SCIENTIFIC REALISM, THE GALILEAN STRATEGY AND REPRESENTATION [1]

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Abstract: This paper critically reviews Philip Kitcher's most recent epistemology of science, *real realism*. I argue that this view is unstable under different understandings of the term "representation", and that the arguments offered for the position are either unsound or invalid depending on the understanding employed. Suitably modified those arguments are however convincing in favor of a deflationary version of real realism, which I refer to as the *bare view*. The bare view accepts Kitcher's Galilean strategy, and the ensuing commitment to the existence of unobservables; but it does not trade on a correspondence or copy theory of representation. So the bare view, unlike real realism, does not entail that our representations match reality even approximately.

1. Models and Realism

"Scientific models" is an old topic in the philosophy of science. Duhem and Poincaré both discussed models extensively and acknowledged, with some degree of disaffection, their prominent role in science (Duhem, 1914/54; Poincaré, 1908, esp. Book I; Poincaré, 1935). Although the logical positivists were on the whole critical of the use of models (e.g. Carnap, 1966, esp. Part V) – the topic resurfaced in the contemporaneous well-known work of Norman Campbell (Campbell, 1920, part I). It achieved its heyday probably in the late 1960's, in the wake of Mary Hesse's consummate and masterly work on analogy (Hesse, 1966). Later, in the writings of the proponents of the semantic conception, it became assimilated to the different topic of understanding the structure of theoretical knowledge, and consequently the 1970's and 1980's saw the focus of

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philosophical attention move somewhere else – namely, towards the epistemology and structure of scientific theories. (Suppe, 1974).

However, models have recently emancipated themselves again, and philosophers of science have returned to their study with renewed energy (Morgan and Morrison, 1999), (Magnani et al., 1999), (Jones and Cartwright, 2005). The focus of the scholarship of the last decade is both distinct and original. The logical positivists and their successors in the semantic tradition focused on the abstract nature and structure of models, while recent philosophical attention has shifted towards the function and role of models in scientific practice. In other words, rather than focusing on "models" – as isolated entities – the recent philosophical scholarship has focused on "modelling" – the activity of building and applying models. Thus recent work on models emphasises the different ways in which models belong in the context of their use; and in particular it stresses the ways in which the functions of models relate to the purposes of the agents that use them. The autonomy of such purposes from the aims of theorising and data-collection thus reveals hitherto unsuspected levels of autonomy of models both from high-level theory and data.

In more recent years some of the attention has focused even more narrowly upon to the notion of scientific representation. [3] Representing is one of the central purposes of modelling, so it is not surprising that as the modelling literature is turning away from considering the nature and structure of abstract models and towards their practical use in the activity of modelling, so is the representation literature slowly moving away from the abstract nature of the representational relation and towards the practice of representing. [4]My contribution to this movement has been to expound and develop a new conception of representation – the inferential conception – which I see as essentially embedded in the pragmatist tradition while respectful of some central realist intuitions.

My purpose in this paper is to show that this ongoing debate on scientific representation has implications for Philip Kitcher's epistemological writings on science, in particular

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[3] For some examples see the papers delivered at the 2002 PSA symposium on the pragmatics of scientific representation, particularly Giere, R. (2004), Van Fraassen, B. (2004) and my own Suárez, M. (2004).
[4] For a conspicuous example see Van Fraassen (2008).

for the position (*real realism*) that he has defended in his recent and brilliant article in *The Philosophical Review* (Kitcher, 2001). In particular the aim is to analyse Kitcher's epistemological work through the lens of the recent debate on representation, testing the strength of his theses against the background of the different conceptions of representation available. My claim is that doing so illuminates the actual reach and content of Kitcher's position. In particular I shall argue that Kitcher's arguments for real realism are valid but only under the right interpretation of representation; and under this interpretation they are not arguments for any kind of scientific realism worth its name.

In the range of positions in the realism-antirealism debate, Kitcher's own estimate is that his *real realism* lies somewhere between the quietism of Arthur Fine's Natural Ontological Attitude – which I favour – and the more radical metaphysical anti-realism of Hilary Putnam's badly misnamed "internal realism". I shall argue that once the right conception of representation is identified and applied coherently, these arguments in fact provide further ammunition in favour of a quietist position in the epistemology of science. This is a view that abstains from the realism debate altogether – as long as practiced in the abstract arena of philosophical meta-reflection on the nature of science as a whole, as opposed to attending case by case to the details of the science. Thus my conclusion will combine a degree of scepticism with a dose of enthusiasm. I shall remain sceptical that a realist perspective on science is thereby forced upon us, while enthusiastic about the force of some of Kitcher's arguments (the "Galilean strategy" in particular) – as long as they are understood as arguments in favour of a quietist position concerning the philosophical meta-debates, a position most closely associated in the scientific epistemology literature with NOA (Fine, 1986, chapter 7).

2. Realism, Empiricism, and Kitcher's Galilean Strategy

2.1. *Scientific Realism*

As I shall argue, Kitcher's characterisation of realism is subtle, multifaceted, and intricate. However, I shall also argue that the intended characterisation adds nothing essential to Van Fraassen's famous description of the position: "*science aims to give us,*

in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true". (Van Fraassen, 1980, p. 8).

