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► **To cite this version:**

Bowen Sun, Xiaofeng Wang. The Model of an Explanation of Self and Self-awareness Based on Need Evolution. 5th International Conference on Intelligence Science (ICIS), Oct 2022, Xi'an, China. pp.29-36, 10.1007/978-3-031-14903-0_4. hal-04666453

HAL Id: hal-04666453

<https://hal.science/hal-04666453v1>

Submitted on 1 Aug 2024

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The Model of an Explanation of Self and Self-Awareness based on Need Evolution

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Abstract. The nature of the self has always been an unsolved problem. This study combines a biological theory of the essential features of life with a review of views of the self in philosophy, brain science, mathematics and artificial intelligence. Combining the primary needs of living things with evolutionary theory, a new explanation of the fundamentals of life is provided. The primary needs of life are centred on energy and the transmission of information about oneself. These two intrinsic needs combine with the environment to form a new universal need and a necessary mechanism. And driven by the need the organism's perception of its own needs and state gives rise to self-awareness. Based on this new theory, an iterative model of the evolution of needs and an evolutionary model of the self are proposed. These models are alternative interpretations of the self and self-awareness, and offer improved directions for machine simulation of artificial intelligence.

Keywords: Self · Primary needs · Evolution of needs.

1 Background and Significance

The nature of the self has long been an unsolved problem for human beings to contemplate, and has been investigated by philosophers. With the rapid development of brain science and life sciences such as neurobiology, many famous neurobiological and cognitive scientists have joined the research bandwagon and tried to study the self from the perspective of neural mechanisms. Mathematicians and experts in artificial intelligence and information technology have begun to explore the issue from the perspective of models and engineering applications, and have achieved some enlightening research results.

There are three main dimensions to the study of the self.

- Philosophy and psychology
The study in the nature of the self and the mystery of life is mainly based on the relationship between human with society, environment, nature and the universe. In the field of philosophy and psychology, the most representative viewpoint is the philosopher Descartes "I think, therefore I am"[4].
- The Brain and Neurobiology
Reflections from neurobiological experiments and cases exploring the brain and biology of the self. [2] explored the self and self-awareness in terms of

evolution and brain evolution. A threefold self of autobiographical selfcore selfproto self is proposed.

- Mathematics and Artificial Intelligence [10] described the personified entity-the ‘self’, through five attributes: identity, physical embodiment, mental states, experiences, and reflections on how others may think about oneself. To explain self-awareness, a brain inspired model of self-awareness is proposed.

Scientists in three fields(philosophy, brain science, mathematics and artificial intelligence) offer perspectives on the self from their own perspectives. We believe that if we describe life as matter and information, the most important parts of the self, apart from the physical organism of life (matter), are the two parts of needs and mechanisms (corresponding to the information part). All life has needs, and needs drive the evolution of life. All the activities of living beings are a continuous process of satisfying various needs. This paper proposes a model of the self based on the evolution of needs to explain the self and self-awareness from another perspective [9].

2 The Nature and Needs of Life

2.1 The Nature and Representation of the Self

We believe that the nature of the self should be the same as the nature of life. In terms of the relationship between the organism and its environment, the self, representing the organism, is the starting and origin of observation of the world. This starting stems from the birth of life. With the development of perception, it grows to become the observer and manager of life, the system that identifies and controls the relationship between the object and the environment on behalf of the living object. Only if these conditions are met can the self be characterised and self-awareness explained.

2.2 The Primary Needs and Principle of Life

The nature of life involves the structure and origin of life, and there is no universally accepted conclusion on the origin of life. However, there is a relatively unanimous consensus that life consists of both material and information [3, 11, 7].

Being alive is not only a primary needs of living beings, but also a goal to be pursued and a source of various needs. The primary needs of life are thus briefly summarised: energy and the transmission of information about oneself. Further, taking into account the history of the evolution of life, we have the following primary principles of life [8].

- All life has primary needs that are endogenous to the organism and live and die with it.
- In an open and changing environment, the needs of life change in response to changes in form and environment, but the primary needs remain the same.

