Dossier temático «La semiótica de C. S. Peirce en la intersección de información y comunicación»

The contribution of icons to the information value of symbols and other representations

La contribución de los iconos al valor informativo de los símbolos y otras representaciones

A contribuição dos ícones para o valor informativo dos símbolos e outras representações

Winfried Nöth[1] ORCID: 0000-0002-2518-9773

[1] Pontifícia Universidade Católica de São Paulo, Brasil. Rua Monte Alegre, 984, São Paulo, CEP: 05014–901. Email: noeth@uni-kassel.de

Abstract

Peirce distinguishes between information which symbols imply and information which symbols convey. All symbols imply information, but only propositional symbols (dicents) can convey information. The information a symbol implies is the store of knowledge accumulated in it minus the signification contained in its definition. The information a symbol conveys is the new knowledge an interpreter derives from it in the form of a propositions of which it is the subject or predicate. Only symbols, not icons or indices, imply information. According to Peirce's early theory (1865–68), information is the product of the quantities of signification and denotation of a symbol. Peirce's later semiotic theory reinterprets information as a result of the interplay between icons, indices, and symbols. Denotation is reconsidered in terms of indexicality, signification in terms of iconicity. Neither symbols nor icons or indices can convey information alone. Sentence subjects are reinterpreted as conveying indexical, and predicates as iconic information. The icons through which symbols convey information are mental images, which are interpretants of the symbol. The paper examines why Peirce attributes to icons a «dream exciting power» and why the qualities signified by them are somehow «of the nature of a sleeping consciousness».

Keywords: INFORMATION; REPRESENTATION; ICON; INDEX; SYMBOL; PEIRCE, C. S.

Resumen

Peirce distingue entre información que los símbolos implican e información que los símbolos transmiten. Todos los símbolos implican información, pero sólo los símbolos proposicionales (dicentes) pueden transmitir información. La información que implica un símbolo es el conocimiento acumulado en él menos el significado contenido en su definición. La información que transmite un símbolo es el nuevo conocimiento que un intérprete deriva de él en forma de proposiciones de las cuales es sujeto o predicado. Sólo los símbolos, no los iconos o índices, implican información. Según la primera teoría de Peirce (1865-68), la información es el producto de las cantidades de significación y denotación de un símbolo. La teoría semiótica posterior de Peirce reinterpreta la información como resultado de la interacción entre iconos, índices y símbolos. La denotación se reconsidera en términos de indexicalidad, la significación en términos de iconicidad. Ni los símbolos ni los iconos o índices pueden transmitir información por sí solos. Los sujetos de las oraciones se reinterpretan como portadores de índices y los predicados como información icónica. Los iconos a través de los cuales los símbolos transmiten información son imágenes mentales, que son interpretantes del símbolo. El artículo examina por qué Peirce atribuye a los iconos un «poder excitante de sueños» y por qué las cualidades que ellos significan son de alguna manera «de la naturaleza de una conciencia dormida».

Palabras clave: INFORMACIÓN; REPRESENTACIÓN; ICONO; ÍNDICE; SÍMBOLO; PEIRCE, C.S.

Resumo

Peirce distingue entre informações que os símbolos implicam e informações que os símbolos transmitem. Todos os símbolos implicam informação, mas apenas símbolos proposicionais (dicentes) podem transmitir informação. A informação que um símbolo implica é o estoque de conhecimento acumulado nele menos o significado contido em sua definição. A informação que um símbolo transmite é o novo conhecimento que um intérprete deriva dele na forma de proposições das quais ele é sujeito ou predicado. Apenas símbolos, e não ícones ou índices, implicam informações. De acordo com a teoria inicial de Peirce (1865-68), a informação é o produto das quantidades de significação e denotação de um símbolo. A teoria semiótica posterior de Peirce reinterpreta a informação como resultado da interação entre ícones, índices e símbolos. A denotação é reconsiderada em termos de indexicalidade, a significação em termos de iconicidade. Nem símbolos, nem ícones ou índices podem transmitir informações por si só. Os sujeitos das frases são reinterpretados como portadores de informações indiciais e os predicados como informações icônicas. Os ícones através dos quais os símbolos transmitem informações são imagens mentais, que são interpretantes do símbolo. O artigo examina por que Peirce atribui aos ícones um "poder excitante de sonho" e por que as qualidades por eles significadas são de alguma forma "da natureza de uma consciência adormecida".

Palavras-chave: INFORMAÇÃO; REPRESENTAÇÃO; ÍCONE; ÍNDICE; SÍMBOLO; PEIRCE, C.S.

Charles S. Peirce's «theory of information», as he once called it (CP 5.288, n.1, 1868), developed in two phases, which may be roughly distinguished as his «logical» or early and his «semiotic» or later phase. The terms of this distinction are not meant to ignore that, for Peirce, logic, «in its general sense», was «only another name for semiotic (σημειωτική), the quasi-necessary, or formal, doctrine of signs» (CP 2.227, c.1897). Instead, they serve to indicate that Peirce's early approach was still indebted to the framework of traditional logic, whereas his later approach was based on his fully developed semiotic system. The title of this paper refers mainly Peirce's later semiotic approach to information, but to understand Peirce's later semiotic approach, an outline of his earlier logical approach to information is first necessary.

Peirce's early logical approach to the theory of information

Peirce is aware that information is ordinarily understood «to mean testimony given privately» whereas his own logical conception of information «departs widely from this ordinary use of the word» (CP 2.418, n., 1893). The main writings on information from the earlier phase can be found in his Harvard Lectures of 1865 on the Logic of Science (W1, pp. 161–302), his Lowell Lectures of 1866 on the same topic («Or: Induction and Hypothesis»; W1, pp. 357–504), in his paper «Upon Logical Comprehension and Extension» of 1867 (W 2, pp. 70–86), and in the revised version of the latter, which Peirce planned to publish as ch. 15 of his *Grand Logic* (CP 2.391–2.428) in 1893. Studies of Peirce's early as well as his later writings on information are Johansen (1993, pp. 145-151), Debrock (1996), Liszka (1996, pp. 28-31), De Tienne (2005), Nöth (2011), and Bellucci (2018, pp. 38-46).

The study of information begins with the notion of *state of information*:

> I use the word information to mean a state of knowledge, which may range from total ignorance of everything except the meanings of words up to omniscience; and by informational, I mean relative to such a state of knowledge. Thus, by "informationally possible," I mean possible so far as we, or the persons considered, know. Then, the informationally possible is that which in a given information is not perfectly known not to be true. The informationally necessary is that which is perfectly known to be true. The informationally contingent, which in the given information remains uncertain, that is, at once possible and unnecessary. (CP 4.65, 1893)

Only knowledge not yet contained in a state of information can convey information at all, for, «if you inform me of any truth, and I know it already, there is no information» (MS 463, p. 13, 1903).

