Processes of consciousness

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Abstract – *This paper presents consciousness as the sum of describable processes, without limiting it only to verbal understanding. Consciousness is presented as a buffer space of the unconscious, accessed by any mental decision-taking processes. Consciousness is composed of sequential outputs of non-conscious processes that form, as frames in a picture, the impression of our ego continuity. The functional consequences on real-life information fusion problems are then further discussed.*

Keywords: Consciousness, conscious, unconscious, decision-taking process, information fusion, ego, alter ego, model of reality, objective.

2000 Mathematics Subject Classification: 68T01 Artificial Intelligence - General.

Motto: Consciousness is just a wondering flashlight in the dark hall of the inexhaustible factory that is the unconscious.

1 Introduction

Information fusion is not a problem easy to tackle. Coming as a natural objective from various high-demanding fields of activity, information fusion is an inovative approach on turning the immense flow of information into precious knowledge. The age of content-independent tools is reaching its peek: from the first statistical methods to the more modern data mining and text mining tools using machine learning techniques, researchers tried to automatically classify data in relevant and non-relevant disregarding the particularities of information. The future tools of information fusion need to artificially understand language (NLP) and, furthermore, consciousness, because information, as a resource, is present in a human-only accessible form. In my previous article "Premises for a multimedia Memory" [12], I've defined consciousness as the sum of processes we are aware of and that, accordingly, can be described at a latter time. Now it is time to analyze the consequences of this definition and see how well it does describe the actual human mind. The first encountered problem using this definition was the unknown origin of conscious queries on non-conscious processes, queries that were presumptively the communication channel between the conscious and the non-conscious mind.

I then realized that we are aware of what we ask ourselves and that we can reproduce verbally any philosophical question that troubles our mind, but we cannot explain the process of arriving at this question. The logical thread of sentences is not continuous. The easiest explanation could be the shift of our attention focus. Still, this only happens when mind is disturbed by exterior factors. But in the process of deep thinking or meditation, the process is not discontinued by any of those factors: instead, we are making leaps of consciousness, gestalts that inner-change our focus. At least that is what appears to our conscious minds. So, if we keep the definition of consciousness as the sum of describable processes, then consciousness reduces to a simple interface between two non-conscious processes:

Two questions arose from this diagram:

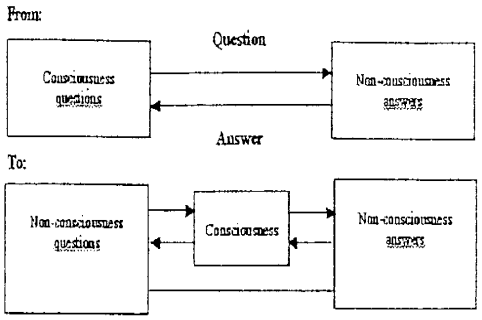

Figure 1: Consciousness is just a transit space between two non-conscious processes

1. If all questions are made and resolved inside non-consciousness why the need of consciousness?

2. If consciousness is just awareness of the outcome of our non-conscious processes where is our free will?

What we need to discover is the process that inputs the information of the transit space of consciousness and has will as the outcome. If the outcome of the process is a choice then a decision was made inside of it.

The diagram changes again according to figure 2:

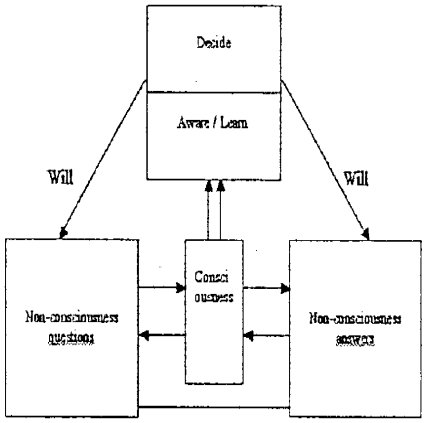

Figure 2: Consciousness is just superficially continuous

Consciousness is in fact it is composed by sequential outcomes of various processes needed in decision-making. The logic of all processes obeys the laws of neutrosophy [1] [10].

In fact, the entire triangle of non-conscious processes forms the human impression of consciousness. We call conscious a process whose outcomes are often stored in our short-term memory and that can be the object of a decision-taking process.

