# REMARKS ON REPRESENTATION AND MISREPRESENTATION

COMENTARIOS SOBRE LA REPRESENTACIÓN
Y LA TERGIVERSACIÓN

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**Resumen:** *La representación es un aspecto común a nuestra vida, arte y ciencia cotidianos. Sin embargo, no puede darse por sentada y en la era postmoderna ha sido sometida a la crítica e incluso al ataque de muchos filósofos. Aunque algunos de estos críticos se reconocen así mismo como "pragmatistas", en este artículo defiendo que la semiótica de Charles S. Peirce provee de una teoría satisfactoria de la representación. Esta aproximación semiótica es asimismo unificada dado que ilumina variaciones de este tema dentro de las ciencias cognitivas, la filosofía del lenguaje, la filosofía de la ciencia y la estética. Por otra parte, puede clarificarse el problema conexo de la tergiversación ("misrepresentation") por medio de las ideas de verosimilitud e idealización desarrolladas en el espíritu del realismo científico crítico por los filósofos de la ciencia.*

**Palabras clave:** *caricatura, Goodman, tergiversación, Peirce, referencia, representación, semiótica, verosimilitud.*

**Abstract:** *Representation is a common aspect of our everyday life, art, and science. But this notion cannot be taken for granted, and in the postmodern era it has been subjected to criticism and even attack by many philosophers. Even though some of these critics call themselves "pragmatists", I argue in this paper that a satisfactory account of representation is provided by Charles S. Peirce's semiotics. This semiotic approach is also unified in the sense that it illuminates variations of this theme within cognitive science, philosophy of language, philosophy of science, and aesthetics. The related*

*problem of misrepresentation can be clarified by the account of truthlikeness and idealization developed by philosophers of science in the spirit of critical scientific realism.*

**Keywords:** *caricature, Goodman, misrepresentation, Peirce, reference, representation, semiotics, truthlikeness.*

## 1. REPRESENTATION EMBATTLED

Examples of representation can be found in the use of language in everyday life, works of art in various fields, and theories and models in different scientific disciplines. We use several kinds of signs to refer to objects around us and to represent even fictional objects in art and unobservable theoretical entities in science. As Woosuk Park[1] suggests, we need a unified theory of representation which seeks connections between linguistics, cognitive science, aesthetics, and philosophy of science. But such an account should also give a reply to the postmodern critics who have challenged the need or the viability of the notion of representation altogether. This issue is connected to the problem whether it is possible to combine realism (i.e. mind-independent reality as the object of knowledge) and fallibilism (i.e. uncertainty and corrigibility of all factual knowledge claims). Therefore, the account should also deal with the problem of misrepresentation which philosophers of science have discussed in their treatments of truthlikeness and idealization.

In this paper I argue that the ingredients of a rich account of representation are provided by the theory of semiotics that Charles S. Peirce (1839-1914) developed already a century ago[2]. Peirce was the American founder of pragmatism whose system of ideas was based on his theory of signs or "semeiotic"[3]. In the mid-twentieth century in Europe, Peirce's semiotics had to compete with Saussure's alternative approach. But even though semiotics has become a highly fashionable international research field, it is curious how often authors who are discussing and criticizing the notion of representation ignore Peirce's seminal contribution in this area.

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[1] Woosuk PARK, "Misrepresentation in Context", in *Foundations of Science* 19 (2014) 363-374.

[2] See I. NIINILUOTO, "Representation and Truthlikeness", in *Foundations of Science* 19 (2014) 375-379.

[3] See C. S. PEIRCE, *Collected Papers*, vols. 1-6, C. Hartshorne and P. Weiss, eds., Cambridge, MA, Harvard University Press, 1931-35; C. S. PEIRCE, *Collected Papers,* vols. 7-8, A. BURKS, ed., Cambridge, MA, Harvard University Press, 1958 and T.L. SHORT, *Peirce's Theory of Signs*, Cambridge, Cambridge University Press, 2007.

