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Operational and Optimal Iconicity in Peirce's Diagrammatology

In this book, we have unproblematically assumed Peirce's concept of iconicity as referring to the semiotic function of similarity between sign and object. For a closer look, however, two different conceptions of iconicity compete in Peirce's diagrammatical logic. One is articulated in his general reflections on the role of diagrams in thought, in his diagrammatology – the other is articulated in his specific construction of Existential Graphs as an iconic system for representing logic. One is operational and defines iconicity in terms of which information may be derived from a given diagram or diagram system — the other has stronger demands on iconicity, adding to the operational criterion a demand for as high a degree of similarity as possible and may be termed optimal iconicity. Peirce himself does not clearly distinguish these two iconicity notions, a fact that has caused some confusion. By isolating them, we get a clearer and more refined conceptual apparatus for analyzing iconic signs. This chapter investigates the two iconicity notions and addresses some of the problems they involve.

1. The basic iconicity definition

The basic concept of iconicity in Peirce's semiotics and logic is presented in his second trichotomy of sign types, the well-known distinction between icons, indices, and symbols, respectively.[i] This trichotomy deals with the relation between the sign and its dynamic object, and the idea is that this relation may take three different forms. Icons function by means of a similarity between the sign and the

object, or, as Peirce may also say, by shared characteristics between the sign and its object. Indices function by means of an actual connection between the sign and its object, either of a causal character (the footprint on the beach) or of a purposive character (pointing gestures, deictics, pronomina or proper names in language). Symbols, finally, function by means of a habit, in mind or in nature, of connecting two otherwise unconnected entities to a sign. It should be clear by now that the sign types of this trichotomy, just as is the case in the later Peirce's other ten tricotomies, do not correspond directly to distinct, independent classes of signs. They rather pertain to *aspects* of signs, so that pure icons, indices, and symbols, respectively, may be conceived of as borderline cases only, while most typical (and indeed most interesting) signs involve all three aspects to different degrees.[ii] It is possible, though, in many cases, to point out which of the three aspects is *basic* in a given sign or a given sign type – so, for instance, diagrams being basically icons, and only secondarily (but still necessarily) having also indexical and symbolical aspects.

These basic definitions do not, however, state any clear criterion for the "similarity" between sign and object. This has caused some confusion. Is similarity detected by the immediate psychological experience of resemblance such as is often assumed? Or is it a relational property that may, in some cases, be difficult to establish? And which signs are subsumed by the definition of iconicity? Most semioticians will agree that pictures, paintings, photographs, movies, etc., have iconical qualities. In Peirce, as we have seen, iconicity also pertains to diagrams, algebra, grammar, etc. This issue, of course, requires a criterion for iconicity. This is what Peirce gives in what I call *operational* iconicity.

2. Operational iconicity

In the basic iconicity definition by similarity or shared characteristics, as outlined above, neither of the two iconicity concepts to be discussed here become obvious. They only appear when a further determination of similarity is attempted. The first, operational, definition appears in the discussion of the semiotics of diagrams, and it is developed by Peirce already in the 1880s, even if the full

articulation of it awaits Peirce's mature philosophy of the years around the turn of the century.

Diagrams can be initially defined by reference to Peirce's detailed taxonomy of signs from his late period. Here, icons come in three subtypes: images, diagrams, and metaphors, respectively. Images are to be taken in a special, technical sense not corresponding to our everyday image notion: they are icons whose similarity functions by means of simple qualities only; color, sound, pitch, shape, form, etc. Thus, images are very simple icons, functioning by one or few such qualities only. The crescent shape as a sign for the moon may serve as an example. The simplicity of images is made clear by their contrast to diagrams. Diagrams are skeletal icons, representing their object as analyzed into parts among which "rational relations" hold, be they explicit or implicit. Such relations may be spatial, temporal, logical, mathematical, or any other type that may make clear the specific type of connection holding between parts. So, as soon as the icon consists of parts whose relations mirror the relations between the corresponding parts of the object, and the sign is used to gain information about those parts and their interrelations, a diagram is at stake.[iii] In contrast to this technical notion of image, being much more narrow than the everyday use of the word, Peirce's technical notion of diagram is much wider than the everyday diagram notion: it will include any use of, e.g., a painting, in which the relation between its parts plays a role in the interpretation — and it will include also algebraic notations that may not, at a first glance, seem diagrammatical. Metaphors, to finish this trichotomy, are icons functioning through the mediation of a third object, for instance, an ancestral tree, charting family relationships in a branching diagram structure through the intermediate icon of a tree. The important notion here is the very wide sense of the notion of diagram that stems, in fact, from the operational criterion for iconicity. An icon is a sign "... from which information may be derived," Peirce simply says (*Syllabus*, ca. 1902, 2.309), and this is the basic idea in the operational criterion: icons as the only sign type able to provide information. This is why all more complex sign types must involve or lead to icons in order to convey information. Later in the same paper, Peirce adds that "An Icon, however, is strictly a possibility involving a possibility . . ."

(ibid., 2.311), and in this enigmatic formula, the first "possibility" should be read as referring to an icon being a possible sign of everything that resembles it in the respect so highlighted (only an index may make explicit which object or class of objects the sign more precisely refers to –in the shape of a proposition). The second "possibility," however, refers to the fact that the similarity characteristics defined by the first possibility in themselves involve possibilities that are not explicit and that may be further developed:

"For a great distinguishing property of the icon is that by the direct observation of it other truths concerning its object can be discovered than those which suffice to determine its construction"
("That Categorical and Hypothetical Propositions are one in essence, with some connected matters," c. 1895, 2.279).

I have earlier argued (Stjernfelt 2000a, 2007) that this idea constitutes an epistemologically crucial property of the icon: it is an operational specification of the concept of similarity. The icon is not only the only kind of sign directly presenting some of the qualities of its object; it is also the only sign by the contemplation of which more can be learned than lies in the directions for the construction of the sign. This definition immediately separates the icon from any psychologism: it does not matter whether sign and object for a first (or second) glance seem or are experienced as similar; the decisive test for iconicity lies in whether it is possible to manipulate or develop the sign so that new information as to its object appears. Icons are thus signs with implicit information that may be made explicit. This definition is non-trivial because it avoids the circularity threat in most definitions of similarity which has so often been noted.[iv] At the same time, it is what connects the concept of icon intimately to that of deduction. This is because, in order to discover these initially unknown pieces of information about the object involved in the icon, some deductive experiment on the icon must be performed. The prototypical icon deduction in Peirce's account is the rule-governed manipulation of a geometrical figure in order to prove a theorem — but the idea is quite general: an icon is characterized by containing implicit information about its object that, in order to appear, must be made explicit by some more or less

complicated deductive manipulation or experiment procedure accompanied by observation. Thus, Peirce's diagrammatical logic rests on the basic idea that all knowledge, including logical knowledge, indispensably involves a moment of observation. Peirce thus writes, as early as 1885, in the context of presenting his first, algebraic notation for first order predicate logic:

"The truth, however, appears to be that all deductive reasoning, even simple syllogism, involves an element of observation; namely, deduction consists in 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, of experimenting upon this image in the imagination, and of observing the result so as to discover unnoticed and hidden relations among the parts." ("On the Algebra of Logic: A Contribution to the Philosophy of
Notation," 1885, 3.363)

This operational criterion makes the breadth of the diagram category within icons obvious. As soon as rationally related parts of an icon are distinguished, and the manipulation of such parts is undertaken, we perform a diagram manipulation, developing some of the implicit possibilities involved in the icon. A very important effect of this operational criterion of similarity is now the appreciation of iconicity where at first glance it may not be obvious. Peirce himself makes use of this operational criterion when arguing that syllogistic logic or algebra are, in fact, instances of diagrammatical iconicity. In what I believe is Peirce's most detailed account for the diagrammatical reasoning process in general, abstracted from particular diagram systems, he thus argues this point:

