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Sensory Information and the Development of Cognition

Walter Riofrío
Department of Statistics, Demography,
Humanities and Social Sciences, Faculty of Science and Philosophy,
Universidad Peruana Cayetano Heredia, Lima, 15102, Perú. orcid.org/0000-0002-7304-6072

Abstract:- Understanding when and how cognitive phenomena emerge during evolution remains a challenging problem. Determining the explanatory framework that combines several observations and data is a further crucial challenge in neuroscience research. These circumstances pose the question of whether the so-called neural code is governed by universal laws. What is the link between neuronal responses and the sensory indicators or signals that these purportedly represent? Indeed, it is a significant problem to provide explanations that allow us to appreciate how living organisms piece together acquired sensory information and how they represent it. In this brief work, we investigate some conceptual concerns about the relationships between sensory information perceived by the brain and its representational capacities. We propose specifically that the physical origin of information can be defended. As a result, we will study the ramifications of using the information idea as an ascribed concept as well as its connections to employing the same concept to refer to a real-world object.

Keywords:- *binding problem; constant absolute target direction; constant bearing; emergence; neural code.*

I. INTRODUCTION

When we say that the brain is capable of producing representations, we mean that it generates specific forms of information processing from external data and signals. And so, these processes "somehow" form an integration in which a coherent and coordinated response is generated as a result of neural activity.

This representation could be a picture, sound, taste, or concept. In other words, the so-called "binding problem" exists (1, 2, 3, 4).

Thus, explaining the relationship between the actions of a network of cells specialized in collecting and sending information and the generation of answers mediated by the representational capacity of these cells' aggregates is a basic challenge.

We discovered in the brain separate centers with the ability to interpret specific sorts of information (such as images at the moment of observing a table or a book) and we discovered that there are a great number of synchronized neuronal connections (5, 6, 7, 8).

At one point, it provides a tune between synchronized neural firing in one region of the brain and synchronized neural firing in other regions of the brain.

Currently, we lack the ability to create a design in laboratories or computer simulations that can manage the spatial and temporal coordination of all processed data to provide a cohesive conclusion, such as the identification of obstacles.

We approach this challenge with the idea that "low-level" mental processes are not entirely explicable in terms of mechanisms, functions, and computations.

In other words, we argue that it is necessary to expand upon the concept of information and tie it to the concept of emergence, the capability of neuronal structuring, and future scaling-developments in evolutionary terms.

Our working theory suggests including inquiries into the most fundamental mental occurrences. With the ultimate objective of tracing the development of these vastly expanded abilities in the world of life to their final effects, researchers are attempting to determine their origin.

The primary purpose of our study proposal is to develop a theoretical approach (conceptually and with the capacity to design reliable algorithms) that will facilitate a comprehensive understanding of the successive phases underlying the emergence of mental levels.

II. SENSORY INFORMATION IS INTEGRATED

Imagine something that happens every day: a person walking through a park starts clapping his hands, and the birds in the grass around him fly away. We can ask, "What did these claps mean to the birds?" Also, how would it feel about another animal in the area, like a cricket or a mouse?

These circumstances prompt the question of whether the so-called neural code is governed by underlying general principles: what might be the link between neuronal responses and the sensory signs or signals that they supposedly represent?

The terms "stimulus" and "response" can be used to refer to a wide variety of different things, such as the various ways in which living organisms receive a specific kind of sensory information or the various and multiple ways in which this sensory information flows through a specific group of reception centers. These two terms can cover a wide range of topics (smell, taste and so forth). The varied dynamics observed in the predator-prey interaction, for instance, represent a typical example.

Recent research on the behavior of bats as they chase their prey contains an intriguing examination of these themes (9). On a large scale, it appears that the constant bearing (CB) method is the most utilized evolutionary tactic. Following a straight path or a known trajectory, this is the most effective approach for a predator to capture its prey or a moving object (10, 11).

