those for the lexical density index, whereas, once again, in everyday speech they are much lower. What emerges above all else is a vision based on repeated abstractions such as climate change, violent conflict, mass migration, median crop yields and malnutrition.

In each of these extracts, phenomena are represented as being apparently objective or definitive, rather than as contingent events that depend on circumstances and agencies, while human beings as agents in the world are completely absent. The phenomena themselves are the abstract agents held responsible for the consequences suffered by human beings (Climate change will displace hundreds of millions of people ….) rather than the results of the agency of human beings themselves. Nominal language constantly de-personalizes events, de-democratizes processes, de-responsabilizing and consequently disempowering the people involved. Every time we use, for example, the word desertification, we eliminate people, their actions and the consequences of these actions at the level of those who suffer and try to survive in such conditions, those who act to cause or exacerbate the problem, those who perhaps would or could act to do something to change something. Moreover, it is absolutely paradoxical that the spread of nominal language so intimately correlated with the growth of objective knowledge and the idea of scientific progress, risks causing us to lose sight of the very humanity that developed natural language and can easily find itself in danger of being cancelled by that same language.

8. Language and metaphor

Halliday (1985) considers the use of nominal language as a kind of grammatical metaphor. A process (for example, to see) is transformed into a product (sight). In other words, a grammatical class of word, a noun, substitutes another one, a verb. This is but one example of another feature of natural language that certainly dates back over a number of millennia and perhaps to its very outset. The use of the signifiers of a language evolves on two intersecting planes: those of the literal use and the figurative or metaphorical use. If we say, for example, essential, this literally expresses the idea of the essence or vital part of something. In everyday language, however, the number of times that essential is used in the literal sense will tend to be very limited. Much more common is the figurative use expressing the sense of necessary or indispensible. The figurative sense obviously derives directly from the literal one, but in everyday language use we often tend to lose sight of the relationship and risk not seeing that we are using a figurative or metaphoric meaning both in our reflection and our action. Similarly, succeed literally expresses the idea of following or coming after something, while the figurative or metaphorical meaning expresses the idea of overcoming obstacles or winning a challenge, something positive in no way necessarily present in the literal use.

Potentially every word can be used at the literal or the figurative or metaphorical level,

and for the vast majority of words this is what actually happens. In every sphere of use of natural language they both intersect, often without our realizing it. A plate may be hot, but so may a debate. We can taste the food on a plate or taste defeat and decide what to do as a consequence. A hole can be deep and so can thought. As I write, I too constantly use the a mixture of literal and figurative language. All our concepts - spontaneous and everyday or elaborated and scientific - are constructed based on the interplay between these two levels or types of language. Very often we are unaware of how everyday concepts are based on a prevalent use of figurative language we risk believing is literal or "the way things are".

Similarly, the construction of scientific concepts may also require a more conscious use of literal language and an understanding of its relationship with the figurative. A historical reconstruction is literally a process of putting together again the pieces of a structure, or is it a way of proceeding, a methodology of research and discovery? What is the relationship between a rational number and a rational person? Does a rational number have the same "good sense" as a rational person ? Is an irrational number as unpredictable or unreliable as an irrational person?

The examples are endless. The interplay between literal language and figurative language is central to the relationship between language and cognition, living and learning (Lakoff and Johnson, 2003) and the relationship between science and metaphor is the subject of ongoing debate (Brown, 2003). What is crucial is being able to detect differences and complementarities and to reflect and act consciously with both types of languages. As regards the relationship between language and sustainability, the major risk is that of believing literally what is expressed metaphorically or understanding in everyday, figurative terms what is intended in literal terms.

9. Conclusions

Language is "both the constricting horizon and the energising atmosphere within and by which all human activity must be understood" (Said 1975, p.284). This paper has been an attempt to trace some of these constrictions and energies in relation to sustainability within a dynamic and evolutionary perspective. The emphasis has been on how the principal biophysical properties of language and the technologies they give rise to - from sound waves to speech and from light waves to writing - are inextricably interwoven with our ways of being and doing, of reflecting and acting, and on how the sustainability of human life depends on this.

In their paper "Tipping Toward Sustainability: Emerging Pathways of Transformation", Westley et al. ask the question:

Can we innovate sufficiently rapidly and with sufficient intelligence to transform our system out of a destructive pathway and into one that leads to long-term social and ecological resilience?

and continue:

We define resilience as ''the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to still retain essentially the same function, structure, identity, and feedbacks'' (Walker et al. 2004; Folke et al. 2010) and transformability as the capacity to create untried beginnings from which to evolve a fundamentally new way of living when existing ecological, economic, and social conditions make the current system untenable (Walker et al. 2004; Chapin et al. 2010; Folke et al. 2010, 2011). We argue that a complex system perspective that recognizes the dynamic links between the social, ecological, and technological subsystems is needed to understand what we see as the paradox of innovation: innovation is both a contributing cause for our current

unsustainable trajectory and our hope for tipping in new more resilient directions. (Westley et al. 2011)

If sustainability depends on the dynamic interaction between systems that evolve, then it is essential to recognise that social, ecological and technological systems, like all forms and manifestations of life, depend on language for their being and doing as systems and consequently for their resilience and transformability. At the same time, language itself, in all its types and varieties, is a system which has always shown the necessary capacity to absorb perturbations and self-reorganise while changing and transforming itself into new ways of being and doing, reflecting and acting. The challenge that faces us is that of building and maintaining awareness of its role, of using language with the intelligence required to ensure that its and humanity's trajectories remain sustainable.

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Affective Ecology for Sustainability

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Abstract. Affective Ecology is the branch of ecology that deals with our connecting with Nature. Its epistemological statute is interdisciplinary and founded upon two scientific hypotheses: the biophilia hypothesis and the theory of multiple intelligences. Biophilia can be defined as a set of innate learning rules that have evolved in the human species to enable individuals to benefit from a wholesome relationship with Nature; while naturalist intelligence is the ability to recognise living organisms and natural objects, to take care of them and to interact with them in subtle ways. Biophilia and naturalist intelligence can be considered as the two poles of an educational journey about the environment. Biophilia represents the mental energy that nourishes our relationship with Nature; whilst naturalist intelligence is the full realisation of our inborn biophilic potential to connect to the natural world, to pay it attention, to care and to empathise with it. Starting from this theoretical framework, we have evolved a programme of experimental research that has enabled us to make a number of observations regarding the fascination that Nature exercises upon our psyche. Fascination may indeed account for the affective bond that establishes between human beings and Nature in some circumstances and that may also provide a powerful emotive lever favouring of an ethic of sustainability.
Keywords: Affective ecology, active silence, biophilia, fascination, naturalist intelligence.

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***Perspective**: Educational vision*

***Fields**: Earth life support systems*

***Issues**: Educational processes – Ecological Education*

The protection of the environment and the search for new eco-sustainable social arrangements cannot ignore from the "type of creatures we are and what we must become in order to survive" (Caldwell, 1995, p. 10). Simply possessing knowledge of Nature is not sufficient to know how to appreciate it, in the same way that it is not sufficient to know that smoking is bad for your health in order to make yourself stop smoking.

We need to go to the root cause of human sentiments, emotions and the instincts that govern the way that we act in relation to the environment. Gaining a deep understanding of Nature is certainly a necessary step, but appreciating Nature – and appreciating ourselves as part of it – involves the human emotional sphere. It is for this reason that alongside Cognitive Ecology, the term we used to describe the science of ecology, its epistemological statute and theory, Affective Ecology also needs be present, the branch of ecology that educates people about Nature by bringing them into direct contact with it; indeed, only by immersing oneself within Nature can the energies be rediscovered that can only be restored by establishing the right kind of connection with Nature (Barbiero, 2011). Cognitive Ecology and Affective Ecology can act in synergy within one another: knowledge may stimulate a more intimate rapport with Nature and a more intimate affective experience of Nature may stimulate a greater desire for knowledge.

1. A theoretical framework for affective ecology

The construction of Affective Ecology requires a solid theoretical framework that regards the phylogenetic and ontogenetic development of the human psyche, a framework into which is it possible to insert specific research hypotheses relative to the Man-Nature relationship. A reliable theoretical framework has started to take form, the origins of which can be traced back to two fundamental discoveries, which curiously were both published in 1984:

a) the human intelligence is not a monolithic construct, but it can instead be divided into different manifestations (Gardner, 1984), one of which can be defined as naturalist intelligence (Gardner, 1999);

b) a set of innate learning rules exist that bind us to Nature and govern our relationship with it: this set of rules manifests as a form of biophilia (Wilson, 1984).