Perhaps the strongest attack on representation comes from Richard Rorty's[4] attempt to rewrite the history of philosophy without assuming that the human mind is "a mirror of nature". Rejecting "privileged representations" like Immanuel Kant's intuitions and concepts, and appealing to "heretical followers" of Edmund Husserl and Bertrand Russell, Rorty takes his clues from John Dewey's rejection of the "spectator theory of knowledge", Donald Davidson's philosophy of language, which admits that we and our languages have only causal relations to the world, Ludwig Wittgenstein's conception of language as a tool rather than a mirror, W. V. O. Quine's rejection of the analytic-synthetic distinction, and Wilfrid Sellars' account of truth in terms of correct assertability by means of inferential steps within language. Rorty thinks that Peirce is "overpraised", as "his contribution to pragmatism was merely to give it a name, and to have stimulated James"[5]. His version of pragmatism without the correspondence notion of truth rejects the idea of a world which is independent of our conceptual schemes and our knowledge – this is just a meaningless "world well lost"[6]. Rorty (1991)[7] concludes with "antirepresentationalism" which "does not view knowledge as a matter of getting reality right, but rather as a matter of acquiring habits of action for coping with reality". This framework eschews discussion of realism-vs-antirealism by denying that the notion of "representation" has any useful role in philosophy[8].

Huw Price[9] calls his position "non-representationalism" or "anthropological pragmatism". With influences from Robert Brandom's Sellarsian view of statements as inference tickets instead of word-world correspondences, and from "expressivism", where moral statements are interpreted as expressions of evaluative attitudes rather than assertions of matters of facts, Price's account of the functions of our linguistic interactions is such that the question about more or less correct representation of reality does not even arise.

For a Peirce scholar any position of "pragmatism" without semiotic relations seems utterly strange. One may recall that Peirce in 1905 renamed his doctrine as "pragmaticism", which is "ugly enough to be safe from kidnappers"[10]. But the real issue here is not only nomenclature about a

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[4]   Richard Rorty, *Philosophy and the Mirror of Nature*, Princeton, Princeton University Press, 1980.

[5]   Richard Rorty, *Consequences of Pragmatism*, Minneapolis, University of Minnesota Press, 1982, pp. 160-161.

[6]   *Ibid.*, pp. 3-18.

[7]   Richard Rorty, *Objectivity, Relativism, and Truth*, Cambridge, Cambridge University Press, 1991.

[8]   *Ibid.*, p. 2.

[9]   Huw Price, *Naturalism Without Mirrors*, Oxford, Oxford University Press, 2010.

[10]  CP 5.414.

philosophical school, but rather what Jaakko Hintikka[11] has called "the ultimate presupposition of twentieth-century philosophy". Hintikka draws a contrast between two positions: language as a *universal medium*, which claims that we cannot step outside language so that semantic relations between language and the world are inexpressible or ineffable, and language as a *calculus*, which allows the systematic variation and study of the interpretation of linguistic expressions and their referents in the world. In the former camp, he includes Frege, Russell, Wittgenstein, Quine, and Heidegger, in the latter Peirce, Hilbert, Husserl, later Carnap, Tarski, and Hintikka himself. Hintikka defends his calculus view by interpreting Wittgenstein's language-games as a method of establishing language-world connections, and develops this idea in detail with his game-theoretical semantics for natural and formal languages. On the basis of this distinction, one may find that the presuppositions of contemporary antirepresentationalists –from Davidson and Sellars to Rorty and Price– belong to the universal medium view.

In aesthetics, the trend of postmodernism suggested that the notion of representation needs rethinking, as the artists have learnt to play with many kinds of representation modes[12]. Nelson Goodman's *Languages of Art*[13] criticized heavily resemblance theories of representation. Many French post-structuralists and deconstructionists concluded that semiotic systems are closed in the sense that they cannot refer to anything extra-linguistic outside the endless relations between signs. According to Jacques Derrida, "there is nothing outside language", and Jean Baudrillard (1983)[14] claimed that signs not only distort and "pervert" their referents but often function as *simulacra* which hide the disappearance or non-existence of their apparent objects. Among philosophers of science, Baudrillard's account has been used as an argument for the thesis that "realism is dead"[15].

Representation is a widely used concept in cognitive science, as one can see in Jerry Fodor's *Psychosemantics*[16]. Here this notion is not under attack, since the need of mental representations is presumed, but the problem lies in its use in specific senses which –without arguments– exclude others.

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[11]  Jaakko Hintikka, *Lingua Universalis vs. Calculus Ratiocinator: An Ultimate Presupposition of Twentieth-Century Philosophy,* Dordrecht, Kluwer, 1997.

[12]  See B. Wallis, ed., *Art After Modernism: Rethinking Representation*, New York, The Museum of Contemporary Art, 1984.

