A "4d" vision about knowledge physiology

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Abstract: As Wittgenstein pointed out, the lived concepts articulate their meaning (reduce their ambiguity) at the moment (in the context) of their use. Learning and application of knowledge in actions- are interlaced processes, "sculpting" progressively a cognitive destiny, which, in interrelation with other individual adventures- determinates a socio-cognition history. The dynamics of knowledge use is consubstantial with its evolution. The "pragmatic Web" promoters with "4d" visions should scrutinize the global physiology of systems (processes) including persons, objects and activities- that involve knowledge. In the GEFO and LORNET projects, I have introduced "functions": models of activities, usable in their coordination, based on evolving competences. These "active use cases" belong to an intermediary layer between the reality and its image in the conceptual mirror. Finally, the model that I propose replaces the "layered vision" with one based on "interpenetrated reality levels".

1. Vision

1.1 Concepts? Ambiguity, contextuality, inseparability, explanation

Despite if we like it or not, the evolution Wittgenstein vision is an important meditation source for those attracted by a "pragmatic approach" of the "semantic Web". The transition of such a subtle and intense thinker, from the search of a language reflecting- without ambiguities- the meaning of concepts… to the conviction that such a univocal sense does not exist, deserves a profound exploration. The essence of the "pragmatic" conversion of Wittgenstein is the revelation that the semi-sense of a "generic" concept is completed ("desambiguousated") locally, depending on the context use of every particular instance, within the framework of the language/action "game" in which the representing word is implied (used).

I believe that he encountered this intuition also as a result of the frustrating experience that he lived, while trying to teach scientifically how to think, to read and to write to children of a Moravian village... Being influenced by readings like [1],[2] I also confer a diffuse and “undulatory” essence to concepts, after a long-lasting experience dedicated to the comprehension and to the modelling of the explanation phenomenon (synthesized in my doctoral thesis- [3]. My conclusion was that "explanation" is based on the cognitive consonance lived by a human pair.

Phenomenology reveals the unity of the (observed object / observing subject) pair. We can extend this vision to take into account the shared character of concepts, including, in a single whole, the represented subject, the representing symbol and the human pair communicating on the subject, through the representation. Thus, we obtain a systemic meaning of a "concept", realizing that its physiology is based on cognitive consonance, that "knowledge" IS cooperation.

Even if we adopt discrete existential models, we may arrive at a systemic perception. The physical and conceptual "entities", tied by relationships, create systemic units and determine their global behaviour (physiology). Conversely, the physical and cognitive processes sediment structures (entities and relations). The perception of the "spatial" unity of the conceptual space must be combined with that of its temporal integrity. A complete systemic vision reveals this existence-becoming duality. From here also derives the interdisciplinary character of the studies on this subject, so difficult to coagulate in a unified (transdisciplinary) vision (as the one prone in [4]. The pioneer works of the (cognitive) living theorists, like Varella and Maturana ([5],[6]) also stress the integrity of the "autopoetical" systems (having the morphology continuously re-modelled by a physiology dedicated to the identity conservation).

The procedural-systemic approach is natural for the researchers interested in "distributed cognition" (as [7], [8]). In the same way a cell's metabolism coexists and interferes with the metabolism of the organism it belongs to, the individual cognitive metabolism is "situated" in that of the community (see also Clancy conclusions after some AI drawbacks [9]). Thus, communication can be seen as a relationship between two distinct cognitive systems, but also as a manifestation of the cognitive physiology of the human species' system, ensuring knowledge reproduction.

1.2 Paradigms? Systems, processes, 4d vision, complexity.

As Mizocouchi signals (in [10]) each of us approaches the "semantic" debate based on his position face to the primitives of thought: space, time, matter, entity, relation, conscience etc (see an example of polemics in [11], [12]). A splendid and still actual demonstration of this "divide" may be found in the classical Leibnitz-Newton dialog. For the partisans of a "4d type" existential vision- like the realities (entities/processes) which they reflect- conceptual coagulations evolve continuously- on a “trajectory” which determines their flowing existence. That is why, the dynamic of the concepts- on thee one hand- and their history- on the other hand- cannot be separated from their essence. Concepts become. *Knowledge + evolution= learning.*

My vision [13] use a holist - systemic key of interpretation (formed while climbing the scale of readings like ([14], [15], [16],[17]) The modern research on the structure of matter (as pointed in [18],[19]) emphasize on the dualities: structure - process, matter - energy, particle - wave and have produced “theorems of inseparability” of the physical entities… Therefore, I cannot see a base for still believing that the cognitive space (which reflects this diffuse unitary reality) is structured "corpuscularly" and can be modelled like a network of conceptual blocks, clearly separable, univocally defined, interconnected through problematic creatures… named “relations”. Perhaps… precisely on language's ambiguities. They allow us to

hide our philosophical or epistemological options (see for example the debates about the "explanation logic" ([20],[21]) or the importance of adopting a modal, fuzzy or contradictory logic (as Lupasco - [22]) behind a claimed objectivity (see also my testimony in [23]) . Encountering fundamental problems like the relation between the existence and the essence, the external object and the internal reflection, the representative and the representation, the mechanical and the living system - computer scientists must respect the profoundness and the importance of the implied topics.