[1]Neutrosophic logic (or *Smarandache logic*). A generalization of fuzzy logic based on Neutrosophy [9]. A proposition is t true, i indeterminate, and f false, where t, i, and f are real values from the ranges T, I, F, with no restriction on T, I, F, or the sum $n = t + i + f$

The dialog between non-conscious processes is registered in the "memory stack" and accessed by the decision-making process. Like in a no-ending genetic algorithm, various solutions of the problem are generated, saved in the stack and then the best of them is chosen. This representation is internal and anthropological plausible[2].

To prove it, we are going to get a little bit metaphysical. If we change the labels of the diagram we will have this representational juxtaposed-analogy (see figure 3).

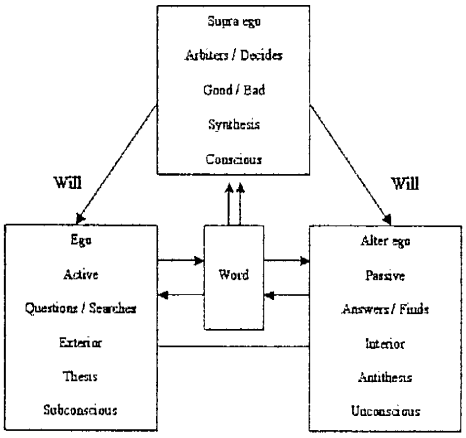

Figure 3: The common unconscious assumptions made on mind's structure sustain the 3-stage diagram [4, 5, 6].

To exploit the new discovered framework of consciousness, we need to define a set of specialized terms.

2 Definitions

Model (mental model): A particular view on information.

Key elements of a model:

- assumptions/activation
- patterns/memorized
- instances/classification
- rules/integration
- dimensions/proprietary
- queries/action
- scenarios/solving scenarios.

1. **Assumptions** = express the 'genealogy' of the model (set produced at the time of the making of the model); [function] places the model in the hierarchy of models/set also used in verbal processing;
2. **Activation pattern** = the prototype created and updated by the memorized instances; [function] activates the model;
3. **Memorized instances** = instances interpreted and memorized according to the given model; [function] the backbone of the model / they offer the prototype of the modeled reality and also the fuzzy limits of the model;

[2]These arguments can be further used as according to "Outline of a General Methodology for Consciousness Research" [1]: "empirically study our conception of consciousness ... can lead to progress on consciousness itself "

4. **Classification rules** = updated with the results of the latest classified instances; [function] rules for interpreting the new information / rules for predicting future behavior;

5. **Integration dimensions**[3] = the points of view from which the information is processed and integrated; [function] multidimensional access to memories;(value-scale)

6. **Proprietary query templates** (see query) = created in the interaction with other models; [function] cross-hierarchical processing;

7. **Action scenarios** [3] = an assembly of actions from the pool of known possible actions, valued by its chance of success and utility; [function] the processing power of the model (generating and optimizing scenarios could be solved through genetic algorithms, especially genetic programming);

8. **Solving scenario** = a particular form of action scenario, where the actions are all replaced with proprietary queries on other models; [function] the interaction scheme of the model;

9. **Synthesis mechanism** = a non-conscious version of genetic programming; [function] creates a single version of incoming partial solutions, the explicit form of information-fusion;

The above-mentioned key elements are grouped together in the following manner:

1. [4, 9, 10, 12] The **objective model of reality** = what is commonly thought as objective knowledge: awareness of space, time, cause and effect, etc. Also called the *general predictive model of reality*, because it internally represents the expected behavior of the environment in a non-interventionist scenario.

2. [1, 3, 6, 8] The **interactive model of reality** = the subjective knowledge of possible actions exercisable by the actor on the given reality. This model is context-dependent because actions are seen as possible depending on the value-scale used at that particular time.

3. [5] The **value scale** used at the reference moment.

The interactive model of reality and the value scale compose various **attitudinal models** that expresses the subjective view on the world and that is more susceptible to be prone to change.

Main reality model - The winning model at a given time. It is used as a reference plane in the model hierarchy.

Operational models (action models, solving models) – particular models that establish the interpretation and the set of possible actions for a limited part of reality.

