# On Peirce's notion of information: remarks on De Tienne's paper "Information in Formation"

*Sobre a Noção Peirceana de Informação: Observações sobre o Artigo "Informação Em Formação" de De Tienne*

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**Abstract:** De Tienne characterized icons, indexes, and symbols as processes of form communication and suggested that symbolic form communication constitutes what Peirce called genuine information (*Cognitio*, São Paulo, v. 6, n. 2, p. 149-165, jul./dez. 2005). He mentioned our recent attempts to describe information as a meaningful semiotic process in the context of biological information systems. Here we summarize our view about Peirce's concept of meaningful information process as a triadic-dependent relation of mediation connecting Sign, Object and Interpretant, in the context of *semiotic systems*, systems that produce, communicate, receive, compute, and interpret signs of different kinds.

**Key-Words:** Information. Peirce. Semiosis. Semiotic systems.

**Resumo:** De Tienne caracterizou os ícones, índices e símbolos como processos de comunicação de formas e sugeriu que a comunicação de formas simbólicas constitui o que Peirce chamou de informação genuína *Cognitio*, São Paulo, v. 6, n. 2, p. 149-165, jul./dez. 2005. Ele mencionou nossas recentes tentativas para descrever informação como processo semiótico, no âmbito dos sistemas biológicos de informação. Sumarizamos aqui nossa visão sobre o conceito peirceano de processo informacional dotado de significado como uma relação triádico-dependente conectando Signo, Objeto e Interpretante, no contexto dos sistemas semióticos, que são sistemas que produzem, comunicam, recebem, computam, e interpretam signos de diferentes classes.

**Palavras-chave:** Informação. Peirce. Semiose. Sistemas semióticos.

## 1. Introduction

According to De Tienne's paper "Information in Formation" (2005), Peirce's concept of information must be associated to the mature notion of sign as a medium of communication – "A discussion of Peirce's conception of information cannot omit his 1906 definition of the sign as a "medium for the communication of a form" (De TIENNE 2005: 161). Furthermore, De Tienne characterized icons, indexes, and symbols as kinds of processes of form communication. He also suggested that symbolic form communication constitutes what Peirce called "genuine information", particularly associated with the anticipation of events. This paper offers interesting insights to readers who are familiar with Peirce"s semiotics and are interested in the theory of information.

De Tienne mentioned some of our recent attempts to describe information as a meaningful semiotic process in the context of biological information systems (e.g. QUEIROZ, EL-HANI 2006b; EL-HANI, QUEIROZ, EMMECHE 2006; QUEIROZ, EMMECHE, EL-HANI, 2005; EL-HANI et al. 2005). We will summarize our view about Peirce's mature concept of meaningful information as a triadic-dependent relation of mediation connecting Sign, Object and Interpretant, in the context of "semiotic systems", i.e., systems that produce, communicate, receive, compute, and interpret signs of different kinds (FETZER 1997). In these arguments, we also treat semiosis as an emergent process. Nevertheless, we will not develop here our arguments for an understanding of semiosis as an emergent process. We have already discussed this problem in a previous paper (QUEIROZ, EL-HANI 2006a).

An approach to this topic seems to be crucial in the domain of semiotic investigations, particularly as regards the debates about Peirce's pragmatic model of meaning. Moreover, as we have argued in previous papers, the use of Peircean semiotic concepts to interpret "information talk" in biology can significantly contribute to the construction of a coherent account of meaning and information in living systems. This is an important task, since biology is pervaded by informational concepts, particularly in fields with important social and technological implications, such as genetics, molecular biology, and genomics, but currently lacks a theory of biological information.

## 2. Sign as a Medium

As it is already well-known, Peirce defined semiosis as an irreducible triadic relation between a Sign, its Object and its Interpretant. We will hereafter refer to this triad as S-O-I. That is, according to Peirce, any description of semiosis involves a relation constituted by three irreducibly connected terms, which are its minimal constitutive elements (MS 318:81; CP 2.242).[1] In Peirce's words:

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[1]    We shall follow the practice of citing from the Collected Papers of Charles Sanders Peirce (PEIRCE 1931-35, 1958) by volume number and paragraph number, preceded by CP; the Essential Peirce, by volume number and page number, preceded by EP. References to the Annotated Catalogue of the Papers of Charles S. Peirce (1967) will be indicated by MS, followed by the manuscript number and pages.

> My definition of a sign is: A Sign is a Cognizable that, on the one hand, is so determined (i.e., specialized, bestimmt) by something other than itself, called its Object, while, on the other hand, it so determines some actual or potential Mind, the determination whereof I term the Interpretant created by the Sign, that that Interpreting Mind is therein determined mediately by the Object (CP 8.177).