[13]  Nelson Goodman, *Languages of Art*, Indianapolis, Hackett, 1976.

[14]  Jean Baudrillard, *Simulations*, New York, Semiotext,1983.

[15]  M. N. Wise, "Realism is Dead" in M. R. Jones and N. Cartwright, eds., *Idealization XII: Correcting the Model. Idealization and Abstraction in the Sciences*, Amsterdam, Rodopi, 2005, pp. 269-285.

[16]  Jerry Fodor, *Psychosemantics*, Cambridge, MA, The MIT Press, 1987.

Philosophers of science, who are interested in the representative capacity of scientific theories and models, have proposed "minimalist" approaches which are not committed to any specific type of representation. For example, Mauricio Suárez[17] argues that representation should not be tied with the traditional notions of isomorphism and similarity: for a minimalist "inferential" account of representation it is sufficient that the "representational force" of model M points toward target R, and that M allows competent and informed agents to draw specific inferences regarding R. Dyadic notions of representation between models and targets have been challenged by Tarja Knuuttila[18].

## 2. Peirce's Semiotic Account of Representation

Many of the worries, which have motivated attacks against representation, are answered by the theory of semiotics that Peirce developed around the year 1900[19]. According to Peirce, "a sign, or *representamen*, is something which stands to somebody for something in some respect or capacity"[20]. This notion of representation is extremely broad, as it allows anything to be a sign as long as some interpreter finds a ground for taking it to denote or stand for something. It is irreducibly triadic, as it always involves a sign (or sign-vehicle), object, and interpretant. Even though the "interpretant" for Peirce is not the same as "interpreter" in person, but rather another sign or "an idea to which it gives rise"[21], which suggests the process of "unlimited semiosis"[22], the "final interpretant" gives the whole truth about the sign's object[23]. The "immediate object" is the object "as cognized in the sign", and the "dynamic object" is the object itself "in relations as unlimited and final study would show it to be"[24].

Instead of Peirce's triadic approach, the European trends followed Ferdinand Saussure's semiology, where a sign is a dyadic relation between a "significant" and "signifié"[25]. Typically this is a coded conventional relation between a spoken word and the expressed mental idea or meaning, so that semiology does not include the sign-object relations of Peirce's triad. This led to the post-structuralist and postmodernist images of us in the midst of an

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[17]   Mauricio Suárez, "An Inferential Conception of Scientific Representation" in *Philosophy of Science (Symposia)* 71 (2004) 767-779.

[18]   Tarja Knuuttila, "Isolating Representations Versus Credible Constructions? Economic Modelling in Theory and Practice" in *Erkenntnis* 70 (2009) 59-80.

[19]   See Niiniluoto, "Representation and Truthlikeness".

[20]   CP 2.228.

[21]   CP 1.139.

[22]   U. Eco, *A Theory of Semiotics*, Bloomington, Indiana University Press, 1976, p. 68.

[23]   Short, *op.cit.*, p. 190.

[24]   CP 8.183.

[25]   See K. Culler, *Saussure*, Glasgow, Fontana/Collins, 1976.

unlimited semiosis without links to extra-linguistic reality. However, perhaps the main point of Derrida's deconstructionism was to oppose Platonist universals, or the assumption of "a transcendental signified", instead of denying the objective material world.

Peirce introduced several threefold divisions of signs, so that on the whole his system is quite complex. But his semiotics is "minimalist" in the sense that its taxonomy of signs includes as special cases different grounds for denotation or the sign-object relation[26]: an *index* refers to its object by virtue of a causal connection (e.g. smoke is a sign of fire), an *icon* by its likeness or similarity with the object (e.g. a picture of a cat is an icon of a cat), and a *symbol* by a rule or convention (e.g. the word 'cat' is a symbol of a cat).

Note that this classification of signs is not exclusive, since it allows mixed cases. Photographs are indexical, as they are causally produced by their objects, and at the same time iconic, as they are similar to their objects. Theoretical terms in science may have an indexical element, as their descriptions sometimes employ causal terminology (e.g. electrons leave a trace in Wilson chambers), but still such terms are conventional symbols.