The early logical framework

The conceptual framework of Peirce's early studies in the logic of information can be found in the vocabulary of traditional logic from the Scholastics to 19th century authors. Recurrent key concepts are term, symbol, proposition, character, and the dichotomy of denotation–connotation, alternatively defined as extension–comprehension, extension–intension, breadth–depth, or application–signification, in diverse treatises of logic, which Peirce discusses in depth from historical, terminological, and logical perspectives. In his own early writings, Peirce used the terms *extension* vs. *intension*, *denotation* vs. *comprehension*, and *breadth* vs. *depth* alternatively (W 1-2, 1865–1867). In later writings, his preference was *denotation* vs. *signification* (e.g.: EP 2, p. 304, 1904).

A key concept to Peirce's early writings is *representation*, a term later substituted for the one of *sign*. The further triadic subdivision of «signs or representations» into icons, indices, and symbols, is the one «which I most frequently use», Peirce wrote in an undated manuscript (CP 8.368). Representation, in these early writings was part of the trichotomy «Thing–Representation–Form», which anticipates the one of object–sign–interpretant of Peirce's later semiotic writings:

> Representation is anything which is supposed to stand for another and which might express that other to a mind which truly could understand it. Thus, our whole world […] is a world of representations. […] The *thing* is that for which a representation might stand […]. The *form* is the respect in which a representation might stand for a thing […]. We only know *forms* and *things* through representations. (W1, p. 257, 1865)

Two further trichotomies contextualize representations in the framework of Peirce's early writings in logic. One it the above-mentioned early triadic subdivision of representations into «signs» (later: indices), «copies» (later: icons), and symbols. The other is the subdivision of symbols into terms, propositions (later: rhemes, dicents), and arguments (W1, p. 347, 1866).

A *proposition* expresses a relation between two terms, of which the first is the subject and the second the predicate. For example: *Dogs are mammals*, or *Humans are mortal*. The *subject* is what the proposition is about. The *predicate* attributes *characters* to the class denoted by the subject term. Characters «characterize» the «things» denoted by the symbol, for example, among the characters of a *human being* are 'mammal' and 'mortal'.

A *term* is a representation that *denotes* a class of really existing or imaginary objects. It has typically the form of a noun or an adjective phrase, but already in 1866, Peirce discovered that terms need not be symbols but may also be icons (called «likeness-terms») or indices (called «index-terms»; W1, p. 485, 1866). Symbols denote or apply to «things» (objects). They have real or imaginary objects as their *extension* or *denotation*, and they connote (or signify) the characters of these objects.

A *character* attributes a quality to an object and expresses the signification (connotation or intension) of a symbol. The distinctive semantic features of 20th century structural semantics, also defined as *semes*, are formulations of characters as Peirce defined them in his early writings on logic. A character is a characteristic of the thing represented by a symbol. In reply to the question «What is a 'term', or 'class-name', supposed to be? », Peirce explains, «It is something which signifies […] certain characters, and thereby denotes whatever possesses those characters» (CP 2.341, c.1895).

Denotations and significations are not mutually independent entities of logical analysis. Peirce argued that the former are «created» by the latter (W 1, p. 287). We can only determine the denotation of a symbol when we know its signification; and vice versa: we must know its denotation when we want to determine its signification (cf. Liszka, 1996, p.124).

Symbols have both denotation and signification. They are «general representations», which «connote attributes and so connote them as to determine what they denote» (W1, p. 468, 1866), that is, they denote classes of objects, but classes of object must have certain characters or attributes in common to be considered as such.

These logical instruments lead Peirce to a first conclusion about the difference between icons, indices, and symbols with respect to their denotation and connotation: Only symbol terms have both denotation and connotation. Only they can denote as well as signify objects. An index term, by contrast, «has no adequate extension», and an icon term «has no known extension» (W1, p. 485, 1866). An indexical expression has no adequate extension because, unlike a symbol, it represents a singular object, not a class of things with characteristics in common. An icon term has no known extension because it only resembles some object, and this representation is too vague to denote anything in specific.

The quantification of denotation and signification

A recurrent topic of Peirce's early logic classes is «the law of the inverse proportionality of extension and comprehension» (CP 2.400, 1867), which Peirce attributed to Kant and to which he occasionally referred as «Kant's law» (CP 2.406, 1867; for the history of this law, see Bellucci, 2018, p. 39). It states that the quantity of denotation of a symbol is in a relation of inverse proportionality to the quantity of its signification. *Quantity* of denotation (extension), according to this conception, is the measure of the number of things denoted by a symbol, and quantity of signification (intension) is the measure of the number of predicates implied in the symbol:

> Symbols […] may denote more or fewer possible differing things; in this regard they are said to have *extension*. In the second place, they may imply more or less as to the quality of these things; in this respect they are said to have intension». (W 1, p. 187, 1865)

A *mare* is a 'female horse'. The things denoted by this symbol are hence roughly half as many as the things denoted by the symbol *horse*, but the number of

characters that define this symbol is one more (+ 'female') than the ones of the symbol *horse*.

This law reflects the practical insight of lexicography that a word with a broader denotative scope usually needs fewer words for its definition than a word with a narrower denotative scope. For example, *Collins Cobuild Advanced Dictionary* of English defines *horse* as «a large animal which people can ride», and *donkey* as an «animal which is like a horse, but which is smaller and has longer ears» (Sinclair, 2008). The dictionary attributes the same core features to the denotata of both words and distinguishes them by adding two semantic features to the word for the presumably rarer species.

Notice, however, that Peirce's measure of the quantity of extension is neither the real number of things that constitute the extension of a symbol nor the frequency of the word (which usually corresponds to the number of things denoted by it). For Peirce, the difference in the extension of the symbols *horse* and *donkey* is neither a matter of the actual number of horses and donkeys that live on earth nor the frequency of the occurrence of the two words in language use. Here lies an essential difference between the Shannon-Weaverian and Peirce's concept of information. For information theoreticians in the tradition of Shannon and Weaver (1949), a rarer word has more information than a more frequent one. Supposing that the word for the rarer species, *donkey*, is also rarer in language use, this word is more informative than the word *horse*, according to a Shannon-Weaverian calculus. Likewise, the word *mare* is more informative than the word *horse* because the former word is rarer than the latter.

In Peirce's above-quoted definition (W 1, p. 187) by contrast, the criterion is not the actual number of things that a symbol denotes but whether the symbols «denote more or fewer *possible differing* things» (W 1, p. 187, emphasis added). The difference in the extension of two symbols need only be determined relatively, and the different objects of reference to be calculated are not actual things but only logically possible ones. This is particularly relevant when the symbol is not only a word, but a whole phrase, a proposition, an argument, or even «a whole book», to which Peirce extended the scope of symbols as early as in 1866 (W1, p. 468).