Model hierarchy – has the main reality model as the reference plane, but can shift the analysis to any other models' point of view. 'This entire hierarchy, comprising all the models is in fact a **representational multi-space**, according to Dr. Florentin Smarandache definition (from 'Transdisciplinarity, a neutrosophic method')[8]:

Let S_1 and S_2 be two distinct structures, induced by the group of laws L, which verify the axiom groups A_1 and A_2 respectively, such that A_1 is strictly included in A_2. One says that the set M, endowed with the properties:

a) M has an S_1-structure,

b) There is a proper subset P (different from the empty set $\emptyset$, from the unitary element with respect to S_2, and from M) of the initial set M which has an S_2-structure,

c) M doesn't have an S_2-structure, is called an S_1-structure with respect to S_2-structure.

[3]Integration dimensions are given by the four value scales= Moral scale (evil-good), Aesthetic scale (beautiful - ghastly), Axiological scale (true/false), Pragmatic scale (useful – inutile).

Let S_1, S_2, ..., S_k be distinct space-structures. We define the Multi-Space (or k-Structured Space) as a set M such that for each structure S_i, $1 \leq i \leq k$, there is a proper (different from the empty set, from the unitary element with respect to S_i, and from M) subset M_i of it which has that structure. The M_1,M_2, ..., M_k proper subsets are different two by two.

Query – a request that contains information shaped to fit the activation pattern. Returns the set of applicable models;

Objective – describes a commensurable state (that can represent the fulfillment of multiple desires);

Will – represents the impulse of an objective (or its entropy);

Objective function – the *complex structure that generates new objectives; the functional ego.*

The Decisional, Questioning and Answering modules – represent the key elements of the proposed framework (see fig. 2). They are treated as modules because although they represent processing stages, they are not strictly sequential and they can all run in the same time.

3 Solving an objective. Information fusion using module dynamics.

Module 1 (the questioning module) *receives* the **objective** transmitted by the mean of **will** and *searches* for a set of questions that answer the problem according to the **main reality model**. More generally, it *shapes the queries' data* to fit the solving modules' activation patterns. The nature of the objective set in the decisional module (or stage) determines:

- the nature of the attitudinal model;
- the effective time frame of solving;
- the vegetative functions to be engaged (and their biological counterparts);
- recall of past experience and solving strategies.

On the basis of the attitudinal model, **module 1** establishes the *solving strategy*[4] (as a set of queries/questions). Usually the solving strategy is not complete. If a decision must be made on the next step of the strategy, this itself becomes an objective and a solving strategy is searched. There could be multiple levels of embedded solving strategies, but the nature of the last of them is always verbal. The question that arises is: *What is the next step?* At this level formal processing comes into play and the problem is solved using abstract representations[5]. A solving strategy is produced dynamically by module 1 in dialog with module 2 (the solving module).

Module 2 (the answering module) *receives* the **question (pattern)** and *searches* for **eligible models** to describe it. If none of the models fully answers the question, further processing is needed. The set of models must be restricted and **another decision takes place.** After that, **further questions are made**, according to the elected model.

If no alternative models are detected in the unfolding hierarchy no other decision process is started so the intermediate dialog is not saved into consciousness. The attention focus remains on the last consciously chosen model. The subsequent queries are all non-conscious:

Objective O – Question L_1

To Answer L_1 Question L_2 according to M_1

To Answer L_2 Question L_3 according to M_2

...

To Answer $L[n]$ do $M[n]$

[4]An evolved form of action scenarios.

[5]The abstract form of symbols entices the ability to double-references (referring references), to talk about a previous discussion, for example.

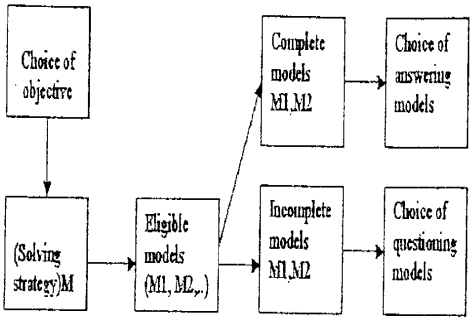

Figure 4: The decision module can be recurrently called inside the other modules.

Module 3 (the decision module) - The decision module is unique for all the models. It is called anytime when a high-uncertainty choice must be made. It *receives* the **non-conscious outcome** and *decides*:

a) in the case of a unique model M_1, if M_1 is suitable for solving the given problem. If not:

- The question is rephrased (the data is reshaped – calls module 1)
- Another model is searched (calls module 2)

b) in the case of multiple competing models (M_1, M_2, M_3, ...) which subset provides a better action scenario.