Biophilia, on the one hand, and naturalist intelligence, on the other, constitute the two cornerstones founding research in the field of Affective Ecology (Barbiero, 2011).

1.1 Naturalist Intelligence

Until the mid 1980's a single and almost unanimously shared definition of intelligence existed that was based on three concepts: 1) an individual is born with a certain intelligence, defined as the "intelligence potential"; 2) the intelligence potential is, for the most part, genetically inherited and it is therefore difficult to modify; 3) certain specialised psychologists (psychometrists) are able to recognise this potential by means of a test composed of short-answer questions, and in this way establish the intelligence quotient (IQ) of a person.

This definition of intelligence has various limitations and has been heavily criticised by a new generation of psychologists. Robert Sternberg, for example, whilst at Yale University, discovered that the human intelligence is highly structured and that it manifests itself by means of three principal ways of interpreting reality: analytical intelligence, creative intelligence and practical intelligence (Sternberg, 1985). At roughly the same time, Howard Gardner, a psychologist at Harvard University, reported being able to distinguish at least seven different manifestations of intelligence

(Gardner, 1984). Thus the dogma of intelligence as a uni-polar manifestation in relation to reality no longer held. Despite this, an orthodox school of thought continues to exist today that considers intelligence in the traditional way, but this outlook must now face and consider the experimental data gathered by researchers with others aspirations; scientists who retain that intelligence possesses multiple phenomenology.

Gardner's classification, compared to that of Sternberg and to other similar formulations, has the advantage that it provides a very powerful tool for pedagogy, because it makes use of well-defined distinctions between the different manifestations of intelligence, but it does not separate them. In this model, each manifestation is connected to all others, and since situations commonly occur that require the active interaction of multiple forms of intelligence, the hypothesis that the different manifestations of intelligence operate as an inter-dependent network is born. Gardner groups the different manifestations of intelligence into three key categories: the symbol analyst intelligences, which include linguistic-verbal intelligence (I) and logical-mathematical intelligence (II), which also represent the forms of intelligence best indexed by traditional IQ tests; the intelligences linked to relationships, which include inter-personal intelligence (III) and intra-personal intelligence (IV); and non-canonical intelligences, which include musical intelligence (V), spatial intelligence (VI) and bodily-kinesthetic intelligence (VII). In 1999, Gardner added a further form of intelligence to this last group, the most elusive of all: naturalist intelligence (VIII).

In order to identify each particular form of intelligence, Gardner recognised six general criteria. The first criterion is clinical case studies, where cerebral lesions allowed the loss of specific faculties to be identified. If a preferential cerebral area exists where a certain predisposition tends to be developed and if damage to that specific area results in compromised abilities, then this can be considered as evidence for a neurological basis of that particular manifestation of intelligence. The second criterion is the existence of child prodigies, children that demonstrate particular ability in one of the manifestations of intelligence. It may be that a child is very talented with regard to one manifestation, yet absolutely normal or even below average in the other manifestations. The third criterion regards the capacity to activate distinctive operations (for example, to play an instrument) and the possibility that this operation can be encoded in a symbolic system, for example the notes on a music stave. The fourth criterion is ontogenetic and is connected to the possibility of identifying a psychological and pedagogical course of development that permits the production of individual expertise. The fifth criterion, on the other hand, is phylogenetic: the possibility that evolution might be able to create the background that determines expertise; in this case, expertise would result from a specific and efficacious adaptation that enhances chances of survival. Finally, the sixth criterion is the existence of experimental and psychometric data that permit a determined ability to be detected.

For a long time, naturalist intelligence eluded the criteria adopted by Gardner because it shares a neurological-functional basis with other constructs (for example, later on we will address the importance of attention and empathy) and above all because the distinctive functions of naturalist intelligence cannot be encoded into a rigid symbolic system. Nevertheless, in the end Gardner came to a definition of naturalist intelligence: "Naturalist intelligence processes information related to distinguishing among natural and manmade objects, which is evolutionarily derived from the hominid capacity to recognize, group, and label distinctions among natural phenomena" (Gardner, 2006). This form of intelligence requires developed sensory skills for the perception of objects,

the capacity of logical reasoning that permits such objects to be distinguished and classified on the basis of certain logical parameters, a particular emotional sensitivity towards all that is "natural", and finally a certain existential understanding that allows us to link all these qualities together.

If naturalist intelligence is not only the ability to discern living organisms and natural objects, but it is also the desire/ability to take care and interact with them on a more subtle level, we must ask ourselves what pedagogic strategy is the most adequate to develop this potential to the maximum. As a university lecturer, I have often asked myself what type of naturalists, teachers and professionals am I helping to train? Our students are almost always endowed with good logical-mathematical intelligence, and sometimes they are also able in linguistic-verbal intelligence. But what about their naturalist intelligence? Paradoxically, even in the curricula of courses directed at the natural sciences, it does not seem that naturalist intelligence is deemed to be important.

1.2 Biophilia

Our connection with Nature could run much deeper and be more vital than we suspect. E. O. Wilson, Ecologist and Entomologist at Harvard University, tells about an experience he had in Bernardshop, a small village on the outskirts of a tropical forest in Surinam. Out of the blue, Wilson had a vision in which he "saw" the living creatures that inhabit the village as luminous dots against a black background (Wilson, 1984). An intimate and arcane communion (common union) connects us to living creatures and compels us to love and take care of them. This connection seems to be present in all human beings and has been named biophilia (Wilson, 1984). However, biophilia is not comprised of just a single instinct. Like all complex behaviours that characterise the human species, biophilia is characterised by a set of learning rules. The sentiments and the behaviours that emerge from these learning rules traverse a wide spectrum of different and at times even contradictory emotions: from attraction to aversion, from a sense of peace to one of fear and anxiety (Wilson, 1993). Thus is it not easy to define this human instinct with precision. Nevertheless, many lines of empirical evidence are accumulating that support its existence, such that the biophilia hypothesis "can provide a unifying framework across numerous disciplines to investigate the human relationship with Nature" (Kahn, 1999); it can therefore be justifiably put forward as a plausible evolutionary explanation for a series of innate human behaviours which mould our relationship with the natural world.

But what happens when biophilia is not adequately stimulated? The human functions that regulate our relationship with the natural world can persist, generation after generation, atrophied or manipulated according to the needs of the new environments into which technology has catapulted humanity (Wilson, 1993). "Even apparently remote capacities – such as recognizing automobiles from the sounds of the engines, or detecting novel patterns in a scientific laboratory, or discerning artistic styles – may exploit mechanisms that originally evolved because of their efficacy in distinguishing between, say, toxic and nontoxic ivies, snakes, or berries (Gardner, 1999, p. 50). In modern human culture, biophilia seems to assume the characteristics of an ex-adaptation, a characteristic that was evolved to fulfil a certain purpose and that, with time, has become useful for a different purpose. However, since biophilia is the source of the mental energies that connect us with Nature, we should revert to its primary evolutionary adaptation: the development of a healthy relationship with Nature. The more that we are able to propose and develop educational programmes that stimulate the biophilic instinct, the more effective Affective Ecology will become in helping children, adolescents and adults understand how a

close relationship with Nature is essential for the harmonic development of one's personality.

2. The connection between biophilia and naturalist intelligence

Biophilia and naturalist intelligence can be considered as the two poles of an educational journey. Biophilia is the more ancient of the two; it is the mental energy that nourishes our relationship with the natural world. Naturalist intelligence is the full realisation of our inherent potential to attend, to care for and to empathise with the natural world. Biophilia represents the capacity to relate to the natural world while naturalist intelligence is the capacity to use this psycho-biological potential to create relationships able to resolve the problems that our presence poses upon our natural environment.

In this context, the learning rules that constitute the biophilic construct (that are apparently innate and universal) could constitute the prerequisites necessary for developing naturalist intelligence. Each specific competence is developed starting from precise requirements that are in some way inherent to human nature. For example, analytical intelligences (linguistic-verbal and logical-mathematical) require some prerequisites, like the capacity to become spatially orientated (for example, to distinguish left from right, up from down, and so on), the capacity to categorise in a logical manner (for example, to group objects of the same form, colour, and so on) and the capacity to recognise and distinguish symbols (for example, letters and numbers). The prerequisites arise naturally in all children of a given age. Indeed, no great effort needs to be made to teach these capacities to children. At the most, these elements of development may need to be stimulated in some children who for some reason are delayed in acquiring such skills. However, it is absolutely counterproductive to force them.

