REPOSITIONING REALISM

Emma Ruttkamp-Bloem

Éditions Kimé | « Philosophia Scientiæ »

2015/1 19-1 | pages 85 à 98

ISSN 1281-2463
DOI 10.4000/philosophiascientiae.1042

Article disponible en ligne à l'adresse :

https://www.cairn.info/revue-philosophia-scientiae-2015-1-page-85.htm

Philosophia Scientiæ

19-1 (2015)
Logic and Philosophy of Science in Nancy (II)

Emma Ruttkamp-Bloem

Repositioning Realism

Référence électronique
Emma Ruttkamp-Bloem, « Repositioning Realism », *Philosophia Scientiæ* [En ligne], 19-1 | 2015, mis en ligne le 10 avril 2015, consulté le 27 avril 2015. URL : http://philosophiascientiae.revues.org/1042 ; DOI : 10.4000/philosophiascientiae.1042

Éditeur : Université Nancy 2
http://philosophiascientiae.revues.org
http://www.revues.org

Document accessible en ligne sur : http://philosophiascientiae.revues.org/1042
Ce document est le fac-similé de l'édition papier.

Repositioning Realism

Emma Ruttkamp-Bloem
Department of Philosophy, University of Pretoria &
Centre for Artificial Intelligence Research, Meraka Institute,
CSIR (South Africa)

Résumé : On présente le « réalisme naturalisé » comme une version du réalisme qui soit plus compatible avec l'histoire des sciences qu'avec les formes explicationnistes ou convergentes de réalisme. On expose son contenu en se référant à quatre thèses : 1) La question de savoir si le réalisme est garanti par rapport à une théorie particulière dépend du type et de la qualité de preuves disponibles pour cette théorie ; 2) La référence est une affaire d'interaction causale avec le monde ; 3) La plus grande partie de la science se situe quelque part entre instrumentalisme et réalisme scientifique, dans un continuum de positions concernant le statut des théories ; 4) Le degré auquel le réalisme est garanti a quelque chose à voir avec le degré auquel les théories réfèrent avec succès, plus qu'avec la vérité des théories.

Abstract: "Naturalised realism" is presented as a version of realism which is more compatible with the history of science than convergent or explanationist forms of realism. The account is unpacked according to four theses : 1) Whether realism is warranted with regards to a particular theory depends on the kind and quality of evidence available for that theory ; 2) Reference is about causal interaction with the world ; 3) Most of science happens somewhere in between instrumentalism and scientific realism on a continuum of stances towards the status of theories ; 4) The degree to which realism is warranted has something to do with the degree to which theories successfully refer, rather than with the truth of theories.

1 Introduction

It is suggested in what follows that realism must be repositioned in order to save it as a viable philosophy of science and thus a new version of realism is

Philosophia Scientiæ, 19(1), 2015, 85–98.

outlined. This "naturalised realism" does more justice to current understanding of the functioning of science and its history than either traditional scientific realism or instrumentalism typically does. Naturalised realism is "fallibilist" in the unique sense that it mimics the self-corrective core of scientific knowledge and its progress. This view may sound like a pessimistic meta-inductivist's dream, but actually this is so only if one views it as a traditional "no-miracles", "explanationist" kind of scientific realism (compare [Ruttkamp 2011]). Rather the naturalised realist suggests that the current (pre-dominantly explanationist) scientific realist debate should be dissolved into a continuum of possible stances towards the status of theories which are based on the quality of evidence available in support of a theory at a given time.

The account of naturalised realism argued for here is unpacked according to four theses: 1) Whether realism or instrumentalism is warranted with regard to a particular theory depends on the kind and quality of evidence available for that theory; 2) Reference is about causal interaction with the world; 3) Most of science happens somewhere in between the extremes represented by instrumentalism and scientific realism on a continuum of stances towards the status of theories; 4) The degree to which realism is warranted has something to do with the degree to which theories successfully refer, rather than with the truth of theories. The conclusion is that realism is alive and well if it can be rescued from the stifling straitjacket of no-miracles imperialism (compare [Mäki 2005]), as Laudan already suggested 3 decades ago [Laudan 1981].

2 Evaluating science on a continuum

The first thesis of the argument for naturalised realism is that whether realism or instrumentalism is warranted with regards to a particular theory depends on the kind and quality of evidence available for that theory. In these terms the realism/instrumentalism debate is a misguided attempt to take a global attitude towards science, when in fact both of these attitudes are reasonable towards different parts of science at different times in the history of science. The naturalised realist dissolves the extremes of this debate into a continuum of stances towards the status of theories. This "continuum" has been artificially cut up into two discrete positions until now, and these positions then applied to the whole of science. Such "out-of-step-ness" with the history of science is not in line with the arguments for naturalised realism offered here, nor even with more traditional ones such as those offered by Boyd [Boyd 1984], Putnam [Putnam 1984], and others during the past 50 years or so.