When Goodman[27] claimed that resemblance is not sufficient for representation, for Peirce's followers he is right in the trivial sense that a two-place relation between two entities cannot establish a representative relation without the activity of the community of interpreters. For example, identical tokens of a letter do not represent each other, unless they are so interpreted[28]. In the Peircean approach, a painted portrait is an icon of an actual person (whom it may fail to resemble) only when accompanied by an indexical sign, such as an attached label, or in respect to the history of its production[29]. Further, it does not even make sense to ask whether the relation of representation is reflective and symmetric, since it is not dyadic. The role of interpretative cultural codes is highlighted in Umberto Eco's[30] sophisticated discussion of pictorial representation. For similar reasons, it is misleading to treat isomorphism simply as a two-place relation between two structures M and R, since an isomorphism always presupposes as the third component a key or mapping between the corresponding elements of M and R. This was clearly recognized by Erik Stenius[31] in his careful explication of the picture theory of language in Wittgenstein's *Tractatus*.

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[26]   CP 2.247-249.

[27]   Nelson Goodman, *Languages of Art*.

[28]   Cf. Short, *op.cit.*, p. 215.

[29]   *Ibid.*, 216.

[30]   Umberto Eco, *A Theory of Semiotics*.

[31]   Erik Stenius, *Wittgenstein's Tractatus: A Critical Exposition of Its Main Lines of Thought*, Oxford, Blackwell, 1964.

Peirce's semiotic lesson can be seen in the recent "pragmatic" accounts by philosophers of science. Using the slogan "no representation without representers", Ron Giere[32] replaces the dyadic relation "X represents W" by "S uses X to represent W with purpose P"[33]. Bas van Frassen[34], whose "empiricist structuralism" requires that empirical substructures of theoretical models should be isomorphic to "data models" and "surface models" of observable phenomena, uses a triadic account including a representational structure X, a target structure W, and a user, and it is up to the user's decision that X represents W. Iranzo[35] protests that appeal to user's decision is not sufficient and should be constrained by an additional condition that a representational model in science should be able to convey some truthful knowledge about the purported target.

The distinction between indices, icons, and symbols shows that all representation need not be iconic or based upon similarity. When Goodman[36] and others argue that similarity is not necessary for representation, Peirce's semiotics agrees: smoke does not resemble fire. Goodman's[37] more specific objections to the notion of similarity are answered in Niiniluoto[38] Goodman claimed that "similarity cannot be equated with, or measured in terms of, possession of common characteristics". But his thesis that "any two things have exactly as many properties in common as any other two" is based on a nominalist account properties in terms of all Boolean combinations of predicates. The problem disappears when degrees of similarity are defined relative to a selection of respects which are taken to be relevant to the comparison[39]. As representation without resemblance or "mirroring nature" is possible, Rorty's anti-representationalism is based on a too narrow notion of representation. Still, resemblance relations may have interesting roles in semiotic systems[40].

[32] Ron Giere, *Scientific Perspectivism*, Chicago, The University of Chicago Press, 2006.

[33] See also U. Mäki, "Missing the World: Models as Isolations and Credible Surrogate Systems", in *Erkenntnis* 70 (2009) 29-43.

[34] Bas Van Fraassen, *Scientific Representation: Paradoxes of Perspective*, Oxford, Oxford University Press, 2008.

[35] V. Iranzo, "Models and Phenomena: Bas van Fraassen's Empiricist Structuralism" in W. Gonzalez, ed., *Bas van Fraassen's Approach to Representation and Models in Science*, Dordrecht, Springer, 2014, pp. 63-76.

[36] Nelson Goodman, *Languages of Art*.

[37] Nelson Goodman, *Problems and Projects*, Indianapolis, The Bobbs-Merrill Company, 1972.

[38] I. Niiniluoto, *Truthlikeness*, Dordrecht, D. Reidel, 1987, pp. 35-38.

[39] See I. Niiniluoto, "Models, Simulations, and Analogical Inference", in V. Karakostas and D. Dieks, eds., *EPSA 11: Perspectives and Foundational Problems in Philosophy of Science*, Cham, Springer, 2013, pp. 19-27.

[40] See W. Park, "Misrepresentation in Context", *Foundations of Science* 19 (2014) 363-374.