We can also observe how a child's relationship with Nature changes with time. From a very young age, between six months and two years of age, children are spontaneously attracted to living forms that move, according to a sort of equation that states " what moves = alive". At around two-three years, an attraction towards the young of many vertebrates develops, while a fear and aversion to spiders, snakes, scorpions and insects, like wasps, develops. Between three and six years of age, children start to demonstrate an interest towards certain types of plant life, especially flowers, fruit and seeds. From the point of view of developmental psychology, these stages are easy to recognise in all children: they correspond to the preoperatory phases (Piaget, 1967) and may be the universal biological basis of biophilia. It therefore stands to reason that these competences are only correctly acquired when the child can come into contact with the right stimuli. Unfortunate events or forcing contact can bring about aversions that sometimes result in biophobias. Alternatively, the absence of stimuli may conceal these potentials and the mental energies that accompany them, as we have seen, are dispersed or used for purposes very different to those for which they were evolved. As this possibility is widespread within our society, it should not be excluded that when the role of biophilia is assigned a lower level of importance than was evolutionarily intended that this can indirectly provoke mental disorders (Louv, 2005; Charles, 2009). Thus it becomes fundamental for the mental integrity of the child that contact with Nature ensues and accompanies a child along his/her entire developmental journey.

Around six years of age, children start to acquire operatory skills that allow them to execute logical thought processes and to engage them with concrete actions and to the concept of time and space. If, until six years of age, the primary learning channel in children is fundamentally of an affective nature, from

this age onwards (and coinciding with the start of formal school education) children also start to develop a cognitive interest for the natural world; they start to become aware of the emotional states of domestic animals, to show an interest for smaller animals, like ants and beetles, and to perceive the plant world as being alive. Between nine and twelve years of age, cognitive development allows them to develop their own interest in nature that continues to expand until it also to includes the non-living world of rocks, water and the natural landscape; while from the start of adolescence, youngsters start to mature ecological awareness, which they express in the form of wanting to care for and conserve the well-being of living species and natural environments. In developmental psychology, this phase appears to be tightly correlated to the development of empathy (LoCoco, 1998).

With this theoretical background, we can now start to formulate some initial ideas about the education of naturalist intelligence. During early childhood (2-6 years) it is important that the biophilic learning rules have the opportunity to be established through adequate sensory-motor and preoperatory experiences of Nature. More cognitive stimuli can be introduced around six years of age, the age at which children start to develop their individuality and are able to open up to the world "beyond the self". The educational process should be directed at reinforcing the biophilic instinct in the child. Progressively, the intellectual interest of the child can be stimulated with an environmental educational programme appropriate for the child's age, trying to maintain, as much as possible, the affective and cognitive components of ecology in balance (Barbiero, 2007).

3. Experimental research

Starting from this theoretical setting – that organises in an interdisciplinary way the empirical experiments of environmental education, the discovery of biophilia and naturalist intelligence, and knowledge about developmental psychology – it has been possible to direct experimental research towards more focussed objectives.

In collaboration with Rita Berto, an environmental psychologist at the University of Padua, we have started to develop an experimental plan, starting from a more precise formulation of the biophilia hypothesis: "the innate tendency to focus upon life and lifelike forms, and in some instances to affiliate with them emotionally" (Wilson, 2002, p. 134). Starting from this definition, we have attempted to isolate and individually analyse the two fundamental constructs of biophilia, attention and empathy, concentrating initially on the former.

In psychology, attention is defined "as the process through which some elements of sensory information are encoded and elaborated whilst other aspects of reality are neglected" (Valenza, 2002). Although our senses continuously receive an enormous mass of stimuli and information originating from both the external and internal environment, only a small part is consciously perceived and thus attracts our attention. Specifically, directed attention is the capacity to activate a state of alertness or to consciously direct ones attention towards the object or process that is of interest. It is a phylogenetically adaptive form of attention and it has evolved in man in response to basic survival needs, developing characteristic neural network configurations corresponding to the different modalities with which it manifests.

However, directed attention cannot be sustained for long periods of time because it requires very large amounts of mental energy and thus a very intense metabolic expenditure. From the evolutionary point of view, the development of processes that regenerate directed attention without jeopardising an individual's capacity to react to stimuli would be extremely useful. Rachel and Stephen Kaplan, environmental psychologists and husband-and-wife research team at the University of Michigan, have studied in great depth the processes that regenerate directed attention and have come to the conclusion that there at least two forms of experience that are able to significantly stimulate the regeneration of directed attention following mental exertion: the wilderness, immersion into an environment perceived as being totally natural (Kaplan, 1995) and mindfulness, a meditation practice that develops the capacity to self-observe and become self-aware (Kaplan, 2001).

These observations have had very important implications for our research because they have allowed us to formulate the fascination hypothesis. According to the Attention Restoration Theory (ART) of Rachel and Stephen Kaplan, fascination is one of the four properties that an environment must possess in order to be regenerative for directed attention; the other properties are: the sensation of being away from ones everyday setting; compatibility of the environment with one's own purposes or inclinations; and the perception that a certain environment has its own consistency within which we can harmoniously insert our own purposes. But compared to the other three properties, fascination is the only one that requires that the subject behaves in a truly passive manner, simply present and attending without expectation. If this is true, it means that the environment, i.e. Nature, is not only a collection of objects, as might a library also be for example, but it has its own precise evocative power within our psyche. It is an active subject in relation to the human observer. It is thus Nature itself that fascinates the human being. It is the human being that becomes fascinated by Nature and that becomes regenerated by it. Indeed, an extraordinary point of convergence can be noted in the cultures of the many and vastly different human populations that have inhabited the Earth that is the maternal bond that connects man to Nature.

The Nature that embraces, that protects and that regenerates is interpreted as a Goddess, with countless epiphanies that have left their traces in the myths and the legends: the Egyptian Iside, the Greek Demetra, the Jewish Sekina, the Celtic Eire, the Latin Tellus Mater, the Scandinavian Freya, the Christian Myriam, and many others. If one wanted to give a name to this regenerative Goddess, perhaps the most appropriate name today would be Gaia, the goddess of Greek cosmogony that the scientific community has borrowed in order to name the fine layer of life that covers the planet, that influences in particular the chemistry of the atmosphere and the temperature of its surfaces (Lovelock, 1979; Volk, 1998). The scientific community sees Gaia as: a golden crib boasting a perfect equilibrium between its chemical and physical elements that permits humanity to survive. But Gaia is also an archetype. Thus might it also be possible that this chemical-physical connection that we have with Gaia can also be perceived on a deeper mental level?

3.1 The Active Silence programme (2006-2009)

One possible interpretation of Wilson's biophilia hypothesis says that Nature is able to trigger a process that activates involuntary attention, which in turn allows directed attention to regenerate itself. A fundamental characteristic of involuntary attention, and of fascination, is the absence of effort. In relation to the natural world, fascination might be the equivalent of involuntary attention: i.e. it is Nature that allures the human being, who

only needs to absorb in a passive manner its regenerative effect upon directed attention. The capacity to become responsive to the allure of Nature may be another of the innate learning rules that characterise biophilia, since shortening the times required to recuperate directed attention might represent an evolutionary advantage. In other words, a genetic predisposition to let oneself be fascinated by Nature and therefore to recuperate quickly from mental fatigue could have conferred to our ancestors the capacity to sustain activities that require directed attention for longer periods of time.

If a phylogenetically determined predisposition to fascination indeed exists, it would constitute an innate mental faculty, and as such it could be consciously cultivated and transformed into a permanent mental state of naturalist intelligence. Nature exerts its fascinations upon us and we can respond by giving it our open attention, without prejudice, in the here and now. In its purest form, open attention shares with fascination the trait of being receptive and effortless, but it can be differentiated by the element of awareness.

With the help of Dinajara Doju Freire, a Zen Buddhist monk, we have perfected an experimental protocol where fascination is exercised through the use of exercises derived from mindfulness meditation techniques. Freire had already experimented and obtained success using these techniques in various primary schools, where the children were exposed to a series of games involving simple self-awareness techniques (Freire, 2007). We have since called this protocol "Active Silence Training" (AST); it uses silent observation, as an instrument to develop self and body awareness, and play, as a way of stimulating fascination and the activation of involuntary attention. The study involved over a hundred children attending a primary school in Aosta (Italy), whom we followed over the course of four years. The objective of the study was to test the effect of Active Silence on certain physiological parameters – including heart rate and arterial blood pressure – and above all its effect on the regeneration of directed attention. The results of this initial phase of the study were very encouraging: the experimental group demonstrated a significant reduction in heart rate, in the absence of variations in arterial blood pressure; moreover the children practicing AST were able to complete a test of sustained directed attention significantly faster than those belonging to the control group (Barbiero, 2014). Not only was it encouraging that the children voluntarily took part in games involving Active Silence Training, but the fact that the exercises were effective in regenerating directed attention was a particularly promising result.