Peirce (see De TIENNE 2003, HULSWITT 2001, BERGMAN 2000) also defines Sign as a medium for the communication of a form or a habit embodied in the Object to the Interpretant, so as to determine (in semiotic systems) the interpreter"s behavior:

> …a Sign may be defined as a Medium for the communication of a Form. [...]. As a medium, the Sign is essentially in a triadic relation, to its Object which determines it, and to its Interpretant which it determines. [...] That which is communicated from the Object through the Sign to the Interpretant is a Form; that is to say, it is nothing like an existent, but is a power, is the fact that something would happen under certain conditions (MS 793:1-3. See EP 2.544, n.22, for a slightly different version).

In short, a Sign is both "a Medium for the communication of a Form" and "a triadic relation, to its Object which determines it, and to its Interpretant which it determines". If we consider both definitions, we can say, then, that semiosis is a triadic process of communication of a form from the Object to the Interpretant through Sign mediation (Figure 1).
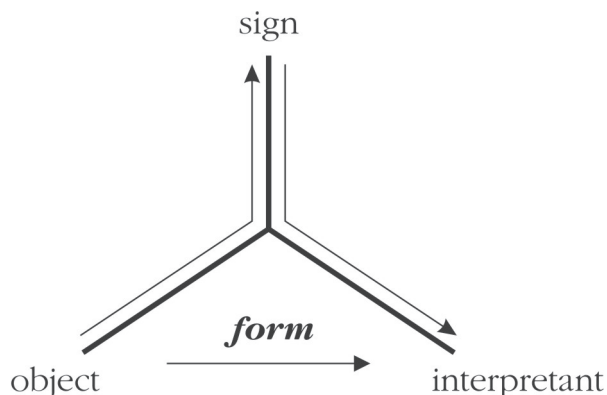


**Figure 1.** Semiosis as the communication of a form from the Object to the Interpretant through Sign mediation.

In Peirce's works, form is defined as having the "being of predicate" (EP 2.544) and it is also pragmatically formulated as a "conditional proposition" stating that certain things would happen under specific circumstances (EP 2.388). It is something that is embodied in the object (EP 2.544, n. 22) as a habit, a "rule of action" (CP 5.397, CP 2.643), a "disposition" (CP 5.495, CP 2.170), a "real potential" (EP 2.388) or, simply, a "permanence of some relation" (CP 1.415). Form can also be defined as potentiality ("real potential", EP 2.388). If we consider these definitions, we can conclude that form can show the nature of both firstness and thirdness.

## 3. Meaning, Information and Semiosis

The notions of "meaning", "information", and "semiosis" intersect in different ways (JOHANSEN 1993). Debrock (1996) comments that Peirce defined "information" at least ordinarily (CP 2.418), metaphysically (CP 2.418), as a connection between form and matter, and logically (W 1.276), as the product of extension and intension of a concept. We argued in previous papers that the definitions of Sign mentioned in the previous section lead to a definition of information as the communication of a *form* from O to I through S (QUEIROZ et al. 2005; EL-HANI et al. 2006). In these terms, it amounts to the communication of a habit embodied in the Object to the Interpretant, so as to constrain (in general) the Interpretant as a Sign or (in semiotic systems) the interpreter's behavior. To put it differently, the production of an effect of the Sign on the interpreter results from the communication of the form embodied in the Object (as a regularity), *via* Sign, to the Interpretant. According to this approach, "information" can be strongly associated with the concepts of "meaning" and "semiosis".

It is important to emphasize that the form communicated from the Object to the Interpretant through the Sign is a regularity, a habit that allows a given semiotic system to interpret that form as indicative of a class of entities, processes, phenomena, and, thus, to answer to it in a regular way. Otherwise, the semiotic system would not be really capable of interpreting the Object by means of its effect on it (Interpretant), mediated by a Sign.

Peirce's (CP 8.177) idea that a Sign determines an Interpretant in some "actual" or "potential" Mind (in other passages, a "quasi-mind"; see CP 4.536) also plays an important role in our arguments. On the grounds of this idea, we differentiate between "potential" and "effective" semiosis. We understand potential semiosis as a triadically-structured process that might be, but it is not effectively taking place at a given time $t$. Effective semiosis, in turn, is a Sign in effective action, *i.e.*, a Sign that, by being actualized, has an actual effect on the interpreter. Following the distinction between potential and effective semiosis, we can define potential and effective information (see below).

According to our interpretation of Peirce's ideas, information has a processual nature: it is a process of communicating a form to the Interpretant that operates as a constraining influence on possible patterns of interpretative behavior. When applying this general semiotic approach to semiotic systems, information will most often be an *interpreter-dependent objective* process. It cannot be dissociated from the notion of a situated agent. It is interpreter-dependent in the sense that information *triadically* connects representation (Sign), Object, and an effect (Interpretant) on the interpreter (which can be an organism or a part of an organism). The form – as a regularity embodied in the Object – acts as constraint on the interpreter's behavior. In sum, information in a semiotic system depends on both the interpreter and the Object (in which the *form* communicated in information is embodied as a constraining factor of the interpretative process).