An example of how signification and denotation change when symbols are not individual words but compound forms is the following: «If *horse* be divided into *black horse* and *non-black horse*, *black horse* has more intension» (W 1, p. 272, 1865). Compared with the symbol *horse*, the compound symbol *black horse* denotes fewer possible things but signifies more because of its additional character 'black'.

On the basis of these logical principles of quantifying denotation and signification, Kant's law of the inverse proportionality of denotation and signification can be interpreted, with Peirce, as the law according to which any addition to the denotation of a symbol diminishes its signification and vice versa : «The greater the extension, the less the comprehension» of a symbol (W 1, p. 465, 1866), or: the greater the comprehension, the less the extension.

Information and its quantification according to Peirce

Kant's law of the inverse proportionality of denotation and signification only states that the result of calculating the relation between the two variables is a constant. It does not deal with information. To quantify information, it must enter the calculus a third variable besides the ones of signification and denotation. Peirce defines this third variable, information, as «real knowledge» (W 1, p. 187). Real knowledge is knowledge about the things denoted by a symbol beyond, or in addition to, «what is contained in its definition» (W 1, p. 275). The symbol *man* in the sense of ' is sufficiently defined as 'rational animal'. This symbol has both denotation and signification, but the knowledge that defines a word in its lexical sense is not informative because the word *man*, defined as 'human being', for example, already implies and thus signifies the characters 'animal' and 'rational', and it denotes by definition all human beings.

In allusion to Aristotle's characterization of the human being as the only animal that can laugh (*homo ridens*), Peirce then adds the word 'risible' to the symbol *man*. This is an addition that increases the number of characters but does not diminish the denotation of the symbol. Peirce concludes that the resulting compound symbol, *risible man*, is informative because it conveys knowledge not already contained in the essential characterization, the definition, of *man* as a

human being (W 1, pp. 275-276, 1865). The example illustrates why Peirce defines information as a surplus of the signification of a symbol beyond what is already contained in its definition, or as Peirce put it: «Information measures the superfluous comprehension» (W 1, p. 467).

Knowledge grows with new information, conveyed by representations in learning processes. How information contributes to the growth of knowledge is the topic of the scenario of a blind person who learns, not by real experience, but through words, what the color red denotes and signifies:

> When a blind man learns that *red* is not-blue, *red not-blue* becomes for him equivalent to *red*. Before that, he might have thought that *red not-blue* was a little more restricted term than *red* […], but the new information makes it the exact equivalent of red. […] Thus, every addition to our information about a term, is an addition to the number of equivalents which that term has. Now, in whatever way a term gets to have a new equivalent, whether by an increase in our knowledge, or by a change in the things it denotes, this always results in an increase either of extension or comprehension without a corresponding decrease in the other quantity. (W 1, p. 464, 1866)

Against the backdrop of these instruments of traditional logic, Peirce summarizes a first general definition of information in a formula that extends Kant's law by introducing information as a third variable besides denotation and signification (extension and comprehension):

> We must therefore modify the law of the inverse proportionality of extension and comprehension and instead of writing
>
> $$\text{Extension x Comprehension} = \text{Constant}$$
>
> which crudely expresses the fact that the greater the extension the less the comprehension, we must write
>
> $$\text{Extension x Comprehension} = \text{Information}$$
>
> which means that when the information is increased there is an increase of either extension or comprehension without any diminution of the other of these qualities. (W1, p. 465, 1866)

This new formula is not meant to yield a precise mathematical calculus of information, as it was later the ambition of Shannon and Weaver (1949). Instead, it calculates information in relation to the actual knowledge horizon of a learner, subtracting the elements of signification and of denotation the symbol has by definition. Peirce justifies this subtraction with the argument that the lexical

knowledge of words cannot convey knowledge about the things denoted by them. It is only *verbal knowledge*:

> I call any acquisition of knowledge «information», which has logically required any other experience than experience of the *meanings of words*. I do not call the knowledge that a person known to be a woman is an adult nor the knowledge that a corpse is not a woman, by the name «information», because the word «woman» *means* a living adult human being having female sexuality. Knowledge that is not informational may be termed «verbal». […] Nor is our knowledge that a woman is not a brute a part of this meaning of woman but is due to the meaning of brute being that a «brute» means any living animal lower in its mental faculties than a normal human being. (MS 664, p. 19-20, 1910)

Although verbal knowledge is excluded from being informative, individual symbols are not necessarily devoid of information because a symbol does not only signify the characters necessary to distinguishing it from other symbols. Signification and denotation go far beyond, including the «total fact which the symbol embodies» (W 1, p. 276, 1865). More precisely, the information which a symbol embodies comprises «all the synthetical propositions in which its objects in common are subject or predicate» (W 2, p. 59, 1867). Hence, the totality of biological, social, and cultural knowledge associated with *women* (in contrast to men, daughters, sons, etc.) is information embodied in this symbol.

Information as an object of a representation, and uninformative representations

From the perspective of Peirce's later semiotic doctrine, it is interesting that his earliest writings conceived of information as an *object* of a symbol, defined, quite differently from Peirce's later definitions of the object of the sign, as «a thing corresponding to a representation regarded as actual» (W 1, p. 274, 1865). The «informative object» is one of three possible objects of a symbol besides the denotative and the connotative one:

> All symbols besides their denotative and connotative objects have another; their informative object. The denotative object is the total of possible things denoted. The connotative object is the total of forms manifested or implied. The informative object is the total of symbols translated and is measured by the amount of intension the term has, over and above what is necessary for limiting its extension. For example, the denotative object of man is such collections of matter the word knows while it knows them, i.e., while they

are organized. The connotative object of man is the total form which the word expresses. The informative object of man is the total fact which it embodies; or the value of the conception which is its equivalent symbol. (W 1, p. 276, 1865)

Here it becomes evident that Peirce's early considerations concerning the three objects of a symbol anticipate roughly what he later defined as the *immediate object* of a sign, namely, the «idea» of the real object «in the intention of its utterer» (EP 2, p. 409, 1907) or «an image, or notion, which the interpreter is supposed to have already formed in his mind before the sign is uttered» (MS 318, p. 16, 1907).

If «all symbols» have «their informational object», all symbols, whether terms or propositions, must have information. Peirce formulates this law of information categorically as follows:

A symbol not only may have information but it must have it. For every symbol must have denotation that is must imply the existence of some thing to which it is applicable. It may […] be intended to be a fiction and the very form of the word may hint that intention as in the case of abstract terms such as *whiteness*, *nonentity*, and the like. […] No matter how general a symbol may be, it must have some connotation limiting its denotation; it must refer to some determinate form; but it must also connote *reality* in order to denote at all […]. And so every symbol has information. To say that a symbol has information is as much as to say that it implies that it is equivalent to another symbol different in connotation. (W1, p. 287-288)

However, there are exceptions to this rule. The first is the case of omniscience (CP 2.409, 1867). Nothing can be informative to an omniscient knower. Of course, there are no all-knowing beings, so that this exception is only a hypothetical one.