In the instance of bats, the authors propose that CATD, not CB, is the most effective strategy for this type of predator-prey relationship (constant absolute target direction). Based on the absolute direction between the predator and the prey, this tactic calculates a bearing by basing it on the absolute direction in which the predator is moving in relation to the prey. In their experiments, the researchers determined that the bat captures its prey by adjusting its flight route and pursuit speed. As a consequence ofthis, it would keep an unwavering focus on the target during the entirety of the pursuit: "...When the bat converges to (and maintains) the ideal bearing, the absolute direction to the target does not change". The CATD method creates a trajectory that makes the pursuer appear stationary against a distant background from the target's point of view, and the reverse is also true. (9, 12).

In point of fact, determining how we might arrive at the explanations that would enable us to comprehend how living organisms organize and represent sensory data is one of the most critical tasks that needs to be accomplished.

III. INFORMATION EMERGENCE

Focusing for a moment on a debate between the conclusions derived from the principles of quantum physics and the physics of black holes, we have on the one hand, the former, which asserts that information (equivalent to energy) "cannot be created or destroyed." On the other hand, "information cannot escape" from a black hole. This is known as the "information dilemma of black holes" (13, 14).

It is possible for the following scenarios to occur: First, we request the information stored in a certain object, such as a CD player. Second, we ask what information would be required to produce in a random manner, somewhere in the cosmos, all the essential physical events for the components of a watch to "self-assemble." The third scenario involves the prospect of measuring the information content necessary for an ant colony to investigate the requisite techniques for detecting, locating, and delivering a sugar supply to their nest, which is located some distance from the source. We must consider if the term "information" is being utilized consistently in these instances. If what we are discussing is how we might formalize the measurement of the information content in these circumstances, then the answer is likely yes.

Nonetheless, it appears that in the case of the ants, the concept of information includes a few more components that are not present in other cases. We may assert that, among the phenomena created by the ant colony, it must have been possible for the ants to transfer information to one another in order to produce the observed coordinated activity.

In the other two instances, it is impossible to affirm this with certainty. Consequently, it appears that there are two applications of the concept of information; the first has to do with the manner in which "we assign" a particular information content that is amenable to formal treatment by a proper information theory. The second instance has more to do with the "generation of information" utilized by entities, which are adaptive, dynamic systems, and which may also be amenable to formal treatment. What is the difference between these two cases?

A first approximation is to suggest that this distinction between the usage of the concept of information (in the circumstances outlined above) is not coincidental. Instead, it may be presenting a dilemma that ultimately causes us to rethink the composition and interplay of the world's most fundamental components (15, 16).

It could be a difficulty that establishes the distinction between utilizing a concept through ascription (imposed by us to better our grasp of specified phenomenology) and using the same concept to indicate its physical reality for particular worldly entities.

The second purpose could be to demonstrate that the concept of information exists in the real world; information is a capacity, attribute, or characteristic of some things in the real world. In other words, "information" has a tangible meaning in the real world.

The first application may suggest that some concepts (such as the concept of information) may be vulnerable to being highly abstracted and, as a result, applied "on a broad scale" to virtually everything in the universe.

Consequently, the first usage (the "large-scale method") is theoretically and practically valid, as we have discovered that it is genuine. Importantly, as a result of our earlier argument, it may be conceivable to claim that there was a period when information first appeared in the cosmos, that information had a beginning.

To better understand how these animals' brains process sensory input, this study focuses on the evolutionary factors that have contributed to the development of interpretations (meaning) in their brains. A fascinating question is whether biological information already has a "meaning" (basic semantics) and is likely linked to the molecular processes that generate biological functions within a network of actions. A deeper grasp of biological information and functions, as well as their possible links, isn't impossible in the quest for cognition's origins.

IV. CONCLUSIONS

As was mentioned in the introduction, the binding problem raises the question of how perceptions come to possess coherence. To put it another way, how does it come to be that various perceptual aspects are brought together to form a single experience? Multiple findings from our investigation have led us to the conclusion that densely interconnected brain regions may be able to provide the conditions for neural information and network functions to induce functional and semantic integration. This integration would have been increased throughout the course of evolution as a result of changes and enhancements to the brain's architecture.

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