Since spontaneous play is in itself a source of regeneration of a child's attention and since the AST protocol also comprised games involving silent self-awareness (Mindful Silence) and Cooperative Play, in a second study we tried to distinguish between these two components of Active Silence Training. The results of this second study revealed the mindful silence activities to produce significant improvements in the regeneration of directed attention that were longer lasting than those produced by cooperative play, which, on the other hand, induced faster improvements in the regeneration of directed attention but of shorter duration (Berto, 2014).

3.2 The Etroubles conifer wood experiment (2010-2011)

The study of Active Silence Training within the classroom provided us with an important starting point that allowed us to make the next step and propose an experimental protocol that involved bringing the children into direct contact with Nature, nominated the "The Etroubles Conifer Wood Experiment". Etroubles is a small village within the Grand Combin Mountain Community in the Aosta Valley of Italy that

presents a typical alpine landscape (to which the children taking part in the study are very familiar), with expansive meadows that alternate with conifer woods. At the time, we had just started to understand that fascination was a form of attention that did not require the exertion of conscious effort and that following a state of mental fatigue, immersing oneself within a fascinating environment would allow directed attention to rest and to regenerate itself, in accordance with Attention Restoration Theory. But would direct experience of nature prove to be as regenerative as Active Silence Training in the classroom?

To answer this question we needed to adapt the experimental protocol to assess more complex conditions that would take into account the specific state of fascination – or perhaps it is better to say enchantment (in its literal sense) – that the children would find themselves in and that would be all too easy to disrupt, or even bring to an end, when taking our measurements. After much deliberation, we decided to seek assistance from the O Thiasos theatre group from Rome, a group that is experienced in performing in natural environments. We delegated this group the task of accompanying the children whilst they immersed themselves within the wood. With the help of Alice Benessia, a gifted artistic photographer who had been working together with the O Thiasos theatre group for some time, we were able to document the experiment with photographs and by recording the children's comments.

In addition to measuring the usual physiological parameters of the children – heart rate and arterial blood pressure – and evaluating the regeneration of directed attention, we introduced two questionnaires corresponding to the Italian versions of two evaluation scales adapted for primary school children: The Perceived Restorativeness Scale (PRS/IT; Pasini, 2009) and the Connected to Nature Scale (CNS; Mayer & McPherson, 2004). The intention was that the first questionnaire would evaluate the perception of the four regenerative qualities of the environment that the children were experiencing: distance from the everyday setting (the school); fascination of the new environment (the wood); the compatibility of the environment and the freedom to do things within it (facilitated by O Thiasos); the joy of being in the environment. The second questionnaire, on the other hand, was meant to evaluate the level of connectedness that the children felt with the natural world. The CNS is an empirical tool that is widely used in research to evaluate the level of feeling emotionally connection with the natural world. It was the best tool available for making an approximate assessment of biophilia in children.

The expert performers of O Thiasos immediately fascinated the children. As soon as the children disembarked the coach in the car park, accompanied by their teachers, they started along the footpath that led to the conifer wood. Once they were within one hundred meters from the edge of the wood, the O Thiasos performers greeted the children singing – immediately creating an atmosphere that the children happily accepted to accompany them along their explorative journey through the wood and which helped them use of all their senses to grasp the vital energy of their surroundings. We made use of games, singing and story-telling to help the children become fully immersed and feel fully at ease within the environment. Surprisingly, the children responded even better than we could ever have hoped for with regard to the restorative perception of the environment, although their level of emotional connectedness with the environment did not appear to significantly alter (Berto et al., in preparation).

4. Conclusions

Only a naïve scientist would think that psychometric scales, as ingenious and complex as they may be, can justify the

complexity of any human experience, let alone the relationship of man with Nature. During our studies, we also took the opportunity to collect qualitative data and observations; subjective observations experienced at first hand that no test would be able to reveal. But even these qualitative results can only depict a part of the experience, the tip of the iceberg. Moreover, there is all that cannot be measured or detected, but that we nevertheless need to take into consideration.

A second limitation of the observations that we have made until now regards the bias of the observations themselves. All of our studies have so far concentrated on the faculty of attention. We have not yet been able to investigate empathy – the other important mental faculty (Barbiero, 2007) – in a systematic manner, neither in relation to biophilia nor naturalist intelligence. And it is easy to predict that this line of research will also be the bearer of interesting surprises. Nevertheless, we can still derive some conclusions from our series of experiments that, even in their preliminary form, provide a solid starting point for future studies.

The games involving mindful silence and those of cooperative play successfully regenerate directed attention following mental fatigue, most likely through a process involving the activation of a state of fascination (Barbiero, 2014). The games of mindful silence act more directly on the faculty of directed attention (Berto, 2014). However, cooperative play also exerts effects on the sphere of empathy. In the future, it will be interesting to study this second fundamental aspect of biophilia more specifically (Barbiero, 2009), but for the moment we must remain satisfied with the fact that the games of mindful silence and cooperative play are able to act in synergy and can be used effectively as part of "Active Silence Training".

The children found the guided exploration of a natural environment more fascinating than playtime in an artificial environment (Berto, et al., in preparation). It would be interesting to test whether mindful silence and cooperative play can enhance the ability of the children to familiarise themselves with a natural environment or whether these exercises obstruct the perception of being connected with Nature.

It is important to highlight the fact that in no study have we ever been able to modify the perception of being connected with Nature (Berto et al., in preparation). It is probable that this perception is associated with a layer that goes deeper than our relationship with Nature, than the simple perception of the power to restore attention. It is difficult for a person to feel part of a natural world to which we are continuously less and more sporadically exposed. One potential line of research could use mindful silence as a means to establish a deeper and more continued connection, as previously proposed by Kaplan (2001). A heightened awareness of oneself, of one's own body and its senses, might also help us perceive more consciously and deeply the world that surrounds us.

It stands to reason that a deeper connection with Nature can stimulate a sincere interest in all the more intellectual aspects of our relationship with ecology. As observed by Stephan Harding (2008), to establish an affective connection with the natural world brings with it the desire to know it on a deeper level, where the verb "to know" returns to its original meaning of "to love".

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Unveiling biophilia in children using active silence training: an experimental approach

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Abstract. Biophilia – the innate tendency of human beings to focus on and to affiliate with natural life emotionally – occurs spontaneously in school children. In this study we hypothesized that the development of biophilia is facilitated by an active silence training (AST). In AST silent observation is used as a means to achieve self-knowledge, while games are used as a way of evoking fascination, i.e. to help directed attention to rest and to be restored. Therefore an experimental protocol was set up with aim of assessing how effective the AST would be in restoring the attention of 120 children of a primary school in Aosta (Italy). The results show that the experimental group's performance on the attention test improved as a result of the AST, without affecting either systolic or diastolic blood pressure. Hence, AST seems to be a good way to restore children's attentional capacity.
Keywords: biophilia; active silence; direct attention; fascination.

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***Perspective**: Educational vision*

***Fields**: Earth life support systems*

***Issues**: Educational processes – Affective Ecology*

1. Biophilia

On the basis of different experimental and empirical observations, some authors claim that an intimate relationship with nature is essential for harmonious personal growth (Kellert, 1997; Kahn, 1999; Camino, 2005; Louv 2005). Indeed, the loss of contact with the natural world that is typical of the industrialised era we live in, can cause serious damage to children's mental and physical development, impoverishing their sensory capacity, making thought less effective and rendering their spirituality more barren (Vegetti Finzi, 2006). However, it would seem that, during our species' long evolutional path, we have acquired an instinct that facilitates the recovery of psychophysical balance simply through contact with the natural world. This instinct – or, more specifically, this set of phylogenetically adaptive rules of learning – is termed biophilia (Wilson, 1984; 1993). Biophilia was recently described as "the innate tendency to focus upon life and lifelike forms, and in some instances to affiliate with them emotionally" (Wilson, 2002, p. 134). Biophilia would appear to be present even in school children and could constitute a fundamental resource for the development of a profound ecological culture.