- The primary needs inherent in all organisms are the fundamental driving force behind their evolution. And all life phenomena are the result of the internal needs of organisms acting on themselves and interacting with their external environment.

Briefly, the primary needs of life are centred on energy and the transmission of information about oneself. These two primary intrinsic needs, combined with the internal and external environment, drive and give rise to complex forms of life, giving rise to a multitude of new needs. Different stages of evolution and different types of life have different expressions of life forms and needs.

3 Evolution and Representation of the Needs of Life

On the basis of the previous arguments we can argue that

- primary needs and life are essentially the same and unified. So this primary needs, which is endogenous to the organism, should be the central feature of the primitive self.
- As life evolving, needs evolving and expanding, the primordial self also evolves and develops.

3.1 Needs Representation and Original Self-Evolution in Single-Celled and Complex Organisms

Pheromones in the Reproduction of Budding Plant Yeast The budding yeast is a mononuclear fungus with two reproductive phenotypes [5], a and α , each secreting a a and α factors, a peptide pheromone. a cells secrete an a factor that also expresses a GPCR as a receptor for another α factor. And α cells secrete an α factor that also expresses a GPCR as a receptor for another a factor. In order to reproduce and mate, the opposite cells secrete peptide pheromones that activate receptors. The opposing factor and its own receptor are internalised to activate the cellular pathway. Then the a and α cells grow towards each other's polarity and produce a cell fusion. More budding yeasts are then propagated. The example of budding yeast illustrates that cells have the ability to express their needs and sense information about their environment. Thus, in addition to its primary needs (such as replicating DNA and capturing glucose), a single-celled organism interacts with its environment, including exchanging energy and information. Environmental changes, as well as organismal experiences, also alter genetic information.

The needs of an organism, such as biological perception, emotional needs and social needs, are generated by the interaction of an intact individual organism with its environment and other organisms. Thus, the core features of the 'self' of a complex multi-cell organism from a simple primitive self, it evolves into a complex 'primary self'. This 'primary self' is characterised by a number of coding proteins, neurons and neural impulses that encode the needs of the core characteristic of the 'self'.

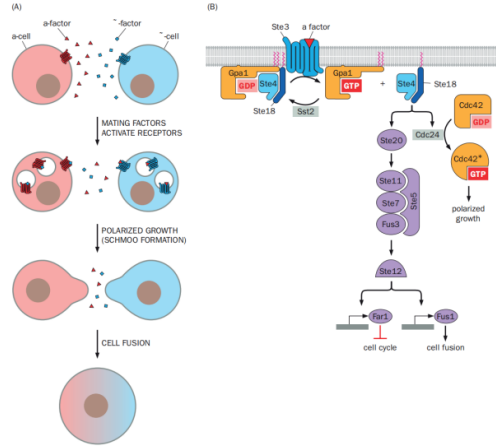


Fig. 1. Mating propagation of budding plant yeast.[6]

From an evolutionary point of view, the move from a gene-cellular self to an organismal self integrated into a system is a breakthrough. The ‘self’ of each relatively independent functioning system brings together the ‘selves’ of many cells, and the ‘self’ of a complex multi-system organism brings together the self of many systems. The ‘self’ of a multi-system complex organism brings together the ‘self’ of multiple systems. A recursive nested pattern of selves is formed.

3.2 Representation Needs and Self-Awareness of Human

What is most important in humans compared to other primates and mammals is that the brain has a well-developed neocortex. The neocortex, together with the hippocampus, provides a variety of specific neurological functions for the memory and sensory processing of information. The neocortical system includes several centres for the processing of sensory information such as language, vision, hearing, smell, touch, taste, movement and decision-making. Neural groups such as the hypothalamus and amygdala are responsible for primary needs perception and regulatory processing functions such as fear, hunger and thirst, sexual urges and emotions. The clusters of neurons form a distributed multicentre sensory processing system that works in concert with each other to process the various needs inherent in the organism[1].

The neocortex has the capacity for long-term memory, feature extraction and inductive deduction of needs and experiential information. This ability allows

human needs to evolve from simple and clear primitive needs, rich and concrete primary needs, abstract and complex higher needs. It also allows the self to evolve into a complex system of abstract concepts.

