



Chiara Ambrosio

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Iconicity as Homomorphism: The Case of Picasso's *Guernica*

Chiara Ambrosio
University College London

[I]n contemplating a painting, there is a moment when we lose the consciousness that it is not the thing, the distinction of the real and the copy disappears, and it is for the moment a pure dream – not any particular existence and yet not general. At that moment we are contemplating an Icon. Peirce, CP 3.362

1. Introduction

For over four decades, Charles S. Peirce's semiotic formulation of iconicity has been the object of intense debates. Classical conventionalist and nominalist arguments (Eco, 1975; 1997; Bierman, 1963; Goodman, 1962) regarded iconicity as a weak representative relation based upon a form of similarity or likeness.

I propose an interpretation of iconicity which overcomes classical "iconoclast" arguments. Iconicity is a structural relation established by a mind between certain representing facts and the states of affairs that they represent. I argue that such a structural relation is more accurately expressed in terms of the mathematical concept of homomorphism (Shin, 2002; Norman, 1999). A theory of iconicity as homomorphism accounts for structure preservation as a relation which is established through a cognitive act, rather than a physical similarity or a superficial, point-to-point correspondence. In this respect, it can be used as a theoretical device to overcome mimetic accounts of artistic representation.

Pablo Picasso's 1937 painting, *Guernica*, can be used as a testing ground for a theory of iconicity as homomorphism. I examine the painting as a case of iconicity in context and argue that it conforms to Peirce's definition of icons as "composite photograph[s] of images" (CP 2.317) of the objects they represent. The canvas, as such, is an asserted icon – a sign that stands for certain states of affairs by virtue of a structural relation. Iconic representations such as *Guernica* are by their own nature cognitively fertile, as they evoke in a direct and immediate manner mental icons, or what Peirce called "pure dreams" (CP 3.362) – mental representations that are neither particular nor general and that ultimately amount to generalizations from experience.¹

2. Beyond (and against) resemblance: a few misunderstandings on the nature of iconicity and iconic signs

In his 1962 classic work *Languages of Art*, Nelson Goodman developed the thesis that a notion of resemblance between a sign and the object it stands for is neither relevant nor informative to explain representation relations (Goodman, 1962, pp. 3–6). Goodman's arguments initially focused on a notion of representation in the visual arts and in particular on pictorial depiction. However, in the course of his discussion, he extended his views against resemblance to any kind of relation of signification (Dipert, 1996, p. 379; Shin, 2002, p. 25).

A central claim in Goodman's work is that representation is independent from resemblance: his argument is based on the assumption that resemblance is neither a necessary nor a sufficient condition for signification (Goodman, 1962, p. 5). Goodman motivates his claim by stating that while resemblance is reflexive, representation is not: objects resemble themselves, but this does not mean that they represent themselves. Moreover, resemblance is symmetric: an object A resembles an object B as much as B resembles A (and vice-versa). According to Goodman, the same does not hold for representation: it is possible to say that a portrait represents someone, but it is not possible to say that a person represents his/her portrait (Goodman, 1962, pp. 4–5). To conclude, Goodman stated that "no degree of resemblance is sufficient to establish the requisite relationship of reference. Nor is resemblance *necessary* for reference; almost anything may stand for almost anything else. A picture that represents – like a pas-

¹ I am grateful to Mats Bergman for drawing my attention to this illuminating reading of iconicity in the course of a personal communication (June 2006).

sage that describes – refers to and, more particularly, *denotes* it. Denotation is the core of representation and is independent of resemblance” (Goodman, 1962, p. 5).

Goodman’s criticism is addressed to a view of representation considered and defined exclusively in terms of resemblance. It must be noticed, however, that no philosophical definition of visual representations focused exclusively on a notion of resemblance to explain the relation between pictorial representations and the objects they represent (Dipert, 1996, p. 381; Shin, 2002, p. 25).

A proliferation of nominalist and conventionalist theories of representation followed from Goodman’s critique of similarity; some of them explicitly addressed the representational status of iconic signs. In a 1963 article entitled “That there are no Iconic Signs”, Arthur Bierman claimed that iconic signs dispense with connotation: they only denote and signify. However, there are no signs whose denotation depends exclusively on resemblance; therefore, iconic signs are not signs at all (Bierman, 1963, pp. 244–5). Along similar lines, in his 1975 “Trattato di Semiotica Generale”, Umberto Eco stated that “the category of iconicity is useless” (Eco, 1975, p. 282), because it identifies a manifold of phenomena that are not necessarily semiotic and that, just like symbolic representations, hinge on conventions.