According to Edward O. Wilson, *attention*, i.e. the ability to be *fascinated* by natural stimuli, together with *empathy*, i.e. the ability to affiliate emotionally with various life forms, or, more specifically, to participate in their condition in a differentiated manner (Silvia Bonino, personal communication), are the two most important mental faculties characterising the human instinct to love and care for nature and should, therefore, be nurtured.

Attention concerns a variety of psychological phenomena. In particular, *direct* attention can be defined, in short, as the ability to inhibit or block distractions (competing stimuli) when performing an activity (Kaplan, 1995). Direct or *voluntary* attention (James, 1892) is employed when something is not, in itself, interesting/*fascinating*, but must be taken into consideration because it is necessary. William James (1892) stressed the central role of effort in this type of attention that, if subject to intense, prolonged requests, becomes saturated, leading to *mental fatigue*. Mental fatigue presents itself with a concomitant increase in distractability, tension and the presence of hostile and impulsive behaviour. Attentive efficiency can be recovered after a period of rest and regeneration, obtained through the activation of *involuntary* attention (James, 1892), or *fascination*, i.e. the type of attention that, according to Attention Restoration Theory (ART), does not require any effort on our part and is fatigue-resistant (Kaplan, 1995). Fascination can be derived from a process, such as playing, listening-telling stories, resolving problems, etc., or in the presence of people, animals, vegetation, etc. Exposure to fascinating stimuli allows direct attention to rest and regenerate after a state of mental fatigue (Berto, 2005).

Empathy, considered herein as the ability to feel, understand and share the thoughts and emotions of another person, evolves together with the child's mental development. Around the age of 3 or 4 years, children experience the first forms of empathy, that accompany them throughout childhood, through participatory sharing. During adolescence, with the development of an increasingly sophisticated cognitive ability, the ability to feel and share the thoughts and feelings of others is extended to the understanding of whole social groups (empathy for general conditions; Bonino, 1998). In a translated form, this ability is also extended to participating in the "emotions" and expressivity of animals and the sacred nature of plant life (Hill, 2000) and certain natural places (Naess, 1976; Snyder, 1990). Empathy is therefore transformed into *differentiated participation* in the various forms of life and natural objects (Barbiero, 2007).

Our hypothesis is that *fascination*, or involuntary attention, and *differentiated participation* can be favoured and sustained by mindfulness meditation (Segal, 2002; Kabat Zinn, 2005). In its basic form, mindfulness is an

active silence practice that offers the chance to experience moments of suspension from the many audio and visual stimuli and to establish a relationship with one's inner space. These were the premises on which we developed an experimental approach to teaching for primary school children aimed at stimulating biophilia, i.e. the child's inborn tendency to concentrate attention on forms of life and their surroundings, through the regeneration of attention and development of empathy. In this exploratory study, we present the trial protocol used to assess the efficacy of active silence training in the regeneration of direct attention in children.

2. A teaching approach for revealing biophilia in primary school children

2.1 Training attention: the "Room for silence" teaching module.

"Room for silence" is a teaching module that aims to introduce children and teachers into the dimension of silence through a specific type of *Active Silence Training* (AST; Freire, 2007). The module consists of six meetings held at school, with the following distribution:

- two preliminary meetings with class teachers;
- three meetings with the children;
- a final meeting with the teachers and the children's parents.

We will now take a more detailed look at these meetings.

2.1.1 Preliminary meetings with the teachers: "The practice of active silence in primary school teaching"

Teachers are invited to share a space in order to sit in silence and perform a creative activity - bodily expression, drawing or creative writing - guided by an instructor, a person considered to be an expert in mindfulness meditation (D.D.F., in our case), as well as a space in which to discuss the difficulties and the positive aspects that children and teachers could encounter when practising active silence. For the medium- and long-term success of the programme, the instructor gives the teachers a *specific* active silence training, in order to allow them to continue the activity unaided, by experimenting it on themselves and helping the children to achieve an aware and relaxed presence through a silent and conscious sitting posture that focuses on their breathing.

2.1.2 Meetings with the children

The preparatory teachers' meetings are followed by three meetings with the children. In the first meeting, titled "Breathing in silence", the children learn how to practice active silence, described in section 2.1.2.1; in the second "Learning from animals", they learn to develop the practice of active silence, described in section 2.1.2.2, and lastly, in the third session "Slow and gentle", they are introduced to the topic of "mental presence" or "tranquil mindful attitude", by becoming aware of their own breathing, as described in section 2.1.2.3. The teaching of active silence is performed compatibly with the children's times and needs.

2.1.2.1 First meeting: "Breathing in silence"

During the first meeting, the children are taught to simply listen to their breathing by trying to find the best posture for being able to hear it. Teachers and pupils learn to share a period of silence, even of just a few minutes, in a natural way, without trying to achieve any particular result. Indeed, this silence is not imposed on the children as usually happens at school, rather it is an experience shared in silence. By playing non-verbal games in which they perform breathing exercises in certain postures together, the teachers and children learn to release tension and the environment, intended as the place in which the active silence is practised, therefore becomes more tranquil and less demanding. This is, perhaps, one of the most moving parts of the whole experience, when adults and children feel the collective, rather than individual ability to grasp and share the

inner emotional states of the other human beings present.

2.1.2.2. Second meeting: "Learning from animals"

The second meeting, which takes place about a week after the first, involves an acting exercise. The children are invited to take part in a game in which they imitate animals. Each child is free to choose an animal and, in silence, to imitate its postures and gestures: looking for food and water, finding or building shelter, looking after itself and its young, resting, waking up, listening to the calls of other animals and so on. It is an elementary emotive contagion experience. Through motor mimicry, children tend to produce an emotive state similar to that which according to their own imagination is (or should be) that of the animal mimicked in that given context. During the exercise, the children are also asked to "listen" with their whole body: they learn from the animals they imitate to perform one action at a time (animals concentrate totally on what they are doing), not to waste (animals only eat or drink what they need, nothing more), to consciously observe the environment they live in even when they do not have anything else to do (animals do not get bored) and so on. Using the game as a basis, conversations and reflections on topics such as respect for nature, the environment and all the living beings that belong to it are developed with the children.

2.1.2.3 Third meeting: "Slow and gentle"

The third meeting takes place about one month after the second and focuses on the topic of slowness and gentleness. After some preliminary active silence exercises, the children are invited to pretend that they are clouds that peacefully overcome any obstacle, with no friction. The sense of lightness that the children feel whilst pretending they are clouds helps to create a positive emotive state in the children towards the other people or objects present in the space they are in, and that they interact with and touch when performing the exercise. After this game, the children are invited to think about the bond each of us has with nature, in order to develop an approach that can be lighter, more gentle and, ultimately, more naturally respectful. During this meeting, all those present (children, teachers and leaders) can share their comments and observations on this and the previous meetings.

2.1.3 Final meeting with teachers and parents

The final meeting involves the teachers and parents and starts with a moment of active silence, followed by the presentation of the instructor's observations. The aim is to establish an exchange between the experience of the instructor and the experience of the teachers and parents as witnesses of what the children express about the experience outside of school.

2.2 Educating empathy: the "I and others" teaching module

The "I and others" teaching module was developed specifically for this study. It was presented to the teachers and children in the weeks leading up to the active silence experience in order to prepare them gradually to grasp unconventional "ways" of conducting the day at school. The "I and others" teaching module is conducted by an expert in cooperative games for primary school children (M.F., in this case) and consists of two sessions following those with the teachers and before the "Room for silence" teaching module.

The teaching aim is to introduce the children to the empirical approach on different levels (Bonino, 1987; Loos, 1989; Novara, 1990; Jelfs, 1998). The game not only favours empathy, it is also a source of fascination (Kaplan, 1995), i.e. it attracts the child's attention spontaneously. Fascination is necessary for direct/voluntary attention, namely the attention that requires effort and is used by children during lesson time, to regenerate. The games in the "I and others" module (Bello, 2002) are designed to favour the involvement of the child's involuntary attention (James, 1892) by presenting fascinating stimuli, stimuli the child

pays attention to consciously but effortlessly. It is precisely the involvement of involuntary attention that allows direct attention to rest and, above all, regenerate (Kaplan, 1995; Berto, 2005).