"Now necessary reasoning makes its conclusion *evident*. What is this "Evidence"? It consists in the fact that the truth of the conclusion is *perceived*, in all its generality, and in the generality of the how and the why of the truth is perceived. What sort of a Sign can communicate this Evidence? No index, surely, can it be; since it is by brute force that the Index thrusts its Object into the Field of Interpretation, the consciousness, as if disdaining gentle "evidence." No Symbol can do

more than apply a “rule of thumb” resting as it does entirely on Habit (including under this term natural disposition); and a Habit is no evidence. I suppose it would be the general opinion of logicians, as it certainly was long mine, that the Syllogism is a Symbol, because of its Generality. But there is an inaccurate analysis and confusion of thought at the bottom of that view; for so understood it would fail to furnish Evidence. It is true that ordinary Icons, — the only class of Signs that remains for necessary inference, — merely suggest the possibility of that which they represent, being percepts *minus* the insistency and percussivity of percepts. In themselves, they are mere Semes, predicating of nothing, not even so much as interrogatively. It is, therefore, a very extraordinary feature of Diagrams that they *show,* — as literally *show* as a Percept shows the Perceptual Judgment to be true, — that a consequence does follow, and more marvellous yet, that it *would* follow under all varieties of circumstances accompanying the premisses." (“PAP”, 1906, a parallel version to “Prologomena to an Apology for Pragmaticism” from the same year, NEM IV 317–318)

Here, the operational criterion is used in order to include traditional syllogistic reasoning within the field of diagrams: the structure of syllogism simply *is* a diagram, even when presented in the clothing of ordinary language. The same criterion was early used by Peirce in order to include algebra as icons, even involving icons “par excellence”, in the manipulation rules of the algebra:

"As for algebra, the very idea of the art is that it presents formulae which can be manipulated, and that by observing the effects of such manipulation we find properties not to be otherwise discerned. In such manipulation, we are guided by previous discoveries which are embodied in general formulae. These are patterns which we have the right to imitate in our procedure, and are the icons par excellence of algebra." (“On the Algebra of Logic: A Contribution to the Philosophy of Notation,” 1885, EP I, 228, 3.363)

In this very paper, Peirce develops his linear notation of logic that, unlike his later graphs, sticks to traditional algebraic representations — the notation that, via Schröder and Peano, became the standard

representation of first-order predicate logic and thus forms the backbone of modern formal logic notation. But already here, he acknowledges at the same time that such formal representations must necessarily be diagrammatic, as measured on the operational criterion of iconicity. Elsewhere, cf. Ch. 7, he extends that criterion to include aspects of linguistic grammar in the diagram category. This operational criterion of iconicity thus becomes a very strong tool for a Peircean in trying to chart the limits of iconicity. Unfortunately, Peirce never went into a further taxonomical exercise in order to chart the possible subtypes of diagrams — the only reference in this direction is a brief comment upon the diagram types of maps, algebra, and graphs, respectively ("On Quantity," ca. 1895, NEM IV, 275). In any case, the operational criterion forms a very strong argument in a Peircean diagrammatology — yielding the means of a logical similarity test that is immune against psychologism and any subjective similarity impressions or confusions. This broad iconicity and diagram criterion is not, however, without problems. One terminological issue is that the technical, Peircean notion of diagram is now extended to such a degree that the common-sense notion of diagrams vanishes in the haze and seems to constitute only a small subset of the new, enlarged category. Another more serious problem is that Peirce still tends to take such diagrams as *prototypical* diagrams in many discussions, generalizing diagram notions taken from them to the whole category of diagrams. This goes, e.g., for his distinction between corollarial and theorematic reasoning, distinguishing conclusions that may be directly read off the diagram, on the one hand, and more difficult inferences requiring the introduction of manipulation or new entities in the diagram (see Ch. 10). This distinction is taken from the prototypical diagram case of Euclidean geometrical diagrams where the new entities introduced are auxiliary lines, etc. As Hintikka says it was Peirce's "brilliant insight . . . that this geometrical distinction can be generalized to all deductive reasoning" (1983: 109). The most serious problem, however, in the generalization of the diagram concept, is connected to the lack of a rational subtaxonomy of diagrams; namely, by which semiotic means should we now distinguish between, e.g., algebraical representations and topological-geometrical representations of the same content as, for instance, the graphical and

algebraical-arithmetical representations of the same mathematical functions? If the same amount of information may be derived from such representations, they are, to the exact same degree, diagrammatical representations, and Peirce's diagram category offers no means for us to distinguish the particular properties of these different representations.

3. Optimal iconicity

This problem seems, indeed, to lie behind Peirce's introduction of a second, stricter notion of iconicity. It is well known that Peirce, in the latter half of the 1890s, left behind his early algebras of logic, now preferring the development of graphical systems known as entiative and existential graphs. Especially the development of the latter was seen by Peirce himself as one of his major achievements, and they have been an inspiration for diagrammatical or multimodal logics of our day, because they involve "iconical" representations in two or more dimensions that differ highly from algebraical or "symbolical" representation systems of linear formal logic, e.g., in the Peano-Russell tradition. I place "iconical" and "symbolical" in scare quotes here to emphasize that the use of such words in this context runs directly counter to Peirce's operational iconicity criterion. For, according to this criterion, such representation systems are indeed diagrammatical and iconical *to the exact same degree*, provided they yield similar possibilities for extracting new information about their object. If the same theorems may be inferred from two such systems they are, on the operational criterion, to the same degree operationally iconical. And if we take Peirce's two finished systems of "iconical" logic graphs, the Alpha and Beta systems of existential graphs, they have indeed been proved complete and consistent representations of propositional logic and first-order predicate logic, respectively. So, in terms of which theorems may be derived from them, the Alpha and Beta graphs are just as iconical as propositional logic and first-order predicate logic, as developed within mainstream formal logic.

Peirce's operational iconicity criterion does, it is true, provide the strong insight that these results of mainstream formal logic are *not,* contrary to widespread belief, "symbolical" in the sense that they do

not involve iconical representations. They may, of course, be termed "symbolical," understood in the sense that they employ symbols to a larger degree than Peirce's graphs (which, it should be noted, also employ symbols), but this term may no longer be taken, implicitly, also to mean that they do not contain iconical representations of their object. This is, indeed, a very strong and maybe to some extent counter-intuitive result of Peirce's operational iconicity criterion. But it immediately raises a further question: *What is then the difference between "iconical" and "symbolical" logic representations (examples: Peirce's algebra vs. Peirce's graphs) when it may no longer be expressed in terms of iconicity?*

Even if Peirce does not explicitly pose the question in these terms, this issue is involved in his introduction of a second, stronger iconicity criterion. He does not introduce technical terms to distinguish the two kinds of iconicity. It takes place, however, particularly in his discussion of the adoption of different conventions used in his Beta system, which is equivalent to first-order predicate logic, so it goes without saying that it transgresses operational iconicity. While the Alpha system requires only a sheet of assertion, letters representing propositions, same location of graphs indicating conjunctions, and cuts representing negations, the Beta system adds to these entities further conventions representing quantifications, variables, and predicates. The whole machinery of these issues is introduced by means of a very simple convention. Predicates with up to three variables (equivalent to functions with arguments in the Fregean tradition) are introduced by means of the verbal/predicative kernel of the predicate written directly on the graph with the corresponding subject slots indicated by hooks ending in blanks to be filled in by symbols for the subjects involved (nouns, pronouns, or proper names). In ordinary text, such blanks are indicated by blanks delineated by underscores, as in "_gives_to_ " involving three blanks. In the Existential Graphs, similar lines are interpreted as "lines of identity" so that any further determination of the identity of the subjects of these blanks are to be added to the ends of the lines. The single piece of line of identity thus refers to a variable, and the line may branch in order to tie to different slots in different predicates, indicating that the individual(s) referred to by that line takes those

predicates. The spots at the end of such lines are subject, consequently, to the second convention added. They refer, as indices, to the binding of the variables bearing the predicates in issue. Thus, the whole logical machinery of quantification, variables, and predicates is represented by these very simple means. If a line of identity abuts on the sheet of assertion (or on any evenly enclosed part of it, that is, by 2, 4, 6, ... cuts), then this immediately indicates the existential quantifier of "Something exists that ..." and the three dots are then filled in by the predicates to which the line of identity connects this implicit quantification. Similarly, any such line of identity having its outermost end in an unevenly enclosed cut immediately indicates a negative universal quantifier.[v] Peirce is proud of this very simple sign of *Line of Identity* being able to perform so many logical tasks at the same time (thus preempting the Frege-Russell claim about the ambiguity of the copula): the representation of variables, their quantification and their predication at one and the same time. This is why he subjects it to an analysis making clear the indexical, symbolical, and especially the iconical aspects of the Line of Identity:

"Remark how peculiar a sign the line of identity is. A sign, or, to use a more general and more definite term, a *representamen*, is of one or other of three kinds: it is either an icon, an *index*, or a *symbol* ...
The value of an icon consists in its exhibiting the features of a state of things regarded as if it were purely imaginary. The value of an index is that it assures us of positive fact. The value of a symbol is that it serves to make thought and conduct rational and enables us to predict the future. It is frequently desirable that a representamen should exercise one of those three functions to the exclusion of the other two, or two of them to the exclusion of the third; but the most perfect of signs are those in which the iconic, indicative, and symbolic characters are blended as equally as possible. Of this sort of signs the line of identity is an interesting example. As a conventional sign, it is a symbol; and the symbolic character, when present in a sign, is of its nature predominant over the others. The line of identity is not, however, arbitrarily conventional nor purely conventional. Consider any portion of it taken arbitrarily (with certain possible exceptions

shortly to be considered) and it is an ordinary graph for which [*Figure 1*] might perfectly well be substituted.

Figure 1. —is identical with—

But when we consider the connexion of this portion with a next adjacent portion, although the two together make up the same graph, yet the identification of the something, to which the hook of the one refers, with the something, to which the hook of the other refers, is beyond the power of any graph to effect, since a graph, as a symbol, is of the nature of a *law*, and is therefore general, while here there must be an identification of individuals. This identification is effected not by the pure symbol, but by its *replica* which is a thing. The termination of one portion and the beginning of the next portion denote the same individual by virtue of a factual connexion, and that the closest possible; for both are points, and they are one and the same point. In this respect, therefore, the line of identity is of the nature of an index. To be sure, this does not affect the ordinary parts of a line of identity, but so soon as it is even *conceived*, [it is conceived] as composed of two portions, and it is only the factual junction of the replicas of these portions that makes them refer to the same individual. The line of identity is, moreover, in the highest degree iconic. For it appears as nothing but a continuum of dots, and the fact of the identity of a thing, seen under two aspects, consists merely in the continuity of being in passing from one apparition to another. Thus uniting, as the line of identity does, the natures of symbol, index, and icon, it is fitted for playing an extraordinary part in this system of representation." (“Logical Tracts, No. 2”, 1903, 4.447-448)

The Line of Identity in the Beta and Gamma graphs is thus praised for two outstanding qualities. One is that it unites symbolic, indexical, and iconic qualities. It is a symbolic convention that receives its general meanings within the system of conventions defining those graphs. It is indexical because it points out individuals. And it is iconical because of its continuity being an iconic sign of the identity/predication/subsumtion relations between its indexical end points. This last aspect constitutes its second outstanding quality: it is

"in the highest degree iconic". Here is introduced the idea of iconicity coming in degrees. This is why I name it *optimal* iconicity. In his development of the Beta system, Peirce places a large emphasis on the fact that the representation of quantification, bound variables, and identity by the means of lines of identity is *more iconical* than the logically equivalent representation of the same issues by means of the repeated identification of the same bound variables represented by symbols,[vi] for instance, when he writes that "A diagram ought to be as iconic as possible, that is, it should represent relations by visible relations analogous to them." ("Logical Tracts, vol. 2," 1903, 4.432), In quotes such as this, it may remain ambiguous which iconicity concept is exactly at stake, but the fact that Peirce considers alternative, more or less iconic, representations of the very same propositions and arguments represented in the Graphs, shows an alternative iconicity conception being considered. Consider the Beta Graph in figure 2.

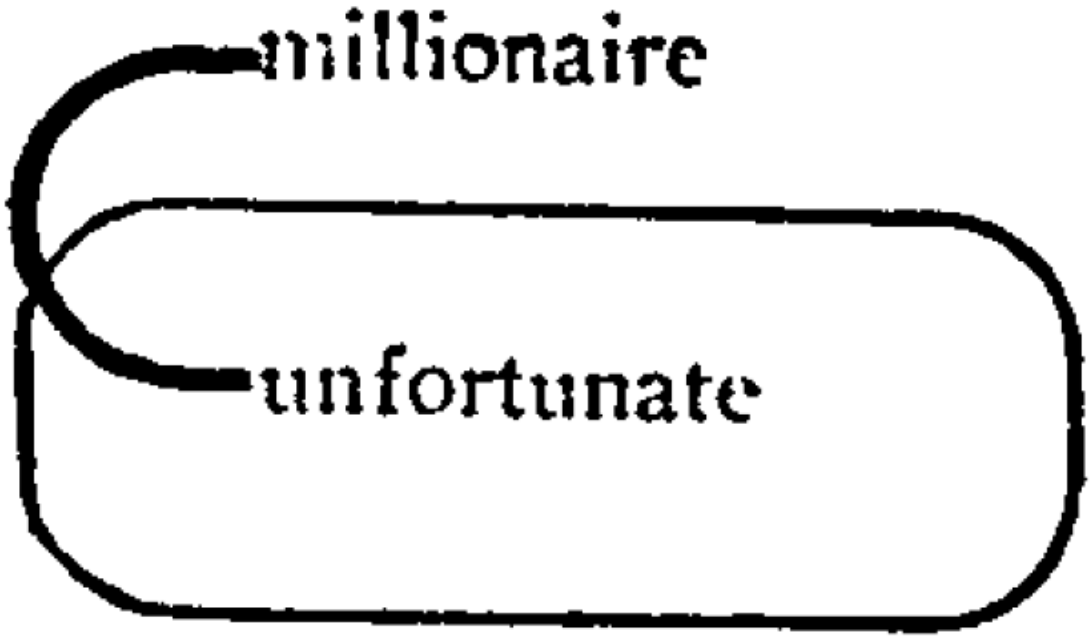


Figure 2. *Beta graph (4.569)*

The graph reads "There is a millionaire who is not unfortunate"; this graph now will be more iconic than the corresponding first-order

predicate logic notation of it:

$$\exists(x): M(x) \ \& \ \neg U(x)$$

– already for the simple reason that the Line of Identity of the former uses one sign to refer to one variable – while the variable notation of FOPL represents the same object by no less than three consecutive *x*'s. This is explicitly addressed when Peirce considers an alternative representation as substitutes for Identity Lines in Beta and Gamma Graphs (here "Ligatures" refer to systems of Identity Lines meeting across negation cuts) under the headline of *Selectives*: "A Ligature crossing a Cut is to be interpreted as unchanged in meaning by erasing the part that crosses to the Cut and attaching to the two Loose Ends so produced two Instances of a Proper Name nowhere else used; such a Proper name (for which a capital letter will serve) being termed a *Selective*. "("Prolegomena to an Apology for Pragmaticism," 1906, 4.561)
Using this convention on the graph discussed, it would now appear as in figure 3.