In my view this remains an acceptably accurate characterisation of the position, emphasising all the suitable normative (or methodological), semantic, metaphysical and epistemic dimensions of scientific realism. [5] Let us refer to each of these dimensions as the normative, semantic, metaphysical and epistemic commitments of scientific realism. The normative commitment is implicit in the definition of the aim of science, which articulates a regulative ideal for science fit for realism – an aim that will typically go well beyond the concrete objectives and aims of any particular scientific research project. This commitment makes it clear that realism lies in the contrast class to Feyerabend's methodological "anything goes" anarchism, and various other forms of normative instrumentalism.

The semantic commitment is expressed by the requirement to interpret theories literally (a commitment shared by some antirealisms, such as Van Fraassen's own constructive empiricist alternative to realism). A theory provides a literally true story of the world if and only if "the language of the theory cannot be reinterpreted in non-theoretical terms without some change in meaning". [6] This commitment brings out in full force scientific realism's rejection of a verification-based criterion for the meaning of theoretical terms. Scientific realism is thus shown to be appropriately in opposition to semantic antirealisms such as Carnap's verificationism, pragmatist theories of truth *à la* James, and Dummett's semantic antirealism.

A minimal metaphysical commitment is expressed by the phrase "what the world is like", which implicitly states the independence thesis, [7] at least with respect to our theorising, if not with respect to our minds and the full range of our mental states. So this turn of phrase distinguishes scientific realism appropriately from any radical form of idealism or constructivism that would deny that the contents of the world are dependent upon our theorising.

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[5] Kitcher disagrees (Kitcher 1993, p. 150), but his reasons there do not seem to matter to the arguments presented in his most recent work, and my response to them herein.
[6] Wikepedia's neat entry on constructive empiricism!
[7] The thesis that there is an external world independent of our concepts and our beliefs – see Wright (1992, pp. 2-3).

Finally, the statement that the acceptance of theories involves the belief in their truth suitably expresses, in my view, the very minimal epistemic commitment of any realism worth its name. It is minimal in the suitable sense that it does not require any realist to accept (and hence believe in) all successful theories, it merely states the kind and degree of epistemic commitment that according to realism is implicit in any act of acceptance. In this way it is possible to distinguish appropriately scientific realism from epistemological views that do not require belief in the theory's truth for an appropriate interpretation of scientific practice and theory-acceptance, including certain varieties of pragmatism, such as Dewey's original "instrumentalism", and of course Van Fraassen's own antirealist alternative, namely "constructive empiricism".

No doubt the characterisation so sketched informs a particular *interpretation* of science and scientific activity. It does not need to correspond to any attitude found explicitly or implicitly in the scientific agents themselves. Nor does it need to form an articulate set of doctrines, but might just express an attitudinal commitment to such an interpretation of science (Van Fraassen, 2002). It is nonetheless sufficiently precise, in my view, as a characterisation of some minimal commitments of scientific realism, and it is thus worth fighting for or against it (depending on taste or inclination).

In the remainder of this section I shall argue that for the purposes of this essay Kitcher's intended characterisation of real realism does not improve on Van Fraassen's. Kitcher characterises *real realism* negatively by describing in painstaking detail its alternatives. These alternatives appear grouped in four broad positions, namely: semantic empiricism, epistemological empiricism, semantic constructivism and epistemological constructivism. Each of the next four subsections is devoted to showing that each of these antirealist positions in one way or another denies some of the commitments of scientific realism as characterised by Van Fraassen. Thus, I will conclude, Kitcher's purposes are well served by Van Fraassen's characterisation – since realism as characterised by Van Fraassen is in agreement with *real realism* as Kitcher intends it. Two of these antirealisms will deserve detailed discussion, but let us here at least sketch each of them in turn.

2.2. *Semantic empiricism*

Kitcher characterises semantic empiricism as the conjunction of four theses (Kitcher, ibid. p. 161). (SE1): Our basic terms only receive meaning through our application of them to observable things, properties, and events. (SE2): Any nonbasic terms we use must be introduced using terms that are ultimately reducible to basic terms. (SE3): Any term that is reducible to basic terms applies only to observables. (SE4): The only meaningful language we can use applies to observables.

These four theses provide a generalisation of the verificationist criterion of meaning. And since the language of science is complete with putative references to unobservable entities, it follows that – if it is to make sense – it must be reinterpreted in terms of the only meaningful kind of language, namely the one that applies to observables. But this is another way of saying that theories, if they are to make sense, can not be interpreted literally, since it is explicitly a denial that "the language of the theory cannot be reinterpreted in non-theoretical terms without some change in meaning". In other words semantic empiricism is characterised by its denial that theories provide us with literally true stories about the world, and hence entails a denial of scientific realism in Van Fraassen's definition. Kitcher's formulation of semantic empiricism as the conjunction of these four theses (SE1-4) does not differ from Van Fraassen's characterisation. Its power and interest instead lies in the fact that Kitcher is filling much detail and structure into Van Fraassen's sketchy definition, by providing us with four distinct conditions that are part of the semantic commitment of scientific realism.