All representation need not be based on causal relations, either. Peirce's symbols, among them words in natural language, are conventions by the linguistic community: the words 'cat' in English and 'kissa' in Finnish do not resemble cats as animals, and they need not have causal relations to cats. Still these words have a conventional meaning which allows them to refer to cats. Fodor[41], who thinks –with many physicalist cognitive scientists– that all signs should be icons (the resemblance theory) or indices (the causal theory), tries to analyze symbols by a relation between tokens and their causes: the tokenings of the symbol 'A' are nomologically dependent of the instantiations of the property A. For example, the mental use of the token 'cat' is caused by the presence of cat. This idea is related to causal theories of perception (even though the choice of the token 'cat' in English, instead of 'kissa' in Finnish, depends on the cultural context). But this account is not applicable even to typical terms in natural language, which can be thought and used in many contexts without the presence of their referents –the power of symbolic languages is that they allow us to go beyond "here and now" and to refer to past, present, future, and possible objects. Nor is it promising in the context of science and art, where symbols are used to refer to unobservable and fictional objects. Among the problems of this account is its rejection of the possibility of misrepresentation[42].

### 3. Misrepresentation, Truthlikeness and Caricature

An adequacy condition for a theory of representation is that it should be able to give an account of various kinds of misrepresentation. Pero and Suárez[43] distinguish mistargetting (application of a representation to a wrong object or target) and inaccuracy, where the latter may involve abstraction (neglecting some features of the target), pretence (ascribing features not possessed by the target), and simulation (both abstraction and pretence). They carefully argue that the notion of homomorphism does not allow weakenings which would help to understand the phenomenon of misrepresentation. This argument is incomplete, as it does not consider partial isomorphisms which structural realists have used to explicate the notion of partial truth[44] and thereby to cover at least abstraction as a form of inaccuracy. But while this specific argument about morphisms may be otherwise right, it does not show that all similarity-based treatments of representation are mistaken.

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[41]   Jerry Fodor, *op.cit.*

[42]   See W. Park, "Misrepresentation in Context".

[43]   F. Pero and M. Suárez, "Varieties of Misrepresentation and Homomorphism", in *The European Journal for Philosophy of Science* 6 (2016) 71-90.

[44]   See N. C. A. Da Costa and S. French, *Science and Partial Truth: A Unitary Approach to Models and Scientific Reasoning*, Oxford, Oxford University Press, 2003.

Park[45] observes that problems of misrepresentation in art and science are similar in interesting ways. He refers to Hopkins[46] and Blumson[47] who have discussed examples of pictorial misrepresentation by examples of caricatures and police depictions of dangerous criminals. It is a remarkable coincidence that I have used precisely the same examples in my account of reference by truthlike scientific theories[48]. Indeed, the notion of truthlikeness, as applied to idealized scientific theories, gives a useful and viable approach to misrepresentation, and thereby helps to defend critical scientific realism[49].

Peirce did not speak of misrepresentation in his semiotics, but as a fallibilist he was aware that many scientific theories are erroneous. For him, science is a "self-corrective process"[50] which leads different minds from antagonistic views to "one and the same conclusion"[51]. This ideal limit of the scientific opinion is what is meant by truth[52]. In particular, induction pursues "a method which, if duly persisted in, must, in the very nature of things, lead to a result indefinitely approximating to the truth in the long run"[53]. W. V. O. Quine[54] objected that Peirce's characterization of truth as the limit of inquiry is mistaken, since the notion "nearer than" is defined only for numbers but not for theories. In the same year Karl Popper started to develop his comparative notion of verisimilitude for scientific theories[55].

Popper thus suggested that it makes sense to say that one scientific theory is "closer to the truth" than another. When his explication of this notion of *truthlikeness* or *verisimilitude* was refuted by David Miller and Pavel Tichý in 1974, a new "similarity approach" was started. It defines the degree of truthlikeness of a theory T by the requirement that the complete states of affairs ("possible worlds") allowed by T are similar to the true state[56]. More precisely, theory T in language L is truthlike if it is similar to the complete truth C\* (in so far as it is expressible in L) about a real system W, or if the models of T are

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[45]   W. Park, "Misrepresentation in Context".

[46]   R. Hopkins, *Picture, Image and Experience*, Cambridge, Cambridge University Press, 1998.

[47]   B. Blumson, "Images, Intentionality and Inexistence", in *Philosophy and Phenomenological Research* 79 (2009) 522-538.

[48]   See I. Niiniluoto, "Reference Invariance and Truthlikeness", in *Philosophy of Science* 64 (1997) 546-554.

[49]   See I. Niiniluoto, *Truthlikeness*, Dordrecht, D. Reidel, 1987 and I. Niiniluoto, *Critical Scientific Realism*, Oxford, Oxford University Press, 1999.