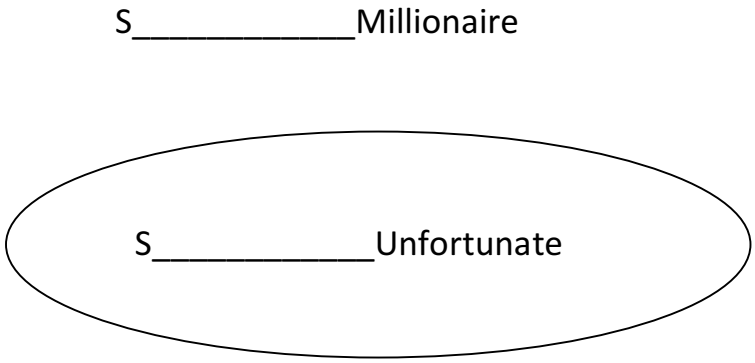


Figure 3. *The proposition "There is a Millionaire who is not Unfortunate" expressed in Beta Graphs with Selectives (S)*

Now, the S's in figure 3 only serve to identify the two pieces of Identity Line as referring to one and the same object – just like the *x*'s in ordinary First Order Logic. In cases where many different variables are involved and the web of Lines of Identity in a Beta or Gamma graphs becomes so entangled that may be difficult to survey, some of

these lines may be cut, and the identity of the now severed and scattered bits of Identity Line may be secured by the addition of identical symbolical letters to the outermost end of the remaining identity line bits. When reading the graph outside-in, the reader must now take note of the quantification indicated by the location of that outermost identity line end, remember the letter representing the selective, and identify the more inner appearances of the same letter with the first quantified variable. Peirce explicitly and strongly regrets the introduction of these Selectives exactly because they lack the iconicity of identity granted by the continuous line connecting the different predicates that this Identity Line takes:[vii]

"[The] purpose of the System of Existential Graphs, as it is stated in the Prolegomena [4.533], [is] to afford a method (1) as *simple* as possible (that is to say, with as small a number of arbitrary conventions as possible), for representing propositions (2) as *iconically*, or diagrammatically and (3) as *analytically* as possible . . . These three essential aims of the system are, every one of them, missed by Selectives." (“The Bedrock beneath Pragmaticism” [2], 1906, 4.561, note1)

The substitution of selectives for the line of identity is less iconic because it requires the symbolic convention of identifying different line segments by means of attached identical symbols. The line of identity, on the other hand, is immediately an icon of identity because it makes use of the continuity of the line that, so to speak, just stretches the identity represented by the spot — and that is, at the same time, a natural iconical representation of a general concept: "The second aim, to make the representations as iconical as possible, is likewise missed; since Ligatures are far more iconic than Selectives. For the comparison of the above figures shows that a Selective can only serve its purpose through a special habit of interpretation that is otherwise needless in the system, and that makes the Selective a Symbol and not an Icon; while a Ligature expresses the same thing as a necessary consequence regarding each sizeable dot as an Icon of what we call an “individual object”; and it must be such an Icon if we are to regard an invisible mathematical point as an Icon of the strict

individual, absolutely determinate in all respects, which imagination cannot realize." ("The Bedrock beneath Pragmaticism" [2], 1906, 4.561 note1) The Peircean selective, of course, does exactly the same as quantification with bound variables undertakes in the traditional system: the first presentation of the variable determines the quantification of it, and later occurrences of that variable in the logical expression remains under the scope of that quantifier. But it remains an offensive, anti-iconic representation when one and the same bound variable is no longer represented by one entity only (the line of identity) but is, instead, represented by a series of different lines of identity segments identified only by the addition of symbolical indices, or, as in ordinary formal logic, by the series of *x*'s or *y*'s, identified only by their merely symbolical identity. The reason why Peirce considers the introduction of selectives at all is, of course, that in sufficiently complicated Beta graphs involving many variables taking many predicates, the network of identity lines may form a thicket hard to get a simple visual grasp of. The reason for introducing selectives is thus heuristic and psychological, pointing to the specific visual faculties of a human observer; we might imagine a mind better equipped than ours that would be able to survey in one iconic glance any complicated web of identity lines without having to resort to selectives. But the important issue here is Peirce's very motivation for preferring identity lines to selectives in the first place: they are *more iconical*, because they represent in one icon entity what is also, in the object, one entity. This thus forms an additional, stronger iconicity criterion in addition to the operational iconicity criterion. One could object that Peirce was in no position to know the informational equivalence between his Beta system and what was only later named first-order predicate logic — but, still, his argument was implicitly aimed against his own earlier algebraical logic formalization (the first version of modern mainstream "symbolic" formal logic). In any case, Peirce realized that the two versions of Beta graphs, with identity lines and with selectives, respectively, were logically equivalent, and the latter even in some cases heuristically superior. And still he preferred the former version in as many cases as possible, thereby indicating a criterion for distinguishing more and less iconical (2) representations among iconical (1) representations being equivalent under the

operational criterion. We may indicate these two different concepts of iconicity by iconicity (1), referring to the operational criterion, and iconicity (2), referring to the "more iconical," optimal type of iconicity. Peirce's arguments for and against identity lines and selectives display two different sets of constraints on logic representations. What counts for the selectives were heuristic, practical issues tied to the psychology and aims of the reasoner — obviously a constraint deemed less noble by an avowed anti-psychologist like Peirce. What counts for the identity lines is rather an *ontological* argument: the idea that using them, Beta graphs more appropriately depict logical relations *like they really are*, thus adding to the pragmatist operational criterion of iconicity an ontologically motivated extra criterion. According to this criterion, if two icons are equivalent according to iconicity (1), the representation that is most iconical according to iconicity (2) must still be preferred — if heuristic arguments do not count against it, that is.

This implies that the addition of iconicity (2) to Peirce's iconicity doctrine is connected to his *realism*. It is well known that Peirce's realism developed over the years, such as is documented most famously by his own diamond example from the very birthplace of pragmatism, *How To Make Our Ideas Clear* (1878), to which he returns in *Issues of Pragmatism* (1905) in order to correct what he now sees as a youthful error. In his early doctrine, he claimed that if a diamond was formed within a bed of cotton a remained there until it was consumed by fire, it would be a mere convention to call that diamond hard, because it was never put to any test. In his mature correction, Peirce says that his earlier idea was nominalist and tied to a conception of being that was actualist only and thus focused upon the present moment. Now, he refers to the "real possibilities" inherent in the very concept of diamond, which implies that it is hard because it *would be* tested hard if subjected to the adequate testing – the hardness of the diamond is not only subject to testing but connected to other pieces of knowledge of diamonds' molecular structure, reflection abilities, heat development during burning, etc. While earlier only admitting subjective possibilities – possibilities due to the fact that we possess incomplete knowledge about the fact in issue (thus, it is possible that there are living beings on other planets, because we do

not know it is not the case) — Peirce now admits that certain possibilities such as this also have a *real* character, laws of nature being the most clear expressions of such real possibilities (if I held a stone and let go, the stone would fall to the ground). Peirce's admission of such real possibilities from the latter half of the 1890s considerably changes and enriches his concept of Thirdness as well as his conception of the pragmatic maxim in terms of *would-be*s. Still, this realism was never really incorporated into his logic graphs. In Max Fisch's (1986) famous charting of Peirce's almost life-long development into a still more extreme – or consequent, if you like – realism, the last step, only hinted at in some of Peirce's late writings, was a tendency to see material implication in logic as insufficient. The normal logical interpretation of the implication p → q states its equivalence to "either non-p or q." Of course, the traditional uneasiness with this interpretation is that, according to this interpretation, all cases of p being false automatically render p → q true, in contrast to different versions of strong implication, among those implication in everyday language where p being false rather makes the implication irrelevant than true. For most of his lifetime, Peirce was a strong defender of material implication (under the title of "Philonian," as opposed to "Diodoran" implication, the names stemming from Cicero's reference to two competing Roman logicians), but Fisch is right in indicating that the mature Peirce expressed increasing doubts as to the possible nominalism inherent in material implication, admitting as early as 1898 that it does indeed seem strange that an occurrence of non-lightning should in any way support the implication that "If it is lightening, it will thunder":[viii] "For my part, I am a Philonian; but I do not think that justice has ever been done to the Diodoran side of the question. The Diodoran vaguely feels that there is something wrong about the statement that the proposition "If it is lightening, it will thunder," can be made true merely by its not lightening" ("Types of Reasoning," 1898, NEM IV 169). One even stronger locus of such doubt appears eight years later, and interestingly it addresses the interpretation of exactly the issue of Identity Lines in Beta and Gamma graphs. In order to follow the argument, we have to reproduce a fairly long quote:

"Second, In a certain partly printed but unpublished “Syllabus of Logic,” which contains the only formal or full description of Existential Graphs that I have ever undertaken to give, I laid it down, as a rule, that no graph could be partly in one area and partly in another; and this I said simply because I could attach no interpretation to a graph which should cross a cut. As soon, however, as I discovered that the verso of the sheet represents a universe of possibility, I saw clearly that such a graph was not only interpretable, but that it fills the great lacuna in all my previous developments of the logic of relatives. For although I have always recognized that a possibility may be real, that it is sheer insanity to deny the reality of the possibility of my raising my arm, even if, when the time comes, I do not raise it; and although, in all my attempts to classify relations, I have invariably recognized, as one great class of relations, the class of references, as I have called them, where one correlate is an existent, and another is a mere possibility; yet whenever I have undertaken to develop the logic of relations, I have always left these references out of account, notwithstanding their manifest importance, simply because the algebras or other forms of diagrammatization which I employed did not seem to afford me any means of representing them. I need hardly say that the moment I discovered in the verso of the sheet of Existential Graphs a representation of a universe of possibility, I perceived that a reference would be represented by a graph which should cross a cut, thus subduing a vast field of thought to the governance and control of exact logic.