The second exception to the possibility of conveying information is the case of lexical definitions and analytic statements, such as *Women are female adults* or *Fathers are male parents*. As discussed above, nothing except what defines them as a symbol can be learned from them.

A third case in point is the one of a symbol that has no signification or denotation at all. Peirce can exclude these cases from his theory of information because he defines terms devoid of signification or denotation as «pseudo-symbols». Two examples are the symbols *cats and stoves* and *tailed men*. The compound symbol *cats and stoves* lacks signification «because it does not purport to relate to any

definite quality» since no quality is common to the words that constitute this symbol. The symbol *tailed men* lacks denotation «for though it implies that there are men and that there are tailed things, it does not deny that these classes are mutually exclusive». Hence, «All such terms are totally wanting in information» (W 1, p. 288).

A fourth restriction is associated with the impossibility of conveying knowledge through signs with whose object the interpreter is entirely unfamiliar. The details of this chapter of Peirce's semiotic theory lie in his late doctrine of the necessity of «collateral experience» with the object of the sign as a prerequisite of its interpretation. An outline of it is the following:

> The Sign can only represent the Object and tell about it. It cannot furnish acquaintance with or recognition of that Object; for that is what is meant in this volume by the Object of a Sign; namely, that with which it presupposes an acquaintance in order to convey some further information concerning it. No doubt there will be readers who will say they cannot comprehend this. They think a Sign need not relate to anything otherwise known, and can make neither head nor tail of the statement that every Sign must relate to such an Object. But if there be anything that conveys information and yet has absolutely no relation nor reference to anything with which the person to whom it conveys the information has, when he comprehends that information, the slightest acquaintance, direct or indirect – and a very strange sort of information that would be – the vehicle of that sort of information is not, in this volume, called a Sign. (CP 2.231, 1910)

To have, convey, and to create information

Peirce distinguishes between having and conveying information. The sense in which all symbols *have* information is the sense discussed above. Whenever the meaning of a term changes, increases, or diminishes in its denotative and connotative scope, we acquire more information about its meaning. To say that a word (term or rheme) has information means that it has become associated with meanings in the course of time, but not only the symbol users learn such new meanings. Symbols, too, acquire or lose information as they come to mean more or less than they did before. In this process of semiotic growth mediated by new information, «men and words reciprocally educate each other; each increase of a man's information involves and is involved by, a corresponding increase of a word's information» (CP 5.313, 1868).

Although all symbols *embody* information, not all can *convey* information. Only propositions (dicents) can *convey* information; only a dicent is «the kind of sign that *conveys* information, in contradistinction to a sign from which information may be derived» (CP 2.309, 1903). Rhematic symbols (individual words) do not *convey* and are not interpreted as conveying information, although they *afford* information by implication. Their information can be derived from the store of knowledge accumulated in them.

An individual word, a rheme, is a symbol whose implied information cannot be conveyed through the word alone. The mere utterance of the word *woman* cannot convey the information implied in the totality of biological, social, and cultural knowledge associated with this symbol. Only symbols of the size of a whole book could do that approximately.

The growth of knowledge through new information conveyed to a learner begins with propositions (dicents). As an example of how information is conveyed through a proposition, Peirce considers the statement «No Britons are slaves» to show that the propositional combination of the subject term, *Britons*, with the predicate term, *slaves*, modifies both the extension and the intension of the symbol since it adds 'non-slave' to the characters of the symbol and «also excludes slaves from those objects which are Britons» (W 1, p. 277). Hence, the signification of the symbol *Britons* increases through the addition of the character 'non-slaves'. At the same time, this symbol is narrowed down in its denotation since the class of *slaves* is now excluded from the class of things denoted by the symbol. Hence, the proposition conveys information about the Britons and also proves that «No proposition […] leave[s] its terms as it finds them» (W 1, p. 277).

In addition to conveying information to an interpreter from the knowledge store of an utterer, dicent symbols can also *create* previously unknown knowledge. Peirce describes this creative potential of symbols as a «process of nutrition of terms by which they get all their life and vigor and by which they put forth an energy almost creative» (W 1, p. 464) and exemplifies knowledge creation through symbols with a case of trade name creation, which he interprets as the creation of a symbol through a symbol:

> Perhaps the most marvellous faculty of humanity is one which it possesses in common with all animals and in one sense with all plants, I mean that of procreation. […] If I write «Let *Kax* denote a gas furnace», this sentence is a symbol which is creating another within itself. (W 1, p. 497 = CP 7.590, 1866)

Peirce's later semiotic approach to the study of information

Peirce's later semiotics reinterprets the earlier approach to information in terms of the three main trichotomies of its fully developed system (CP 2.243, 1903). The representations whose information value this theory investigates are no longer only verbal symbols, but include icons, indices, and nonverbal symbols, defined according to the criterion of the relation between the sign and its object. The new theory of information reinterprets denotation in terms of indexicality and signification in terms of iconicity. The term–proposition–argument trichotomy of traditional logic is redefined in the form of the rheme–dicent–argument trichotomy, set up according to the criterion of the sign–interpretant relation. The third trichotomy is the one of the sign considered as such. It divides signs into signs of qualities (qualisigns), signs that are singular phenomena (sinsigns), and signs determined by a law (legisigns).

The reinterpretation of propositions as dicents

The reinterpretation of propositions as dicents (or dicisigns) extends the logical to a semiotic analysis also applicable to nonverbal signs. The two constituents of a proposition are now «the predicate, which excites something like an image or dream in the mind of its interpreter, and the subject, or subjects, each of which serves to identify something which the predicate represents» (MS 280, c.1905; for the iconicity of predicates see also: Ransdell, 2005). In detail:

> A Dicisign […] must, in order to be understood, be considered as containing two parts. Of these, the one, *which may be called the Subject*, is or represents an Index of a Second existing independently of its being represented [i.e., its object, WN], while the other, which may be called the Predicate, is or represents an Icon of a Firstness [or quality or essence]. Second: These two parts must be represented as connected; and that in such a way that if the Dicisign has any Object, it [the Dicisign] must be an Index of a Secondness subsisting between the Real Object represented in one represented part of the

> Dicisign to be indicated and a Firstness represented in the other represented part of the Dicisign to be Iconized. (CP 2.312, 1903; bracketed additions after line 4 are by the editors of the CP)

Conceived as an icon, the predicate part of the proposition is now more generally a sign that «conveys its signification by exciting in the mind some image or, as it were, a composite photograph of images» (CP 2.317, 1903). Whereas the signification implied in a symbol is a mental icon that «carries meaning», pure icons are devoid of meaning and hence information, although,

