

# Info-Autopoiesis and Digitalisation <sup>†</sup>

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**Abstract:** Digital information and communication technologies have been a powerful force for change since the middle of the 20th century. Their Promethean reach demands laying bare their hidden tentacles to maximize benefit and minimize harm to living-beings-in-their-environment, requiring an unambiguous and practical definition of information to show that the interactions of living beings with their environment are constitutive of information generation, information exchange, information relations, and life. The purpose of this paper is to discover the connection between info-autopoiesis, based on Bateson's *difference which makes a difference*, the self-referenced, recursive process of information self-production that engages all living beings in their efforts to satisfy their physiological and social needs; and digitalisation, viewed as both the ability to encode information in multifarious but equivalent forms to allow for embodied syntactic occurrence, and as the means to artificially generate information that is beyond the reach of its originators.

**Keywords:** information; digital humanism; Gregory Bateson; info-autopoiesis; Claude E. Shannon; syntactic; semantic; mystification; alienation; semiosis



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## 1. Introduction

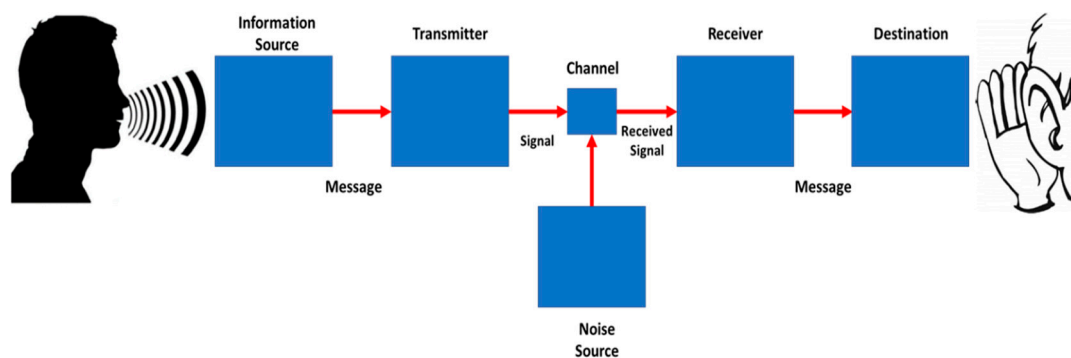
Living-beings-in-their-environment (LB/E) use their sensory organs to discover the non-living and the living. Through their sensory organs, they discover the bountifulness of matter/energy as expressions of environmental spatial/temporal motion/change, or as Bateson *differences which make a difference* [1]. Its undeniable that information is of utmost importance to LB/E, although a unified concept of information is considered elusive [2–5]. A remedy is to naturalize the definition of information. First, the etymological origin of the word *information* shows that it derives from the Latin stem *informatio*, which comes from the verb *informare* (to inform) in the sense of the action of giving a form to something material and as the act of communicating knowledge to another person [3,6–8]. Both interpretations carry the implication that human beings in-form matter and/or other human/living beings, in the sense of interactively shaping matter or shaping the thinking/behaviour of other human/living beings by an act of communication. Another approach to information is Bateson's notion of *difference which makes a difference* [1], a dynamic view of the process of cybernetic human actions, or constitutive absence [9], occupying every instant of our lives, from breathing and eating, to making things by acting on the world, and when engaged in discussions with others. Each of these actions requires constant and recursive determinations of difference by our sensory organs to keep our internal milieu within homeorhetic bounds and/or learn from our actions. The learning process that takes place impacts our ability to deal effectively with our environment. We do this to in-form other objects and subjects, while interactively and reciprocally also being in-formed by said subjects and objects. This unequivocally shows that the only information that exists for LB/E is that created for their own purposes. In short, Bateson's characterization of information is fully compatible with the dynamical nature implied by its etymological

origin. Living beings in-form and are in-formed by their actions on their environment by way of their actions and sensory organs.

This brings to the fore the process of info-autopoiesis, or the self-referenced, recursive process of information self-production that engages all living beings in their efforts to satisfy their physiological and social needs. To better situate the process of info-autopoiesis, the next section reviews Shannon's theory of communication. Subsequently, the process of info-autopoiesis is examined as central to information creation and to digitalisation. A summary and conclusions follow.

## 2. A Communication System

The schematic of a communication system in Figure 1 shows its main elements: an information source, a transmitter, a channel that inevitably incorporates noise, a receiver, and a destination [10,11]. The *fundamental problem of communication* is defined as 'that of reproducing at one point ... a message selected at another point'. Though the messages may have meaning, these semantic aspects of communication are irrelevant to the engineering problem.