In recent years there has been a revival of nominalist and conventionalist arguments, which involved, among other things, a comparison between artistic and scientific representations. Yet, “iconoclast” arguments (advanced in the past as well as in the present) seem to apply exclusively to naïve views of resemblance considered as a superficial, mirror-like correspondence. My contention is that such arguments are based on three fundamental misunderstandings:

1. a misleading conception of similarity as a primitive semiotic notion;
2. a confusion between representations as such and modes of representation;
3. in the case of visual representations, a tendency to criticize a view of representation considered exclusively as a relation of similarity between a sign and the states of affairs that it represents.

A critical examination of Peirce’s formulation of iconicity will provide a satisfactory solution to the problem of similarity in representation. I will

argue that it is desirable, and indeed possible, to do away with notions such as similarity or resemblance in favor of a more fundamental concept of “structural relation”. In spelling out a notion of “structural relation”, I will account for the distinction between representations and representational modes, which is a central aspect of Peirce’s account of icons and iconic signs. Ultimately, in my examination of Picasso’s *Guernica* as a case of iconic representation, I will argue that the painting explicitly questions a view of representation considered exclusively in terms of similarity, and it does so in a way which is to be considered “iconic” in a Peircean sense.

3. Peirce on icons and iconic signs

Peirce defined icons as signs “partaking in the character of the object” (CP 4.531), that is, signs that preserve the relational structure governing their objects. In several instances he seemed to stress that the representative relation at the basis of iconic signs is characterized by a similarity or a likeness with the objects they represent. The definitions below illustrate this point:

[An] icon . . . exhibits a similarity or analogy to the subject of discourse.
CP 1.369

[An icon is a] sign which stands for something because it resembles it.
CP 3.362

The similarity that apparently governs iconic signs in Peirce’s account has been at the core of the misunderstandings that still characterize certain philosophical critiques of iconicity. A more careful study of the representative relation described by Peirce, however, suggests that something more interesting than a simple point-to-point correspondence is involved in iconic representations.

An example from set theory might offer an alternative view of the relation governing iconicity.² In Euler’s diagrams, circles are employed to represent sets. Suppose that we want to represent the expression “Socrates is a mortal”. A strictly symbolic or conventional representation of this expression is “ $S \in M$ ”, where “ S ” denotes Socrates, “ M ” denotes the set of mortals and “ \in ” denotes membership. In Euler’s diagrams this relation is represented in an immediate, visual fashion, by inscribing S inside a circle which stands for the set of mortals:

² The example that follows is adapted from Shin (2002, p. 26).



A comparison of Euler’s diagram and the notation “ $S \in M$ ” shows that the diagram represents the relation of membership between an object and a set in a more natural and immediately observable way. Strictly speaking, however, no physical resemblance is noticed between the diagram and the states of affairs that it stands for.

Additionally, the signs forming the diagram are conventional: they follow a stipulation by which S stands for Socrates and the circle stands for the set of mortal beings. Nevertheless, the way in which the relation of inclusion of an object (in this case Socrates) in a set (the set of mortals) is expressed through the diagram (S being inscribed in a circle) is not conventional: the diagram preserves the relations of the states of affairs that it represents. Such a structural relation allows one to associate the representation of S inside a circle to the relation of membership or inclusion in a set. Despite the conventional nature of the representing facts, the relation between the elements forming the diagrammatic representation of the statement “Socrates is a mortal” is an instance of semiotic iconicity (Shin 2002, p. 26).

It is not a coincidence that Peirce included diagrams and diagrammatic reasoning among the most fruitful kinds of iconic signs. The visual directness of diagrams depends on the iconic component that characterizes them and that is at the basis of their efficacy in the attainment of novel and valuable conclusions (Shin, 2002, pp. 27 ff.; Pietarinen, 2006, p. 113). Such an iconic component should not be identified with a superficial similarity of appearance. Peirce explicitly stressed this aspect of structural relations:

Many diagrams resemble their objects not at all in looks; it is only in respect to the relations of their parts that their likeness consists. Thus, we may show the relation between different kinds of signs by a brace, thus:

$$S_i = \left\{ \begin{array}{l} \text{Icons,} \\ \text{Indices,} \\ \text{Symbols} \end{array} \right.$$