2.3. *Epistemological empiricism*

Kitcher describes epistemological empiricism as the combination of six different theses: (EEA1): The only claims we can directly justify are those about observables. (EEA2): We can only check a putative method of justification by showing that it tends to lead to correct conclusions. (EEA3): Thus we can only check methods of justification that lead to conclusions whose truth values can be directly ascertained just by investigating observables. (EEA4): Therefore we have no basis for trusting putative methods of justification that lead to conclusions whose truth values cannot be directly ascertained just by investigating observables. (EEA5): The truth values of statements that assert the existence of unboservables and that attribute properties to unobservables (for short:

statements about unobservables) cannot be directly ascertained just by investigating observables. (EEA6): Thus, we should remain agnostic about conclusions about unobservables.

Epistemological empiricism is a main kind of antirealism to which I shall return later in the paper. For now I would just like to note that it too marks out a form of antirealism in Van Fraassen's sense. The proof is trivial since Van Fraassen's own constructive empiricism is a form of epistemological empiricism that rejects inference to the best explanation methods when applied to yield conclusions about the unobservable domain. More specifically, epistemological empiricism (EEA6) advices us to remain agnostic about whatever our favoured theories say about the unobservable domain. It follows that according to this view theory acceptance can not entail belief in the truth of our theories *simpliciter* – since this view rejects the need to believe in the truth of what our theories say about the unobservable domain.

2.4. *Semantic Constructivism*

This position is involved and contains eight separate theses that Kitcher denotes as (SC1-8), [8] and which I will not describe here in detail since this kind of antirealism is not directly relevant to the present discussion. For our purposes only (SC1), (SC2), and (SC8) are relevant. (SC1) states that scientific realism must take it that our terms refer to entities that are independent of us and our cognition. (SC2) then asserts that if our terms are to refer as (SC1) claims, then there must be a relation between linguistic (or mental) items and constituents of the mind-independent reality. In other words the referential relations link up our terms with the external world. The remaining theses (SC3-SC7) furnish an antirealist argument against the coherence of such referential relations, which allows the semantic constructivist to derive their main conclusion, namely (SC8). According to (SC8) there is no way to establish the connection between our terms and reality, and the realist view of mind-independent objects and of our relation to them is unintelligible.

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[8] Kitcher, ibid, p. 162. Semantic constructivism is meant to capture subtle forms of anti-realism such as Nelson Goodman's constructivist nominalism (Goodman 1978), and Hilary Putnam's "internal realism" (Putnam 1981); I agree with Kitcher that the latter ought to turn up as a version of anti-realism on any appropriate characterization of scientific realism in general.

Semantic constructivism provides us with a mosaic of different ways to deny the commitments expressed in Van Fraassen's definition of scientific realism. In particular semantic constructivism denies that the aim of science is regulative in the sense required by the realist, since on this view the realist conception of truth turns out to be an incoherent aim for science (and hence impossible as its regulative goal). On a slightly different reading semantic constructivism trivialises the truth component required for the acceptance of theories. For theories that have been developed in proper accordance with the scientific method cannot fail to be true in the only sense of "true" that is coherent, namely the pragmatist-inspired criterion of convergence in the limit of proper inquiry. So our acceptance of theories cannot fail to require us to fully believe in them if they have been constructed in proper obedience to the rules of the scientific method. [9]

2.5. *Epistemological Constructivism*

Kitcher defines epistemological constructivism as encompassing the following five theses. (EC1): All our experience of nature is mediated by our concepts. (EC2): Thus there is no way to check directly which aspects of objects belong to objects independently of our conceptualisation of them. (EC3): The only way of trying to check indirectly is to rely on the success of our representations in terms of the internal coherence of our experience. (EC4): We have no reason to believe that this kind of success is indicative of accurate representation of the properties of objects independently of our conceptualisation. (EC5) Any belief that our representations accurately identify the properties of mind independent objects is unjustified.

Epistemological constructivism aims at capturing forms of coherentism typical of some social constructivist thought, such as the Edinburgh and Bath schools, and possibly Latour's actor-network theory. It clashes with scientific realism as characterised by Van Fraassen at several simultaneous levels. First, the epistemological constructivist denies that science can possibly aim at truth in any sense of the term acceptable to the scientific realist, as correspondence to the world. Second, the acceptance of scientific theories is compatible with full belief in their truth as long as truth is understood as a matter of

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[9] And indeed this reading of semantic constructivism gets it into line with Putnam's internal realism – a very subtle and intricate position indeed, which is not even clear is genuinely stable. For critical discussion see e.g. Van Fraassen (1997) and Frisch (1999).

coherence with the rest of our beliefs – but then this is not much of an achievement from a realist point of view, since it requires a coherence account of truth, which is unacceptable for the realist. And third, possibly, the assumption of a ready made world standing out there to be literally or otherwise described by our theories is compromised if not by denial, at least by a sort of agnostic omission – it becomes a totally idle and redundant presupposition of inquiry.