3. The research hypothesis and experimental protocol

In order to assess whether the "Room for silence" module favours the regeneration of direct attention, an experimental protocol was designed involving 120 primary school children. The protocol involved the measurement of certain basic physiological parameters and the administration of a "sustained attention" test before, during and after AST for the entire trial cohort, consisting of children in the 1st, 3rd and 5th year of primary school. Pupils in the 2nd and 4th year, constituting a control group that did not participate in the AST experience, underwent parameter measurements and were administered attention tests. If AST favours attention regeneration, children in the experimental group would be expected to have better "sustained attention" test results than those in the control group. Specifically, it is supposed that the peaceful state induced by the silence practice and the possibility to allow direct attention to rest thanks to the game, make children in the experimental group more attentive when performing the attention test.

3.1 Measuring basic physiological parameters

In the month preceding the start of the study, information was collected on the gender, age, height and weight of each child. A digital automatic measuring device (Omron M6 Comfort, Omron Healthcare Co, Ltd, Kyoto, Japan) was used to record the heart rate and the maximum and minimum blood pressure values for each one. These physiological parameters were measured at three different time-points: before, during and after the AST. The measurements were performed simultaneously on children in both the trial and control groups. This made it possible to perform within subject and between subject analyses.

3.2 Measuring direct attention

The children's attention capacity was measured using the Continuous Performance Test (CPT), (Cornoldi, 1996). The CPT measures sustained-direct attention and the inhibition capacity and consists in searching for groups of three letters. The CPT includes three tests (CP1, CP2 and CP3), in which the order of the letters in the groups, the size of the letters and the spaces between the characters differ. The CPT measures 4 variables: the number of right answers, the number of wrong answers, the number of omissions and the time taken to complete the test. As with the measurement of the physiological parameters, the CPT was administered to children in both the experimental and control groups, before, during and after AST. Within subject and between subject analysis was also performed for the CPT.

4. Results

The data collected (physiological parameters and CPT performance) underwent *within*-subject analysis, i.e. making comparisons between the physiological parameters and CPT scores within each group (experimental and control), and between *between*-subject, i.e. by comparing the two groups with one another (experimental vs. control). Within group analysis on the CPT variables (correct answers, mistakes, omissions and completion time) showed that mean performance improved significantly between the first and third assessment ($p<.001$) for both groups: with an increase in the number of right answers and a reduction in both the omissions and completion times. Gender appeared to have an effect in the experimental group only ($p<.001$): girls in the experimental group performed better than both boys in the same group and the girls and boys in the control group. There was also a significant difference in test completion times between the

two groups: the experimental group was significantly faster than the control group. As far as the physiological parameters are concerned, the children who participated in the AST were not seen to have significant blood pressure variations (both systolic and diastolic) ($p > .05$), but they did have significant heart rate variations, with a mean reduction of 5% in all three classes taking part in the training. AST would therefore seem to slow the children's heart rate, without affecting their blood pressure. There was no significant change in the control group. The results therefore showed that girls were more receptive than boys to AST and that, regardless of gender, participation in the AST made the children calmer, but, above all, regenerated, in terms of a faster attention test completion time than the control group. According to our hypothesis, the regeneration of attention capacity is due to the fascination exerted by the "Room for silence" module, which is thought to allow direct-voluntary attention to rest momentarily, by capturing involuntary attention. i.e. fascination. According to ART, the only way to regenerate from mental fatigue is to allow one's fascination to "wander", so that direct attention rests and is regenerated and can be used again efficaciously (Kaplan, 1995).

5. Discussion

Active Silence Training (AST) is a form of mindfulness meditation, adapted to suit school children. As stated in the introduction, mindfulness is an active silence practice that arises as a desire for an inner space in which physical and mental "noise" is suspended. According to Stephen Kaplan (2001), mindfulness maintains and regenerates direct attention. Although mindfulness meditation is not directly intended to fulfil this purpose, it shares one fundamental point with Attention Restoration Theory (ART): to avoid using direct attention when it is not necessary by eliminating voluntary participation in thought flows.

This point of contact between mindfulness and ART would appear to be particularly interesting, as the mechanism that makes inner dialogue possible is specifically *direct attention* (Kaplan, 2001; Kabat Zinn, 2005). Therefore, were mindfulness confirmed as being able to regenerate children's attention capacity, it could constitute the first part of a teaching programme intended to awaken children's biophilia and to develop their naturalist intelligence in a new and efficacious way (Gardner, 1999). Indeed, if biophilia truly depends on the mental faculties of attention and empathy, the practice of active silence could be supplemented with a corresponding educational activity to favour the emergence of the faculty of empathy and compassion (Boella, 2004).

Our current hypothesis is that the biophilia potential of each child has a better likelihood of being realised if accompanied by an educational programme involving active silence and interpersonal and interspecific relations, i.e. those between human beings and other species, aimed at favouring the maturation of an ecological awareness (Barbiero, 2009). A programme that, by analogy with others developed previously in other sectors (Kabat Zinn, 1990; Segal, 2002), we suggest calling *Mindfulness-Based Affective Ecology*.

Mindfulness-Based Affective Ecology could represent an important research-action tool in the context of what could be termed *affective ecology*, i.e. the sector of ecology that deals with the establishment, growth and maturation of genetically determined and evolutionarily adaptive cognitive and affective relationships between human beings and other living organisms (Barbiero, 2011). Affective ecology is an essential part of the affective appraisal process of environments, namely the attribution of affective qualities to environments that is closely connected to environmental preference. Affective appraisal is also one of the components of environmental schemas (cognitive, behavioural, affective and appraisal component) i.e. the knowledge structures that organise environmental information deriving from perception and that guide behaviour (Berto, 2002), thereby contributing to the process of familiarising with the environment.

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Lev Tolstoy and modern science

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Abstract. Modern Science, an essay written by Lev Nikolàevič Tolstoy in 1898 is here reproduced in its complete version, as a historical document containing philosophical reflections on the practical functions and the cultural and educational role science has, or should have, in contemporary societies. The text was cited by Aldous Huxley in the foreword to Science, Liberty and Peace, a booklet written in 1946 in the aftermath of the second world war, with the threat of nuclear doomsday on the horizon. Are science and technology really at the service of universal needs, as it is continuously claimed – Tolstoy asks, and Huxley echoes – or are their services rather directed to preserving the power of the elites or dominant classes against the multitude of the oppressed?

Keywords: Science and Peace, Science and Art, Lev Tolstoy, Aldous Huxley

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***Perspective**: Educational vision*

***Fields**: Human sciences*

***Issues**: Educational processes – Art and Siustainability*

In 1946, the English writer and essayist Aldous Huxley (1894-1963) – brother of the internationalist and philosopher Julian Huxley and nephew of the evolutionary biologist Thomas Huxley, the first pugnacious defender of Darwin's ideas – wrote a renowned and acclaimed booklet entitled Science, Liberty and Peace, a collection of reflections on the relationship between science and power, the violence inherent in modern production and consumer trends and possible routes to a nonviolent transition in the role of science in modern societies.

After the earliest terrifying conflagrations of the nuclear age, and in the shadow of the ruins of World War II, with only a feeble hope for an enduring peace, Huxley vehemently denounced the subjection of science and technology to power, arguing that in each and every activity of mass control, like armaments, communication media, and industry, science and technology play a crucial role. However, contrary to what is usually believed, their major contribution in instrumental terms results in giving support to the oppressors and frustrating the development of peace and human rights. Throughout the nineteenth century – Huxley added – the intervention of the "popular military forces of liberation" seemed able to open important pathways and perspectives for the emancipation of poor multitudes through barricades and forks that opposed the cavalry and cannons of the ruling classes. Subsequently, in the face of the rapid development of armaments technologies, the possibilities of resistance by working class citizens were dramatically reduced, becoming symbolic in most cases or of minimal efficacy. Similarly, mass communications and control of the media – at that time corresponding to printed press and radio – were becoming above all successful means of coercion in the hands of the oppressors, once again reiterating the possibility for a minority to manipulate the many. Since then – Huxley concluded – mass production, which is the very essence of industrial society, has played a fundamental role in control and social subjection processes, and that is why centralized production, which is in the hands of governments and big corporations, still creates all manner of obstacles to the widespread and participated production of goods of any type.

In Science, Liberty and Peace Huxley began with a quotation from the Russian writer and philosopher Lev Nikolàevič Tolstoy (1828-1910). Although best known for his literary masterpieces, Tolstoy composed also various essays on art, history, politics, philosophy and religion. While Huxley did not refer directly to any of Tolstoy works as a source of inspiration, the original text is clearly recognizable. In the period between the nineteenth and twentieth centuries, Tolstoy was moved to commenting on a text by the English writer Edward Carpenter (1844-1929) Modern Science: a Criticism, published in Civilization: its Cause and Cure, in 1885. Tolstoy wrote his commentary, Modern Science, in the form of a preface to the Russian translation of Carpenter's essay by his older brother, Count Sergius Tolstoy. This is the manuscript Huxley referred to in his booklet on science and peace.