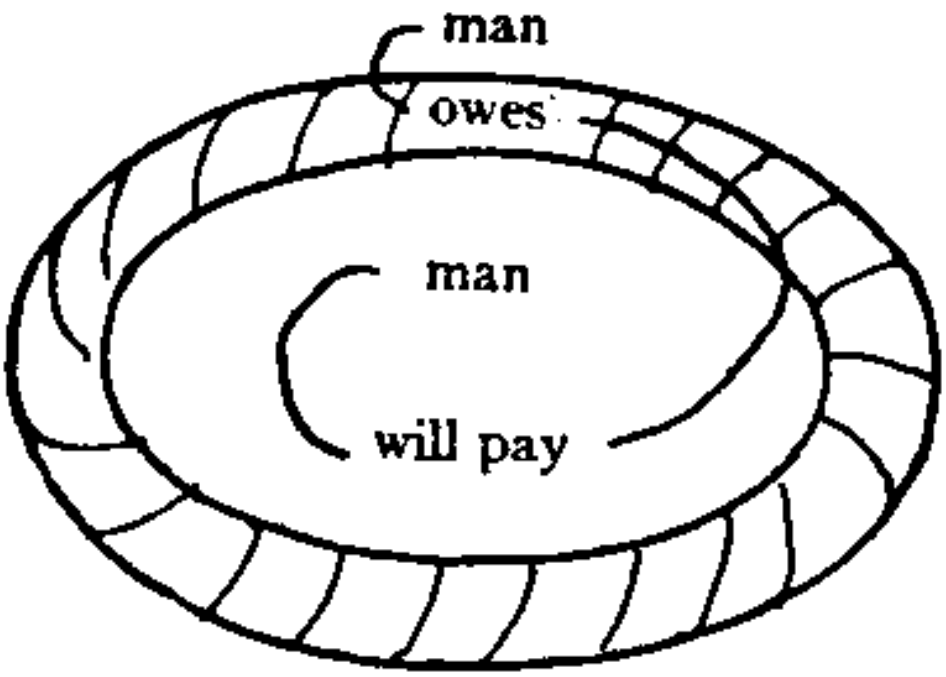


Fig. 219†

Figure 4. *Peirce's figure 219 (4.580)*

Third, My previous account of Existential Graphs was marred by a certain rule which, from the point of view from which I thought the system ought to be regarded, seemed quite out of place and inacceptable, and yet which I found myself unable to dispute. I will just illustrate this matter by an example. Suppose we wish to assert that there is a man every dollar of whose indebtedness will be paid by some man or other, perhaps one dollar being paid by one man and another by another man, or perhaps all paid by the same man. We do not wish to say how that will be. Here will be our graph, [figure 4]. But if we wish to assert that one man will pay the whole, without saying in what relation the payer stands to the debtor, here will be our graph, [figure 5].

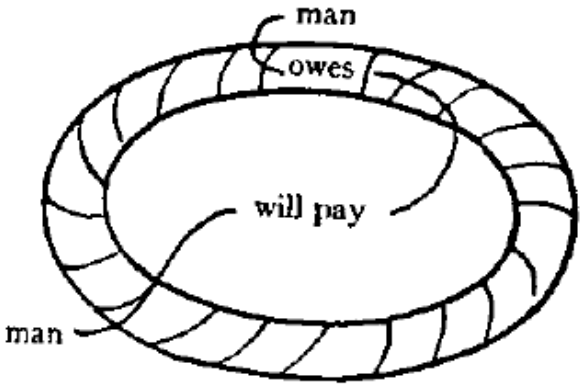


Fig. 220

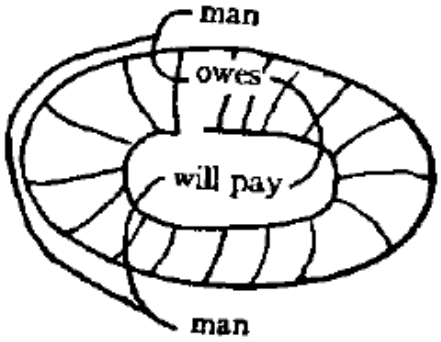


Fig. 221

Figure 5-6 (4.580)

Now suppose we wish to add that this man who will pay all those debts is the very same man who owes them. Then we insert two graphs of teridentity and a line of identity as in [figure 6]. The difference between the graph with and without this added line is obvious, and is perfectly represented in all my systems. But here it will be observed that the graph *"owes"* and the graph *"pays"* are not only united on the left by a line *outside* the smallest area that contains them both, but likewise on the right, by a line *inside* that smallest common area. Now let us consider a case in which this inner connection is lacking. Let us assert that there is a man A and a man B, who may or may not be the same man, and if A becomes bankrupt then B will suicide. [Fig. 7-8] Then, if we add that A and B *are* the same man, by drawing a line outside the smallest common area of the graphs joined, which are here bankrupt and suicide, the strange rule to which I refer is that such outer line, because there is no connecting line within the smallest common area, is null and void, that is, it does not affect the interpretation in the least ...

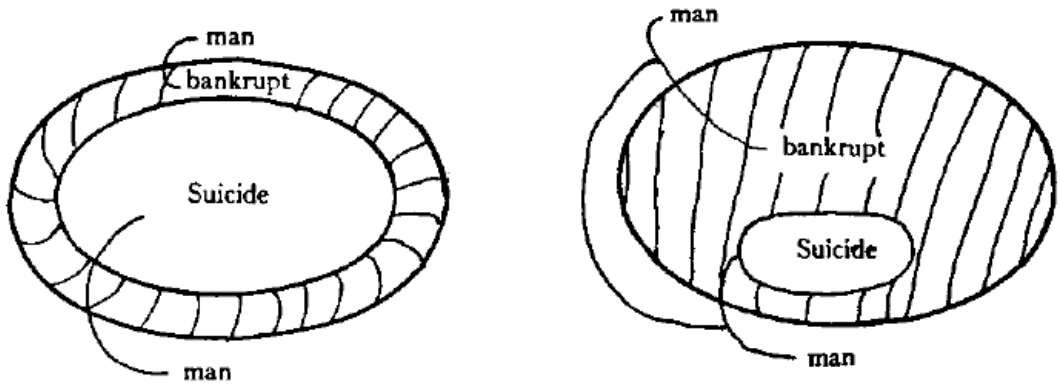


Fig. 222 Fig. 223

Figure 7-8 (4.580)

