Anticipation: Human Versus Machines

Christine Hardy & Stéphane Grès
C. Hardy, PhD: Centre ECO-Mind, Ormoy, 91000, FRANCE
101515.2411@compuserve.com
S. Grès: Afscet – s.gres@magic.fr

Abstract

Features of anticipation are compared in human and AI systems. In AI systems, a concept's semantic space is equal to, or smaller than, what is strictly defined by all occurrences of the concept within the system. While in a human cognitive system, the semantic space of a concept is always larger, more complex, divergent, and fuzzy, than what has been theorized or formalized. A crucial superiority of a human anticipatory system (over the AI one) is to be able to view a crisis situation in its globality, according to values of the highest order. Specific matrixes of logic and knowledge are used by the mind for analyzing and understanding situations and experiences: the *logfields*. A meta-model, by interweaving different scientific logfields, may create a multidimensional cognitive space in which divergence and variety of worldviews enrich the collectivity.

Keywords: Semantic space; Self-organization; Cognitive systems; Logfields; Meta-model.

1. Introduction

We will view anticipation in the broadest sense, as a capacity for a complex knowledge system to infer or expect (predict, foresee, forestall, forecast) the future state of a system, or future events. Thus, building anticipations leads the system to modify its own behavior in order to adjust to the forestalled state or event. Anticipatory systems (or AntSys) are able to plan a course of action, or modify their internal organization, or else adjust their interrelation with another system. The AntSys system may be contained in a larger system, or containing sub-systems. In this paper, we will distinguish between two types of AntSys, the human cognitive system, and systems based on artificial intelligence (AI). Our objective is to establish their differences in terms of anticipatory features, specific qualities, and constraints. We have thus:

- **Human-AntSys**: the human mind and its mode of anticipating.
- **AI-AntSys**: Artificial Intelligence Anticipatory-System. These are for the most part systems of logical rules, based on Boolean algebra and algorithms.
- **AI-techno AntSys:** The AI-AntSys may itself be coupled with other modules to form a larger system comprising the AI module controlling a technological or physical machine (such as, for example, advanced flight simulators.)

In view of the great complexity involved in neural nets and complex nonlinear systems, we will not include them fully in the comparison between artificial and human AntSys – despite the fact that neural nets are more and more internally coupled with classical AI rule-systems and that algorithms simulating network processes are now integrated to them as modules.

2. Features of Anticipation in AI Systems

The AntSys is an AI system: Artificial Intelligence (AI) is a field in constant evolution and, keeping this fact in mind, the following description of AI-AntSys is by definition incomplete and bound to change. However, it might be useful to remember some of the limitations of classical AI systems in terms of predictive and anticipatory processes. Classically, the AI system is a system of rules and data (of the Turing machine type). In such systems, anticipation consists in the activation of inference or deduction rules, which leads to predictions. The predictions about future events or the future state of a given system are thus strictly logical.

The AntSys is an AI-techno system: In mathematical and physical systems, anticipations amount to the computation of equations. The computation of physical laws, of chemical processes (e.g. molecular bonding), and of dynamical systems (e.g. flight simulation), etc., belong to that group whenever they are coupled to an AI or cybernetic system able to predict the future state of the system and to adjust some internal parameters in accordance. Thus, complex cybernetic systems, comprising a control module, function on an implicit calculated anticipation of the behavior of both the controlling and the controlled system(s). These are "strong anticipations" according to Daniel Dubois's (2000) definition: "Strong anticipation refers to an anticipation of events built by or embedded in a system."

If we take a cybernetic system such as the automatic pilot in a sophisticated craft, we obtain:

- sensors →
- AI controlling system
    - computation of sampled data
    - applying rules to check system's behavior
    - applying rules to check its interactions with coupled systems →
- tuning of control variables according to computations →
- modifying parameters in the controlled system →
- controlling the effect on the system →
- sensors →

Let us take, as a second example, the automatic pilot in a plane: the flight trajectory is plotted in 3 dimensions and control rules calculate the departure from this trajectory and correct it.

Thus, in AI and AI-Techno systems, we have two features of anticipations:

2.1 The anticipation is strictly logically dependent on the system of rules and equations.

For example, the rule may be of the IF...THEN type: IF such a threshold is trespassed, THEN apply this rule. The types of problems that could lead to false or biased anticipations may arise through :

- the competition/conflict between rules
- the absence of needed (interface) rules
- the environment has not been adequately modeled (e.g. some environmental variables may show anomalous behaviors, impossible to predict within the scope of a certain model.)
- a conflict or a deficient interface between levels
- the lack of a whole domain of data (the non-conceived)
- inadequacies of the rule system (descriptors, parameters, processes, etc.) to the complexity of the AI system or of the coupled system/environment.