This is an icon. But the only respect in which it resembles its object is that the brace shows the classes of *icons*, *indices* and *symbols* to be related to one another and to the general class of signs, as they really are, in a general way. CP 2.282

The representational nature of diagrams is particularly effective for a clarification of Peirce’s notion of iconicity. Peirce specified that diagrams,

as all iconic signs, rarely function as pure icons:³ symbolic elements intervene in the representation and background knowledge of such conventions is indispensable to attain the desired information. In Peirce's terms:

A *Diagram* is a representamen which is predominantly an icon of relations and is aided to be so by conventions. Indices are also more or less used. It should be carried out upon a perfectly consistent system of representation, one founded upon a simple and easily intelligible idea. MS 492:1⁴

Like diagrams, other examples of iconic signs participate in semiotic processes in a mediated form – that is, in the form of signs that are produced in order to be interpreted by a mind. Considered in a mediated form, iconic signs include conventional and indexical elements, which are indispensable for their construction.

The utmost value of icons consists of instantiating a cognitive rule that allows the mind to establish new relations between previously unconnected representations. Evidently, Peirce's formulation of iconicity is not limited to a superficial resemblance between a sign and the object it stands for. On the contrary, it is a semiotic category that directly concerns the role of representations in the progress towards novel and productive results. The efficacy of iconic signs consists of the process that they trigger in the interpreter's mind. As a result, icons are cognitively treated as real objects rather than representations.

Peirce explained this feature of iconic signs in an illuminating passage of his 1885 "Algebra of Logic":

A diagram, indeed, so far as it has a general signification, is not a pure Icon; but in the middle part of our reasoning we forget the abstractness in great measure, and the diagram is for us the very thing. So, in contemplating a painting, there is a moment when we lose the consciousness that it is not the thing, the distinction of the real and the copy disappears, and it is for the moment a pure dream – not any particular existence, and yet not general. At that moment we are contemplating an *Icon*. CP 3.362

In the passage, Peirce uses the trichotomy *icon-index-symbol* as an illustration of three classes of signs introduced in his new algebra of logic.

³ Peirce clarifies that in most cases a sign displays features that belong simultaneously to the class of symbols, indices and icons. He stressed that iconic representations partly consist of symbolic components and considered diagrams as examples of iconicity in mediation. See, for instance, CP 2.276 ff.

⁴ Quoted in Pietarinen (2006, p. 111).

What is particularly interesting here is the fact that such an illuminating observation on two instances of iconic signs (diagrams and images, specifically paintings) is made by Peirce in a logical and mathematical context. This might eventually lend further support to the concept of iconicity as a structure-preserving relation that I am trying to advance and apply to the case of Picasso's *Guernica*. This point will become clearer in section 4 of this paper.

If conventional and/or indexical components are temporarily left aside, iconic representations participate in reasoning processes as if they were real entities ("the diagram is for us the very thing"). Peirce maintained that, in this process, the interpreter deals with "pure dreams", that is, representations which are neither general nor particular. Icons enter thought processes in the form of "composite photograph[s] of images" (CP 2.317) of the objects they represent. This does not imply that thought literally proceeds through pictures in the mind. Instead, icons are to be interpreted as "average images" (Bergman, 2006) of real objects, that is, as generalizations deriving from experience. The function of iconic signs, (which are asserted icons, or icons as they appear in communicative processes) consists of evoking mental icons ("pure dreams", in Peirce's terms). The fundamental connection between asserted icons and mental icons is at the basis of the perspicuous and fertile character of certain visual representations. This is also what makes iconicity a constitutive feature of thought processes culminating in genuine discoveries.

4. Iconicity as homomorphism

The structural relation posed by Peirce at the basis of iconic representations is more accurately expressed in terms of the mathematical relation of homomorphism. Homomorphism is a structure-preserving mapping between two algebraic structures or sets. Contrary to isomorphism, homomorphism is not a one-to-one (bijective) mapping. A set A (source domain) can be mapped onto a smaller set B (target domain), so long as their relevant structure is preserved. This requires a correspondence between properties (symmetry/asymmetry; reflexivity/irreflexivity etc.) and operations (relations between elements) of both sets. Notice that, in abstract algebra, homomorphisms do not have to map between sets that have the same operations (for instance, addition can be mapped onto multiplication). Moreover, the structural relation between the sets A and B does not necessarily extend to all the elements of the target domain: part of the elements in

the target domain might not be included in the mapping. In mathematical terms, the target domain thus obtained is said to be a homomorphic image of the source domain (Norman, 1999, pp. 21–22; Bartels, 2006, p. 8).