4 Self-model Based on the Evolution of Needs

4.1 Iterative Model of Needs Evolution

In section 3, the evolution of needs is discussed in terms of the evolution of life. By constantly exchanging energy and information with the environment, new needs and processing mechanisms evolve, and a new self evolves, in an interactive iterative process with reflexivity. This section further takes a formal approach to represent this self-referential reflexive interactive iterative process in a mapping to construct an iterative model of needs evolution.

X represents the space composed of all needs and Y is the space of information and the energy of inside and outside the organism.

Mapping $F: X \rightarrow Y$ represents the needs x of the living organism, the effect of energy and information on the environment through action F as y , i.e. $y = F(x)$. Mapping $Q: Y \rightarrow X$. The energy and information of the environment is y , and the effect on (self) needs through the feeling process Q is x , i.e. $x = Q(y)$. $x \subseteq X$ is the needs corresponding to the self, and $y \subseteq Y$ is the environmental energy and information associated with the self.

Q and F mathematically represent mappings, which are actions and processes for the organism. $x' = Q[F(x)]$ represents the iterative evolution of self-needs as they interact with the environment. When $x \subseteq x'$, the needs is increasing with time.

This iterative evolution takes place in specific spatial. So it is important to consider the spatio-temporal aspects of the evolution of life. $x(t+1) = Q[F(x(t))]$, t is time and represents the different stages in the evolution of life. For example, single-celled organisms, fish, reptiles, mammals, primates, humans, etc.

If t_0 is the primitive stage of life, then $x(t_0)$ is the primitive intrinsic primary needs of life (energy and information), which correspond to the primitive self. If t_1 represents the neuronal emergence stage, then $x(t_1) = Q[F(x(t_0))]$ adds intercellular communication and simple integration to the primitive needs, similar to the ascidian model. If at the t_m stage life evolves a long-term memory nervous system, a well-established metabolic system, a simple language system, $x(tm)$ is a multi-layered, complex system of needs. The sum of all needs and the corresponding need-processing mechanisms form a 'primary self'. The primary self, with its predictive and simple reasoning capabilities.

When evolution reached the primate and human stages, the needs for social communication led to the evolution of a well-developed long-term memory system, complex language and abstract concepts. And primates and humans develop the ability to abstract, reasoning, thinking and comprehension. At some point during the $m+1$ stage the brain's nervous system integrates and abstracts

information about its various needs and states into a symbol and binds it to itself. The primary self evolves into the social self.

$x(t+1) = Q[F(x(t))]$ indicates from the perspective of needs evolution that life increases in needs from simple to complex in its interaction with the environment as it evolves through time and space. The growth of energy and information in living organisms can also be observed in terms of $y(t+1) = F[Q(y(t))]$, indicating that the information memory and processing capacity of living organisms grows as life evolves, from genes, protein molecules, to neuronal cells and clusters of neuronal cells. In addition to natural biological memory, humans have invented new methods of memory storage such as paper, magnetic media and photoelectric media to meet the growing needs for complex information memory and processing.

This iterative process reveals that the mystery and meaning of life lies in the continuous transformation of energy into information. Life is a product of information and a processor of information, as well as a converter of energy to information.

Needs are the driving force behind the continuous evolution within the living organism. The evolution of needs facilitates the evolution of mechanisms for the representation of needs and the management of needs, forming the self and self-awareness. The self and the model of self evolution are further explored below.

4.2 Evolutionary Model of the Self

Self-Awareness Self-awareness is an organism's perception of its own needs and state, driven by the self (needs). The needs-centred self of single-celled organisms is still in its infancy. Mammals have long-term memory, and some ability to integrate abstraction, and a needs-integrated abstraction of the self begins to emerge. Some animals that live in packs and cooperate, such as wolves, have some language and have the need to express themselves and their self-perception, i.e. awareness. Needs is integrated and abstracted into a speech. The needs is integrated with the state of the self and map to the brain nervous system to gain attention. The sum of the needs of the biological individual is the connotation of the self. The organism's degree of self-awareness of this abstraction of needs constituting the self varies, depending on the ability to abstract and predict.