The proposition that there is a man who if he goes bankrupt will commit suicide is false only in case, taking any man you please, he will go bankrupt, and will not suicide. That is, it is falsified only if every man goes bankrupt without suiciding. But this is the same as the state of things under which the other proposition is false; namely, that every man goes broke while no man suicides. This reasoning is irrefragable as long as a mere possibility is treated as an absolute nullity. Some years ago, however, when in consequence of an invitation to deliver a course of lectures in Harvard University upon Pragmatism, I was led to revise that doctrine, in which I had already found difficulties, I soon discovered, upon a critical analysis, that it was absolutely necessary to insist upon and bring to the front, the truth that a mere possibility may be quite real. That admitted, it can no longer be granted that every conditional proposition whose antecedent does not happen to be realized is true, and the whole reasoning just given breaks down. I often think that we logicians are the most obtuse of men, and the most devoid of common sense. As soon as I saw that this strange rule, so foreign to the general idea of the System of Existential Graphs, could by no means be deduced from the other rules nor from the general idea of the system, but has to be accepted, if at all, as an arbitrary first principle – I ought to have asked myself, and should have asked myself if I had not been afflicted with the logician's bêtise, What compels the adoption of this rule? The answer to that must have been that the interpretation requires it; and the inference of common sense from that answer would have been that the

interpretation was too narrow. Yet I did not think of that until my operose method like that of a hydrographic surveyor sounding out a harbour, suddenly brought me up to the important truth that the verso of the sheet of Existential Graphs represents a universe of possibilities. This, taken in connection with other premisses, led me back to the same conclusion to which my studies of Pragmatism had already brought me, the reality of some possibilities. This is a striking proof of the superiority of the System of Existential Graphs to either of my algebras of logic. For in both of them the incongruity of this strange rule is completely hidden behind the superfluous machinery which is introduced in order to give an appearance of symmetry to logical law, and in order to facilitate the working of these algebras considered as reasoning machines. I cannot let this remark pass without protesting, however, that in the construction of no algebra was the idea of making a calculus which would turn out conclusions by a regular routine other than a very secondary purpose ..." ("For the National Academy of Sciences, 1906 April Meeting in Washington", 4.579-581)

In this long quotation, Peirce considerably revises parts of the foundation of Beta and Gamma graphs. Cuts no longer represent negation, but merely possibility — they only represent negation if they enclose a further blank cut (meaning everything can be derived from the contents of the first cut, evidently making those contents false). Furthermore, material implication is relativized: not all conditional propositions with false antecedents are true. References as relations are included as represented by graphs connecting actuality and possibility, evenly and unevenly enclosed cuts, making modal logic expressions possible referring to possibilities of actual existing things. Finally, there is the relation of identity line conventions and real possibilities that Peirce admitted in his metaphysics from the later 1890s onwards (cf. the diamond discussion). The "strange rule" that Peirce refers to is presented earlier that very same year and says in its brief form that "... there is some one individual of which one or other of two predicates is true is no more than to say that there either is some individual of which one is true or else there is some individual of which the other is true" ("Prolegomena to an Apology for Pragmatism," 1906, 4.569). Now, this rule will imply that the two

graphs saying "if A becomes bankrupt, B will suicide," and "if A becomes bankrupt, A will suicide," are identical. Both are falsified if every man goes bankrupt without committing suicide. However, the two propositions are, evidently, not identical, A and B being potentially different persons in the former proposition, not so in the latter. Peirce's hasty and difficult reasoning at this point must refer to the fact that the possibility of A and B being identical is not a mere subjective possibility but a real possibility, given by the possible causal link between bankruptcy and suicidal tendencies, forming a real tendency in social life. But the "strange rule" exactly makes of such possibilities mere "nullities." The "strange rule" allows us to identify and disidentify A and B at will by the introduction or removal of Identity Line between them. The ontological correlate to this rule is that properties are taken to be independent: it does not have any significance whether two properties occur in the same object or whether they occur in different objects. In both cases, it is true that there is an *x* having property 1 and property 2. But the ontological assumption of Real Possibilities is that properties come in clusters: some of them imply others in different ways, and the property of bankruptcy is objectively related, with some weight, to the occurrence of suicidal tendencies. What Peirce is looking for, hence, is a way of logically expressing a stronger implication than material implication, an implication expressing the dependency of properties, a sort of "ontological implication." This points to some important ontological issues. The British philosopher Barry Smith has pointed to the fact that superficial features of first order logic have led many analytical philosophers to assume simplistic ontological doctrines (Smith 2005). First order logic places all that is general in logic in the predicates – thereby giving rise to important misunderstandings. One is that property universals ("red") is given priority at the expense of kind universals ("electrons"). Another is that these property universals are conceived of as atomistic – they may be combined at random, leading to nominalism. It is this random combination of properties that Peirce indirectly addresses in his withdrawal of the "strange rule." There is a link, a "real possibility" connecting bankruptcy and suicide that is not addressed if you adopt the "strange rule." But is that link made evident by the mere giving up of the "strange rule"? Real possibilities, after

all, is a matter of ontology, not of logic, just like Smith points to the need of keeping logic and ontological languages separate. The investigation of which universals and particulars exist and how they combine is an ontological task, not a logical task. What would be Peirce's response to this? The abolishment of the "strange rule" leads to the distinction between the cases of

$\exists(x)$: A(x) & B(x) (1)

and

$\exists(x)$: A(x) & $\exists(y)$: B(y) (2)

– but it does not in any way give an analysis of the relation between the predicates A and B making (1) true. It merely removes a hindrance in the use of Lines of Identity from considering predicates occurring in the same variable and thus for considering the virtual Real Possibility holding between them. Thus, the removal of the "strange rule" could be said to motivated in general, formal ontology — but not in the material ontology which determines the relation between single predicates.[ix]

This change in the conventions for the Line of Identity has further iconicity implications. The fact that it is the very system of Existential Graphs that leads Peirce to these conclusions is taken to count among the chief virtues of that system. While his own earlier algebras hid such facts as the problems with the "strange rule" behind "superfluous machinery" constructed with their (secondary) aim as reasoning machines, the Existential Graphs are not so constructed, but with the aim of displaying to the highest degree of detail and clarity every single logical step taken in reasoning. The heuristic efficiency of the algebras is thus contrasted to the higher iconicity, logical detail and simplicity of the graphs – this is an argument referring to the larger degree of iconicity (2) of the graphs, even if they may be equivalent as reasoning machines; that is, with respect to iconicity (1). This leads to a further reinterpretation of the iconicity inherent in Identity Lines:

"The System of Existential Graphs recognizes but one mode of combination of ideas, that by which two indefinite propositions define, or rather partially define, each other on the recto and by which two general propositions mutually limit each other upon the verso; or, in a unitary formula, by which two indeterminate propositions mutually determine each other in a measure. I say in a measure, for it is impossible that any sign whether mental or external should be perfectly determinate. If it were possible such sign must remain absolutely unconnected with any other. It would quite obviously be such a sign of its entire universe, as Leibniz and others have described the omniscience of God to be, an intuitive representation amounting to an indecomposable feeling of the whole in all its details, from which those details would not be separable. For no reasoning, and consequently no abstraction, could connect itself with such a sign. This consideration, which is obviously correct, is a strong argument to show that what the system of existential graphs represents to be true of propositions and which must be true of them, since every proposition can be analytically expressed in existential graphs, equally holds good of concepts that are not propositional; and this argument is supported by the evident truth that no sign of a thing or kind of thing – the ideas of signs to which concepts belong – can arise except in a proposition; and no logical operation upon a proposition can result in anything but a proposition; so that non-propositional signs can only exist as constituents of propositions. But it is not true, as ordinarily represented, that a proposition can be built up of non-propositional signs. The truth is that concepts are nothing but indefinite problematic judgments. The concept of man necessarily involves the thought of the possible being of a man; and thus it is precisely the judgment, “There may be a man.” Since no perfectly determinate proposition is possible, there is one more reform that needs to be made in the system of existential graphs. Namely, the line of identity must be totally abolished, or rather must be understood quite differently. We must hereafter understand it to be potentially the graph of teridentity by which means there always will virtually be at least one loose end in every graph. In fact, it will not be truly a graph of teridentity but a graph of indefinitely multiple identity. We here reach a point at which novel considerations about the constitution of knowledge and

therefore of the constitution of nature burst in upon the mind with cataclysmal multitude and resistlessness." (“For the National Academy of Sciences, 1906 April Meeting in Washington”, 4.583-584)