> that to which meaning prompts is the appearance of an image. An image may be regarded as a sign, but it carries no meaning. It simply exhibits itself and in doing that represents anything that it resembles, in so far as it resembles that other image. (For it can resemble nothing but an image.) This element of meaning is called *signification*. (MS 693b, p. 381-383, 1904)

Icons and indices as the interpretants of symbols

Peirce accounts for his reinterpretation of subjects (and objects) in terms of indexical signs and of predicates as icons as follows:

> In most cases the subject-index is compound and consists of a set of indices. Thus, in the proposition, «A sells B to C for the price D», A, B, C, D form a set of four indices. The symbol «– sells to – for the price –» refers to a mental icon, or idea of the act of sale, and declares that this image represents the set A, B, C, D, considered as attached to that icon, A as seller, C as buyer, B as object sold, and D as price. If we call A, B, C, D four subjects of the proposition and «– sells – to – for the price –» a predicate, we represent the logical relation well enough, but we abandon the Aryan syntax. (CP 2.439, c.1893)

A key to this interpretation is the term «mental icon». The words as such, the verb *sells* or the noun *price*, are symbols, but their interpretations – Peirce defines them as the *interpretants* of the symbols – have the mental representation of an icon, insofar as they evoke mental images of a seller, a buyer, a merchandise, and the price for which it is exchanged. The verbal signs that represent this scenario are symbols, but their interpretants are icons, mental scenarios of selling and buying together with indices that identify the kind of merchandise and the trading partners involved:

> The proposition conveys definite information like the genuine index, by having two parts of which the function of the one is to indicate the object

meant, while that of the other is to represent the representamen by exciting an icon of its quality. (CP 5.76, 1903)

Only in dicents can icons, in combination with indices and symbols, *convey* information. As signs, verbal propositions are symbols, whose interpretation requires learning and habits of use. The interpretants of the subjects and predicates, however, are icons and indices. For example, in order to understand the proposition, *The rose is red*, an interpreter needs to relate the symbol *rose* indexically to its denotatum, i.e., a real flower, often experienced in real life, and also available as a stored image in the interpreter's memory (cf. Kappner, 2004, pp. 215-219).

The interaction of iconicity and indexicality in an informative dicent is a pervasive topic of Peirce's semiotic theory of information. In a manuscript of 1902, he describes how it gives rise to information:

> Every proposition is capable of expression either by means of a photograph, or composite photograph […] together with some *sign* which shall show the connection of these images with the object of some index, or sign or experience forcing the attention, or bringing some information, or indicating some possible source of information; or else by means of some analogous icon appealing to other senses than that of sight, together with analogous forceful indications, and a sign connecting the icon with those indices. (MS 599, p. 9; Johansen, 1993, pp. 230-231)

Symbols are too general, and icons too vague to convey information, although both are needed to connect the signs with ideas about, and the reality of, the interpreter's universe of experience. The function of mental indices is to connect the symbols and their iconic interpretants with the universe of real experience in time and space. Only indices can connect the symbols and the iconic representations of the form of their objects to real experience, since «the real world cannot be distinguished from a fictitious world by any description» (CP 2.337, 1903). The following scenario serves to prove this argument:

> Two men, *A* and *B*, meet in a country road, when the following conversation ensues:
>
> B. The owner of that house is the richest man in these parts.
>
> A. Which house?
>
> B. Why do you not see a house to your right about seven kilometers distant, on a hill?

A. Yes, I think I can descry it.

B. Very well, that is the house.

Thus, *A* has acquired information. But if he walks to a distant village and says, «the owner of a house is the richest man in those parts», the remark will refer to nothing, unless he explains the interlocutor how to proceed from where he is in order to find that district and that house. Without that, he does not indicate what he is talking about. To identify an object, we generally state its place at a stated time; and in every case must show how an experience of it can be connected with the previous experience of the hearer. (EP 2, p. 7, 1894)

The imaginary dialogue confronts us with an utterer whose intended information can only gradually be conveyed to the interpreter since the indices to make the dialogue informative are first missing. Without such indices necessary to distinguish the denotated object from other objects not meant, the utterer's symbols first lack information.

Representations as informational agents

In the above-discussed sense, in which all symbols *have* information, the information they imply is independent of any individual human agent. The symbol, in combination with indices and icons, is, so to speak, an autonomous semiotic agent. Peirce's later theory of information emphasizes even more that the source of information is not necessarily a human mind and that symbols, combined with indices and icons, are semiotic agents able to convey information on their own, even independently of the utterer's intention (cf. Nöth, 2009). The symbol is semiotically active even when there is no interpreter to interpret it since a symbol has a purpose to be interpreted that is independent of the purpose (or intention) of a possible utterer or conveyor of information. This is what Peirce means when he writes, «An ordinary Proposition ingeniously *contrives to convey novel information* through Signs whose significance depends entirely on the interpreter's familiarity with them» (CP 4.543, 1906; italics added).

The mind of the utterer of a symbol is thus not the only source of information. The object of the sign is another source of information, and this source conveys a message that is independent of the utterer's intentions. After all, Peirce's most fundamental cognitive assumption is that «all our knowledge comes to us by

observation» (CP 1.238, 1902). Since observation means observation of reality, and since «the real is that whose characters are independent of what anybody may think them to be» (CP 5.405, 1877), the information conveyed to the interpreter is not only under the control of the agent who produces the sign. The object of the sign, located in the sphere of a reality independent of the intentions of an utterer and an interpreting subject, turns out to be an agent producing information itself.

True, fictitious, and false information

Peirce's early logical approach defined the informed breadth (extension) of a proposition as «the aggregate of possible states of things in which it is true» (CP 2.407, n. 1, 1893) and the informed depth (intension) of a term as «all the real characters […] which can be predicated of it (with logical truth, on the whole) » (CP 2.408, 1867). In 1906, Peirce abandoned the criterion of truth and suggested instead that information may also include other modalities of representation: «Besides the logical depth and breadth, I have proposed (in 1867) the terms *information* and *area* to denote the total fact (true or false) that in a given state of knowledge a sign embodies» (EP2, p. 305, 1904). After the turn of the century, *all* propositions with possible denotations and significations convey information, not only the true ones. The information conveyed by a symbol may be «certain or doubtful» (W 2, p. 87, 1901), fictitious or real, true or false. The fictitious is informative as long as it is not impossible that it might be real, for «the Possible, in its primary meaning, is that which may be true for aught we know, that whose falsity we do not know» (CP 3.374, 1885). Truth is not necessarily the correspondence of statements with the facts they denote. It may even «be in some sense a creation of the mind», as long as «once created, it is in a measure independent of thought» (MS 463, p. 9-10, 1903). The informative includes the merely possible. «That is possible which, in a certain state of information, is not known to be false» (CP 3.442, 1896). Even the false is in some sense informative. To the one who knows that it is false, it conveys at least the information that it does not represent the real.