I believe that the use of the term “ontology”- to designate gnoseological instruments- can produce undesirable confusions. I prefer to use the expression “semantic reference system” (the “references” becoming “semantic coordinates”) - also to include other forms of concepts representation. A reading of Kant's "Critic of pure reason" can remind us the depth (difficulty) of subjects approached with too much ease. I confess that after working hard to pursue the argumentation of Kant concerning the distinction between the analytical and synthetic concepts (not to convert to apriorism but to understand the difference between narrating fortuitous events and describing deductible developments) I gained only the suspicion that I don't know yet how to ask such questions. And with a serious prudence.

About what are we speaking when we refer to "knowledge"? About the cognitive experience of someone at a given moment, about the entities (external, internal, real or imaginary, concentrated or diffuse) to which it refers, about the representation (reification) of the internal concepts on a material support (signs, models, words, etc.) or about some references towards these representations? Which is the "sentence P"? That thought, that emitted (orally or in another form), that coded in the "message" (incorporated in its support)- or that being perceived (understood, memorised)? When is A in a communicative relation with B? When- without knowing that he is observed by B- he makes gestures that this one perceives and interprets- knowing that they are not addressed to him? When he acts, conscious that he is observed by someone who do not know that he is aware. When he proceed demonstratively- based on an agreement between him and his observer? What kind of modelling can distinguish between these nuances?

Even if they stand at the base of the organization of processes as communication, information, instruction, support, the "objective and a-personal knowledge", not incarnated in a conscience (but incorporated in an abstract "curriculums") are problematic … concepts (let us not forget the crises produced by some epistemological paradoxes in mathematics and physics).

1.3 Modelling or influencing? The cybernetics of the reality - image pair.

Figure 1 suggests the distinction between an object (person, process), its reflection in cognitive spaces, the secondary object (sign) used for the representation of the primary phenomenon (or for its internal image), internal images produced by the representation, external signs of these images, and so on…

The person A2 is involved in a process P (procedure, phenomenon) that implies also a person A3 and two objects X and Y. He creates an internal image p1 of the

process P, implying (we don't know if separable) images x1, y1 and a3-1 (corresponding to external elements) and the Me-1 image of his own participation (based on his self-consciousness).

The process P is observed from outside by an observer A2 that builds an internal image reflecting somehow the implied elements. We can presume similarities between x1 and x2, y1 and y2 (although we can not speak about their identity). But, the posture of the a1 image is essentially different, as a "Him" instead of a "Me" (in a similar position as a3-2, as long as the observer does not embark in dialog with A1, transforming the "Him" into a "You").

To be able to communicate with A2 (for example to give him advices concerning its actions in the P game) A1 resort to an exteriorisation M (model, textual message, verbal sentence, etc.). This model "represents" (in accordance to a convention shared at least between him and A2) the P situation - signalling objects (x' si y'), actors ("him "- for A3 and "you"- for A2) and processes (symbolically- the isomorphic representation of a processes by a "processual sign" being not usual).

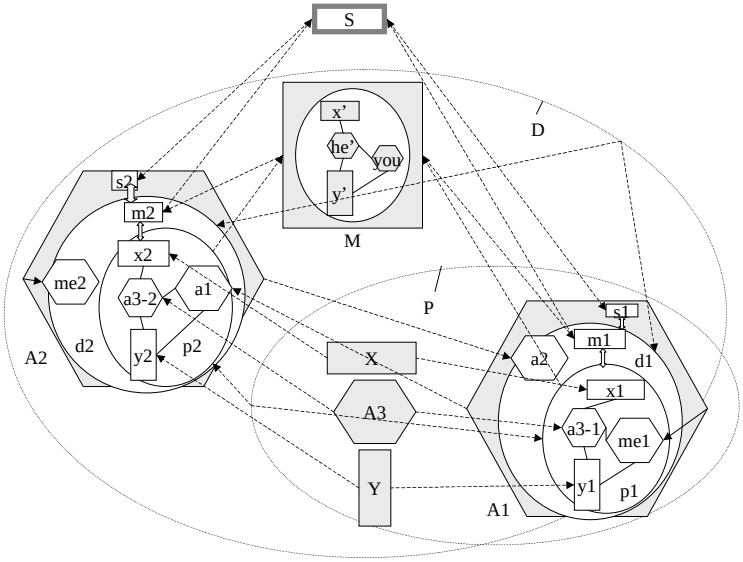

Figure 1: external fact, internal image, representation- a recursive chain

A1 can watch the model M (as an external fact) forming an internal m1 image - correlated with that of the modelled phenomenon p1. He has also a perception of the communication process D in which a2 represents the interlocutor and p1 the discussed subject.