2.2 Therefore the parameter of efficiency and correctness of anticipations are parameters of the rule-system itself or the model it is based on.

That is, incorrect anticipations always point to limits or shortcomings existing *within* the rule-system, or else, to problems inherent to a specific model or theory used to construct the rule-system.

When, to the contrary, the predictions built within a rule-system are correct, they lead to efficient countermeasures to systems deficiencies (such as the probable failure of a piece of hardware at a given time), and to the planning of solutions. In case a countermeasure is successfully set in motion, that means retroactively that the implicit anticipations were 1) correct, 2) efficient, 3) the solution to this specific failure was planned (i.e. the internal reorganization of the system was successful), and 4) the model was adequate. However, let us remember that in such AI systems, the reorganization is often a re-combining of rules or a reconfiguration of a piece of hardware (such as the activation of an emergency pump in a plane).

3. Semantic Spaces in Human Versus AI-Techno Systems

3.1 In an AI-Techno system:

In an AI-Techno system, the concepts, names, signs, that is, the semantics and the semiotics of the anticipations and possible problems *are all strictly defined by the system's rules and equations themselves*. Of course, let us remember that cognitive subjects have been the ones to build the AI system in the first place, and thus to insert human concepts and semiotics within the AI system – as Leroi-Gourhan (1964) points out, a semiotic system always bears the traces of the thought of the culture that created it. However, this does not rule out the fact that the AI system is bound and constrained by its own structure and the way concepts and definitions have been inserted in it.

That means that the precise cause of a problem and the role of a part in it are described by the rules and equations of the scientific domain (whether implicitly or explicitly).

3.2. In a human cognitive system:

When a scientist works on a specific domain, their mind is investigating and scanning a wide range of conceptual possibilities. The whole of their rational intelligence, but also emotional intelligence (Goleman, 1995) and relational, symbolic, or artistic, intelligence may be at play simultaneously when a philosopher ponder on some fundamental concepts of humanity – there are, as said Gardner (1983), many modes of intelligence. Then, only a few facets of all the ideas they have thought about will be formalize into clear concepts and a model (e.g. laws, equations).

Thus in a human AntSys, the space of conceptual play is much wider than the space of formalized concepts and laws. That means that when Einstein thinks about ENERGY as a concept, his mind is grasping a much larger domain of conceptual possibilities (*thought-space*) than what he was already able to express within his own theory (*theoretical space*), and the latter is itself larger than what he has precisely formalized in models and equations (*formalized space*). The process, then, is for the scientist to shuffle through a lot of divergent and disordered ideas, then to select the most significant concepts and relations to build a theory (theorized space), and finally to go through another stage of extraction and simplification to invent a model or an equation; the process thus consists in structuring and stabilizing. Of course, the stages of theorizing or modeling may themselves trigger a lot of novel ideas that will enrich the thought-space, but the point is that the thought-space will always be larger and more divergent (less stabilized) than the other two semantic spaces.

3.3. Comparison Between Human vs. AI Semantic Spaces

To the contrary, when an AI system reads the concept ENERGY, it can access only the concept as it is strictly defined logically or by the equations. Hence the law:

In an AI-Techno system, the semantic space of a concept is equal or smaller than what is strictly defined by all occurrences of the concept in the definitions, rules, and laws, contained or embedded within the system. To the contrary, in a human cognitive system, the semantic space of a concept is always larger, more complex, divergent, and fuzzy, than what has been theorized or formalized.

When a system is so simple that 1 module represents [1 definition = 1 rule = 1 process], then there are no incompatibilities. However, when, as in computers, each software has a different set of concepts (some overlapping in divergent semantic spaces) and different logics built in, then incompatibilities are daily problems. Thus, in an AI or Information system, the greater the complexity, the more varied the modules, and the more probable and frequent the incompatibilities – hence the recourse to modeling based on fuzzy mathematics (Zalila, 1996).

The point is that even if we take one scientist having conceived his/her own AI-system embedding his/her own concepts, there will be NO perfect overlapping of the semantic space of his/her own concepts (immensely more fuzzy and larger) with his/her AI-system's semantic space. How much more of a problem it will be when the expert controlling a machine has not been the one to conceive it! In consequence, in a human-machine system, many a problem arising in the course of the interaction of the expert with the AI-AntSys could be due to the non-perfect overlapping of the human semantic space with the AI-system's semantic space. For example, a human expert could "read" and understand a given concept in a broad sense (even within the very scientific domain of the system), while the information system is using the concept in an extremely constrained way, strictly inferred by the equation.

