



A Receptive-Relation Understanding of Information Paradigm Change [†]

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Abstract: This paper examines the evolving understanding of information and its increasing importance in the age of big data and artificial intelligence. It outlines three main approaches to comprehending information: source-preexisting, signal-carrying, and receiver-assigning. These approaches pave the way for a comprehensive understanding of information that requires a fundamental paradigm shift. This paper argues that understanding information as a relation is crucial to this shift, with organism receptivity being key to fully grasping original information. Through receptive relations, we can comprehend not just biological information but also the information nature of DNA. This paper further contends that differentiating information from information encoding is essential to lifting the veil of matter/energy from information and resolving the dilemma of information conservation. We conclude that research on receptive-relation understanding and the nature of information has profound implications for theory and practice, offering broader prospects for development in human cognition.

Keywords: information; receptive relation; paradigm; paradigm change



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1. Introduction

The understanding of information that fundamentally determines the information paradigm shift is not only one of the most complex problems human beings face, but also a major issue that needs to deepen understanding more and more urgently with the development of big data and artificial intelligence.

The scientific understanding of information aims to serve practical use in the realm of science, but there are higher requirements for its philosophical understanding. The former clearly states its application scope. The more basic paradigm shifts needed for the proper understanding of information cannot be achieved without the integration of science and philosophy.

In the research of information, source had our earliest attention, followed by signal and receiver. Within nearly one century, the development of the understanding of information has experienced a step-by-step, in-depth process, and there have been three main ways: the source-preexisting understanding, the signal-carrying understanding, and the receiver-assigning understanding of information. These three ways of understanding come from the same paradigm but are gradually moving closer to the proper understanding of information. They have formed important logical phases for information research, and these approaches provide a foundation for further explorations. In order to reach a proper understanding of information from them, we need to deal with a more fundamental paradigm shift [1,2]. The further breakthrough of information understanding involves basic paradigm transfer: understanding information as some kind of relation.

There have been certain studies on information that indicate a clear tendency of understanding information as a relation [3,4], yet not being updated to the paradigm level.

Understanding information as a relation shows its significant meaning in the change of paradigm. Since most relations have nothing to do with information, there arises a key question that needs to be further addressed: What kind of relation is information? That is the basic question involving the shift to a more fundamental paradigm of information.

2. Three Basic Approaches of Information Understanding

In the research of information, source had our earliest attention, followed by signal and receiver. Therefore, our present understanding of information mainly belongs to the source-preexisting understanding, the signal-carrying understanding, and the receiver-assigning understanding.

2.1. The Source-Preexisting Understanding of Information

The source-preexisting understanding of information, originating in physics and biology, seeks to uncover the "information" inherent in physical objects. The widely accepted view is that "information is physical" [5], connecting quantum mechanics with information [6]. However, equating information with matter leads to a dilemma as information must still comply with the law of conservation of mass. Information is not necessarily a property of matter, and the source itself may not be matter/energy. Including information itself in the source leads to a better understanding of information, resulting in a reversed genetic relationship between information and matter/energy. The source-preexisting understanding claims that information flows from its source as a tangible object [7–9], leading to a signal-carrying understanding of information.

2.2. The Signal-Carrying Understanding of Information

The signal-carrying understanding of information in communication science regards the signal being processed as information itself, leading to the suggestion that information is defined as a signal. This view is a big step forward from the source-preexisting understanding and is critical for the development of communication science [10], but information and its carrier are confused in this information understanding under the condition that source and signal are all matter. The importance of the signal itself makes the signal-carrying understanding of information significant for understanding information, establishing an important path for moving from the signal-carrying understanding to a more proper understanding of information. Message is not information but is composed of signals, and information is neither signal nor message.