[50]   CP 5.575.

[51]   CP 5.407.

[52]   CP 5.565.

[53]   CP 2.781.

[54]   W. V. O. Quine, *Word and Object*. Cambridge, MA, The MIT Press, 1960.

[55]   See K. Popper, *Objective Knowledge*, Oxford, Clarendon Press, 1972.

[56]   For details, see I. Niiniluoto, *Truthlikeness*.

similar to W. (The latter condition is equivalent to Giere's[57] condition, even though he does not want to use the "hybrid" concept of truthlikeness.) This notion does not reject the absolute notion of truth (explicated by Tarski's model theory) but presupposes it: a theory T in language L is maximally truthlike if and only if it is equivalent to the complete truth in L.

This account allows us to say that one theory is a better representation of reality than another. In particular, it can be applied to *idealized* theories and models which either ignore or distort some relevant aspects of the target: for example, Boyle's law is true about ideal gas but only truthlike about real gas[58]. So, a theory or a model as a whole is compared to the real system by analogy or resemblance[59], even if the terms and functions used by such theories are symbols rather than icons in Peirce's semiotics. In fact, Pero's and Suárez's talk about positive and negative analogy can be directly associated with Amos Tversky's treatment of *degrees of similarity* by "feature matching"[60], which has recently been used to measure the similarity between scientific models and targets[61] and the truthlikeness of scientific theories[62]. The roots of this idea go back to John Stuart Mill's 1843 treatment of analogy, which Peirce elaborated in 1883 in his treatment of hypothetical analogical inference[63]. According to Peirce, the probability of such inference depends on the "r-likeness" of two objects *a* and *b*, defined as the ratio of the number of shared properties of *a* and *b* to the number of all properties of *b*[64].

Scientific theories, which describe domains of entities with their properties and lawful relations, are often compared to maps which more or less successfully represent some selected structural relations of landscapes or territories[65]. For example, a map of London subway describes correctly the available routes of trains, but the locations and distances between stations are

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[57]  R. Giere, *Explaining Science: A Cognitive Approach*, Chicago, The University of Chicago Press, 1986.

[58]  See I. Niiniluoto, "Theories, Approximation, Idealizations" (1986), in R. Barcan Marcus, G.J.W. Dorn and P. Weingartner, eds., *Logic, Methodology, and Philosophy of Science*, vol. vii, Amsterdam, North-Holland, pp. 255-289. Reprinted in J. Brzezinski, F. Coniglione, T.A.F. Kuipers and L. Nowak, eds., *Idealization I: General Problems*, Rodopi, Amsterdam, 1990, pp. 9-57.

[59]  See I. Niiniluoto, "The Verisimilitude of Economic Models", in A. Lehtinen, J. Kuorikoski and P. Vlikoski, eds., *Economics for Real*, London, Routledge, 2012, pp. 65-80, and I. Niiniluoto, "Models, Simulations, and Analogical Inference", in V. Karakostas and D. Dieks, eds., *EPSA 11: Perspectives and Foundational Problems in Philosophy of Science*, Cham, Springer, 2013, pp. 19-27.

[60]  See I. Niiniluoto, *Truthlikeness*, pp. 33-34.

[61]  See M. Weisberg, "Getting Serious about Similarity", in *Philosophy of Science* 79 (2013) 785-794.

[62]  See G. Cevolani, R. Festa and T. Kuipers, "Verisimilitude and Belief Change for Nomic Conjunctive Theories", in *Synthese* 190 (2013) 3307-3324.

[63]  CP 2.706

[64]  See I. Niiniluoto, *Truthlikeness*, p. 24.

[65]  See R. Giere, *Explaining Science: A Cognitive Approach*, Chicago, The University of Chicago Press, 1986.

only approximate. The notion of truthlikeness allows us to treat maps in the realist way as truthlike descriptions of reality. In the same way, theories can be compared to portraits and drawings as depictions of human subjects. No two-dimensional portrait or three-dimensional sculpture is identical with its object, nor a completely accurate representation of its object, since it always involves a selection of features. In addition to mere likeness of facial structure and expression, a good portrait (even a photograph) uses perspective, colors, lights, and other contextual aspects to illuminate the mood and personality of its target. But still portraits are similar to their objects, so that even computers can run algorithms of face recognition which identity persons by comparing digital pictures with pre-existing patterns.