To sum up, I have argued that Kitcher's alternatives to realism (semantic and epistemological empiricism, semantic and epistemological constructivism) are all appropriately and explicitly in the contrast class of Van Fraassen's definition of scientific realism. Kitcher's characterisations are subtle and informative, since they add plenty of detail to the alternatives to scientific realism, and hence help to draw a panoramic yet intricate view of its multiple commitments. However, the position that results out of this procedure (realism and its subspecies, *real realism*) does not differ significantly from the more sketchily one characterised by Van Fraassen – the former is at worse a particular case of the latter, if not coincidental. This thus justifies the use of Van Fraassen's definition, no matter how sketchy, in the remainder of this essay.

3. The Representational Assumption

I now turn my attention to Kitcher's own specific brand of scientific realism, what he calls *real realism*: "We thus envisage a world of entities independent not just of each but of all of us, a world that we represent more or less accurately, and we suppose that what we identify as our successes signal the approximate correctness of some of our representations" (Kitcher, ibid, p. 155). Real realism is intended to be a particular form of denial of the four antirealist views described in the previous section, and hence it is intended to lie within the logical space of scientific realism as characterised by Van Fraassen. However, it is significant that the notion of representation, which is conspicuously absent in Van Fraassen's characterisation, should be so prominent in Kitcher's definition. I will argue that there are more or less realist-leaning interpretations of the term "representation", and that real realism is not invariant under changes of interpretation. That is, unlike the more general Van Fraassen-inspired version of scientific realism, real realism is unstable under different readings of the term

"representation" that appear in its definition. Under some interpretations of the term "representation" real realism indeed turns into a subspecies of scientific realism, and it has an empty intersection with each of the four antirealisms described by Kitcher. But under a sufficiently deflationary interpretation of representation, I will argue, the position that results is not a subspecies of Van Fraassen's scientific realism, and contrary to Kitcher's intention, its intersection with at least some of the antirealisms is *not* the empty set.

Kitcher's argument is intricate and sophisticated; he develops his view through a detailed explanation of three assumptions: Arthur Fine's *natural ontological attitude* (NOA) towards science's existential commitments, an analogous assumption regarding our epistemic stance that Kitcher calls the *natural epistemological attitude* (NEA), and a third assumption that Kitcher brands the *Galilean strategy*. Kitcher contends that the first two assumptions are built into even the most ordinary instances of everyday cognition from infancy: they are a presupposition of everyday cognition. The third (the *Galilean strategy*) is the bit added by modern science to allow us to cognitively move from the level of ordinary (observed or at least observable) objects and their properties to the level of the unobserved or even unobservable objects and their properties postulated by science, whenever these can be detected through the aid of modern instrumentation. This is the assumption that Galileo inaugurated with the use of his telescope and it would indeed be hard to comprehend most of present-day science without it. The conjunction of these three assumptions is intended by Kitcher to yield real realism.

NOA is notoriously (meant to be) neutral between realism and antirealism since it is supposed to describe just the core assumptions that they share. Kitcher argues plausibly that the Galilean strategy must be accepted by anyone committed to modern science, regardless of their position in the realism / antirealism debate. The claim is then that this shows that real realism is grounded upon ordinary cognitive assumptions that are in no way contentious in the epistemological debate. Hence real realism *must* be rationally accepted by all participants, whatever their initial intuitions in epistemology. However, it is important to stress that for this argument to work, all three assumptions must be shown to be shared by all the participants in the debate, regardless of any additional views. Indeed Kitcher claims this status for NEA as well, i.e. he claims that this

assumption too is neutral in the debate between realism and antirealism. But he does not articulate a defence of this claim beyond stating that it is a presupposition of everyday cognition of ordinary (observable) objects and their properties. I shall argue that whether or not this claim holds depends strongly on the conception of scientific representation adopted.

In a scientific representation a *source* (such as a physical object, a diagram or an equation) stands for some *target* (a system, process, or state of a system). There is first a realist-friendly interpretation of the term "representation" according to which a theory or model represents if and only if it stands in the appropriate one-to-one relation with what it represents, providing a sort of "copy" or match for it. I will refer to such theories as "substantive reductive" theories since they aim to fully analyse the relation of representation down to some set of objective relations between objects and their properties, excluding the purposes of agents. In the next section I will provide a few different detailed renditions of this type of theory. For now it is enough to mention that under a substantive reductive interpretation of representation, real realism indeed coincides with the position sketched out by Van Fraassen. We would paraphrase real realism under this interpretation as follows: "We thus envisage a world of entities independent not just of each but of all of us, a world that we mirror or copy more or less accurately, and we suppose that what we identify as our successes signal the approximate correctness of some of our mirrors or copies".

This definition adds some detail to the metaphysical dimension of Van Fraassen's characterisation of realism; while taking away the explicit normative commitment to the aims of science (which we can however take to be implicit). Conversely, a denial of real realism, always under a substantive reductive interpretation of the term "representation", would entail the denial of scientific realism as characterised by Van Fraassen since it would entail denying either of the three dimensions of realism (metaphysical, semantic, epistemological) that are built into Van Fraassen's characterisation. Hence, for instance, denying that what we "identify as our successes" signal "the approximate correctness of our representations" would entail a denial of Van Fraassen's characterisation since it entails a denial of the epistemic dimension.