**Figure 1.** Schematic of a system of communication.

Is that all there is to the fundamental problem of communication? Are there any missing elements that would merit inclusion for a more comprehensive analysis? For example, who designed, built, and uses this communication system? Where does the message originate? Who is the ultimate recipient of the message? These questions suggest we may suffer from *alienation*, or an inability to recognize our handiwork in the products of our labour. We seem to forget that the communication system that we are describing is brought about by our handiwork. Further, there is a living being (LB/E) at the left side and right side of the communication system in Figure 1. The LB/E at the left side generates a message that is the result of a process of creation of semantic and syntactic information to send to the LB/E at the right-side. However, only the syntactic in-form is sent through the communication system and reaches the ears of the LB/E at the right-side.

In this process, we also seem to suffer from *fetishism*, or an attribution of inherent value, or powers, to information. Such is the postulate that information is a fundamental quantity of the universe in addition to matter/energy [12–15]. The implication is that information exists in the environment and is readily accessible, but it is unclear whether LB/E possess sensory organs for detection of information. What is more readily apparent is that matter/energy are dynamic above a temperature of zero degrees absolute. Additionally, it is this motion that LB/E learn to detect as information or, as *difference which makes a difference*, to satisfy physiological and/or relational needs. In this learning process, LB/E in-form matter/energy and vice versa. In-forming matter/energy interactively and recursively takes place in at least two ways: by actual manipulation of matter/energy in consuming it as nourishment; and by producing all the artificial objects that surrounds us. These artificial creations are all syntactic in nature in consonance with Shannon/syntactic in-form. Nowadays, it is surprising to find the untouched natural world that existed millennia ago, as only un-contacted peoples in the Amazon may claim such access. All in-

formed creations incorporate Shannon/syntactic in-formation, synonymous with ordered structure, including analogue and digital products. Digitalisation and the creation of digitalised objects provide the advantage of acceleration of the process of Shannon/syntactic artificial creation.

In summary, Figure 1 shows the process of communication where the LB/E on the left side, after an internal process involving semantic and syntactic information, externalizes Shannon/syntactic information to message the LB/E on the right side. The LB/E on the right side internalizes the received Shannon/syntactic information to produce its own semantic interpretation. It can then choose whether to externalize Shannon/syntactic information in a response.

### 3. Info-Autopoiesis

The *fundamental problem of information* is the basis for the phylogenetic and ontogenetic development of a LB/E. It poses the query of how an LB/E, in a self-referential, recursive process, develops from a state in which its knowledge of the LB/E system is almost non-existent to a state in which the LB/E not only recognizes the existence of the E but also sees itself as part of the LB/E system. Additionally, it asks how the LB can self-referentially engage with the E and navigate through it, and even transform it in its own image and likeness [16,17]. This is another way to identify the process of info-autopoiesis or of describing how LB/E in-form matter/energy and vice versa [17]. Info-autopoiesis is nothing more than a description of the process of LB/E as producers of *self-referenced, recursive* information. This is the only information that exists for LB/E.

The role of the sensory organs cannot be underestimated. The left part of Figure 2 shows a conceptual image of a living-being subsumed in-its-environment (LB/E) depicting interactive, recursive, self-referenced relations. Ontogenetic feedback–feedforward control reflex-actions keep the internal milieu of the living being within homeorhetic bounds. To clarify Bateson’s *difference which makes a difference*, consider the beginning of the LB/E cyclic interactions as the detection of environmental noise by the senses of the LB/E. This is the only window that the LB/E has to access the E. The primary motivation of the LB/E in sensing the noisy environment is to maintain and satisfy its physiological and/or relational needs [16–20]. This self-referential, recursive process leads to the LB/E finding meaning in its circumstances. Two essential connections define the asymmetrical relationship between the LB/E and its E. First, a single sense element serves as intermediary between the external environment and the internal milieu of the LB/E. Interactions result in an electrical signal or action potential (AP), which is used by the LB/E to generate self-referenced, recursive information, by way of the comparator, as a *difference which makes a difference*. The comparator uses feedback and feedforward circuits incorporating quantities  $k_{fb}$  and  $k_{ff}$ , respectively, to modify error/difference/information,  $e$  [17,20].

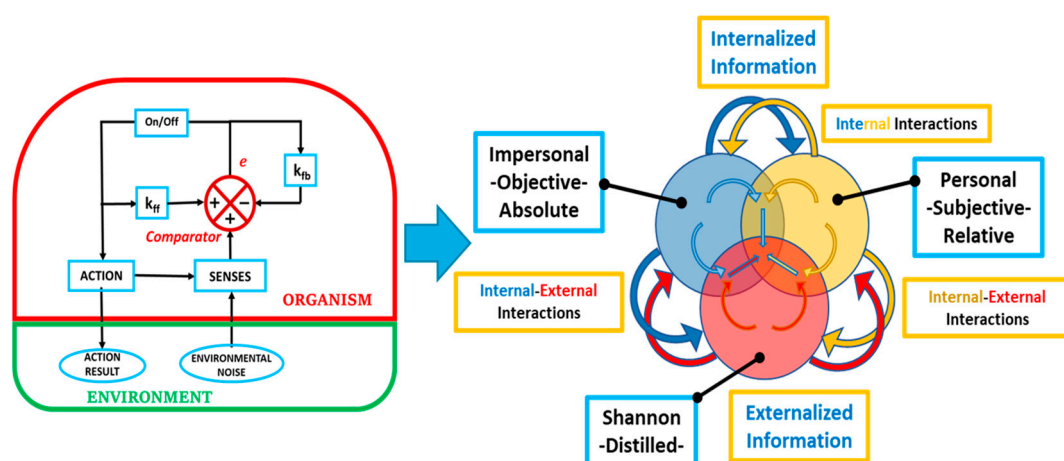


Figure 2. The process of info-autopoiesis.