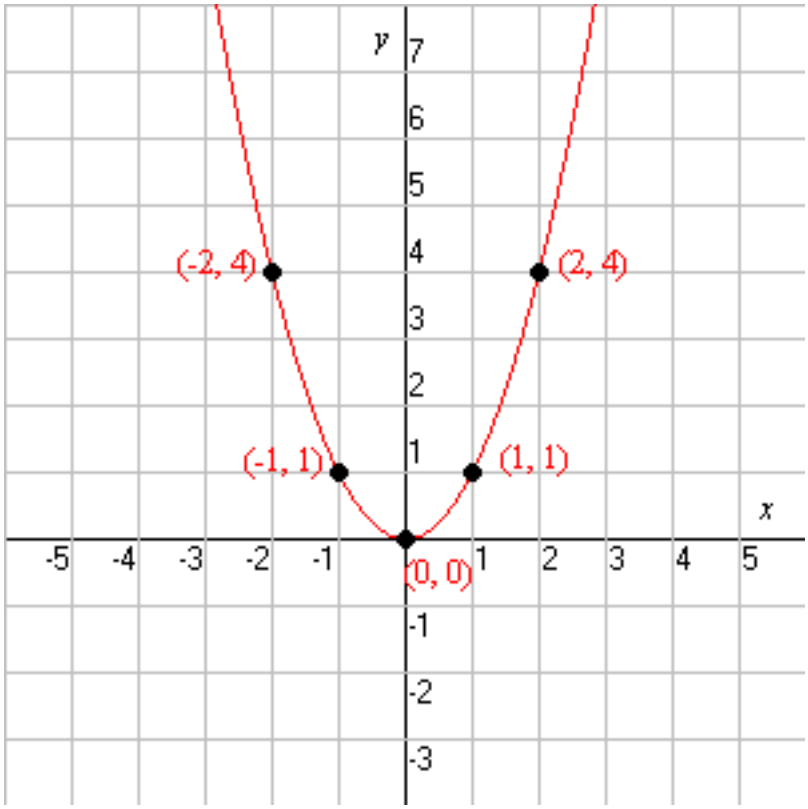
All identity lines are now to be considered implicitly polyadic. The basic argument is that objects represented in the graph are necessarily not completely determined, which is why an open end of the Line of Identity should always be left (if only implicitly) in each Identity Line variable in order to indicate further, yet undetermined properties of that variable. An open end of the continuum of the Line of Identity would thus serve as an iconic (2) sign of the openness of the object represented. Variables thus being underdetermined, their polyadicity implies that the entities referred to may have other predicates in common than the ones explicitly mentioned in the graph, thus potentially sharing real possibilities which are not referred to in the explicit graph. These musings on the status of Identity Lines are connected to Peirce’s conception of the blank Sheet of Assertion on which the graphs are scribed: its continuity depicts the continuity of implicit truths that the users of the graphs agree to hold within the Universe of Discourse they consider. The polyadicity of the single Identity Lines thus refers to their forming part of that real continuum. Peirce never consistently revised the Graphs after the "cataclysms" of ideas proposed here, but it is obvious that the proposals discussed pertain to the overall idea of iconicity (2) — the attempt at making the graphs match general ontological structure to as large a degree as possible and to leave the system open for material ontological determinations.

4. The two iconicity notions in pictures

The distinction between two iconicity notions becomes obvious in Peirce’s logic diagrammatizations because of the explicit difference between the proof power of a logical representation (operational), on the one hand, and the ontological depiction aspect of the representation on the other (optimal). Can this difference be generalized to iconicity in the broader sense? Consider the well-

known fact that any pixelated picture may be represented as a picture, in print or on a screen, on the one hand, and as a linear sequence of digital information on the other. Like the case with linear logic representations and existential graphs, these two representations are informationally equivalent; the same amount of information can be derived from each, and it is possible to transform one into the other. It is a psychological fact pertaining to human perception that the image representation is far easier for a human being to decode. But this is due only to the specific architecture and the special abilities of the human visual system (surface smoothing, contour sharpening in the retina, object detection, etc.). It is also due to the fact that, in the pictorial representation, object contours are represented in the shape of continuous line structures, object surfaces are represented in the shape of continuous plane segments – which is, of course, not the case in the linearized digital representation, where those informations are disseminated over large parts of the code? Here we thus find an analogous relation: the two representations are equivalent as measured on iconicity (1), but the image is superior as measured on iconicity (2). More fluid distinctions appear, of course, if we vary the granulation of the pixels; with pixel growth, we will find an inverse proportional change of both iconicities, and the difference between them harder to distinguish. Consider the simple mathematical example in figure 9. The graphical representations in 9.a) and the arithmetic equation

a)



b) $y = x^2$

Figure 9. *An geometric diagram and an algebraic diagram partially depicting the same mathematical state-of-affairs*

9.b) partially refer to the same mathematical function. Still, they differ in many ways. The algebraic representation is universal and has unlimited precision. For any x, the corresponding y value may be computed, given the algebraic rules of transformation constituting the iconicity of algebra. And the computation is as precise as the x value given. The parabola graph has none of these qualities. It only represents the values of the function for $-3 < x < 3$, and correspondingly $0 < y < 8$. And computations may be made with approximately one decimal only using the naked eye; maybe up to 1/20 using a ruler or other measurement instruments. The graph, however, has other facilities. It permits to grasp the overall structure of the function in one glance, it permits to see the solution to the equation immediately; namely, where the graph touches the x axis ($x = 0$), it permits one to see the differential properties of the equation (maxima, minima, saddles, etc.), in this case the function minimum in

(0, 0), it permits to judge the function goes to ∞ for *x* going to plus or minus ∞.[x] This information may also be derived, it is true, from the algebraical representation, this requiring the use of a bit of calculus. Here, the algebraical representation evidently is the stronger as measured on iconicity (1). But as to the selected segment indicated around the origo, the graphical representation could be argued to be stronger as to iconicity (2): the continuity of the function, its overall shape and its differential properties are directly represented. Thus, Peirce's unspoken distinction between operational iconicity and optimal or ontological iconicity may be extrapolated from logic representations also to the iconicity of diagrams and pictures in the broader sense of the word.

5. The pragmatic maxim and the two iconicity notions

The coexistence of two competing iconicity criteria in the mature semiotics of Peirce raises further questions. What about the pragmatic maxim, Peirce's basic idea that the content of all conceptions may be exhausted by considering which practical effects those conceptions would be conceived to have under imagined circumstances? The operational iconicity criterion seems molded after the pragmatic maxim due to the reductivist action foundation of both: any aspect of an idea that does not have conceivable consequences, practically or theoretically, may be discarded. The investigation of possible practical consequences in the former case mirrors the investigation of possible theorems to be inferred in the latter. But this interpretation seems to leave iconicity (2) in a strange vacuum. If optimal iconicity remains without any practically conceivable consequences, it may be thought to belong to what may be discarded by the maxim as superfluous, empty verbiage. For is there any conceivable practical difference between Lines of Identity and Selectives in Existential Graphs, if the difference in formalism does not give any difference in terms of provable theorems? Of course there is the realist conviction that Lines of Identity may refer to real generals that may be easier grasped (in some cases, at least) by identity lines than by Selectives. And, of course, there is the practical issue that, in complicated cases, Selectives may facilitate an easier use of the graphs than Lines of

Identity. But, at the same time, the amount of theorems, of new information, accessible by the two means are supposed to be exactly the same. Maybe this difference corresponds to two different readings of the pragmatic maxim, cf. Peirce's own two readings without and with the hardness of the untested diamond, respectively. The untested diamond hardness and the realist interpretation of the pragmatic maxim seem to correspond to the addition of iconicity (2) as a criterion with its possibilities for distinguishing between more and less iconical representations in addition to the provision of new information, while the earlier, nominalist idea corresponds to the version of the maxim where it charts testable regularities and nothing more. Just like existence is no predicate, it seems like Peircean reality is no predicate neither (but rather the relation between several predicates), and the addition of reality does not add to the amount of information that may be taken out of any given predicate. But Iconicity (2) may add, in some cases, to the heuristics of working with representation systems, just as it presents the same information in an ontologically more valid form, so to speak. If that interpretation is correct, then the introduction of iconicity (2) as a criterion constitutes yet another step in Peirce's lifelong movement towards realism, as charted by Max Fisch (1986). In that case, Iconicity (2) is tightly interwoven with the step leading from the Real Possibilities introduced in the latter half of the 1890s as the central mode of Thirdness, on the one hand, and, on the other hand, to Peirce's last and most realist position in search for stronger, ontological implication constraints than material implication in the years after 1900.