The point made here is that the real challenge realism faces, rather than focusing on the separate parts/stances making up the continuum, actually has to do with explaining how such a continuum might work *as a continuum*. The naturalised realist accomplishes this by 1) relating possible stances on the continuum to the type and degree of evidence for theories, and 2) introducing a

notion of evolutionary progressiveness. This hangs together with the fallibilist epistemology driving naturalised realism (more on this below).

This highlights the second thesis of the naturalised realist argument—namely that reference is about causal interaction with the world (specifically evidence gathering). The naturalised realist construes realism as a particular kind of causal gathering of evidence, and thus stances on the continuum are determined by the number or proportion of purportedly reference-fixing descriptions that fit the current empirical (observational and experimental) data and accompanying theoretical scaffolding. Defining reference as a kind of causal interaction implies realism is appropriate to the extent that there is this kind of interaction.

Think of an example from geology—it is currently impossible to reach the solid inner core of the earth which is estimated to be 1,370 km deep, but descriptions of it, based on the behavior of seismic waves, make up explanations of the earth's structure. However it still seems more plausible to think of the molten core of the earth as really existing, whereas, jumping to physics, it seems to feel more comfortable to simply believe (for now) that quarks are predictively powerful calculating devices and no more. In other words, stances towards the results of causal interaction possible with the core of the earth differ from stances towards the results of interaction possible with quarks. Thus sometimes the "reference" of theoretical terms is so tenuous that the theory incorporating them may be viewed as no more than a device to comprehend the domain being studied to such a degree that it can be explained or predictions can be made about it.

On the other hand, reference relations may become more complex and more refined, as scientific theories evolve and progress, and scientific descriptions of and explanations for particular domains of nature multiply and strengthen (e.g., the development of a science such as virology has, at least in terms of some viruses, already run the full gamut of instrumentalism through to realism). In these terms a traditional verdict of instrumentalism can never be final, much rather it is an evaluation of a scientific theory that, *at that stage*, portrays weak reference—or even no reference at all. In its turn, on the other end of the spectrum, realist stances sometimes have to be trimmed back to the barest instrumentalism, e.g., in the case of Newtonian science, where Newtonian descriptions of concepts such as absolute space and time turned out to be misguided, however well established they had been for centuries. Thus, considered or evaluated over periods of time, science, via its theories, comes to tell entire stories of series of interlaced interactions with aspects of reality oscillating between instrumentalism and traditional scientific realism.

These interactions are made up of their own series of to-and-fro movements, which are more than Hacking's "interventions" in the sense of manipulating unobservables in certain ways, because they incorporate both the empirical and the theoretical aspects of scientific processes [Hacking 1983]. Actually, if one recalls Suppes' hierarchy of models and theories (and background the-

ories) between the theoretical and experimental level, "interaction" means a constant complex rippling of mutual adapting according to changes at both levels as various parts of networks of theories and models develop through the course of science [Suppes 1989]. And, if this interaction is taken seriously, then it implies acknowledging that most of science happens somewhere in between the extremes of traditional instrumentalism and traditional scientific realism in continuous to-and-fro movements—this is the third thesis of the naturalised realist argument. Consequently, naturalised realism is not about the triumphant announcement of a single theory's truth (or success), but rather is about the unfolding of scientific knowledge in series of theories as the result of constant causal interaction between science and reality.

An objector to this view might say that even the hardest-nosed realist won't believe in the approximate truth of very tentative research outputs, while a hardcore constructive empiricist would refuse to believe in unobservables no matter what evidence came in. But this makes the point argued for here—this is indeed how the debate has been cast until now. The account of realism offered here has something to say about the shift from uncertainty to greater certainty (and sometimes to and fro), whereas traditional realists and constructive empiricists typically don't.

This brings us to the fourth thesis: The implication of the no-miracles argument that science and its success can be explained in two ways only, namely via the truth of scientific explanations, or as a miracle, has "rigged" the "game" in a sense and has cost the realist dearly in the sense that realists were forced to give anti-realists much more than was perhaps necessary. Moreover the naturalised realist does not view truth as the property that makes the calls in the realism debate, but rather depicts truth as a pragmatic non-metaphysical notion which is about establishing evidence for realist claims. Truth is a dynamic and functional notion that is constantly *made evident or revealed by various relations of reference* through the course of investigations of a particular aspect of reality at issue in the history of science.

Thus the degree to which realism is warranted in the first instance has something to do with the degree to which theories successfully refer (not with truth as a static notion)—which, in turn, has to do with the nature and extent of our (evidence gathering) interactions with the world. And in these terms truth is assembled—and disassembled and re-assembled—via relations of reference revealing the truth of aspects of reality under investigation bit by bit, always provisionally and through trial and error. And, *what* precisely it is that can be believed on the grounds of science is evaluated continuously at different intervals of the course of science via a causal-descriptivist theory of reference. In these terms "truth" means "warranted assertability" and how "warranted assertability" is interpreted depends on the fallibilist epistemology within which naturalised realism is suggested (see below).