The private images m1, m2 of the M model of the P phenomenon, can, in their turn, be symbolized (exteriorised) - with shared signs (S) - usable in a meta- dialogue.

This spiral (recursive) process can continue indefinitely, producing a "notional bundle" (similar to that obtained by putting two mirrors face to face) and creating a mixed P-D phenomena and the blend between the P' and D' images. This circular (cybernetics) situation becomes difficult to describe graphically, especially when the observers participate in the observed process or use the external model of the

phenomenon, as an instrument facilitating its implementation. (Between M and P some physical connections may be realised- allowing for example the launch/control of the X application by the aim of the x' button which represent it).

We are not astonished enough by the force of the narrative language, which can combine coherently external and internal incursions, description and metadescription, stories about what I am doing (I want to do), what are You (I believe that you are) doing, what we do (we must do) and what others do (have to do).

Probably, more important than the organization of taxonomic "ontologies" as (animals: fish, birds, etc.) or even of "task" oriented ones (which don't process the labels but label the processes- an example in [24])- attacking a problem as (subject: "me", "you", "he", "us", "they") could highlight the *contextual dimension* of the "concepts" concept.

Influenced by bio-cybernetic visions (as [1] and [6]) which I applied intensely as engineer of electronic regulatory loops, I observe the physiology of the total system, formed by a primary external reality (objects, persons, process), its internal reflections (evolutionary cognitive spaces), the external reflection of the conceptual spaces (language, reference system, representations, models, messages) an so one - bound circularly, in an infinitely recursive game.

2 Short history of a research

I can't afford to describe in detail here the succession of experiments, which led me to the vision and questions exposed in the first paragraph and to the proposals of the paragraph 3. I will only signal the main perplexities:

1 Between the semantics of the explanatory cooperation, its instrumentation, physiology and modeling. My interest for the semantics (didactic) of explanation arose from the experiments (successful or unhappy) as pupil, student, teacher, trainer in industry. In my PhD thesis [3] I have tried to conceive a model for the (instrumented) explanation phenomena

2 Between knowing, doing and to co-acting. Throughout my experience as learner/teacher studying/presenting procedural chains, I have perceived the intimate relationship between "doing to learn" and "learning to do". Hence the interest for the study of pedagogical co-action - insufficiently approached in CSCW [25].

3.Between procedures' emergence, modelling, orchestration and reproduction. Having the task to integrate the LICEF applications [26])- I observed that the most fluid approach was to facilitate the transition of a model from the hypostasis of a phenomenon image to that of an interface for its implementation (coordination). Thus, I arrived at the formulas for procedures reproduction explored with the GEFO "function manager" [27].

4 Between artificial intelligence and semantic matching facilitated by a synaptic computer network I had tried to deepen the issue of distributing the initiative between human and artificial agents [25], arriving to the conclusion that the computer network can provide matching, contact, contract and management services- forming a "synaptic" infrastructure for the collective brain's physiology

5 Between local applications, services providers and expanding distributed structures After analyzing the inter-operation between LICEF's and other's systems I conceived a distributed, evolutive and extensible architecture (by recursive aggregation) for the "middleware" TELOS (tele-learning operating system- [28])- which seeks technical and semantic inter-operation between educational service sources and resources repositories, accessible through Internet

6 Between complexity, perplexity and pragmatism: models and meta-models. A solution to face complexity is to use models of the phenomena (to be understood, equipped, orchestrated, reproduced) and metamodels of their management trough models. In GEFO [27] the simultaneous observation of piloted and piloting procedures (metafunctions correlated with the functions of which they model the lifecycle) allows as the definition of "life modes"- conforming to a *evolution typology*.

7 Between knowledge, references and competences. The indexation of persons, documents, ant activities on a common reference system produce a "semantic aggregation" [29]. But such "coordinates" are not sufficient to observe and facilitate learning. The characterization of someone's relation with a concept requires "competence indicators" [30]. Thus the circle of my research has been closed: starting with the semantics (didactic) of the explanation, I passed to the physiology of its emission, perception and communication, from there to the instrumentation and the organization of instructional systems, to finally return to knowledge- analyzing its global physiology.