Thus real realism so characterised is indeed a position that can be fully classified as "realist". Kitcher argues that it follows from the three aforementioned assumptions. I have already mentioned that I find his use of NOA and the Galilean strategy unimpeachable in this context. So let me turn to the third assumption, which Kitcher refers to as the Natural Epistemological Attitude (NEA), and which will turn out to be crucial to the evaluation of this argument. Kitcher states it as the assumption that "we are animals that form representations of the things around us; that is, the world sometimes puts human beings into states that bear content. Those states, in turn, guide our behaviour. In observing, or thinking about, other people, we take it for granted that their representational states sometimes adequately and accurately represent objects, facts and events that we can also identify" (Kitcher 2001, p. 154). This is the assumption that provides the representational content in real realism. Yet, as with real realism itself, this assumption has several readings, which yield very different commitments. I will argue that in line with the ambiguity in the term "representation", NEA is ambiguous between a realist-friendly substantive reductive interpretation and a deflationary reading that has no realist connotations. On a substantive reductive reading, NEA could be paraphrased as follows: "we are animals that construct mirror images of the things around us; […] we take it for granted that […] representational states are sometimes adequate and accurate matches of objects, facts and events that we can also identify". Let us refer to this realist-friendly version of NEA as NEA Realist or (NEAR).

In conjunction with NOA and the Galilean strategy, NEAR is certainly capable of yielding the form of real realism that satisfies Van Fraassen's characterisation, as I just pointed out. However, there are other interpretations of the term "representation" that provide us with different readings of NEA, and which do not give rise to any form of realism. In the next two sections I outline a few notions of representation available, and I analyse how the different readings of NEA fare with respect to them.

4. Substantive Reductive Theories of Representation

I have referred to the class of realist friendly theories of representation that are sometimes implicitly if not explicitly discussed in the literature as *substantive reductive*

(Suárez, 2009). They are attempts to analyse the notion of representation down to some privileged kind of relations between the objects that function as source and target, and their natural properties. Two kinds of relations have been available in the literature for some time: similarity and isomorphism. Ronald Giere (1988, 1999a) and Aronson, Harré and Way (1993) have defended the importance of similarity for representation. Bas van Fraassen (1992, 1994) has focused on the virtues of isomorphism; and other writers in the structuralist tradition, including most prominently Brent Mundy (1986) have appealed to weakened versions of isomorphism. Elsewhere I have described these two theories as follows: [10]

The similarity conception of representation [sim]: A represents B if and only if A and B are similar.

Note that [sim] is not strictly a resemblance theory: it does not assert that resemblance is a necessary and sufficient condition for representation. Similarity is a weaker condition, which neither requires nor includes similarities in visual appearance. It is typically assumed that something like an identity theory of similarity will hold: A and B are similar if and only if they share a subset of their properties. In accordance with this theory, similarity is reflexive (A is maximally similar to itself), and symmetric (if A is similar to B on account of sharing properties p_1, p_2, … p_n, then B is similar to A on the same grounds); but non-transitive (A may share p_1 with B, and B may share p_2 with C, without A and C sharing any property – other than the property of sharing a property with B!).

The isomorphism conception of representation [iso]: A represents B if and only if A and B instantiate isomorphic structures.

Isomorphism is a mathematical relation between extensional structures. Hence the above definition presupposes that any two objects that stand in a representational relation exemplify isomorphic structures. The notion of structure-instantiation turns out to be ridden with difficulties; but the definition has the virtue that it makes sense of

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[10] Suárez (2003, pp. 225-244). Note that I am not claiming that the authors mentioned above have actually defended what I call substantive reductive theories about representation (although they are often taken to have done so) – only that they have provided the two paradigm kinds of relations that provide the basis for the reduction postulated in such theories.

object-to-object representation outside pure mathematics. The claim that two physical objects A and B are isomorphic is then short-hand for the claim that the extensional structures that A and B instantiate are isomorphic. In what follows "A" will indistinguishably denote the source and the structure that it instantiates, and "B" will denote the target and the structure that it instantiates. Isomorphism then demands that there be a one-to-one function that maps all the elements in the domain of one structure onto the elements in the other structure's domain and vice-versa, while preserving the relations defined in each structure. Hence A and B must possess the same cardinality. More precisely, suppose that $A = <D, P^n_j>$ and $B = <E, T^n_j>$; where D, E are the domains of objects in each structure and P^n_j and T^n_j are the n-place relations defined in the structure. A and B are isomorphic if and only if there is a one-to-one and onto mapping f: $D \rightarrow E$, such that for any n-tuple $(x_1,\ldots, x_n) \in D$: $P^n_j [x_1,\ldots, x_n]$ only if $T^n_j [f(x_1),\ldots, f(x_n)]$; and for any n-tuple $(y_1,\ldots, y_n) \in E$: $T^n_j [y_1,\ldots, y_n]$ only if $P^n_j [f^{-1}(y_1),\ldots, f^{-1}(y_n)]$. In other words, an isomorphism is a relation preserving mapping between the domains of two extensional structures, and its existence proves that the *relational framework* of the structures is the same.