2.3. The Receiver-Assigning Understanding of Information

The receiver-assigning understanding of information highlights the involvement of the receiver and their aesthetic expression of meaning, providing a basis for a more profound and precise understanding of information. However, it tends to ignore both the source and signal and has limitations in its exclusive focus on the human receiver. The receiver-assigning understanding usually follows with the ignorance of information objectness if information is within the receiver, just as we say that beauty is in the eye of the beholder. To have a more precise understanding of information, the assigning understanding must consider the role of the source and signal, as well as the wider and deeper exploration of the receiver [11]. The integration of source and receiver in humans can lead to ignorance of the objectivity of information, but understanding information in the complicated relation between source, receiver, and signal is key to a more proper understanding of information. Further breakthroughs in information understanding must involve a paradigm shift towards understanding information as receptive relation.

3. The Receptive-Relation Understanding of Information

The three approaches above serve as individual piers for the understanding of information and construct a "bridge" from matter and energy to information, building a foundation for reaching the receptive-relation understanding of information.

In the most basic sense, information is not matter or energy [12] but is receptive relation based on matter and energy. Its typical state is receptive relation between receiver and source at its mature stage. This is a process relation or relation process.

“Recept” refers to perceived stimuli. Receptivity refers to the characteristic of receiving and responding to stimuli. In the case of plants, their receptivity to nutrients and sunlight reveals the biochemical ways in which organism receptivity receive and respond to their environment. In animals and AI, typical forms of sensory receptivity occur within the organism—in organismic processes, more precisely—while perception occurs through sensory processes.

Receptive relation refers to the process of receptive effect initially or the reception of the receiver regarding the source or the signal from the sender in the mature case. The core mechanisms of AGI, life, and consciousness all deeply involve information as receptive relation. However, there is still a core mechanism issue between the establishment of receptive relations, the AGI, and the mysteries of consciousness and life that needs to be addressed. Research in these areas must be based on the foundation of information as receptive relation.

Receptive relation is a process of receptive interactions. Based on receptive-relation understanding, we suddenly realize that quantum mechanics is the best field for understanding information. Human observation in the quantum field is a typical example of illustrating the relation between matter/energy interaction and information interaction, even the relation between matter/energy and information. As an observation effect or production, the “quantum phenomenon” itself is information as receptive relation. “The moon in the water” and “the flower in the mirror” [13] in perception are all, indeed, information. In this sense, classical physics is the kind in which information can be ignored, and quantum physics is the kind in which information cannot be ignored. The next key question is how to understand information as receptive relation before the development stage of separation of the source and receiver.

The receptive-relation understanding of information makes it distinguishable from information encoding [14]. It is of great importance to realize the difference between information and information encoding, which concerns the critical point for removing the shroud of matter/energy from information. Regarding the material coding of information as information itself is an inevitable result before achieving receptive-relation understanding of information.

For the receptive-relation understanding of information, biological information denoted by DNA is the final fortress to be conquered and is also regarded as the “promised land” for information paradigm transition [15].

The biological information that had long existed before humans stepped onto the stage is indeed critical to understanding information. Marcello Barbieri conducted important studies on biological information. He started from two major discoveries in molecular biology, not only describing how information understanding develops in the field of biology but also involves information paradigm transition [16].

4. The Most Fundamental Paradigm Change

On the one hand, receptive interaction is closely related to the matter/energy part, and on the other hand, it enables the development of receptive relation. It is receptive relation that forms the point of Archimedes for the paradigm transition of information understanding.

4.1. The Information Paradigm

Barbieri explored biological information at the ontology level based on the two paradigms “information paradigm” and “chemical paradigm” [16]. The understanding of the two paradigms here is proper and critical. The “chemical paradigm” is the matter/energy paradigm closest to receptivity, from which the “information paradigm” differs greatly. The involvement of “the position of ontology”, especially the perception of “difference at ontology level”, even relates to the transitional development of ontology itself. The

“chemical paradigm” regards information as a metaphor, a term that refers to the potential detailed structure of matter/energy; this is the typical understanding of information as matter/energy. On the other hand, the “information paradigm” regards information as a real fundamental part of the everyday world, yet traces of the old paradigm are obvious as it progresses into the new paradigm; thus, the information paradigm has not and even cannot be truly achieved.