The right part of Figure 2 shows how the process of info-autopoiesis as a sense-information-action process results in a triadic relationship involving internal and external information relevant to the LB/E. Internalized components relate to the creation of Personal–Subjective–Relative (PSR-I) and Impersonal–Objective–Absolute (IOA-I) information. Externalized components include Shannon-distilled or syntactic information [10,11]. PSR-I may be considered as intrasubjective, arbitrarily generated information, motivated by the satisfaction of physiological (internal and external) and relational needs, where sensorial percepts, feelings, and emotion are important to a LB/E. Some actions produce pain/harm to an LB/E, who takes notice and realizes that it has access to the beginnings of IOA-I. Not all PSR-I can become IOA-I. The interlacing of the PSR-I and IOA-I circles is to express their dependent connection; whereby IOA-I is dependent on PSR-I, which is primary. Crossing arrows pointing away from and back to each of the information circles imply the ongoing and ever-present processing and recursive interactions between these information types. The arrows inside the information circles show the flow of information toward the region of triadic overlap. This region benefits from the interaction of PSR-I, IOA-I, and SD-I, which results in an optimal state of LB/E development. One can but wonder if this is the sweet spot of the highest expressions of human thought and action. Individual PSR-I and IOA-I can only be accessed if an individual is willing to share its contents using language, gestures, pictographs, music instruments, sculptures, writing, etc. Coding is required for the distillation of individual PSR-I and IOA-I to externalize their content and transform it into Shannon/distilled information (SD-I). Thus, SD-I is secondary to PSR-I and IOA-I and cannot exist by itself. SD-I is the basis for the existence of this syntactic artificial world which we inhabit.

In short, Figure 2 summarizes the process of info-autopoiesis as a process of the triadic transformation of the sensory experience of a LB/E into information, *a difference which makes a difference*, to produce internal and external information. Internal information takes the form of semantic and syntactic information. External or syntactic information is synonymous with artificial creation.

#### 4. Info-Autopoiesis and Digitalisation

The process of info-autopoiesis shows that LB/E are the creators of all existing information, including the information that establishes and shapes our institutions and their influence in our societies which, at the same time, interactively impacts us. This unavoidable mutual interaction, over which we may not have control, cannot but define the digitalisation process that is now pervasive in our societies, while also affecting us in sometimes consequential ways. Digitalisation is just one more technology that creates the challenge of controlling its proliferation and impact. In some ways, it is no different from the proliferation and impact of nuclear power or fossil fuels on our environment. Though one significant difference might be its unparalleled capacity for exponential growth for us to artificially in-form our environment [21]. This effect is easily identifiable in metrics such as the speed of computation, Moore’s law of integrated circuits, increase in wireless transmission, sequencing the genome, 3D printing, development of mRNA vaccines, etc. It is now a pervasive element in our societies.

The challenge may be summarized by paraphrasing the Vienna Manifesto on Digital Humanism (<https://dighum.ec.tuwien.ac.at/>; accessed on 4 February 2021): we must shape societies in our world in accordance with the human values and needs of all its members, instead of allowing technologies developed in deformed societies that serve the interests of the 1% to shape all living beings. Our task is to identify the downsides of information and communication technologies before they are developed to encourage living-being-centred flourishing and innovation. We call for a Digital Humanism that naturally develops from such a society maximizing the benefit and minimizing the complex interplay of technology and humankind, fully expecting that such efforts will lead to a better society and the good life that respects the universal rights of all living beings in all

corners of the world. Neglect of one might impact all. The COVID-19 pandemic and global warming are but examples of what neglect might mean for humanity.

## 5. Summary and Conclusions

The etymological origins of information and Bateson's *difference which makes a difference* are used to highlight how a naturalized perspective impacts the interpretation of reality for a LB/E and highlights its ability to achieve sensing–information–action. A critical examination of Shannon's theory of communication shows that the triadic process of information creation or info-autopoiesis can only be understood as internal/external to the LB/E and consists of semantic/syntactic components. The externalization of information, as in-formed matter, can only be in the form of Shannon/syntactic information, with digitalisation leading the way to unprecedented exponential economic growth and loss of control of our artificial world, demonstrated by the COVID-19 pandemic and global warming.

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