A theory of representation along the lines of [iso] and [sim] might well underwrite Kitcher's argument for real realism, since when the term "representation" that appears in NEA is interpreted as these theories imply that it must be, we obtain the NEAR that actually yields real realism. However, it is possible to argue against these substantive reductive theories on the basis of five different arguments (what I call the variety, logical, misrepresentation, non-sufficiency and non-necessity arguments, respectively). These arguments show these theories to be untenable and I won't rehearse them here – see (Suárez 2003) for the details.

There are weakened versions of these theories, which I will neither describe here, and which do a little better in confronting the variety, logical, misrepresentation, non-sufficiency and non-necessity arguments; and they might well do the job demanded in turning NEA into the NEAR required to yield – always in conjunction with NOA and the Galilean strategy – a kind of realism. But showing this in detail is besides the point for the purpose of this paper. The point I am making is that turning the conjunction (NEA & NOA & Galilean strategy) into an argument for real realism requires some prior realist-friendly interpretation of the notion of representation invoked in NEA. In

other words it requires that we replace the general formulation of NEA by a more concrete version that is friendly to realist intuitions, namely NEAR, since real realism only actually follows from the conjunction (NEAR & NOA & Galilean strategy). So I am not claiming that NEAR is incoherent – but then I do not need to. It is sufficient for my purposes to show that NEAR is an optional understanding of NEA: There are alternative interpretations that, unlike NEAR, carry no realist implications.

5. An Inferential Conception of Representation

The alternative non-realist account of scientific representation include the DDI account (Hughes 1997) and the inferential conception of representation (Suárez 2004). [11] According to the latter, representation is not a dyadic relation between sources and targets but rather a combination of the scope of intended use and inferential capacities of the source as revealed in the practice and the context of representing. In other words we should focus more on the activity of representing than on the putative relation of representation. [12] And if we are to try to characterise the relation analytically then our best hope is the following definition:

The inferential conception of representation [inf]: A represents B if and only if (i) the representational force of A points towards B, and (ii) A allows competent and informed agents to draw specific inferences regarding B.

I explain the consequences and features of the conception elsewhere – for our purposes here it is enough to note that this is a deflationary and pragmatist conception of representation. It is also non-realist in the specific sense that its application to scientific representations does not require Van Fraassen's strictures on scientific realism at all. This is the case for several reasons. Firstly, the inferential conception separates neatly between representation on the one hand and true, complete or empirically adequate representation on the other. A representational source licenses inferences regarding its target. The representation is true if it licenses no inferences to false conclusions about

[11] I emphasize "non-realist" as opposed to "anti-realist". My claim is that on the inferential conception representation turns out neutral with respect to the realism-antirealism debate.
[12] In nice agreement with the recent focus on practice in the modeling literature described in section 1.

the target; it is <u>complete</u> if it is true and fully informative, licensing inferences to all truths about the target; and it is <u>empirically adequate</u> if it is complete with respect to all the observable or measurable aspects of the target, licensing inferences to all the truths about those aspects. It is important to emphasize that "true", "empirically adequate" and "complete" are not on this conception of representation equivalent to "mirror": the source may be non-isomorphic and as dissimilar to the target as it could be, and still license true conclusions.

Hence the goal of searching for representations of nature – even accurate ones – does not commit anyone to the kind of broad relation of mirroring characteristic of realism. And under this interpretation of the term "representation", (NEA) takes a very different flavor, and must be paraphrased as follows: "we are animals that draw inferences regarding the things around us; that is, the world sometimes puts human beings into states that bear content. Those states, in turn, guide our behaviour. In observing, or thinking about, other people, we take it for granted that their inferences are sometimes adequate or accurate regarding objects, facts and events that we can also identify". Let us refer to this statement, which is the non realist version of Kitcher's NEA under a deflationary conception of representation, as (NEAN). NEAN entails no particular relation between the source and the target of a representation other than the source's capacity (under the right interpretation, in the appropriate context of use, etc) to yield some conclusions about the target.

This reading of NEA has one additional virtue; it squares nicely with Kitcher's own emphasis that NEA "already plays a large role in our everyday lives, for instance in our guidance of children's development" (Kitcher, ibid, p. 154). Indeed it is much easier to see the drawing of inferences playing such a role than the recognizing of either similarity or isomorphism. From that point of view NEAN looks not just a part of our ordinary cognition, but very much its starting point, as anyone acquainted with some early child psychology can testify. Surrogate inference by means of toy-objects is among the first cognitive activities performed by children in their encounter with the external world. It precedes any judgments of relevant similarities between objects, not to mention isomorphisms. It even seems to precede the development of language. Appreciation of similarity and isomorphism is a subtler form of pattern recognition that at best comes much later.

6. Kitcher's Argument Deflated

Here lies the rub for Kitcher's argument. Once we distinguish carefully between two readings of NEA, a realist-leaning reading (NEAR) and a neutral, non-realist reading (NEAN), we can appreciate that *real realism* falls in between the gaps of the argument. Kitcher aims to show that NEA is so natural as to be unavoidable; it is one of those homely truths that belong to a common core of practices that neither realist nor antirealist can deny. He claims that NEA, when combined with NOA and the Galilean strategy – both equally undeniable – yields a robust enough form of realism. So, from the basic assumptions of ordinary cognition, a form of realism already reveals itself as correct; any non-realist alternative is thus just philosophical artifice.