The point here is to accept the fact that there can be no perfect overlapping, unless the human mind would be downgraded to that of a robot! However, while the technician might be distressed by the "errors" he encounters, the other side of the coin is that, in this very fuzziness and chaos, resides the greatest gift of the human mind. The wider semantic space in a human mind is precisely the non-defined space of imagination, conceptual chaos, and fuzzy mentations, images, visions, affect, and dreams – that is, the whole Mind-Body-Psyche system with its unique flexibility and open possibilities leading to continuous changes. It is the mercurial mind-space fostering a constant shuffling of ideas, the morphing of concepts, the shaping and un-shaping of possibilities – the space of chaos and freedom in which intelligence thrives, as well as creativity and innovation. It is the semantic space where humans are the very unique human intelligences, that is, an interplay of intuitions, expectations, feelings, values, sensations, etc., that nurtures and gives birth to genius and innovation. In this perspective, intuition is what is "in sync" with a wider reality than the consciously conceived, a harmony between inside and the outside, a sensitivity to the "turbulent infinity" Henri Michaux was speaking of. (Michaux, 1980).

4. Features of Anticipation in Human Cognitive Systems

4.1 Features of human anticipations

In such a complex system as the human mind, anticipatory cognitive processes are not a single, monolithic, type of process, but rather *a set of widely different dynamics and processes*, interrelated and interwoven. However, they will fall under the same definition of anticipation as in AI-AntSys, that is: the capacity to forestall the future state of an internal/external system or future events. Let us map some of the mind dynamics involving some sort of anticipation:

4.1.1. Short-term anticipation: rehearsal behavior.

The will to act is often preceded by snapshots of the intended set of actions, gestures, body moves, talking, etc. Responses to environmental affordances (in the sense of Gibson, 1986) or behaviors influenced by a specific context (Smith, 1995).

4.1.2. Long-term anticipation:

- decision, intention, will (conatives processes)

- desires, projections on the future, fearful forebodings
- foresight, foreshadow, forecasting, foreseeing,
- decryption of forerunner variables, prognostic, forecasting, prospective
- computing odds and trends, scientific forecasting, prevision, prevention.

The anticipatory process is influenced by the endo-context – the attractors in the mind created through similar past experiences – as well as by the exo-context, that is, the understanding of the evolutionary behavior of complex systems (Hardy, 1998). The more connections and links are created with the outside systems we interact with (whether they are other beings or environmental systems), the more meaning is generated.

4.2. Network-dynamical nature of human cognitive systems

Semantic Fields theory (Hardy, 1998), as a cognitive theory, addresses specifically the issue of the unique capacities of the human mind in terms of flexibility, lability, continuous transformation and evolution leading to creativity and innovation. SFT views the mind as a *lattice* of numerous networks of processes behaving as dynamical systems, and called Semantic Constellations or SeCos. Each SeCo is a transversal network connecting the various levels of the Mind-Body-Psyche (or MBP system) that evolved through self-organization and a connective dynamic, and is dedicated to as task or a capacity. A SeCo connects together a set of processes ranging from abstract concepts to neural patterns in the brain, and that include sensations, ideas, feelings, etc. (Hardy, 1999). This theory poses that thinking is an underlying connective process that works through the creation of spontaneous links between elements or processes having some similarities. Each activated process in its turn activates a whole cluster of semantic elements, or a SeCo, or a chain-linkage of SeCos. Conscious thought is only the tip of the iceberg of this continuous *spontaneous linkage process* in the semantic lattice. Thus the human cognitive system is a lattice of networks (the SeCos) in constant dynamical self-organization and transformation. Through this self-organization happening while the individual lives new experiences, attractors are formed in the SeCos that show the most probable trajectory between all the connected processes. However, as the connective dynamics spontaneously links elements across SeCos along new chain-linkages, it may introduce divergence in the system, and thus trigger a bifurcation, that is, a modification of the attractor type or strength (Abraham & Gilgen, 1995; Guastello, 1995). Hence the theoretical grounding for on the one hand, patterning and convergent processes, and on the other hand, divergent and differentiated processes: attraction to old paths (reflecting the memorized experiences), and freedom to choose or create new paths.

In this framework, human anticipations are as much a function of the attractor's configuration of the activated SeCo (corresponding to the problem-space), than a totally free and divergent network of spontaneous links, generated on the spot by the specific situation. A complex semantic system is constituted, consisting in: the space of the problem, the actual inner state of the person (taking the previously activated SeCos as initial conditions), the person's Mind-Body-Psyche system as a whole (all past experiences, know-how, genetic constraints, etc.), and significant features of the context and the environment. The links formed in this complex system open a spectrum of new possible paths for the mind to explore, and may thus generate a totally novel anticipation, one that has little ground on which to stand (e.g. it is not predicted by the theory, nor deduced rationally, nor is it based on past events); on the contrary, the anticipation will be largely intuitive, and more in sync with what the mind may sense and feel about underlying complex trends in the system or being under scrutiny. This is for example what Koestler (1989) calls the *aha! experience*. The mathematician Poincaré, analyzing the discovery process in mathematics, describes an *incubation* phase (corresponding to an unconscious process), followed by a sudden illumination (Poincaré, 1952). Intuition may also sprout from an inner harmony with *being*, or from a sensitivity to one's own or others' unconscious trends and psychological flow.