The resulting scenario is a synthesis[6] of actions chosen on the estimated probability of various interpretative models (M_1, M_2, M_3, ...) and on the estimated probability of future behavior according to each model. This mix aims to reduce the overall risk and to maximize the profit.

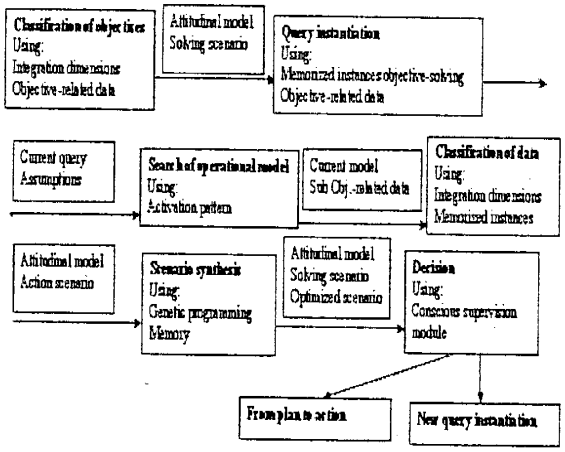

Figure 5: Simplified processing diagram for the 1-query, 1-model case

[6]To make the synthesis possible, all the actions must be translated in a set of functions that increase/decrease proximity to the objective. The functions will be optimized using genetic programming [7]

4 Model construction

Constructing a model always implies a search. There is no coincidence we are using expressions like *searching for a model* or *finding a model.* The search for a new model starts with the new acquired data and the results of failed classifications according to the models normally used. First a set of rules is searched to map the input and the observed output.

The simplest set of rules will be the rules of memorization itself: instance-based. **But mind recognizes them as describing the same reality**, so they must be coherent as a whole. To solve that, mind emits a number of generalization rules that fit most of the data[7] . If the rules contradict the meta-model but still have strong local generalization capacities, the model is considered incoherent with its surroundings and it is isolated as an operational neutral-model (waiting to be coupled with or overthrow the main theory).

If the *generalization* rules do fit with the main reality model, it begins the search for a particular set of rules to explain the contradictions (exceptions) with the main theory. Normally, there is not enough information to single out only one set. So, we will have a set of *probable rule-sets*[8] for the new data.

Inside this set the search is done according to various **dialog strategies**:

- the ego and the alter ego show the pros and the cons of a rule-set using the same main model (inner-coherence);
- the ego and the alter ego are playing the accepted model of reality (meta-model) and the modified model of reality (if the contradiction would be a main rule).(thesis, antithesis, synthesis)(anti-model);
- the ego and the alter ego emulate the main model and one of the operational models partly contradicting the main model (neutral-models) (a new model could represent a link between them or an argument for one of the models). However, a new model is not easily accepted as an alternative to the old meta-model, because it lacks the data to sustain a complex set of generalization rules. Normally, a new model of reality appears after a series of powerful mental experiences (revelations).

Example:

Main model: *Everybody likes me.*
New data: *Dana doesn't seem to like me.*
Rule sets:

Model (hypothesis)1:	Model (hypothesis) 2:
Dana doesn't like me.	*Dana likes me.*
	Dana hides this very well.

Dialog strategy no. 1:

Model 1: *Dana doesn't like me.*
Ego Pros: *She showed me that.*
Alter-ego Cons: *Actual contact with Dana/Past positive experience.*

Model 2: *Dana likes me. Dana hides this very well.*
Ego Pros: *Actual contact with Dana / Past positive experience.*
Alter-ego Cons: *She showed me that. She said it to other persons.*

Because of the difference of the pros and cons nature, model 1 wins as the result of direct experience.

[7]The generalization rules are part of the assumptions and help to locate the model referring to the main model of reality. The generalization rules are in fact the activation pattern of the model. The particular rules further model the data inside the model and represent its innovation degree

[8]Most of the rules are already located in various operational models. The origin of the selected rules is saved as the assumptions of the model.

Dialog strategy no. 2:

Model 1: *Dana doesn't like me.*
Ego-meta-model (thesis): *Everybody likes me.*
Alter ego-anti-model (anti-thesis): *Nobody likes me. They all pretend. Dana is the exception.*

Both of the models are too strict. A synthesis is needed: *Some of them like me, some of them pretend and some of them don't like me and don't pretend (Dana).*

Model 2: *Dana likes me. Dana hides this very well.*
Ego meta-model: *Everybody likes me.*
Alter-ego anti-model: *Everybody likes me. They all show it. Dana is the exception.*
Both of the models are too strict. A synthesis is needed: *All of them like me and some of them show it (because some of them don't show it = Dana).*

The meta-synthesis:
Some of them like me and show it (< PP), some of them like me and don't show it (PD), some of them don't like me and pretend (< PP) and some of them don't like me and don't pretend (PD).