However, it turns out that the only reading of NEA that satisfies the first requirement (being undeniably unavoidable) is a deflationary one, along the lines for instance of the inferential conception. For it is NEAN that is undoubtedly part of our ordinary cognition and might be argued to be a basic part of children's cognitive development from the start. But this is not the reading of NEA that yields realism in combination with NOA and the Galilean strategy. In order to satisfy the second requirement (yielding realism) we must read NEA in its realist-friendly version, NEAR. Hence we have unearthed a fallacy in Kitcher's reasoning: the version of NEA that figures in the first part of the argument (and can thus be inferred from practice) is not the same version of NEA that figures in the second part of the argument (and thus leads to the assertion of real realism). We may summarize Kitcher's argument in four succinct premises and a conclusion:

Kitcher's original argument for Real Realism

1) NEA, the natural epistemic attitude, is undeniably the unreflective epistemic assumption of ordinary life. Since it is an uncontroversial part of ordinary and everyday cognition, it must be accepted by realists and antirealists alike.

2) NOA, the natural ontological attitude of trust in the existence of entities postulated by science, is the basic set of assumptions regarding scientific ontology that are shared between realism and antirealism.

3) The Galilean strategy is the paradigm form of inference from the observable to the unobservable by means of modern scientific instrumentation. It is characteristic of modern science, and must be accepted by anyone committed to the rationality of the scientific enterprise as we know it.

4) The conjunction of NEA, NOA and the Galilean strategy yields a basic form of scientific realism, namely real realism.

Hence:

5) Real realism must be accepted by anyone committed to the rationality of the scientific enterprise as we know it, regardless of further epistemic commitments.

Let me now summarise what I believe to be wrong with this argument. There are two readings of NEA, depending on prior philosophical commitments regarding the notion of representation. Under an objective naturalist reading, NEA turns into NEAR, but under a suitably deflationary reading it turns into NEAN. Once NEA is seen to be ambiguous between these two possibilities, we can also see that the argument above is either unsound or invalid. For only NEAN makes the first premise (1) true, while only NEAR makes the fourth premise (4) true. Hence if we substitute NEAR in place of NEA throughout, the argument turns to be valid but unsound, since premise one is false. And if we substitute NEAN in place of NEA throughout the argument is again valid but unsound, since premise four is now false. So, in either case, real realism does not follow. If by contrast we substitute NEAN into the first premise (1) and NEAR into the fourth premise (4), we obtain a new version of the argument with true premises:

Improved version of Kitcher's argument for Real Realism:

1') NEAN is undeniably the unreflective epistemic assumption of ordinary life. Since it is an uncontroversial part of ordinary and everyday cognition, it must be accepted by realists and antirealists alike.

2) NOA is the basic set of assumptions regarding scientific ontology that are shared between realism and antirealism.

3) The Galilean strategy must be accepted by anyone committed to the rationality of the scientific enterprise as we know it.

4') The conjunction of NEAR, NOA and the Galilean strategy yields a basic form of scientific realism, namely real realism.

On any reading of NEA premises 2) and 3) seem reasonable. That is, Fine's argument for NOA and Kitcher's argument for the Galilean strategy are convincing whether NEAR or NEAN is correct. So the premises of the argument might all well be simultaneously true, and indeed we have been given good reasons to believe them all to be true. The problem is that the improved version of the argument above is invalid as an argument for the desired conclusion 5), because both premises 1) and 4) must be true of the *same* version of NEA in order to yield the conclusion. Hence the improved version of the argument containing only true premises cannot provide genuine rational ammunition in favour of real realism.

7. The Bare View

I have thus disputed Kitcher's *argument* for real realism, but I have not provided any reasons of my own to doubt real realism. It may then be objected that I have not shown real realism to be incorrect, and have certainly not refuted it. However in this final section I would like to briefly point out that a different position is in fact vindicated by Kitcher's argument. This is an epistemological quietism akin to the ontological quietism of NOA, and I claim that it should be particularly attractive from the point of view of pragmatism. [13] Hence in the debate on realism and antirealism as global descriptions of

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[13] And hence might nowadays result more attractive to Kitcher himself, given his recently-found enthusiasm for the pragmatist tradition, and Dewey in particular. His contribution to this volume, for instance, shows that Kitcher's position is nowadays closer than ever to the pragmatism that is shared by NOA and the inferential conception of representation. The exception would seem to remain Kitcher's

science, Kitcher's argument might in the end provide plausibility considerations against adopting any realist commitment towards science, and in favour of a quietist attitude.

In my view Kitcher provides or summarises good and convincing reasons to believe in the truth of premises 2), 3) and 4'). But all the reasons provided for premise 1) are only in fact good and convincing reasons for a different version, namely 1'). Since real realism does not follow from 1'), 2), 3) and 4') Kitcher fails to provide good reasons for *real realism* full stop. The position which he provides good reasons for is instead the correspondingly minimal and deflationary version of real realism, which we can paraphrase as follows: "We thus envisage a world of entities about which we draw more or less accurate inferences, and we suppose that what we identify as our successes signal the appropriateness of some of our inferences". Let us refer to the position expressed by means of this statement as the *bare view*, since it *prima facie* carries no epistemic implications. This view follows from 1'), 2), 3) and a suitably modified version of 4) namely, 4''): 'The conjunction of NEAN, NOA and the Galilean strategy yields the bare view'. It is hard to see how the bare view could be denied by anyone, regardless of their epistemic persuasions. The realist will want to add further commitments relative to the realist relation of models to the world, while the antirealist will wish to add the sort of commitments described by Kitcher as semantic and epistemological empiricism and constructivism.