Cognitive scientists came to recognize the existence of a *cognitive unconscious*: numerous mental tasks are done automatically and part of learning is *implicit*, in the sense that it is acquired without the subject's awareness – for example, a lot of information can be gathered through *subliminal perception* (Reber, 1993). These nonconscious processes may lead to forming anticipations that seem logically or rationally groundless, but that will nevertheless prove correct later. We refer to them under the broad undefined category of *intuition*. Claire Petitmengin-Peugeot (1999) used a pool of interviews to extract a model of the intuitive process; it shows four main phases: 1) a building up process, 2) the connection phase, 3) listening, and 4) the intuition or insight itself.

4.3. Dynamics of human anticipatory processes

We saw that a machine's anticipations are strictly contained within the defined state-space of the system—*that is, within all possible behaviors/states of the system that have been mapped or modeled, as well as within the equations/rules defining the system.* This impossibility for an AI-AntSys to forecast an accident whose possibility has not been mapped within the model, can turn out to be a catastrophic shortcoming in terms of prevention of risks. To the contrary, this is a strong advantage of the human AntSys, which, in our opinion, far outweigh its lesser accuracy in terms of computing and memory.

This capacity of jumping to another 'orbit' of problem-analysis, to shift to a more global perspective or world-vision, to access a wider problem-area that puts in wider perspective the local crisis at hand, is a truly amazing feat of a human mind. Anticipations regarding the problem at hand thus shift to anticipations about a meta-system whose connection to the foregoing problem-space had not even been anticipated before, and even less modeled for that matter. Thus, a crucial superiority of a human AntSys is to be able to view a crisis situation in its globality according to values of the highest order, such as the benefit of the whole human race or the whole planet—a value which may not have been mapped into a decision system more or less constricted to a pre-defined possible or probable crisis.

Let us see the diverse Mind-Body-Psyche processes or cognitive forces that may lead to the building of specific anticipations, by first informing recognition and interpretation patterns.

A. RATIONALITY
- *Logic and scientific prediction, laws, rules, inference, causality*
- *Rational objective, final state, selected output*
- *Scientific domains with their own logic (logfields)*
- *Paradigmatic or theoretical framework (logfields)*

B. AFFECTS
- *Feelings, hopes, desires, (dis)liking*
- *Shared experiences, common values*
- *Unconscious affects, subconscious drives, instincts, the shadow (Robertson, 1995)*
- *Memory, fears, species and ancestral unconscious know-how and matrixes*

C. BELIEFS
- *Beliefs, aprioris, preconceptions,*
- *Ideological, religious, philosophical credos*
- *Values, ethic, worldview*

D. INTENTION:
- *Volition, choice of objectives, valued aims, finality*
- *Trends, visions, utopia, world vision, values*
- *Will, decision, planning, scheduling*

E. ACTIVE MYTHS
- *Personal myths (Krippner & Welch, 1992), symbols, personal or active archetype (Jung, 1966),*
- *Dreams, mythological figures, models, mentors*
- *Influential characters in art, cinema, and literature*

F. INTERRELATIONS
- *Relatedness, projections on others/systems*
- *Feeling of belonging, adoption of a people, a (sub)culture*

G. INTUITION
- *Inner feeling, harmony, and connectedness*
- *Visions, imaginations, empathy, synchronicities (Jung, 1960; Combs & Holland, 1995)*
- *Understanding of one's own evolution, trends, and emergent processes.*

If we were to map the expectations of an AI-Antsys, there seems to be only one dimension (or parameter) to it: that of Rationality. Concerning very complex AI systems, it would be necessary to add interrelations between modules (e.g., circular causality, cybernetic system, etc.). And then, it would be of utmost importance to address and analyze all the expectation parameters implicit in the logfield of the embedding scientific domain, then the expectation parameters of the scientists who invented or built the system (with embedded logfields), and finally, the expectation parameters of the work team using the system: all three being human-Antsys.

On the contrary, if we were to map the expectations of a human-Antsys, we would be all the wiser to expect any one of them to instantiate all the parameters corresponding to the categories just listed above, and to analyze them carefully.

4.4. Paradigms and mental models in anticipations: the Logfields

The mind, when confronted with a problem or a context of thought (such as reading a scientific article), selects a specific matrix of knowledge and experience to analyze and understand the issue. This matrixes have been build up through education, books, a professional formation, or use scientific models and theories. These are sorts of mental models, but dedicated specifically to thinking, and they use an idiosyncratic mode of reasoning, of extracting patterns, and of logic – called *logical field.* With these, whole domains of interpretation are activated, such as a domain of science if I'm reading news about a new technology. Once activated, a logical field then in its turn will in-form the thinking mode, the logic used, and finally both the understanding of a situation and how we will behave in response.