In the belief that this text is still of great pertinence, the complete translation of Modern Science is reproduced as it appeared in a 1961 English edition of Tolstoy's writings, Recollection and Essays, maintaining the early twentieth-century version by Aylmer and Louise Maude, the first British translators of Tolstoy's works.

As noted by Aylmer Maude in his original notes, Modern Science forms a companion article to the conclusion (Chapter XX) of Tolstoy's essay What is Art? (1896) – a treatise concerning the nature and purpose of art, describing how artistic expressions can convey moral values. Tolstoy wrote the essays in the same period and both deal with

practically the same topic: the sense and the purpose that art and science should have and sustain in human society. According to Tolstoy "Science and art are as closely bound together as the lungs and the heart, so that if one organ is vitiated the other cannot act rightly" (Tolstoy 1897, p. 201). Art should not be appreciated so much for its ability to express beauty as in terms of its ability to communicate concepts of morality and aesthetic values. In the same way, the aim of science is not merely to inform or entertain, but to provide a means of expression of any experience and any aspect of the human condition, investigating and bringing to human awareness the truths and the knowledge that the people of a given time and society consider most important.

Tolstoy's view reflected the idiosyncratic and personal nature of his interpretation of Christianity. While he was attempting to define universal and inclusive concepts of art and science, his aesthetic vision was so narrowly focused on considerations of morality that he concluded their definition in exclusive terms related solely to moral and social aspects. "Art should really abandon its false path and take the new direction, it is necessary that another equally important human spiritual activity, – science, – in intimate dependence on which art always rests, should abandon the false path which it too, like art, is following" (Tolstoy 1897, p. 200). The aim of science is to discover, as far as possible, the essential truth of life's meaning, in the conviction that this truth is good and that, once discovered, it will resolve the disagreements and conflicts that plague humanity. Thus "if the path chosen by science be false so also will be the path taken by art (…) a false activity of science inevitably causes a correspondingly false activity of art" (Tolstoy 1897, p. 201).

Huxley echoes Tolstoy in the belief that if science really wishes to devote itself to promoting liberty and peace, then it should readdress its concerns. Scientists should boycott harmful studies and develop actions to sustain the search for social values. To achieve this goal, specific political actions are necessary aimed at public control and democratic redirection of scientific progress and appropriate scientific and technological enterprises, for example, by favouring and guiding in all parts of the world, political freedom and respect for human rights through the spread of knowledge and scientific awareness, or by selecting and developing cheap and easily accessible technological means that ensure energetic and nutritional autonomy for all. Otherwise, in the words of Tolstoy as long as "a small number of people have power over the Majority and oppress it, every victory over Nature will inevitably serve only to increase that power and that oppression." (Tolstoy 1898 p. 185, Huxley 1946).

MODERN SCIENCE

παντὶ λὸγω λογοσ ϊσος αντικειται [1]

I THINK this article of Carpenter's on Modern Science should be particularly useful in Russian society, where more than anywhere else in Europe, there is a prevalent and deeply rooted superstition which considers that humanity does not need the diffusion of true religious and moral knowledge for its welfare, but only the study of experimental science, and that such science will satisfy all the spiritual demands of mankind.

It is evident how harmful an influence (quite like that of religious superstition) so gross a superstition must have on man's moral life. And therefore the publication of the thoughts of writers who treat experimental science and its method critically is specially desirable in our society.

Carpenter shows that neither astronomy, nor physics, nor chemistry, nor biology, nor sociology supplies us with true knowledge of

[1] To every argument an equal argument is matched.

actual facts; that all the laws discovered by those sciences are merely generalizations having but an approximate value as laws, and that only as long as we do not know, or leave out of account, certain other factors; and that even these laws seem laws to us only because we discover them in a region so far away from us in time and space that we cannot detect their non-correspondence with actual fact.

Moreover Carpenter points out that the method of science which consists in explaining things near and important to us by things more remote and indifferent, is a false method which can never bring us to the desired result.

He says that every science tries to explain the facts it is investigating by means of conceptions of a lower order. 'Each science has been as far as possible reduced to its lowest terms. Ethics has been made a question of utility and inherited experience. Political economy has been exhausted of all conceptions of justice between man and man, of charity, affection, and the instinct of solidarity, and has been founded on its lowest discoverable factor, namely, self-interest. Biology has been denuded of the force of personality in plants, animals, and men; the "self" here has been set aside and an attempt made to reduce the science to a question of chemical and cellular affinities, protoplasm, and the laws of osmose. Chemical affinities again, and all the wonderful phenomena of physics are reduced to a flight of atoms; and the flight of atoms (and of astronomic orbs as well) is reduced to the laws of dynamics.'

It is supposed that the reduction of questions of a higher order to questions of a lower order will explain the former. But an explanation is never obtained in this way. What happens is merely that, descending ever lower and lower in one's investigations, from the most important questions to less important ones, science reaches at last a sphere quite foreign to man, with which he is barely in touch, and confines its attention to that sphere, leaving all unsolved the questions most important to him.

It is as if a man, wishing to understand the use of an object lying before him – instead of coming close to it, examining it from all sides and handling it – were to retire farther and farther from it until he as at such a distance that all its peculiarities of colour and inequalities of surface had disappeared and only its outline was still visible against the horizon; and as if from there he were to begin writing a minute description of the object, imagining that now at last he clearly understood it, and that this understanding, formed at such a distance, would assist a complete comprehension of it. It is this self-deception that is partly exposed by Carpenter's criticism, which shows first that the knowledge afforded us by the natural sciences amounts merely to convenient generalizations which certainly do not express actual facts; and secondly that facts of a higher order will never be explained by reducing them to facts of a lower order.

But without predetermining the question whether experimental science will, or will not, by its methods, ever bring us to the solution of the most serious problems of human life, the activity of experimental science itself, in its relation to the eternal and most reasonable demands of man, is so anomalous as to be amazing.

People must live. But in order to live they must know how to live. And men have always obtained this knowledge – well or ill – and in conformity with it have lived and progressed. And this knowledge of how men should live has – from the days of Moses, Solon, and Confucius – always been considered a science, the very essence of science. Only in our time has it come to be considered that the science telling us how to live is not a science at all, but that the only real science is experimental science – commencing with mathematics and ending in sociology.

And a strange misunderstanding results.

A plain reasonable working man supposes, in the old way which is also the common-sense way, that if there are people who spend their lives in study, whom he feeds and keeps while they think for him – then no doubt these men are engaged in studying things men need to know; and he expects science to solve for him the questions on which his welfare and that of all men depends. He expects science to tell him how he ought to live: how to treat his family, his neighbours and the men of other tribes, how to restrain his passions, what to believe in and what not to believe in, and much else. But what does our science say to him on these matters?

It triumphantly tells him how many million miles it is from the earth to the sun; at what rate light travels through space; how many million vibrations of ether per second are caused by light, and how many vibrations of air by sound; it tells of the chemical components of the Milky Way, of a new element helium of micro-organisms and their excrements, of the points on the hand at which electricity collects, of X-rays, and similar things.

'But I don't want any of those things,' says a plain and reasonable man – 'I want to know how to live.'

'What does it matter what you want?' replies science. 'What you are asking about relates to sociology. Before replying to sociological questions, we have yet to solve questions of zoology, botany, physiology, and biology in general; but to solve those questions we have first to solve questions of physics, and then of chemistry, and have also to agree as to the shape of the infinitesimal atoms, and how it is that imponderable and incompressible ether transmits energy.'

And people – chiefly those who sit on the backs of others, and to whom it is therefore convenient to wait – are content with such replies, and sit blinking and awaiting the fulfilment of these promises; but plain and reasonable working men – such as those on whose backs these others sit while occupying themselves with science – the whole great mass of men, the whole of humanity, cannot be satisfied by such answers, but naturally ask in perplexity: 'But when will this be done? We cannot wait. You say that you will discover these things after some generations. But we are alive now – alive to-day and dead to-morrow – and we want to know how to live our life while we have it. So teach us!'

'What a stupid and ignorant man!' replies science. 'He does not understand that science exists not for use, but for science. Science studies whatever presents itself for study, and cannot select the subjects to be studied. Science studies everything. That is the characteristic of science.