A framework for thinking about information as a process can be built in Peircean terms by employing the following definitions:

> [Information ≈ semiosis] A triadic-dependent process through which a form embodied in the Object in a regular way is communicated to an Interpretant through the mediation of a Sign.

[Potential information ≈ potential semiosis] A process of communicating a form from an Object to an Interpretant through the mediation of a Sign that could take place in a given moment.

[Effective information ≈ effective semiosis] The process by which a Sign effectively produces an effect (Interpretant) on some semiotic system (an interpreter) by making the Interpretant stand in a similar relation to something else (the Object of the Sign) as that in which the Sign itself stand. Thus, the Sign mediates the relation between Object and Interpretant. The Sign effectively communicates, in this way, a form from the Object to the Interpretant, changing the state of the interpreter.

## 4. Fundamental Division of Semiotic Processes

According to De Tienne (2005: 162), the form communicated in semiosis can be classified according to the logical-phenomenological theory of categories:

The forms that signs convey are not arbitrarily created out of nothing. Some of them are forms of firstness, and the type of sign that objects can determine in that regard are iconic. Others are forms of secondness, they are agent provocateurs, and bring other entities to react to them, turning them into indices. The third kind of forms, as Peirce puts it in R793, are truths of conditional propositions: "under certain favorable circumstances, this or that type of event would be bound to take place or be the case"; these are forms of thirdness, forms that can only be captured through symbols.

 We have also proposed a similar division, based on Fetzer's notion of semiotic systems (QUEIROZ, EL-HANI 2006b). Additionally, we contextualized this division in the domain of biological systems. As we have mentioned, systems that interpret signs of different kinds can be classified as semiotic systems. As Fetzer (1997, p.358) writes: "What makes a system "semiotic" thus becomes that the behavior of the system is causally affected by the presence of a sign because that sign stands for something else iconically, indexically, or symbolically, for that system". Fetzer is obviously following Peirce's fundamental division of signs. Icons are Signs that stand for their objects through intrinsic similarity or resemblance, irrespective of any spatio-temporal physical correlation that the Sign has with an existent Object. In contrast, indexes can only occur when the Sign is really determined by the Object, in such a way that both must exist as concurrent events. Finally, in a symbolic relationship, the Interpretant stands for the Object through the Sign by means of a determinative relation of law or convention (CP 2.276)**.**

Among the examples of icons mentioned by Peirce, we find images, diagrams, metaphors, pictures, maps. In terms of cognitive processes, icons are associated with sensory tasks. They are present in the sensorial recognition of external stimuli of any modality, and in the cognitive relation of analogy. According to Sebeok (1989, p.121), iconic signs are found in all modalities as circumscribed by the sense organs by which members of a species are able to inform themselves about their environment. Iconicity plays a fundamental role in signal forgery by organisms, for instance, in phenomena such as mimicry. Figure 2 shows an example of an iconic sign, a structure in a thorn bug that mimics a thorn in a plant.

**Figure 2**: Mimicry offers an example of iconicity. In the picture, a thorn bug (Membracid). (Photo from Chip Clark, Smithsonian Institution, Copyright 1993. Reproduced under permission).

The Interpretant in this case is the effect of the thorn on a potential predator of the bug, namely that the latter will not try to eat the bug. In this iconic sign process, the form that is communicated from the Object to the Interpretant through the Sign is a *general similarity* between the thorn in the bug and the thorn in the plant. Generally speaking, an iconic Sign communicates a habit embodied in an Object to the Interpretant, so as to constrain the interpreter's behavior, as a result of a certain quality that the Sign and the Object share (Figure 3).
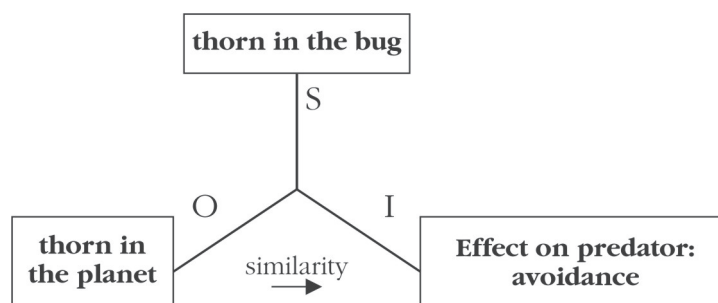