The high dynamical connectivity of the human mind is always in the process of creating new semantic constellations, from which are extracted the logfields: a natural process allowing to synthesize experiences and data. The concepts we use for thinking and anticipating are thus modulated by the logfields; Not only are they constantly shifting and evolving, but they are also structuring interconnections between reasoning-feeling-acting (the mind-body-psyche system). This is what gives the human mind a rare complexity and the emergence of such elusive capacities as intuition, innovation, artistic sense, and of course self-reference.

Here is the definition of a logfield:

A Logical Field (or logfield) is a natural self-organizing system of the thought-process that instantiates a specific, more or less flexible, organization of links between concepts, events, and objects, and thus triggers a particular patterning of thought (Hardy, 2002). Logfields reflect how the mind creates its own thought-patterns to make sense of itself and the world. In the interpretation process, already existing logfields in the mind will be compared with patterns seemingly seen in the environment, thus enabling recognition and the generation of meaning. However, the internalized logfields are themselves an organizing force informing the recognition of patterns, that is, they simultaneously inform the process of extracting patterns, and the process of recognizing theses patterns. As Maturana (1999) points out, the patterns are not already existing as such in an objective world: there is an observer extracting meaningful patterns from an unknowable reality, and thus creating a consensual or idiosyncratic view of this observed reality. The interpretation process leads to assuming the state of the world and of systems we interact with, and their specific state, and from then on it leads to the forming of specific anticipations. With the logfields grid, we are thus looking at the upstream process underlying the building of specific anticipations. And even more upstream are the raw Mind-Body-Psyche forces or parameters that may lead to the creation of specific matrixes of thinking (the logfields) and specific anticipations.

5. Toward a Meta-Logic Space: Freeing the Human Mind

5.1. Logfields and anticipations in the materialistic paradigm

Let us turn now toward the analysis of the various logfields expressed by the diverse domains of science and the way they are coordinated through a paradigm. And, first of all, let us analyze how the classical, materialistic and reductionist, paradigm was constraining the evolution of science as well as the evolution of individuals' consciousnesses.

The classical paradigm in science, derived from Newtonian physics and still dominant until the turn of the century, exhibited an excessively materialistic and deterministic outlook, that considered all phenomena could be explained by analyzing their constituent parts (Goerner, 1999). Thus feelings would be equated to neurophysiological activations, language and semantics to bits of information (Andreewsky, 1991); finally, mind will be reduced to neural patterns in the brain and the computation of rules, as in a computer (hence the term: computational paradigm). Such a reductionist view of the human being could not not have a constraining effect on the way individuals reflected on themselves, on how they built their self images, and in the end, on their anticipations as to their own personal and collective evolution. The materialistic world-vision is still pervading most of the scientific establishment – research fields, universities, journals (Kuhn, 1971); it is still making the stuff of the consensual reality that is being "fed to" the general public.

However, it seems that we are witnessing the emergence of a new form of knowledge and cognition, based on an enhanced intuition, and warrant of an accrued creativity and freedom.

Since Kuhn's 1970 work on paradigms and the postmodern deconstruction, the implicit "politico-technological" bias of the Newtonian paradigm has been analyzed. As was shown by sociologists such as Latour (1989) and philosophers such as Stengers (1987), the scientific "facts" are a product of political and social choices driving the "extraction" of patterns out of a multifaceted and largely unknowable complex reality. In the last 15 years, new scientific domains, intrinsically multidisciplinary, are exploring and tackling a new paradigm based on complexity and the valuing of human consciousness, such as Consciousness studies, Chaos theory, Ecology, and suchlike. Similarly, we can see multiple signs of an emergence happening both at the level of individuals and in the social body, as expressed by the trend toward personal development, coaching, analysis of mental models, techniques of yoga and mind focus, in the business world and the public as well. Notwithstanding all these evolutionary processes, the techno-logical framework still largely influences the overall system of science, politics, and society. It is still this framework that dictates the hierarchy of sciences, with physics at its apex.

In this classical framework, anticipation and prediction methods reflect an engineering perspective, statistical and technological (Grès, 2002). This has a bearing on the social and political life in the sense that such reductionist predictive analysis constrains the range of evolutionary possibilities allowed to the individuals, and may rigidify society, and it certainly has had a negative effect on the normal development of affective and creative potentials.

The classical anticipation mode is using a 4-dimensional grid to plot movements and events in a causal fashion, in a Newtonian-Einsteinian paradigm, or else it uses the statistical analysis of variables to derive general rules of the behaviors of systems – whether these systems are humans or machines. The main objective is to have handy a set of mathematical equations leading to correct predictions that render possible a control and if needed a restructuring of the physical environment. However, this restructuring does not take into account any larger or nested reality or context, such as the existence of a subjective reality in which human minds as well as cultural groups thrive.