Why icons, indices, and symbols alone cannot convey information

In light of the broader applicability of the theory of representation in Peirce's fully developed semiotics, the question requires reexamination whether only symbols can *convey* (instead of only *have*) information, as Peirce had postulated in his early writings, or whether icons and indices can do so, too. The answer reveals another difference between Peirce's early and his later theory of information. In the new framework, icons alone, indices alone, and also symbols alone cannot convey information. Symbols need icons *and* indices to become informative, but icons, combined with indices, can convey information even without symbols.

An icon is always a rheme, a sign defined in Peirce's early lectures on logic, as terms. There are no iconic dicents (propositions) or arguments. Already for this reason, an icon alone cannot convey information, because only propositions and arguments can do so. When Peirce denies the capacity of icons to convey information after 1867, he only affirms what he had ascertained in his earliest writings. In 1896, he writes: «The idea embodied by an icon […] cannot of itself convey any information, being applicable to everything or to nothing» (CP 3.433). In 1904, he affirms the same with respect to the pure icon, that is, the iconic rhematic qualisign:

> A pure icon is independent of any purpose. It serves as a sign solely and simply by exhibiting the quality it serves to signify. The relation to its object is a degenerate relation. It asserts nothing. If it conveys information, it is only in the sense in which the object that it is used to represent may be said to convey information. An *icon* can only be a fragment of a completer sign. (EP 2, p. 306)

In 1893, Peirce extends this argument to pictures in general, signs that are no pure icons but hypoicons, that is, icons with some admixture of indexicality or even symbolicity:

> Pictures alone, – pure likenesses, – can never convey the slightest information. Thus, figure 3 suggests a wheel. But it leaves the spectator uncertain whether it is a copy of something actually existing or a mere play of fancy.
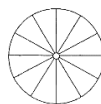

Fig. 3 (EP 2, p. 7, 1894)

However, Peirce now attributes the incapacity to convey information also to «general language and symbols»: «No combination of words (excluding proper nouns, and in the absence of gestures or other indicative concomitants of speech) can ever convey the slightest information» (ibid.). For symbols, this is so because they are general signs, and as such, «a symbol, in itself, is a mere dream; it does not show what it is talking about. It needs to be connected with its object. For that purpose, an *index* is indispensable» (MS 409, pp. 95-96, c.1893-95). Notice that this argument is valid for all symbols, not only for rhematic but also for dicentic and argumentative symbols. Symbols need indices, either gestural or verbal ones, to become informative.

Indexical words are proper nouns, deictic adverbs of time and place, or pronouns, demonstrative or personal ones of the first or second person. Although words, these parts of speech are not symbols because they have no general object. Indexicality is also associated with experience, so that information may also come from the collateral experience of the object represented by a symbol. However, indexical words alone lack information because they can only *show* their objects without informing about them. Peirce describes this incapacity of rhematic indices to inform as follows: «The index asserts nothing; it only says 'There!' It takes hold of our eyes, as it were, and forcibly directs them to a particular object, and there it stops» (CP 3.361, 1885). In sum, as De Tienne (2003, p. 49) puts it, «An index without an icon is blind, a symbol without an index is empty. Pure indexes and pure symbols do not occur, except within the abstract classification of semiotic theory, where their isolation is of course most convenient.»

The incapacity of symbols to convey information must sound provocative to all those who have interpreted the symbol as the key to the advancement of human knowledge and as the semiotic medium by which humans have evolved to the only «rational beings» among all animals. Peirce, by contrast, argues that the semiotic potential of symbols is insufficient. Verbal discourse and even «all thinking» is not possible without the complement of iconic and indexical signs, since

> all thinking is conducted in signs that are mainly of the same general structure as words; those which are not so, being of the nature of those signs of which we have need now and then in our converse with one another to eke

> out the defects of words, or *symbols*. These non-symbolic thought-signs are of two classes: first, pictures or diagrams or other images (I call them *Icons*) such as have to be used to explain the significations of words; and secondly, signs more or less analogous to symptoms (I call them *Indices*) of which the collateral observations, by which we know what a man is talking about, are examples. The Icons chiefly illustrate the significations of predicate-thoughts, the Indices the denotations of subject-thoughts. The substance of thoughts consists of these three species of ingredients. (CP 6.338, 1909)

How do icons contribute to the information of representations? In addition to the answers to this question given above, there are other reasons why, and modalities how, icons contribute to information to be discussed in the following.

The iconicity of predicates and why predicates are dreamlike

As outlined above, Peirce's later semiotic theory of information reinterprets predicates and signification in terms of iconicity. Icons contribute mental images representing the object's qualities and characters: «One cannot better define a proposition […] than as a representation of which one part serves, directly or indirectly, as an index of its object, while the other part excites in the mind an image of the same object» (MS 491, p. 5, c.1903).

When Peirce refers to predicates as exciting in the interpreter's «mind an image of the same object», it is evident that he refers to the interpretant of the sign. The icon implied in the predicate is a mental image evoked in the course of the interpretation of the symbol. An example is the verb *loveth* in the dicent symbol *Ezekiel loveth Huldah*. Its effect, according to Peirce, «is that the pair of objects denoted by the pair of indices Ezekiel and Huldah is represented by the icon, or the image we have in our minds of a lover and his beloved» (CP 2.295, c.1893). This is why verbs and adjectives are icons in their interpretants and why

> a verb by itself signifies a mere dream, an imagination unattached to any particular occasion. It calls up in the mind an *icon*. A *relative* is just that, an icon, or image, without attachments to experience, without «a local habitation and a name», but with indications of the need of such attachments. (CP 3.459, l897)

When it comes to describing the mental icon evoked by the predicate of a dicent symbol, one of Peirce's favorite examples is the sentence *it rains*. In Peirce's picturesque description, the verb of this sentence evokes in the interpreter's mind

«an image of fine up-and-down lines over the field of view; and he looks sharply out of the window, fully understanding that that visible environment is indicated as the subject where the lines of falling drops will be seen» (CP 2.360, 1901).

In another description of the mental image of a rainy day, Peirce uses the metaphor a of a composite photograph, a medium invented in Peirce's time by which composite images were produced through the multiple exposure of the same negative or by means of similar devices. Here, the mental image of a rainy day is the one of a «mental composite photograph of all the rainy days the thinker has experienced» (CP 2.438, 1903). Still another scenario to illustrate the iconicity of a predicate and to characterize the mental image required for the interpretation of its verbal description is the following:

> In the proposition «Anthony gave a ring to Cleopatra», […] the predicate is a word or phrase which will call up in the memory or imagination of the interpreter images of things such as he has seen or imagined and may see again. Thus, «gave» is the predicate of the proposition; and it conveys its meaning because the interpreter has had many experiences in which gifts were made; and a sort of composite photograph of them appears in his imagination. (CP 5.542, c.1902)

In his later writings, Peirce frequently evokes the adjective *imaginary* to describe the mental icon called up by a predicate. «The value of an icon consists in its exhibiting the features of a state of things regarded as if it were purely imaginary» (CP 4.448, c.1903).