Undoubtedly, this has already involved efforts to distinguish information from matter/energy. Yet due to the lack of precise understanding of information, the “information paradigm” cannot effectively win out against the “chemical paradigm” in the field of biology.

Nevertheless, the “information paradigm” is fundamentally different from the “chemical paradigm”, which brings the former totally different purposes and efforts; Barbieri’s further exploration is an example of such efforts. While the indispensability of information is clear, the distinction between this indispensable thing and physical variables is not. Using merely “sequence” to describe is obviously not enough, because physical variables have sequence, too; in this way, there is no longer any purpose to force the “chemical paradigm” on the “information paradigm”. The concept of descriptive entities refers to “abstract entities”, i.e., abstract nouns such as “inevitability” or “contingency”. This description fully illustrates the non-substantiality and relationality of information.

Although it may be hard for the “information paradigm” to persuade against the “chemical paradigm” due to limitations of information understanding, inspiring progress has been made in the understanding of biological information.

Based on the progress of the “information paradigm”, Barbieri developed his distinctive understanding of biological information and proposed a paradigm for analyzing how information is encoded [16]. Apparently, the “encoding paradigm” grasps the fundamentals of biological information on the one hand and holds information in suspension on the other.

Since the encoding is information encoding, according to the encoding paradigm, chemical plus information encoding suffices to form this paradigm, but the question of “What is information?” is still left unanswered. What can be sure is that the distinction between information and information encoding is a critical step forward for biological information understanding, and this is where humans as receivers can easily become lost, including our understanding of the relation between the material and the spiritual.

We can also unfold the basic features of information and explore the sensory development of artificial intelligence, in addition to promoting research on the core mechanism of general machine intelligence based on the understanding of the informational nature of bits and digitization. From the receptiveness of the receiver, the receptive-relation understanding builds up a relational paradigm for understanding information based on the source and signal. It clarifies the relation between matter and information, resolves the dilemma of information conservation, and differentiates information from information code, providing a theoretical premise not only for further research on the creativity, emergence, reciprocity, and shareability of information, but also for deeper exploration on the “Principle of identity for information-matter in operation.

4.2. Information Paradigm Change

The understanding of information, as a basic concept, involves a more profound paradigm transition of human cognition development. During this transition process, source-based information understanding is the first step from the matter science paradigm; signal-based understanding is an important step mainly on the basis of information technology development; and receiver-based understanding is a key step mainly for philosophy on the basis of science development. It is these three approaches and their research results that build up the cognitive foundation for paradigm transition from matter to information. In the light of quantum mechanics, the development of big data and AI allows for information unfolding and its receptive-relation understanding in this era. This indicates a real transition from the matter paradigm to the information paradigm, from which we could see

the basic features of information. This way of understanding allows the basic features of information different from those of matter to be vividly revealed in this paper: information is receptive relation from which we can foresee the different prospects of information in the mysteries of life, as well as human beings themselves, and an understanding of the AGI core mechanism.

5. Conclusions

Based on the above features, a series of new conclusions can be obtained: Research on receptive-relation understanding and the nature of information is of wide and profound significance for theory and practice. We can see broader prospects for development based on receptive-relation understanding of information. One of the most important discoveries is that the relation paradigm transition of information understanding clarifies several inevitable misunderstandings about information, leading us out of the dilemmas encountered in information understanding. The most basic and important dilemma is the unbelievable irrational relation between the inevitable information conservation conclusion in physics and the obvious fact of information creativity.

The paradigm shift of information is a transformation from pure objective entities to receptive relations arising from human perception. Just as relativity theory includes the observer's standpoint in its theoretical framework, making relativistic physics more objective than classical physics, the understanding of information as receptive relation incorporates human perception into the theoretical construction, thus reflecting the foundation of the human knowledge system in a more objective way.

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