And scientists are really convinced that to be occupied with trifles, while neglecting what is more essential and important, is a characteristic not of themselves but of science. The plain, reasonable man, however, begins to suspect that this characteristic pertains not to science, but to men who are inclined to occupy themselves with trifles and to attach great importance to those trifles.

'Science studies everything,' say the scientists. But, really, everything is too much. Everything is an infinite quantity of objects; it is impossible at one and the same time to study everything. As a lantern cannot light up everything, but only lights up the place on which it is turned or the direction in which the man carrying it is walking, so also science cannot study everything, but inevitably only studies that to which its attention is directed. And as a lantern lights up most strongly the things nearest to it, and less and less strongly the things that are more and more remote from it, and does not light up at all those things beyond its reach, so also human science of whatever kind has always studied and still studies most carefully what seems

most important to the investigators, less carefully what seems to them less important, and quite neglects the whole remaining infinite quantity of objects. And what has defined and still defines for men the subjects they are to consider most important, less important, and unimportant, is the general understanding of the meaning and purpose of life (that is to say, the religion) possessed by those who occupy themselves with science. But men of science to-day – not acknowledging any religion, and having therefore no standard by which to choose the subjects most important for study, or to discriminate them from less important subjects and, ultimately, from that infinite quantity of objects which the limitations of the human mind, and the infinity of the number of those objects, will always cause to remain uninvestigated – have formed for themselves a theory of 'science for science's sake', according to which science is to study not what mankind needs, but everything.

And indeed experimental science studies everything, not in the sense of the totality of objects, but in the sense of disorder-chaos in the arrangement of the objects studied. That is to say, science does not devote most attention to what people most need, less to what they need less, and none at all to what is quite useless; it studies anything that happens to come to hand.

Though Comte's and other classifications of the sciences exist, these classifications do not govern the selection of subjects for study; that selection is dependent on the human weaknesses common to men of science as well as to the rest of mankind. So that in reality scientists do not study everything, as they imagine and declare; they study what is more profitable and easier to study. And it is more profitable to study things that conduce to the well-being of the upper classes, with whom the men of science are connected; and it is easier to study things that lack life. Accordingly, many men of science study books, monuments, and inanimate bodies.

Such study is considered the most real 'science'. So that in our day what is considered to be the most real 'science', the only one (as the Bible was considered the only book worthy of the name), is not the contemplation and investigation of how to make the life of man more kindly and more happy, but the compilation and copying from many books into one, of all that our predecessors wrote on a certain subject, the pouring of liquids out of one glass bottle into another, the skilful slicing of microscopic preparations, the cultivation of bacteria, the cutting up of frogs and dogs, the investigation of X-rays, the theory of numbers, the chemical composition of the stars, &c.

Meanwhile all those sciences which aim at making human life kindlier and happier – religious, moral, and social science – are considered by the dominant science to be unscientific, and are abandoned to the theologians, philosophers, jurists, historians, and political economists, who under the guise of scientific investigation are chiefly occupied in demonstrating that the existing order of society (the advantages of which they enjoy) is the very one which ought to exist, and that therefore it must not only not be changed, but must be maintained by all means.

Not to mention theology and jurisprudence, political economy – the most advanced of the sciences of this group – is remarkable in this respect. The most prevalent political economy (that of Karl Marx)[2],accepting the existing order of life as though it were what it ought to be, not only does not call on men to alter that order – that is to say, does not point out to them how they ought to live that their

[2] From the Marxian point of view improvement can be inflicted on a people by external pressure, and there are witnesses to say that this has been accomplished in Russia. But it remains to be proved whether mankind can be made better or happier without freedom of thought or a religious understanding of life. 'For the things which are seen are temporal, but the things that are not seen are eternal.' – A. M.

condition may improve – but on the contrary demands an increase in the cruelty of the existing order of things, that its more-than questionable predictions concerning what will happen if people continue to live as badly as they are now living may be fulfilled.

And as always occurs, the lower a human activity descends – the more widely it diverges from what it should be – the more its self-confidence increases. That is just what has happened with the science of to-day. True science is never appreciated by its contemporaries, but on the contrary is usually persecuted.

Nor can this be otherwise. True science shows men their mistakes, and points to new, unaccustomed ways of life. And both these services are unpleasant to the ruling section of society.

But present-day science not only does not run counter to the tastes and demands of the ruling section of society; it quite complies with them. It satisfies idle curiosity, excites people's wonder, and promises them increase of pleasure. And so, whereas all that is truly great is calm, modest, and unnoticed, the science of to-day knows no limits to its self-laudation.

'All former methods were erroneous, and all that used to be considered science was an imposture, a blunder, and of no account. Only our method is true, and the only true science is ours. The success of our science is such that thousands of years have not done what we have accomplished in the last century. In the future, travelling the same path, our science will solve all questions and make all mankind happy. Our science is the most important activity in the world, and we men of science are the most important and necessary people in the world.

'So think and say the scientists of to-day, and the cultured crowd echo it, but really at no previous time and among no people has science – the whole of science with all its knowledge – stood on so low a level as at present. One part of it, which should study the things that make human life kind and happy, is occupied In justifying the existing evil order of society; another part is engaged in solving questions of idle curiosity.

'What? Idle curiosity? I hear voices ask in indignation at such blasphemy. 'What about steam and Electricity and telephones, and all our technical improvements? Not to speak of their scientific importance, see what practical results they have produced! Man has conquered Nature and subjugated its forces' . . . with more to the same effect.

'But all the practical results of the victories over Nature have till now – for a considerable time past – gone to factories that injure the workmen's health, have produced weapons to kill men with, and increased luxury and corruption' replies a plain, reasonable man 'and therefore the victory of man over Nature has not only failed to increase the welfare of human beings, but has on the contrary made their condition worse.'

If the arrangement of society is bad (as ours is), and a small number of people have power over the Majority and oppress it, every victory over Nature will inevitably serve only to increase that power and that oppression. That is what is actually happening.

With a science which aims not at studying how people ought to live, but at studying whatever exists – and which is therefore occupied chiefly in investigating inanimate things while allowing the order of human society to remain as it is – no improvements, no victories over Nature, can better the state of humanity.

'But medical science? You are forgetting the beneficent progress made by medicine. And bacteriological inoculations? And recent surgical operations?' exclaim the defenders of science – adducing as a last resource the

success of medical science to prove the utility of all science. 'By inoculations we can prevent illness, or can cure it; we can perform painless operations: cut open a man's inside and clean it out, and can straighten hunchbacks,' is what is usually said by the defenders of present-day science, who seem to think that the curing of one child from diphtheria, among those Russian children of whom 50 per cent, (and even 80 per cent, in the Foundling Hospitals) die as a regular thing apart from diphtheria – must convince anyone of the beneficence of science in general.

Our life is so arranged that not children only but a majority of people die from bad food, excessive and harmful work, bad dwellings and clothes, or want, before they have lived half the years that should be theirs. The order of things is such that children's illnesses, consumption, syphilis, and alcoholism, seize an ever-increasing number of victims, while a great part of men's labour is taken from them to prepare for wars, and every ten or twenty years millions of men are slaughtered in wars; and all this because science, instead of supplying correct religious, moral, and social ideas which would cause these ills to disappear of themselves, is occupied on the one hand in justifying the existing order, and on the other hand with toys. And in proof of the fruitfulness of science we are told that it cures one in a thousand of the sick, who are sick only because science has neglected its proper business.

Yes, if science would devote but a small part of those efforts and that attention and labour which it now spends on trifles, to supplying men with correct religious, moral, social, or even hygienic ideas, there would not be a one-hundredth part of the diphtheria, the diseases of the womb, or the deformities, the occasional cure of which now makes science so proud, though such cures are effected in clinical hospitals the cost of whose luxurious appointments is too great for them to be at the service of all who need them.

It is as though men who had ploughed badly, and sown badly with poor seeds, were to go over the ground tending some broken ears of corn and trampling on others that grew alongside, and were then to exhibit their skill in healing the injured ears as a proof of their knowledge of agriculture.

Our science, in order to become science and to be really useful and not harmful to humanity, must first of all renounce its experimental method, which causes it to consider as its duty the study merely of what exists, and must return to the only reasonable and fruitful conception of science, which is that the object of science is to show how people ought to live. Therein lies the aim and importance of science; and the study of Things as they exist can only be a subject for science in so far as that study helps towards the knowledge of how men should live.

It is just to the admission by experimental science of its own bankruptcy, and to the need of adopting another method, that Carpenter draws attention in this article.

[Leo Tolstoy 1898]

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