**Figure 3**: a semiotic interpretation of mimicry in the thorn bug – the form communicated is a similarity.

The notion of spatio-temporal *co-variation* is, in turn, the most characteristic property of indexical processes. The examples include, for example, physical symptoms of diseases, weathercocks, thermometers, etc. In a Peircean analysis, small red spots in a child's skin, for instance, can be treated as a Sign (S) that stands for a disease, say, measles, its Object (O), so as to constrain its Interpretant, the effect the red spots have on an interpreter, say, a doctor performing a diagnosis. The small red spots operate as indexes because they are physically correlated with the disease, which is the primary constraining factor in the process, the form of which will end up producing an effect on the interpreter (Figure 4).
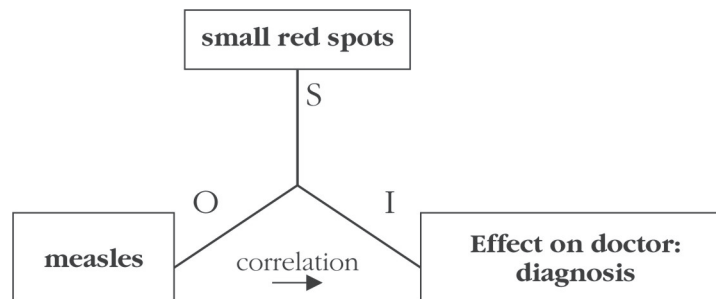


**Figure** 4: a semiotic interpretation of the diagnosis of measles – the form communicated is a spatio-temporal *co-variation* or a correlation.

In this process, the form that is communicated from the Object to the Interpretant through the Sign is a physical correlation between measles and the small red spots in the skin. Generally speaking, an indexical sign communicates a habit embodied in an Object to the Interpretant as a result of a direct physical connection between Sign and Object.

Finally, in a symbolic relation, the Interpretant stands for the Object through the Sign by a determinative relation of law, rule or convention (CP 2.276). We have claimed elsewhere that the alarm-call system used by African vervet monkeys (*Cercopithecus aethiops*), a well-known case of vocal communication in non-human primates, logically satisfies the Peircean definition of symbol (RIBEIRO et al. 2006; QUEIROZ 2003; QUEIROZ, RIBEIRO 2002). These primates possess a sophisticated repertoire of vocal signs used for intra-specific alarm purposes regarding imminent predation on the group (SEYFARTH et al. 1980; CHENEY, SEYFARTH 1990). Field studies have revealed three main kinds of alarm-calls, used to warn about the presence of (a) terrestrial stalking predators such as leopards, (b) aerial raptors such as eagles, and (c) ground predators such as snakes. Adult vervets produce these calls only in reference to the presence of specific predators. Such calls motivate whole-group escape reactions that are specific to predator type.

In this process, the form that is communicated from the Object to the Interpretant through the Sign is a lawful relationship between a given kind of alarm-call and a given type of predator. Generally speaking, a symbolic Sign communicates a habit embodied in an Object to the Interpretant as a result of a regularity in the relationship between Sign and Object (Figure 5).
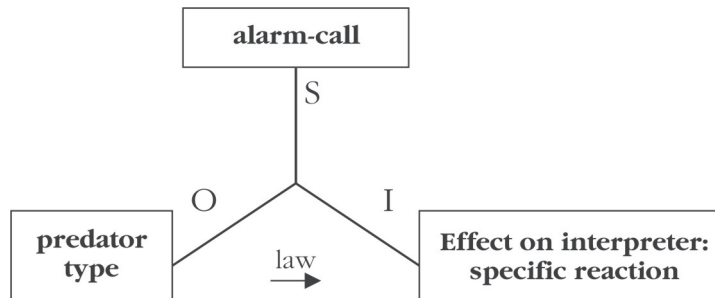
**Figure 5:** a semiotic interpretation of communication in vervet monkeys – the form communicated is a law or convention.

## 6. Conclusion

De Tienne characterized icons, indexes, and symbols as processes of form communication and suggested that symbolic form communication constitutes what Peirce called "genuine information". He mentioned our recent attempts to describe information as a meaningful semiotic process in the context of biological information systems. We focused our arguments here on two aspects: the notion of information cannot be dissociated from semiosis; biological information systems are semiotic systems *(sensu* Fetzer) of different kinds.

Peirce's semiotics provides an analytic framework in which information can be modeled as a triadic-dependent process that irreducibly connects Signs, Objects, and Interpretants (effects on interpreters). In our account, information is treated as semiosis – the communication of a habit from an Object to an Interpretant through a Sign, so as to constrain (in semiotic systems) the interpreter"s behavior. To put it differently, information is a triadic-dependent process through which a form embodied in the Object in a regular way is communicated to an Interpretant through the mediation of a sign.

According to our semiotically-based arguments, meaningful information is an interpreter-dependent process that cannot be dissociated from the notion of a situated interpreter (potential or effective agent). It is interpreter-dependent in the sense that triadically connects Sign, Object (where the communicated *form* in information is embodied as a constraining factor of interpretative behavior), and interpretaqnt.

## Acknowledgments:

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