3 Truth as reference[1]

The naturalised realist believes (with classical realists such as Boyd [Boyd 1984], Devitt [Devitt 1991] and others) that science reveals aspects of an independently existing reality to us. In terms of Psillos' three stances of realism, this is the metaphysical stance of naturalised realism [Psillos 1999]. However, the semantic and epistemic stances are a little bit more complex. The naturalised realist sees the fact that science's revelations happen piecemeal and tentatively and sometimes at different speeds or in different ways as impacting on the semantic and epistemic stances possible for realists in important ways. To see this first consider some examples of scientific processes: 1) Sometimes the same aspect of reality is investigated from within different paradigms, e.g., many scientists worked on different aspects of cathode rays for different reasons from within different frameworks which led to different "discoveries", from X-rays, the existence of radium, the phenomenon of radio-activity, Rutherford's discovery of neutrons and his description of the structure of an atom, through to Bohr's atomic model, and many others; 2) Sometimes different perspectives that remain different can still be informative—phlogiston vs. oxygen, luminiferous ether vs. electromagnetic fields; 3) Sometimes the same notion is refined through years of investigations of the same aspect of reality and related phenomena—e.g., luminiferous ether in all its guises (e.g., see [Whittaker 1951]). The purpose of these examples is to illustrate that 1) the same aspect of reality can be described in myriad ways through the course of scientific history, and that 2) progress does not necessarily or exclusively imply accumulation, and both of these facts impact on the semantic and epistemic stances of a realist account.

More to the point, the goal here is to devise a form of realism that can include, or at least take note of or consider, *all* descriptions or explanations of a certain real system or phenomenon, rather than just acting from the viewpoint of *one* of these. Such descriptions include both refinements of previous descriptions and descriptions of the same aspect of reality under investigation from within different (compatible or incompatible) paradigms. Taken very broadly, science consists of a series of processes in which an aspect of reality is studied according to particular theories (and all their "background baggage") that describe and explain the relevant aspect of reality "adequately" or "successfully" at the time. Then, in time, some theories evolve according to—among other factors not at issue now—changes at the empirical level of science and resultant changes in background theories, which enables them to offer more refined descriptions, conciliations between conflicting evidence, or more detailed explanations of the particular aspect of reality at issue, and so on and so on. Such processes affect a complex network of theories in a specific field of investigation, which are all connected and all impact on each other in the sense that there is growth, revision, change, development, and modification

1. Some aspects of this section have appeared in [Ruttkamp-Bloem 2013].

of different degrees at multiple fronts both at the empirical and the theoretical levels of science. This is how truth is assembled and re-assembled. And, the naturalised realist advocates taking (all) these kinds of networks into account when the status of theories (i.e., a specific stance on the realist continuum) is considered.

Secondly, accumulation is not the only kind of process that guarantees interaction between predecessor and successor theories, since even in cases of "discontinuity" (e.g., phlogiston and oxygen) there is mutual impact. Individual theories that fail to "evolve" or "cannot keep up with" the empirical side of science, shape the networks of theories making up investigation of a certain real system through the course of science, because they point out errors and in that sense "direct" future theory change by indicating necessary adaptations. (This idea is also found in belief revision of the AGM kind, e.g., [Alchourron, Gärdenfors *et al.* 1985], [Gärdenfors 1990].) In order to do justice to the history of science, surely one must understand *why* and *how* scientific theories progress, and not just *that* they do. *To know this depends just as much on the parts of theories that are "adapted" or "rejected" through the course of science than on the parts that are "preserved".* In other words the set of scientific claims representing the "total" knowledge of a real system at a certain time progresses because the available system of knowledge becomes more and more refined as mistakes are corrected and theories are consequently adapted showing that theories that survive are theories that *can accommodate revision.*

And it is this kind of (evolutionary) progressiveness which realism must test and which becomes the criterion for realism as it gives content to assembled truth and the relations of reference revealing assembled truth. Broadly a theory T is "evolutionary progressive" at time t_n iff:

1. it is "empirically (experimentally) adequate" according to experimental practices in the area of investigation at time t_n *in such a way that previous versions of theory* T *at time* t_{n-1} *have been adapted in significant ways* in order to effect this adequacy, AND
2. it is "theoretically adequate" in the sense that *theoretical descriptions made at* t_{n-1} *have been adapted* such that they describe or refer to observable and unobservable entities in the scope of the theory at time t_n.