It is possible to summarize the conditions for a homomorphic relation to hold between a representational source and a target domain as follows:

1. Elements of a source domain A represent elements in a target domain B , with different elements of B represented by different elements of A ;
2. f is a mapping or function between A and B such that:
 - (a) If elements in A stand in some relevant relation R , then there is a relevant relation R' among elements of B to which they are assigned by f .
 - (b) If an element in A has a relevant property P , then there is an element in B with the corresponding property P' .
 - (c) If a relation R in A has some structural property (symmetry/asymmetry, reflexivity/irreflexivity, transitivity etc.), then the same property holds for R' in B .

(Barwise and Hammer, 1996, pp. 71–72; Norman, 1999, p. 22)

Homomorphism helps clarifying the ambiguous notion of similarity or likeness that Peirce considered at the basis of iconic representations. A representational source is an icon of its target if it preserves relevant properties and relations that hold between the elements of the range of phenomena that it stands for. Iconic representations trigger the discovery of novel facts because of the structural relation that they exhibit with the states of affairs that they represent.

A theory of iconicity as homomorphism accounts for structure preservation as a relation which is established by a cognitive act, rather than a superficial correspondence. Moreover, it does not invite conventionalist and nominalist criticisms against resemblance. The two conditions that Goodman posed at the basis of resemblance, symmetry and reflexivity, are no longer indispensable requirements for a homomorphic relation to be established between a source domain and a target domain. This does not imply that symmetry and reflexivity are absent from all mapping operations; it only limits their relevance to specific cases of mapping.⁵

⁵ This is the case – for example – of kinds of mapping such as isomorphism and endomorphism. Homomorphism is admittedly an extremely general form of mapping, which might

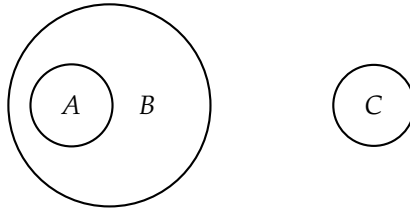
Ultimately, Peirce's discussion of iconic signs offers an interpretative key in support of a theory of iconicity as homomorphism. He stated that physical similarity is only one case of structural relation that can be established between an iconic sign and its object (CP 2.281). He suggested to consider cases in which no physical resemblance occurs, and yet it is possible to devise a structural relation between representing and represented facts: "Every algebraic equation is an icon, in so far as it *exhibits*, by means of algebraic signs (which are not themselves icons), the relations of quantities concerned" (CP 2.282). In the case of algebraic equations, the structural correspondence is inherent in the properties that algebraic signs share with the quantities that they express. Rather than a superficial resemblance based on the physical look of representing and represented facts in a certain representation, it is possible to exemplify this structural relation in terms of a homomorphism between algebraic equations and the states of affairs that they stand for. Peirce extended this line of argumentation to the use of diagrams in mathematical reasoning:

Mathematical reasoning consists in constructing a diagram according to a general precept, in observing certain relations between parts of that diagram not explicitly required by the precept, showing that these relations will hold for all such diagrams and in formulating this conclusion in general terms. CP 1.54

Peirce's description of mathematical reasoning through diagrams relies on the grasping of structural relations that reveal novel aspects of previously ignored facts. Iconicity is an essential component of this process: 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 (CP 2.279).

What did Peirce mean by "direct observation" in relation to iconic representations? And how does observation relate to the discovery of novel aspects of the objects that iconic signs represent? A mathematical example will clarify these questions. Suppose that we represent by means of Euler's diagrams the following propositions: "All *A* are *B*" and "No *B* is *C*" (Shin, 2002, p. 32):

invite Goodman-like objections: it can be argued that anything might be homomorphic to anything else in some respect or capacity. Hence, homomorphisms might need to be "filled in" with other particular kinds of mapping to account for particular cases of representation (Bartels, 2006, p. 9). This would still rely on a concept of structure-preserving mapping, however. In fact, this is exactly what makes homomorphism an interesting and epistemically fruitful representative relation.