3 Proposals

3.1 Two interdisciplinary fluxes and three communication problems

The desire of organizing externalised knowledge structures and modelling cognitive processes preoccupies domains like Knowledge management, Informational and Instructional Systems, Cognitive science etc. Recently, the main engine of this disciplines group is the interest to increase the relevance of information retrieval in the Web labyrinth. I will summarize the passage from the “semantic Web” vision (exposed in [31], [32]) to a “pragmatic Web” approach (exposed in [33], [34]) as a shift of the attention from the knowledge representation structures to the physiology of their use- in the context of communitary cognitive evolution. This is the first trend (stream) met by my proposal.

The second, complementary - come from the opposite direction of the fields traditionally interested in the modelling, orchestration and the management of the (co-operative) procedures implying objects, people and computer agents (CSCW, DSS, CSCL etc- [8]). I also signal, in this context, the increasing interest for problems like: reflection of the communities life [35], instrumentation of their creation or physiology, "narrative" descriptions and "scenario based design" ([36]) evolving systems ([37] and "shared understanding through cooperative design" [38] etc. The refinement of "orchestrating tools" for man-machine ensembles physiology- requires the semantic indexing of the participating elements, face to semantic reference

systems organized so that they facilitate deductions, support services etc (ontology being a good candidate- see [10]). Which arises (see [30]) the difficult problem of the *synthesis* of an optimal organization mode for a reference system- dedicated to sustaining a certain semantic physiology.

The meeting between the “procedures for knowledge” and “knowledge for procedures” trends is accelerated by three problems that create a pressing need for knowledge explicitation [10]. The first - is the facilitation of the communication (coordination) between the human agents (partners) sought in semiotics, communication science, linguistics, CMC, CSCW, DSS, etc. The second - is the attempt to facilitate the supportive intervention of machine agents (retrieval, matching, monitoring, etc.) on the basis of a “comprehension” of the events and messages produced by persons. The third is the desire to organize a “communicative web” between the distributed computer components, which need reciprocally "machine services". The partial overlapping of these three problems creates synergies but also confusions (for example on the appropriate granulation of the representations dedicated to human - human, human - machine and machine - machine communication).

2 A pragmatic model of the knowledge physiology?

My proposal (detailed in [28][27] [29][39]) and included in the conceptual architecture of the TELOS system) is placed at the intersection between the two trends, trying to differentiate and interlace the three communication problems. It is suggested in figure 2

S The society basic level

The entities and process (which incorporates also knowledge) taking part to the life (history) of the inter-related various communities of practice (among which- the community C) are immersed in the society basic level S. The "language" is also rooted here - and is extended by the evolutionary community spaces of conceptual representations. With a first regard, we can see in this layer only the “primary” entities (people, objects, process - represented with no-filled figures) and separate (for other levels) their images in the “mirror” of the models with semantic component (the grey zones -in the figure: N, D, Pa, Re, F, MD, Mpa, Mre,MF). But a second regard will view the models belonging also to the world S, being able for example to take part in processes and to be the object of some meta-modelling.

K The level of the conceptual representations (explicitations)

“The knowledge” used by a community is represented (clarified, declared, organized, explained) in “domains D" also usable as references (a concept being identified by its evolutive “coordinates”) and constituting the collective intellectual capital (memory). We can use various organization modes (norms) N (taxonomies, dictionaries, thesaurus, hypertext document collections, relational databases, conceptual graphs, ontologies, etc). Treating differently problems like the decomposition in sub-concepts and the declaration of associations and properties- they lead to different facilities of interpretation and retrieval. The edition of the organization norm N for the space K and of the domains modelled according to this norm (mp1 metaprocess) can be made by the mpe1 experts- having this mandate. The

modifications made as a result of the analysis phase (feed-back loops) - must preserve the integrity of already existing references (see details in [40]). If the cooperation with others sub-communities Cx of the S society is desired, and these ones use different semantic reference domains or norms, translation mechanisms (for semantic coordinates) or procedures for merging related domains- are necessary.