Scientific idealizations can be compared to *caricatures* which playfully and amusingly select and exaggerate some features of their targets[66]. As caricatures to some extent misrepresent their targets, their ability to refer to their targets is denied by Fregean descriptive theories of reference, which require that a theory can refer only to those entities which it correctly describes. This theory of reference led Thomas Kuhn to his dramatic antirealist conclusions: false theories do not refer to real entities, and theory-changes involve world-changes. However, if we adopt a principle of charity to the effect that a theory refers to those objects which it describes in the most truthlike manner, then such caricatures can refer to their targets[67]. More precisely, a term t in a scientific theory T refers to the object b which maximizes the degree of truthlikeness of T as applied to b. This modified account of descriptive reference includes both singular reference to particulars and general reference to kinds[68]. The possibility of reference failure or mistargetting is explained by choosing a threshold or a lower value for the required degree of truthlikeness: reference is successful only if the fit is good enough.

Park[69], who endorses and elaborates this idea, notes that Ernst Gombrich devoted an entire chapter of his *Art and Illusion*[70] to caricatures. It is well known that Gombrich was influenced by Popper's philosophy of science, but his classic work was published just before Popper started to develop his ideas about verisimilitude. Moreover, Popper's attempted explication of this notion was based upon the idea of overlap of sets of sentences –without invoking the concept of similarity. So it is not clear whether Popper and Gombrich influenced each other in this matter.

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[66]  See I. Niiniluoto, *Critical Scientific Realism*, p. 128.

[67]  See I. Niiniluoto, "Reference Invariance and Truthlikeness".

[68]  Cf. W. Park, "Towards a Caricature Model of Science", in L. Magnani, P. Li and W. Park, eds., *Philosophy and Cognitive Science II: Western & Eastern Studies*, Cham, Springer, 2015, pp. 77-93.

[69]  *Ibid.*

[70]  E. Gombrich, *Art and Illusion: A Study of Psychology of Pictorial Representation,* London, Phaidon Press, 1960.

Goodman[71] does not mention caricatures in his attack against "the copy theory of representation", even though caricatures avoid the objection that resemblance is reflexive and symmetric. With some possible exceptions, no man is a caricature of himself, and Barach Obama is not a caricature of any of his caricatures. But Goodman cites Gombrich's [72] observation that there is no "innocent eye". So there is a problem of specifying the target of pictorial representation, since it is "not an object the way it is, nor all the ways it is, nor the way it looks to the mindless eye"[73]. But it is a virtue of caricatures as an example of iconic signs that they make the issue of resemblance vividly visible. Caricatures are not copies like fingerprints and DNA samples used as forensic evidence, since they are intentionally selected and exaggerated –involving abstraction, pretence, and simulation in the sense of Pero and Suárez[74]. But for many caricatures we can easily identify their targets, who typically are well-known politicians or other public figures. In spite of the boosted nose, eyes, ears, mouth, or jaw, we know well enough how they "really" look like –either by acquaintance or by photos. Even popular caricatures of Charles Darwin as an ape sufficiently preserve his facial features so that it is easy to recognize this great scholar. But in the case of theoretical terms in science (e.g. electron, gene, quark, Higgs field), the target is not yet known, except some partial, uncertain, and indirect evidence. Therefore, as scientific theories are fallible attempts to describe some so far unknown theoretical entities on the basis of incomplete information, they can be compared to the wanted-for posters of unknown criminals sometimes published by police on the basis of partial information by eyewitnesses[75]. Sometimes such pictures are successful, so that the criminal is correctly identified and captured, but they can also be misleading and direct the search to a wrong person.

The caricature theory of reference shows that there is an important analogy between scientific idealizations and pictures in art. At the same time this theory reaffirms the point that representation and misrepresentation by similarity relations has an important role both in science and art.

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[71]   Nelson Goodman, *Languages of Art*, Indianapolis, Hackett, 1976.

[72]   E. Gombrich, *Art and Illusion: A Study of Psychology of Pictorial Representation*.

[73]   Nelson Goodman, *Languages of Art*, p. 9.

[74]   F. Pero and M. Suárez, "Varieties of Misrepresentation and Homomorphism".

[75]   See I. Niiniluoto, *Critical Scientific Realism*, p. 132 and B. Blumson, "Images, Intentionality and Inexistence", in *Philosophy and Phenomenological Research* 79 (2009) 522-538.