So the *bare view* is neither realism nor antirealism; it is instead non-realism. It is a view that remains neutral as a description of scientific activity; and thus acceptable to all participants in the epistemic debate. It would seem to be perfectly acceptable to an instrumentalist of Dewey's stripe – see e.g. Fine (2001, pp. 107-122). It is compatible, under the appropriate provisos, with Van Fraassen's constructive empiricism.[14] It is also compatible with the definition of real realism that results from the inflated, realist-leaning conception of representation that I described in section 2. In other words the bare view is a minimal commitment of all scientific epistemologies. But this is only to

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recalcitrant (and, I would argue, redundant) commitment to a correspondence theory of truth – see (Kitcher, 2002).

[14] The provisos are needed to account for the constructive empiricist's denial of premise 3) in Kitcher's argument – since the Galilean strategy in full generality applies to all types of modern instrumentation that allow inference from the observable to the unobservable domain, i.e. to microscopes as well as telescopes.

be expected since the bare view is entirely neutral in the debate between realism and antirealism – it can be, and must be, appropriated by both.

8. Conclusions and Summary

Let me summarise the view defended in this paper. In response to the different varieties of antirealism Kitcher defends a combination of three commitments – ontological, epistemic and methodological – that jointly entail a basic form of realism, *real realism*. The ontological commitment is the *Natural Ontological Attitude*, the methodological commitment is the *Galilean strategy*, while the epistemic commitment is Kitcher's own *Natural Epistemic Attitude* (NEA). At the heart of NEA there is an primitive and unanalysed notion of representation (section 3). Yet, the recent literature on modelling suggests that the notion of representation itself is problematic, or ambiguous (sections 1 and 2). There are both realist-leaning and deflationary conceptions of representation. I have presented two alternative "substantive reductive" theories of representation as exemplars of the more realist-leaning option (section 4); while presenting the details of the inferential conception that I defend as an example of a deflationary conception (section 5). The term "representation" does not figure in either NOA or the Galilean strategy, and consequently the ontological and methodological commitments mentioned above remain invariant under any reading of representation, and should be acceptable to realists and antirealists alike – with due provisos mentioned regarding Van Fraassen's constructive empiricism.

However, the term representation does play a prominent role in the epistemic commitment mentioned above, NEA, as shown in section 3. And as it turns out this commitment is far from invariant under a change of conception of representation (sections 6 and 7); on the contrary, in moving from a realist-leaning to a deflationary conception there is a subtle and important change in NEA. Although there are versions of NEA compatible with both deflationary and substantive reductive conceptions of representation, they differ greatly in some important respects. In particular the differences affect the main argument advanced by Kitcher in favour of real realism. For while the deflationary version of NEA satisfies the requirement that takes NEA to emerge directly from practice, thus keeping neutral between realism and antirealism, it

21

does not yield real realism. By contrast, the substantive reductive version of NEA yields real realism in conjunction with the other two commitments, but it fails to be grounded directly upon practice and is thus not neutral in the realism-antirealism debate, incorporating elements that are decisively biased in favour of realism.

Hence I hope to have shown that Kitcher's argument does not in fact provide reasons for realism, but instead points towards a sort of quietism with respect to the realism-antirealism debate on the nature of science. For only by assuming realism itself can we make the argument do work in favour of realism. The view that results from a neutral standpoint on representation is what I call the *bare view*, which provides no grounds to assert that science aims at truth, nor that it aims at empirical adequacy, nor any other aim. Note that it does not follow that particular scientific inquiries have no aims. As Arthur Fine once ably put it (Fine, 1984) all scientific endeavours have aims – some of them might be aimed at truth, some at empirical adequacy, some others yet at something else. But to reason from "all scientific endeavours have aims" to "there is an aim that all scientific endeavours have" is to incur in a familiar sort of logical fallacy in the order of the quantifiers.

This is a fallacy that the bare view does not commit, since on this view the activity of surrogate inference-drawing is at the heart of all scientific inquiry, but there is no particular aim that *all* inference-drawing is directed towards. The bare view is thus compatible with any endeavour's aims. Hence, despite Kitcher's best efforts, the realism-antirealism issue is not settled, and the debate lives on. This debate is fruitful only when we stick as closely as possible to the details of each and every scientific case, making no particular assumptions about the nature of science as a whole. For each case, the question is open whether instrumentalism or realism is the best interpretation. We can say that all scientific inquiries engage in the activity of surrogate reasoning, but we can not go on to fruitfully make further assumptions regarding the essential aims that *all* different instances of surrogate reasoning in science might have in common. *That* debate – about the essential aims of science – is not to be settled.

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