A third proposition emerges from the observation of this diagrammatic representation – namely that “No A is C ”, for the circles that represent A and C are not related. This novel piece of information is grasped visually – it is “discovered” – in a direct manner through the act of constructing and inspecting the diagram. In a similar fashion, the homomorphism at the basis of iconic representations implies that missing links are reconstructed starting from the relations that the mapping itself establishes. The discovery of novel facts is directly related to the cognitive act of establishing such a structural relation between the source and the target domain.

5. Iconicity in context: Picasso’s *Guernica*

An interpretation of iconicity as homomorphism is a helpful theoretical device to overcome both nominalist and mimetic accounts of artistic representation. Pablo Picasso’s 1937 painting, *Guernica*, is an illuminating case-study to examine iconicity in context (Ambrosio, 2007). Picasso was a leading figure of avant-garde movements at the beginning of the 20th century. Through Cubism, he proposed a radically novel concept of artistic representation in which geometry played an indispensable role. Geometry allowed Picasso to achieve a simultaneous representation of several perspective points at once. In a sense, it is possible to interpret cubist works as “composite photographs of images” of objects abstracted from experience. Cubist representations preserve properties and relations as they are present in the objects they stand for. Considered as iconic signs, such representations approach the ways in which objects are mentally conceived. This is central to my definition of Picasso’s art as conceptual art. Whenever I will discuss the conceptual nature of Cubist paintings and *Guernica*, I will implicitly address their capability of evoking mental icons in a way which is more faithful to cognitive processes than traditionally figurative artworks.

The story of *Guernica* is relatively well known. In January 1937, the Spanish Republican Government in exile commissioned Picasso to paint a large canvas (3.51×7.82m) for the Spanish Pavilion in the Paris Universal

Exhibition. The painting was to be a statement in support of the Spanish cause against the rise of nationalism. At the moment of the commission, Generalissimo Francisco Franco, commander of the Foreign Legion and future chief of Nationalist Spain controlled over one third of the country. Madrid and the Basque region were both under the threat of air siege. On April 26, the airplanes of the Condor Legion bombed the Basque village of Gernika, known throughout Spain as the oldest centre of democracy. The bombing of Gernika is nowadays remembered as one of the first attacks directed against a population of innocent civilians. Picasso read the news and heard radio reports between 27 and 30 April and began painting on May 1.

A great advantage in studying the creation of *Guernica* is that Picasso classified and dated all the preparatory sketches.⁶ His then partner, the Surrealist photographer Dora Maar, captured all the states of the painting in a photographic record of the canvas in progress. Picasso's preparatory work gives us a glimpse of the way in which he conceived the representational relation governing *Guernica*. *Guernica* does not "resemble" the events that it represents – at best it "evokes" them. Resemblance was not Picasso's aim; instead, he attained a universal denounce of the crimes of war through a pictorial tension between representational and abstract elements. He achieved this result through the systematic use of geometry. The geometric core of Cubism allowed Picasso to produce a conceptual representation, an asserted icon that triggers cognitive process by which viewers establish significant relations with certain states of affairs.

In his study of *Guernica*, Rudolf Arnheim states that the monochrome character of the canvas renders it "closer to a diagram – the visual representation of an idea" (Arnheim, 1962, p. 25). He maintains that the pervasiveness of black, white and scales of grey reduces all objects and characters to their fundamental properties. Other aspects of *Guernica* reinforce Arnheim's parallel between the canvas and a diagrammatic representation. The coloring of the painting is surely a decisive element; however, this must be considered in combination with factors such as the conceptual nature of Picasso's representation in its entirety, which draws upon geometry. *Guernica* is close to a diagram because of Picasso's use of geometry as the privileged means of cubist representations.

Due to its geometric core, *Guernica* exhibits an iconic, homomorphic relation with the states of affairs that it represents. Geometry defines in a

⁶ For a full examination of the preparatory sketches for *Guernica* see Ambrosio (2007, pp. 239–319).

clear and evident way properties and relations between objects in space. In the case of *Guernica*, geometry acted as a privileged vehicle to achieve a conceptual representation in which objects, with their properties and their relations were preserved. It is in this sense that Picasso's canvas represents like a diagram. Applied to the case of *Guernica*, a theory of iconicity as homomorphism accounts for the limits and constraints upon artistic representations considered as efforts to capture satisfactorily a perspicuous image of reality.⁷

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