The materialistic paradigm is also based on a binary logic, and a bipolar structure: cause/effect, true/untrue, success/failure, fight/flight, right/wrong, friend/enemy, input/output, etc. This has been expressed in the Aristotelian logic (a thing is **either** A **or** non-A) and is in logical coherence with an establishment science in which physics is deemed the queen of science and the ground of legitimacy (Grès, 1998); consequently, the principle of objectivity reigns unchallenged: there is no awareness of a distinction between the existence of an entity in itself, and its physical manifestation, or even its scientific description (e.g. the mind is equated to the brain, its physical level, and the brain is equated to its neural patterns of activity).

Understanding all the various domains of science within a single logfield, dominated by Newtonian physics, leads to giving external and physical forms a value of reality at the expense of all other forms or levels of reality. This in turn leads to a linear and flattened thinking process, where only external behaviors (in psychology), or strictly logical thinking modes (cause-effect reasoning) are accepted and reinforced – some trends already favored by the semiotics and grammatical structures of our languages. All this leading to a rigid form of anticipation. However, human beings keep developing their emotional, non-verbal, potentialities. The dominant scientific system (due to its quite rigid internal structure) is not apt to transform itself at the same speed than the human individuals. It does not give enough room to a reality that proves to be plural, multidimensional, complex, and implying an array of connective dynamics – only one of which can be said to be strictly causal (Hardy, 2001).

In our view, the process of anticipating implies much more parameters than the strictly quantifiable physical ones or the lame binary true/untrue evaluation. For starter, the understanding of a cognitive agent can only be based at minima on a multilevel architecture expressed by a Mind-Body-Psyche system's framework. The true/untrue evaluation has to be enlarged by recognizing many modes of thinking, such as analogical, symbolical, metaphoric, imaginary, visual, paradoxical, complex, concurrent, complementary, antagonistic, irrational, intuitive, etc. modes of thinking (Von Bertalanffy, 1967; De Bono, 1970). Let us keep Heidegger's perspective that the human is in-the-making! (Heidegger,1992)

As Karl Pribram likes to remind his audience, "science is a narrative," no more no less than other forms of narratives expressing human knowledge, such as litterature, poetry, art, etc. (Pribram, 1991). Pille Bunnell (1999) and Maturana (1980, 1999) underline that concepts are extracted by an observer, a thinker; they are not describing a 'reality out there' but rather expressing our perception and understanding of reality. And this perception is in the process of being radically modified with the new zeitgeist. We feel the urge, right now, for science to get in sync with a novel sensitivity of humans to recognize and explore their many modes of being, their multimodal awareness of existing, their multiple states of consciousness, their multidimensional creation and expression, the levels of symbolical signification, of the feeling-relating extended personality. The challenge is to create concepts that fit this emergence of the human consciousness, and a possible new grammar, that would generate and warrant a space of freedom in which we may experience and explore the novel sensations and mental space that are emergent in the social body. It would mean to conceptualize or express these new cognitive capacities while imagining a language more apt to translate (in a clear and understandable-for-all fashion) the enhancement of meaning, the augmentation of *semantic energy*, so that we may visualize them better, and get to incorporate the process of emergence. Many wild or "savage" potentials and dynamics are in the works today in the collective unconscious, growing and developing deep in the psyche, but the conceptualization of such enhanced mind dynamics could prove to be a harder problematique than that of their natural emergence. One thing is certain, these novel modes of enlarged consciousness cannot be formalized within a reductionist paradigm that is bound to suppress, through its foundational credos and its very strategies of control and reinforcement, whatever is not in conformity with its own technological logic.

5.2. Toward a meta-model perspective

If each domain of science instantiates a specific logfield, then we could imagine a meta-level that would put in perspective all the particular logfields. Differences in worldviews would thus be understood as seminal variety in human models, and could then be used to create a unique multidimensional mode of awareness and being – the perfect mediation between the one and the many. The challenge would be to interweave and interlace the different worldviews, the cultural diversity, and the various personal viewpoints, in a humanistic and world-conscious approach. Each person, each world vision, would thus find their place as a specificity enriching the whole, thus co-creating a "shared vision" (Senge, 1990). We are talking here about generating a dynamical process of interconnectedness, consisting in putting oneself in rhythm, in sync with the imaginative fecundity of the human and the collective unconscious.