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[i] The trichotomy is the second out of Peirce's three major trichotomies, referring to the sign's relation to itself, to its object, and to its interpretant, respectively. In Peirce's more developed series of ten trichotomies from his later years, it is the fourth.

[ii] Thus, Peirce sees such signs as appearing as aspects of propositions only: "no sign of a thing or kind of thing — the ideas of signs to which concepts belong — can arise except in a proposition; and no logical operation upon a proposition can result in anything but a proposition; so that non-propositional signs can only exist as constituents of propositions" ("An Improvement on the Gamma graphs," 1906, 4.583)

[iii] It is important to note that Peirce's distinctions pertain to sign use rather than

to the specific sign vehicles, based on his dictum “A sign is only a sign in actu ...” (“Truth and Falsity and Error,” 1901, 3.569). Thus, the very same sign token may be used in some contexts as an image – paying no attention to what can be learned from the relation between its parts – and in other contexts as a diagram, focusing upon those relations. If, for instance, we took the simple crescent shape image of the moon, and performed observations on it pertaining to the relation between its parts – if we, say, measured the angle sizes at its two singularities – we would treat exactly the same sign token as a diagram.

[iv] It is an interesting fact in the history of science that such attacks on the notion of similarity have come from otherwise completely opposed camps, namely, the analytical tradition (e.g., Nelson Goodman) on the one hand, and the (post-) structuralists in the continental tradition on the other (e.g., Umberto Eco). See Stjernfelt (2000b) and Stjernfelt (2007).

[v] In his algebras of logic and independently of Frege, Peirce had already invented the “symbolic” quantifier notion. Peirce’s version later became, through Schröder and Peano, the standard notation of ∀ and ∃ (in Peirce’s version Π and Σ, respectively).

[vi] The issue of the iconicity of aspects and conventions of Existential Graphs is far wider than the alternative between Lines of Identity and Selectives that is chosen as the main case in our context because Peirce himself highlights it so thoroughly. The overall iconical motivation in the construction of the graphs is well indicated by Peirce when introducing the details of the graphs: "I dwell on these details which from our ordinary point of view appear unspeakably trifling – not to say idiotic – because they go to show that this syntax is truly *diagrammatic*, that is to say that its parts are really related to one another in forms of relation analogous to those of the assertions they represent, and that consequently in studying this syntax we may be assured that we are studying the real relations of the parts of the assertions and reasonings; which is by no means the case with the syntax of speech." (“Fragments on Existential Graphs”, 1909 Ms. 514, 15). Shin (2002: 53–58) lists three basic iconical features of Beta graphs: lines of identity, quantifiers, and scope. Quantifiers do seem to come naturally because the end of an identity line in an unenclosed graph is simply taken to mean “something is ...,” but it deserves mention that in his earlier formalization attempt from the 1890s known as Entiative Graphs, in many respects dual to Existential Graphs, the very same sign is taken to stand for the universal quantifier. Maybe it could be argued that a point in a plane does indeed more naturally mean “something” than “all.” Scope seems to come naturally in the endoporeutic, outside-in, reading of the graphs (which Shin is otherwise out to dismantle), because the outermost occurrence of part of an identity line defines the scope of the corresponding quantifier, and more inner quantifiers are taken to lie inside the scope of the more outer ones. In addition to these iconicities, a basic iconicity in Existential Graphs is one of its very motivating ideas in Peirce, namely, the representation of material implication by

means of a “scroll”; that is, two nested cuts where the premiss is placed within the outer cut but outside the inner cut, while the conclusion is placed in the inner cut. The geometrical inclusion of the conclusion within the premiss furnishes a simple iconic representation of the idea that the conclusion lies in, is inherent in, or is implicated by the premiss. Peirce proudly refers to this (“The Bedrock beneath Pragmaticism,” 1906, 4.553, note 1) while at the same time complaining about the lack of iconic representation of modality in the Graphs, a lack he attempts to remedy not much later, cf. below. Another issue discussed by Shin – but not in relation to iconicity – is Peirce’s distinction between logic systems as result-oriented calculi and logic systems as representations of logical thought process (a distinction she strangely thinks loses its relevance in graphical systems). Here, the former aims at quick and easy results, and a plurality of logical connectors and rules may be used to further that aim as expediently as possible. In the dissection of logical inference steps, on the other hand, as few connectors and rules as possible should be chosen, in order to be able to compare the single steps – a guideline explicitly followed in Peirce’s graphs. In this connection, Peirce remarks that it is “... a defect of a system intended for logical study that it has two ways of expressing the same fact, or any superfluity of symbols, although it would not be a serious defect for a calculus to have two ways of expressing a fact” (“Symbolic Logic,” 1901/1911, 4.373). This requirement – which Existential Graphs do not perfectly satisfy – is obviously iconical, demanding the extinction of arbitrary; that is, non-iconical, choices between parallel representations. Finally, Pietarinen’s (2006, 128–131) argument against Shin runs along these lines: her rewriting of the inference rules of Peirce’s graphs gives us many more rules and connectors than does Peirce’s own version, and so is less analytical and iconical than his (even if maybe facilitating easier readability on some points). In his defence of the endoporeutic, outside-in, interpretation of the graphs against Shin’s attacks, Pietarinen highlights a further and very basic iconical feature in them: the dialogic structure, rhythmically changing between a Graphist and a Grapheus, responsible for existentially and universally quantified propositions, respectively, and thus responsible for taking turns in a dialogue where each of them manipulates the graph according to Peirce’s rules. Pietarinen, of course, makes this point in order to facilitate his interesting, Hintikkan interpretation of the graphs in terms of game-theoretical semantics. Here, we may emphasize the basic iconicity inherent in this conversational structure of the graphs, motivated in the supposedly dialogical structure of thought, be it between persons or between positions in one person’s thought and mind.

[vii] Given the equivalence between Line of Identity and Selective representations, we might use this idea in reconsidering ordinary Peano-Russell-style formal logic – here, we might see the different instances of the same bound variable in a symbolic expression as connected by an erased identity line running in an additional line parallel to the line of the normal expression.

[viii] Two years earlier, not long before the introduction of Real Possibilities in January 1897, doubt is awakening: “It may, however, be suspected that the Diodoran view has suffered from incompetent advocacy, and that if it were modified somewhat, it might prove the preferable one” (“The Regenerated Logic,” 1896, 3.442–3.443,). But as early as the second “On the Algebra of Logic,” Peirce states that "If, on the other hand, A [the premiss] is in no case true, throughout the range of possibility, it is a matter of indifference whether the hypothetical be understood to be true or not, since it is useless. But it will be more simple to class it among true propositions, because the cases in which the antecedent is false do not, in any other case, falsify a hypothetical." (1885, 3.374,) Here, Peirce observes the problem, but accepts material implication out of simplicity (and not iconicity) reasons.

[ix] The distinction between formal or general ontology, pertaining to all existing objects, on the one hand, and material or regional ontology, pertaining to objects of a specific field (physics, biology, psychology, ... etc.) stems from Husserl (the 3rd Logical Investigation). Both ontologies, in turn, are distinct from formal logic. When removing the “strange rule,” I think it is in order not to prevent the expressivity of logic to represent connectedness between predicates in general – a formal ontological requirement. Any particular such connectedness – as that between bankruptcy and suicide – of course pertains to a material ontology, in this case that of human psychology, and falls outside of logic.

[x] These informations depend, of course, upon the assumption that all of the important parts of function structure is present in the interval chosen.