Elsewhere, Peirce uses the metaphor of a dream to describe the vagueness and indeterminacy of rhematic iconic qualisigns, which, despite their vagueness and indeterminacy, are nevertheless necessary to give form and to convey information about the object of a sign separately indicated by an index. Signification and, more generally, «*meaning* is the association of a word with images, its dream exciting power» (CP 4.56, 1893). In its dreamlike form, a pure image is nevertheless a phenomenon of consciousness, although not of a «a *waking* consciousness, – but still something of the nature of consciousness. A *sleeping* consciousness, perhaps» (MS 945, p. 2, 1897-98).

In one of his descriptions of the dreamlike nature of the mental images created in the mind of an interpreter, Peirce characterizes them as multimodal sense impressions evoked by the utterer, which create

> familiar images, pictures, or, we might almost say, *dreams* — that is, reminiscences of sights, sounds, feelings, tastes, smells, or other sensations, now quite detached from the original circumstances of their first occurrence, so that they are free to be attached to new occasions. (CP 3.433, 1896)

Notice that the mental images evoked by «the deliverer» who «makes signals to the receiver» are not only icons in the sense of of images «the deliverer is able to call up […] at will […] in his own mind» (ibid.); they are also representations of «familiar images […] now quite detached from the original circumstances of their first occurrence», that is, images stored in the interpreter's own memory. Because of this memory-evoking potential and characteristic, «an icon has such being as belongs to past experience» (CP 4.447, c.1903).

The mental icon evoked as the interpretant of a verbal predicate is thus a representation of two different objects. It is an icon of the object also represented by the symbol that constitutes the verbal predicate, which is the so-called dynamical or real object of both signs, and it is an icon of the mental representation available in the knowledge store of the interpreter's memory. This object is the one which Peirce defined as the immediate object of the sign, which is the above-discussed mental object, formed as a result of the interpreter's collateral acquaintance with, or experience of, the same object. This object finds its explanation in Peirce's theory of the collateral «acquaintance with what the sign denotes» (EP 2, p. 494, 1909). The «familiar image or 'dream'» called up in the mind of an interpreter of an external image is an iconic sign of this immediate object which results from the interpreter's previous experience of the real object. Interpreters can only interpret icons of «sights, sounds, feelings, tastes, smells, or other sensations» (ibid.) when they have such experience with, or acquaintance of the sign's denotata. Otherwise, the signs must remain incomprehensible to the interpreter. Peirce illustrates the incapacity of interpreters to interpret signs with whose object they have no such familiarity with the example of a color-blind person unable to interpret the colors never experience visually:

> If a man is blind to the red and violet elements of light and only sees the green element, then all things appear of one color to him, and that color is a green of colorific intensity beyond anything that we with normal eyes can see or imagine. Such is the color that all things look to him. Yet since all things look alike in this respect, it never attracts his attention in the least. He may be said to be dead to it. (CP 6.222, 1898)

Infographics: The efficiency of icons in conveying information

Despite their vagueness, icons do not only contribute to information; they are also highly useful and efficient in doing so: «We find that, in fact, Icons may be of the greatest service in obtaining information – in geometry, for example» (CP 2.314, 1902). One of the reasons for the usefulness of icons is that «the only way of directly communicating an idea is by means of an icon; and every indirect method of communicating an idea must depend for its establishment upon the use of an icon» (CP 2.278, c. 1895).

Not only in geometry, also in maps, architectural ground plans, or infographics, the importance of icons stands out, whether they are combined with symbols or only with indices. The vagueness inherent in icons is informationally compensated by the indices that establish the necessary link between the dreamlike form of the icon and the reality which the representation indicates. Icons are also informative since they can *show* how the things represented by them look like and what sensory qualities they have. The qualities of objects are icons, not only when they are depicted graphically but also when they are described in words able to evoke mental images, as, for example, in the following scenario of a «logically minded» author of a chemistry textbook who uses abundantly (iconic) adjectives in a detailed (iconic) description of what happens in the laboratory:

> If you look into a textbook of chemistry for a definition of lithium, you may be told that it is that element whose atomic weight is 7 very nearly. But if the author has a more logical mind he will tell you that if you search among minerals that are vitreous, translucent, grey or white, very hard, brittle, and insoluble, for one which imparts a crimson tinge to an unluminous flame, this mineral being triturated with lime or witherite rats-bane, and then fused, can be partly dissolved in muriatic acid; and if this solution be evaporated, and the residue be extracted with sulphuric acid, and duly purified, it can be converted by ordinary methods into a chloride, which being obtained in the solid state, fused, and electrolyzed with half a dozen powerful cells, will yield a globule of a pinkish silvery metal that will float on gasolene; and the material of that is a specimen of lithium. The peculiarity of this definition-- or rather this precept that is more serviceable than a definition – is that it tells you what the word lithium denotes by prescribing what you are to do in order to gain a perceptual acquaintance with the object of the word. (CP 2.330, 1902)

Another case in point is a portrait that identifies the name of its sitter through its title. Peirce gives the example of «a portrait of Leopardi with Leopardi written below it», which «conveys its information to a person who knows who Leopardi was, and to anybody else» to whom »it only says 'something called Leopardi looked like this'» (CP 8.183, 1909). Proper names are verbal indices because they represent singular objects, unlike symbols, which represent general ones. The portrait alone is uninformative as long as we only see the unidentified person. It remains vague because it can be interpreted as representing any person that look like the portrait. Only the name in the title of the portrait can identify its sitter and make it informative (cf. Stjernfelt, 2022, ch. 7).

Information without symbols

Peirce's ten main classes of sign (CP 2.254, 1903; 8.341, 1904) can be consulted for answers to the question whether only verbal symbols or also other signs can have information in Peirce's later theory of information. As seen above, rhemes are signs which cannot convey but only offer or imply information, whereas dicents and arguments have the full potential of conveying information. Now, six of Peirce's ten main sign classes are rhematic signs and do hence only qualify for «affording» or implying, not for conveying, information. Among the four remaining sign classes, there are two that consist of symbols, the ones which Peirce had previously discussed as (verbal) propositions and arguments, classes nine (*dicent symbol*) and ten (*argument*) of Peirce's ten main classes of signs. The two remaining nonsymbolic dicentic signs among the ten are indexical ones, *dicent* (*indexical*) *sinsigns* and *dicent indexical legisigns*. As dicents, they belong to the class of signs which have the potential of conveying information. If dicents can be indexical signs that do not involve symbols, it is possible that information is conveyed without symbols.