We need to favor the emergence of a complex and flexible mind (and society) simultaneously able to be anchored in one's own being, and open to interacting in a positive and democratic manner with distinct communities and people expressing a divergence of interests and values (Dennard, 1997). Then, the challenge would be to construct a mediation space, a meta-model (Checkland, 1999) that would permit to understand the variety presented by the diverse cultural logfields of humanity, or the range of logfields expressed by science in a given paradigm. Such a global and multidimensional perspective would lead to a dynamic of anticipation deeply interwoven with intention and the creation of meaning, one that set up a convergence of semantic energies toward a future attractor (Hardy, 2003).

If our society was feeling enriched by diversity and was greeting the divergence of worldviews, we would certainly see the emergence of novel knowledge strategies, highly dynamical and holistic, and we would enjoy a heightened awareness – may be the empathic collective consciousness state that Teilhard de Chardin (1965) called *noosphere* and that he predicted humanity would one day achieve.

6. Conclusion

The brilliant success of AI systems, together with the concomitant development of Functionalism, has led some researchers to expect AI to shed light on human intelligence. Functionalism, as a philosophical school, has served as a strong basis for the 'computational paradigm' that viewed the mind as operating logical-only computations on symbolic representations. In posing that brain and body could be understood as a set of distinct functions, functionalism led to the idea that brain or hardware were mere substrates for the content, that is, they were interchangeable. What mattered was the software, the logical content of mind. Hence the hope that, one day, the content of a human mind could be 'copied' on an AI hardware.

Viewing the brain as hardware, and the mind as software is another way to express the old Cartesian split between mind and body. However, we know now that mind and brain are intricately interlaced and interconnected. In Semantic Fields Theory, it is posed as a Mind-Body-Psyche system from the start. In this MBP system, connective dynamics insure the self-organization of meaningful dynamical networks (the semantic constellations). Expectations are thus the product of multidimensional interactions and of the self-organizing logfields, that is, the matrixes of logics, patterns, and knowledge built through experience.

Also, mind is multimodal: it works not only through logical reasoning, but also through emotions, feelings, relational intelligence, artistic sense, etc. In consequence, the human cognitive system is too complex to lend itself to a replication or a 'copy' of its content. This is why the only functions that could be reproduced easily, were the system of logical rules and the set of data. However, the mind's 'content' is neither a set of data nor a system of logical rules: it is the connective dynamic itself and the self-organization of all multilevel processes, based on meaning and forever changing, learning, and evolving. The whole MBP system's complexity and lability is precisely what is allowing the evolving process called 'thinking'. And thus, even if we imagine an AI-techno system able to make inferences and to learn, even one that would be coupled with an array of sensors (smells, images, etc.) allowing it to 'understand' its environment according to human concepts and categories, this would be a semantic system alright, and able to perform cognitive acts, but it would be a totally specific, idiosyncratic intelligent system--in no way comparable to a human being.

The comparison between the multimodal process of anticipation in humans and the logical process in AI-systems suggests that we could view the two cognitive systems as having distinct properties and capacities, and instead of trying to simulate the human one, we could open the path for a kind of constructive dialogue between them. The comparison also underlines the limits of the basic tenants of functionalism: namely, assuming that 'substrates' could be interchanged. Viewing two distinct systems, to the contrary, would allow us to make the best of the very specific strength of each one and devise a Man-Machine dialog. We would thus open the way for building up a constructive exchange between human variety and AI reproducibility; between the machine capacity to control the known and the human ability to sense the unpredictable; between the precise and constrained analysis of AI-systems and the intuitive leaps of the human minds, able to shift to a new perspective and to grasp whole new levels of reality.

References

Abraham, F.D., & Gilgen, A.R. (Eds.) (1995). *Chaos theory in psychology*. Westport, CT: Praeger Publishers.

Andreewsky E. (1991). *Systémique et Cognition,* Edition DUNOD - Coll. AFCET Système, Paris

Bunnell, P. (1999). Attributing nature with justifications. *Proceedings* of the 43rd annual conf. of the ISSS, Asilomar, CA.

Checkland, P. (1999). *Systems thinking, systems practice*. NY: Wiley.

Combs, A., & Holland, M. (1995). *Synchronicity: Science, Myth, and the Trickster*. New York: Marlowe.

De Bono, E. (1970). *Lateral thinking*. New York: Harper & Row.

Dubois D. M. (2000). Review of Incursive, Hyperincursive and Anticipatory Systems - Foundation of Anticipation in Electromagnetism. *Computing Anticipatory Systems: CASYS'99 (Third International Conference)*. Daniel M. Dubois (Ed.). The American Institute of Physics, AIP Conference Proceedings 517: 3-30.

Dennard, L. (1997). The democratic potential in the transition of postmodernism. *American Behavioral Scientist*, 41(1): 148-162.

Gardner, H. (1983). *Frames of mind. The theory of multiple intelligences,* New York: Harper Collins/Basic Books.

Gibson, J.J. (1986). *An ecological approach to visual perception*. Hillsdale, NJ: Lawrence Erlbaum. (First printing: 1979).