As we can see the sum of the probabilities (PP=past probability, PD=direct probability) is more than 1.

Dialog strategy no. 3:

Model 1: *Dana doesn't like me.* Ego meta-model (main): *Everybody likes me.* Alter-ego neutral-model (underground): *There is no real love between people. Only mutual interest.*

'Dana doesn't like me' can be a relative pro for the non-model. However, it is the nature of the contradiction that is decisive. For example: 'Dana is green.' could be a pro for the non-model: There are people from outer space.

This brings into the discussion the implicit assumptions of the main theory. The origin of these assumptions is hierarchical inside of a class of models. Classes can be unified only when they have the same assumptions from a starting point.

Ego and alter ego

Inside the brain, time, or should I say past, has no meaning. Decomposing parallel processing in two models of ego and alter ego is just a mean to superficially understand it. Because of memory there is no difference between space and time: comparing two models M and $M+1$ that occurred sequentially in time is done in spatial processing[9].

The uneasiness of understanding mind's functioning is due to the fact of time-independent information (relevant existent information doesn't have to be really located; it just 'pops' into consciousness: something appears in consciousness when a conceptual model is properly activated). So various models coexist in non-conscious.

Inner speech

Sequential awareness of parallel processing gave birth to inner speech – an emulation of communication between two parallel processes. Consciousness validates the results of non-conscious using various frames: For example, from the time-frame perspective: the short-term actions must not contradict with the long-term strategy.

[9] M produced $M+1$, but M is not replaced by $M+1$: they run in parallel and can be compared.

Along the process of solving the objective the nature of the operational tasks can change and determine a shift in the attitudinal model. If the attitudinal model changes, the conscious switch between two models is needed because there is no reference point for the fitness functions of the models.

5 Conclusion and further development

The design of the present processing framework is in fact the first stage of a fully developed autonomous learning agent, capable of independent information-fusion processing. The present paper is the third in a series [11, 12] that aims to establish the theoretical principles of its functioning. Further theoretical discussions are needed in the following areas: drawing a parallel with the various stages of consciousness [2], tailoring a viable objective-function, establishing information-fusion capacities (synthesis) capacities using genetic programming, taking working decisions under the long-short term contradictions pressure. The articles to follow will analyze each of these subjects.

References

[1] Antony M.V., *Outline of a General Methodology for Consciousness Research*, Anthropology and Philosophy 3 (2), pp. 43-56, 1999.

[2] Eliade M., *Mythes, Rêves et Mystères*, Edition Gallimard, Paris, 1957.

[3] Frese M., Sabini, J., *Goal directed behaviour: The concept of Action in Psychology*, London: Lawrence Erlbaum Associates, 1985.

[4] Freud S., *The Ego and the Id*, (The Standard Edition of the Complete Psychological Works of Sigmund Freud), W.W. Norton & Company, September 1990.

[5] Hegel G.W.F., *Phenomenology of spirit*, Oxford University Press, 1979.

[6] Jung C.G., *The Archetypes and The Collective Unconscious*, (Collected Works of C.G. Jung Vol.9 Part 1), Princeton Univ. Press, 2nd edition, 1981.

[7] Michalewicz Z., *Genetic Algorithms + Data Structures = Evolution Programs*, Springer Verlag; 3rd Revision edition, 1996.

[8] Smarandache F., *Mixed Non-Euclidean Geometries*, 1969.

[9] Smarandache F., *Neutrosophy / Neutrosophic probability, set, and logic*, American Research Press, Rehoboth, 1998.

[10] Smarandache F., *A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Probability, and Statistics*, (Second Edition), American Research Press, Rehoboth, 2000.

[11] Vasile F. C. , *The building of an artificial memory, the first step towards the artificial intelligence*, Journal of Economic Informatics, 2002.

[12] Vasile F. C. ; *Premises for a multimedia memory*, Proceedings of the International Conference on Economic Informatics, Bucharest , Romania, 2003.