A good example of a *dicent indexical sinsign* conveying information is a weathercock indicating the direction of the wind. Being a sign caused by forces of nature, it is not a symbol but an index, and being singular, it is a sinsign. Peirce describes how this kind of sign conveys information as follows:

> A Dicent Sinsign [e.g., a weathercock] is any object of direct experience, in so far as it is a sign, and, as such, affords information concerning its Object. This it can only do by being really affected by its Object; so that it is necessarily an Index. The only information it can afford is of actual fact. Such a Sign must involve an Iconic Sinsign to embody the information and a Rhematic Indexical Sinsign to indicate the Object to which the information refers. But the mode of combination, or Syntax, of these two must also be significant. (CP 2. 257, 1903)

When Peirce defines dicent sinsigns and dicent indexical legisigns as signs that can convey information, he extends his early theory of information, which was restricted to symbols.

Another typical example of an informative indexical dicent is the photograph. «Known to be the effect of the radiations from the object renders it an index and highly informative» (CP 2.265, 1903). More in detail. Peirce interprets the capacity of photographs to convey information as follows: «The mere print does not, in itself, convey any information. But the fact, that it is virtually a section of rays projected from an object otherwise known, renders it a Dicisign» (CP 2.320, 1903).

Dicent indexical sinsigns often incorporate diagrams and symbols, but even without symbols, they can convey information. Maps without words and other symbols are a case in point. Such maps *convey* information through their diagrammatic icon and cartographic indices and orient their users in the territory represented by the map. Peirce describes this process as follows: «The geometer draws a diagram […], and by means of observation of that diagram he is able to synthesize and show relations between elements which before seemed to have no necessary connection» (CP 1.383, 1890; see also Nöth, 2012). This semiotic potential explains why it is the «great distinguishing property of the icon […] that by the direct observation of it, other truths concerning its object can be discovered than those which suffice to determine its construction» (CP 2.279, c.1895).

Another class of dicents able to convey information in combination with an icon is the *dicent indexical legisign*. This class of dicents differs from the dicent indexical sinsigns only as far as it comprises indexical signs that are set up by a law in the sense of a general rule or convention:

> A Dicent Indexical Legisign [e.g., a street cry] is any general type or law, however established, which requires each instance of it to be really affected by its Object in such a manner as to furnish definite information concerning that Object. It must involve an Iconic Legisign to signify the information and a Rhematic Indexical Legisign to denote the subject of that information. Each Replica of it will be a Dicent Sinsign of a peculiar kind. (CP 2.260, 1903)

Traffic signs and commands are other examples of dicent indexical legisigns. Among this class of informative signs are also deictic utterances such as the answer «It is Farragut» given in reply to the question «Whose statue is this?» (CP 2.265, 1903).

The potential of icons to convey information in conjunction with symbols may be illustrated with forms of argumentation. Diagrammatic icons make syllogisms informative because their arrangement in the form of two premises followed by a conclusion constitutes a mental diagram. Together with the symbols in such diagrammatic arrangement, they convey new information concerning "unnoticed and hidden relations":

> all deductive reasoning, even simple syllogism, involves […] constructing an icon or diagram the relations of whose parts shall present a complete analogy with those of the parts of the object of reasoning […] and of observing the result so as to discover unnoticed and hidden relations among the part. (CP 3.363, 1885)

Let us conclude with a quote by Peirce that may serve as an apology for the necessary incompleteness of any attempt to account for a topic as complex as the interface of semiotics and the theory of information in a paper restricted in its length to the number of pages of this modest contribution to the journal *Informatio*: «It would be interesting to push these illustrations further; but I can linger nowhere. As soon as a subject begins to be interesting, I am obliged to pass on to another» (CP 5.76, 1903).

References

Bellucci, Francesco (2018). *Peirce's Speculative Grammar: Logic as Semiotics*. London: Routledge.

De Tienne, André (2005). Information in formation: A Peircean approach. *Cognitio*, 6(2), 149-156.

Debrock, Guy (1996). Information and the metaphysical status of the sign. In Vincent M. Colapietro and Thomas M. Olshewsky (Eds.), *Peirce's Doctrine of Signs: Theory, Applications, and Connections* (pp. 79-89). Berlin: Mouton de Gruyter.

Johansen, J. Dines (1993). *Dialogic Semiosis*. Bloomington, IN: Indiana University Press.

Kappner, Stephan (2004). *Intensionalität aus semiotischer Sicht: Peirceanische Perspektiven*. Berlin: de Gruyter.

Liszka, James J. (1996). *A General Introduction to the Semeiotic of Charles S. Peirce.* Bloomington, IN: Indiana University Press.

Nöth, Winfried (2009). On the instrumentality and semiotic agency of signs, tools, and intelligent machines. *Cybernetics & Human Knowing*, *16*(3-4), 11-36.

Nöth, Winfried (2012). Charles S. Peirce's theory of information: A theory of the growth of symbols and of knowledge. *Cybernetics & Human Knowing*, *19*(1-2), 172-192.

Peirce, Charles S. (1931-58). *Collected Papers*, vols. 1-6, C. Hartshorne, P. Weiss (Eds.); vols. 7-8, A. W. Burks (Ed.). Cambridge, MA: Harvard University Press (quoted as CP).

Peirce, Charles S. ([1963-1966] 1979). *The Charles S. Peirce Papers,* 30 reels, 3rd microfilm edition. Cambridge, MA: The Houghton Library, Harvard University, Microreproduction Service (quoted as MS [manuscripts] in accordance with the catalogue Robin, Comp.).

Peirce, Charles S. (1982). *Writings of Charles S. Peirce, vol. 1: 1857-1866*. Bloomington, IN: Indiana University Press (quoted as W 1).

Peirce, Charles S. (1984). *Writings of Charles S. Peirce, vol. 2: 1867-1871*. Bloomington, IN: Indiana University Press (quoted as W 2).

Peirce, Charles S. (1998). *The Essential Peirce. Selected Philosophical Writings, vol. 2, 1893-1913)*, Peirce Edition Project (Ed.). Bloomington, IN: Indiana University Press (quoted as EP 2).

Ransdell, Joseph (Comp.) 2005. Passages from Peirce, chronologically ordered, on the role of icons in predication. *Arisbe Website*. Available at *https://www*.sitehost.iu.edu*/rsources/quotes/iconrole.htm*. Accessed Sept. 2023.

Robin, Richard S. (Comp.). 1967. *Annotated Catalogue of the Papers of Charles S. Peirce*. Amherst, MA: University of Massachusetts Press.

Shannon, Claude E. and Weaver, Warren (1949). *The Mathematical Theory of Communication*. Urbana, IL: University of Illinois Press.

Sinclair, John (Comp.) (2008). *Collins Cobuild Advanced Dictionary*. Boston, MA: Heinle Cengage Learning.

Editor's note

The editor responsible for the publication of this article is Fernando Andacht.

Contribution's note

Winfried Nöth is the only author of this paper. There are no other contributors.

Data availability note

Data for this article is not available.