Goerner, S. (1999). *After the clockwork universe*. Edinburgh, Scotland: Floris Books.

Goleman, D. (1995). *Emotional intelligence*. New York: Bantam.

Grès S. (1998). *Management de projet innovants et systèmes d'information*. DESS "Systèmes d'information". Institut d'Administration des Entreprises de Paris.

Grès S. (2002). *Approche pour la conception de systèmes complexes*. Paris: Les Techniques de l'ingénieur.

Guastello, S. (1995). *Chaos, catastrophe, and human affairs*. Mahwah, NJ: Lawrence Erlbaum Associates.

Hardy, C. (1998). *Networks of meaning : A bridge between mind and matter*. Westport, CT: Praeger/Greenwood.

Hardy, C. (1999). Acquiring an artistic skill: a multidimensional network, in R. Ascott (Ed.) *Reframing Consciousness*. Exeter, UK, Portland, OR : Intellect. (pp 248-252).

Hardy, C. (2001). Self-organization, self-reference and inter-influences in Multilevel Webs: Beyond causality and determinism. *Journal of Cybernetics and Human Knowing*. UK: Imprint Academic. Vol.8, no.3.

Hardy, C. (2002). Logical Fields and the dynamics of change: From conflict to cooperation. *CD-rom of the Proceedings* of the 46th annual meeting of the Intern. Soc. for the Systems Sciences (ISSS), China, 8/2-6.

Hardy, C. (2003). Multilevel Webs Stretched across Time : Retroactive and Proactive Inter-Influences. *Systems Research and Behavioral Science,* vol 20, N° 2 (pp 201-215). (Special Issue on: Systems Thinking for Social Responsibility.)

Heidegger, M. (1992). *The principle of reason.* Bloomington, Indiana: Indiana University Press.

Jung, C.G. (1960). Synchronicity: An acausal connecting principle, in *The collected works of C. G. Jung: Vol. 8. The structure and dynamics of the Psyche,* (Bollingen Series, XX), Adler G, Hull RF. (Eds.), Princeton, NJ: Princeton University Press.

Jung, C.G. (1966). *The Collected Works of C.G. Jung, Vol 7: Two Essays on Analytical Psychology*. Bollingen Series, XX, Adler, G. & Hull, R.F. (Eds.), Princeton, NJ: Princeton University Press.

Koestler, A. (1989). *The act of creation*. New York: Penguin.

Krippner, S., & Welch, P. (1992). *Spiritual dimensions of healing*. New York: Irvington.

Kuhn, T. (1970). *The structure of scientific revolutions*. Chicago, Illinois: Univ. of Chicago press.

Kuhn, T. (1971). Les notions de la causalité dans le développement de la physique, in M. Bunge (Ed.), *Théories de la causalité*, Paris: PUF.

Latour, P. (Ed.) (1989). *La science en action*. Paris: La découverte.

Leroi-Gourhan, A. (1964). *Le geste et la parole, technique et langage.* Paris: Albin Michel, Sciences.

Maturana, H. (1980). Biology of cognition (written in 1970), in Maturana H & Varela F, *Autopoiesis and cognition*, Boston: Reidel.

Maturana, H. (1999). Autopoiesis, structural coupling and cognition. *Proceedings* of the 3rd annual conf. of the ISSS, Asilomar, CA.

Michaux, H. (1980). Infinite turbulence. Riverrun Press.

Petitmengin-Peugeot, C. (1999). The Intuitive Experience. *Journal of Consciousness Studies*, 6 (2-3), 43-47.

Poincaré, H. (1952). *Science and method.* New York: Dover Publications.

Pribram, K.H. (1991). *Brain and perception: Holonomy and structure in figural processing*. Hillsdale, NJ: Lawrence Erlbaum.

Reber, AS. (1993). *Implicit learning and tacit knowledge*. New York: Oxford University Press.
Robertson, R. (1995). *Jungian Archetypes. Jung, Gödel and the History of Archetypes*. York Beach, Maine: Nicolas-Hays.
Senge, PM. (1990). *The Fifth Discipline. The Art and Practice of the Learning Organisation*. New York: Doubleday.
Smith, L. (1995). Stability and variability: The geometry of children's novel-word interpretations. In F.D. Abraham & A.R. Gilgen (Eds.), *Chaos theory in psychology*. Westport, CT: Praeger Publishers.
Stengers, I. (Ed.), (1987). *D'une science à l'autre; des concepts nomades*. Paris: Seuil.
Teilhard de Chardin, P. (1965). *Phenomenom of Man*. New York: Harper Torch Book.
Von Bertalanffy L. (1967). *Robots, men and mind*. New York: George Braziller.
Zalila, Z. (1996). Sciences humaines et logique floue. Cours de DEA de l'Université de Technologie de Compiègne.