Embodied mapping is a process of abstract mapping of information about the organism's own self to its own brain. This is because the brain is already equipped with information about its own various needs and states (functional areas of the cerebral cortex). But it may not have integrated the abstraction into a concept. The establishment of the self is completed when the abstraction is mapped into a concept driven by needs.

The human brain has a highly developed neocortical layer. The neocortex is capable of integrating and abstracting the various needs and state information transmitted to the brain's nerves into a representation of the need bundled with symbols and with itself. The expression of this operation is the self. It is a process of embodied mapping of needs. This process is not just a symbol but also manipulates the biological individual with a representation of the highest

level of need. This means that the mapping goes both ways, from the abstract ego which in turn affects needs and itself. This process constitutes the limit loop of the neural network system. Brain networks are distributed and dynamically connected, so the limit loops of this mapping may also be dynamically connected.

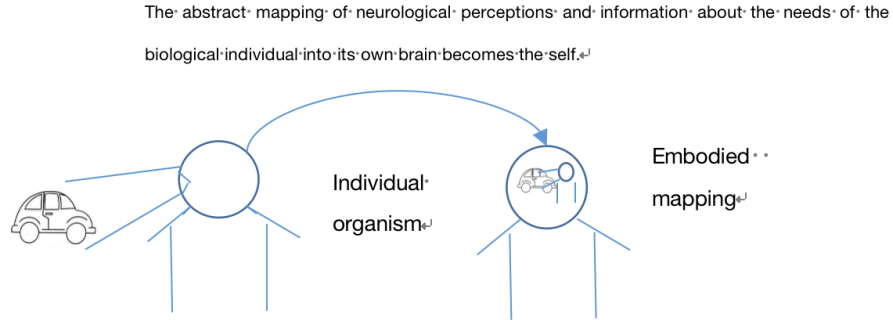


Fig. 2. The process of embodied mapping.

The Evolution Model of the Self. The cell is the simplest and independent living organism. The self is the general term for the sum of the organism and its needs and its management mechanisms. As the environment changes, needs and self, life object and management mechanisms evolve. It evolves from the primitive self to the primary self and the socialised self, etc. Depending on the evolution of the composition of the self and its connotative features, these different evolutionary stages of the self can be expressed in the following formalised model of the quintet or Seven-tuple.

The quintet represents $[O, N, C, M, E]$. O is organism. N represents primitive or complex needs. C is the control mechanisms and awareness. M is memory of based or long-term. E is different kind of environmental interaction.

The Seven-tuple represents $[O, N, C, M, E, Input, Output]$. Compared to a quintet, a Seven-tuple has more inputs and outputs.

Primitive self = (cellular organism, primitive needs, control mechanisms with primitive awareness, genetically based memory and language, primitive environmental interaction), molecular polarity and proteins and DNA as internal language for triadic communication and control, genes encode memory needs information, entity is the cell.

Primary self = (organism with neurological system, complex needs, control mechanisms with prediction and low-level awareness, long-term memory, complex environmental interactions).

Socialized self = (organism with developed nervous system, complex abstract needs, control mechanisms with higher consciousness, long-term memory, symbolic language, input, output).

5 Discussion and Conclusion

The process of human development and growth reflects the evolution of the self and self-awareness.

Self-awareness is the perception of oneself and the establishment of a relationship with the surrounding environment. The human being is progressively refined, a process of knowing oneself. The newborn infant first perceives its own body, successively perceiving the temperature and pressure of the self, the skin, then the mouth, the sense of sight and hearing, the hands and limbs, the torso, etc. Perception of self in relation to needs, for example, the mouth can eat and satisfy the need to eat; vision can see the environment and satisfy a certain sense of security. Then comes the perception of one's own needs and the establishment of a sense of self. Needs are changing and the ego is constantly developing. Self-awareness builds gradually as language and abstraction skills develop. The needs-based model of self-evolution provides ideas for exploring the nature of life and the direction for exploring the development of general-purpose intelligent robots.

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