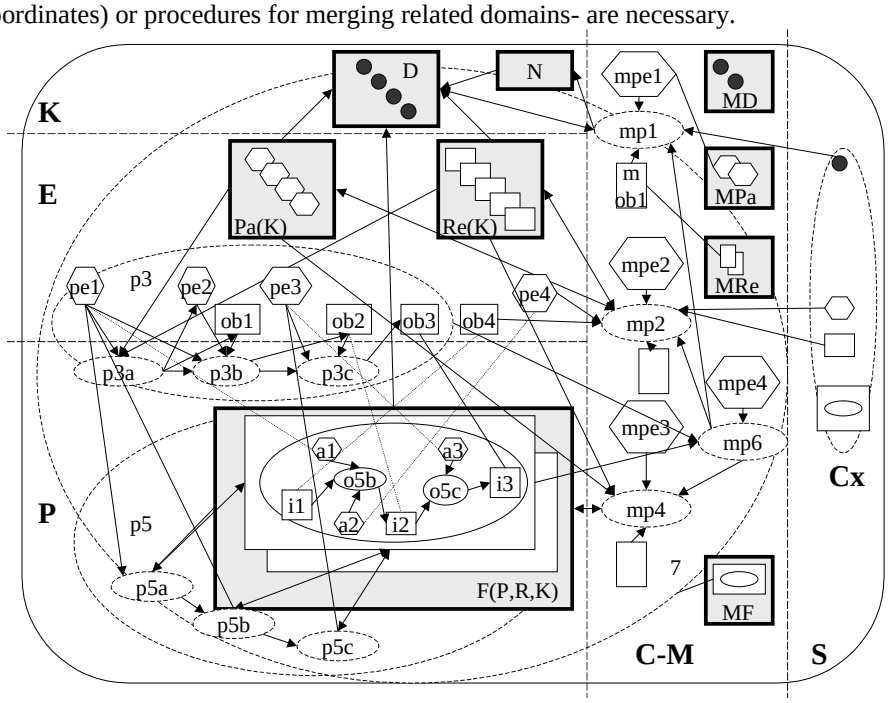

Figure 2: Reality levels composing the global knowledge physiology

E. The level of knowledge incorporated in entities and explicitated by "competences"

The living entities (people) and the objects containing messages (documents - which can be seen as explanatory paths- for the K domains) are "knowledge carriers"? The private evolution of incarnated knowledge (hidden to the community system C) occurs on the S level of the society. To sustain the support mechanisms for the processes occurring on the level P, the situation of the implicit knowledge, must be explicitated (the meta-process mp2) by using the reference systems organized at the K level. The declaration of "competences" (in "postures" as execution, assistance, recommendation, etc) can be done in the suitable fields of the metadata records, grouped in "resources repositories" (declaring the objects) and "participants directories" (declaring the persons). In order not to lose the synchronization between the cognitive reality Pe(k)-Ob(k) and its modeling Pa(k)-Re(k) the competence references can be updated during some P level processes or by feed-back loops triggered by the post procedural analysis at the C metalevel.

P The level of the (cognitive) processes and of their representations

At this level we look at the processes who take place in the C community and imply the use/modification of knowledge.

Some ones happen emergently (as process p3): a person pe1 locate (p3a) a useful object ob1 (with the help of the record re1(K) managed by the resources controller Re(K)) and a support-person pe2 (found with the help of manager Pa(K)); then pe1 uses the support for the realization of the process p3b, in which he evolves cognitively, also producing a resource ob2; using this one, another person (pe3) produces an ob3 object (which can be declared in the resources repository).

The chain of these processes can be intercepted or observed (from the exterior or the interior). On this basis we can edit "functional" models F (meta-process mp4) which comprise "actors" a (labeling the persons/participants), "instruments" i (representing the objects/resources) and operations o (abstracting actual processes) - all being characterized by properties (such as competences declarations). The functions are placed (published) in the corresponding repertory: F(P,R,K). The function editing can continue (in several sessions) by a progressive concretization (connection to the model) of participants and resources, observing the "conditions of competence". Some liberties may be kept for the execution phase (process p5) when the facilities of the "adaptable orchestrated" mode are put in value

C-M The integrated level of the community C and the of meta-processes M

The global physiology of the community cognitive system C, interlaces the processes followed at the level P, the lifecycles of the entities followed at the level E and the evolution of the incorporated concepts- explicited at the level K.

We can use a regard that separates the "primary" processes (like p3, p5) and the meta-process like: p1, p2, p4 (to which may be added p6 - the analysis and the execution of the correcting feedbacks). We will then distinguish "meta-people"(system experts like mpe1) and "meta-objects" (system editors like mob1)- declared in the meta-participant Mpa and meta-resources Mre repositories and having meta-competences, relative to meta-domains MD.

The chains of process on the C level can be modeled using "meta-functions" MF (or be orchestrated on their basis). But the representation of the relations between the world C and the meta- functions that it governs it would have be followed in a meta-meta- level… Avoiding this consequence of a phenomenological recursivity, I have used in the figure a regard that identifies the levels C and M.

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