In this context the different relations of reference underpinning the networks of theories at issue during the course of science offer a mechanism for investigating and fully appreciating the scientific history of interlaced movements relating to the question of more appropriate or adequate levels of adaptation (to instruments, data, anomalies, other theories, etc.)—and thus establishing more appropriate degrees of evidence. The naturalised realist thus views scientific movement not as linear, or converging towards truth, but rather simply as a movement according to current empirical (and theoretical) constraints.

As a last step to understanding the semantic and epistemic stances of the account offered here, briefly consider the fallibilist epistemological framework

from within which this account of realism is suggested. For current purposes, what is notable is that the problem of realism in science is one of the best ways in which to illustrate a solution to the classic problem of fallibilism—namely how to address the implied paradox in speaking of fallible knowledge and justification in one breath. The solution to the paradox lies in interpreting truth in terms of warranted assertability and acknowledging that beliefs are revisable as long as evidence is revisable. But what can be believed and why? Belief depends on the quality and type of available evidence, nothing more and nothing less. Compare the difference between building a puzzle and building a structure with Lego blocks. There is one way to build the puzzle and the outcome is known beforehand. This is not how science works. On the other hand, building a structure with Lego allows for many deviations from the instructions—the same structure can be built with different blocks and the same blocks can be used to build different structures—and one figures all this out as one goes along. This is much closer to how a naturalised realist sees the working of science.

Naturalised realism offers an informed way to "thread a course between the rock of fallibilism and the whirlpool of scepticism" [Lewis 1996, 566] because it at least shares Lewis' [Lewis 1996, 550–551] sentiment that epistemic contextualism must somehow be taken account of when addressing the discomfort one feels in uttering what Rysiew terms concessive knowledge attributions [Rysiew 2001], which are sentences of the form " 'S knows that p, but it is possible that q' (where q entails not-p)" [Dougherty & Rysiew 2009, 123]. In its pure form, epistemic contextualism (e.g., [Schiffer 1996], [Kornblith 2000], [Stanley 2004], [Schaffer 2004], [Weiner 2005], [Greco 2008], [Rysiew 2011]) implies that belief depends on the "knowledge *attributor(s)*' psychology and/or conversational-practical situation" [Rysiew 2001], but for the purposes of the account of realism offered here, this condition is adapted to roughly state that whether or not a statement becomes—or more importantly, remains—a belief depends not on the context within which the statement is made originally so much as on the contexts within which the statement is evaluated through the course of the history of science.

Thus, in terms of the epistemic stance of naturalised realism, realism is about truth as warranted belief and thus about the justification of and evidence for beliefs. Realist beliefs are determined by the context from within which philosophers of science evaluate investigations of one aspect of reality over time. This does not mean that realists can never "be in a position to legitimately claim that science has achieved theoretical truth" [Psillos 1999, xx], but it does mean that the content of realist truth claims—and thus what exactly is assembled as "true" at any time—may change according to other changes in the scaffolding of science—which is perfectly in line with epistemic contextualism [Rysiew 2011]. Scepticism is a possibility only if science is depicted in static terms, and naturalised realists consistently emphasise the dynamic fluidity of science. Meaningless relativism is a possibility only if it is not made clear that belief is dependent on evidence which can be rationally

articulated and made manifest, which is the naturalised realist's view. The claim here is precisely that knowledge claims through the history of science must be constantly evaluated and re-evaluated according to newest empirical (and accompanying theoretical) data. This, in turn, implies that what can rationally be believed are knowledge claims whose revision—or perseverance in the face of changed empirical and background situations—can be made sense of throughout the history of science. In other words, the impact of revisions becomes part of how the processes and progress of science are viewed and, in a sense, the fallibility of science's claims becomes science's greatest strength because science can state its limits of accuracy which surely makes it infinitely more trustworthy than an enterprise that pretends to have no such limits.

Related to this depiction of the epistemic stance, the semantic stance in the naturalised account of realism offered here implies that theories can have truth values, but that these values are never cast in stone. More to the point perhaps, the naturalised realist does not necessarily view semantic claims as existential ones, as she views reference more as an epistemological, than an ontological tool. To see this in more detail, let us consider briefly the account of reference that accompanies naturalised realism. This account is based on Stathis Psillos' causal-descriptivist account of reference [Psillos 1999]. According to Psillos in positing a theoretical entity, some description of fundamental ("kind-constitutive") properties in virtue of which the posited entity plays the causal role attributed to it is usually offered [Psillos 1999, 294–295]. These properties are described in a "core causal description" associated with the term denoting the posited entity. Specifically, Psillos states that: "1. A term t refers to an entity x if and only if x satisfies the core causal description associated with t" [Psillos 1999, 297]. Furthermore he makes it clear that "...referential continuity requires not a mere overlap in properties, but *a substantive continuity* in those properties which explain/ground the causal role attributed to the posited entities" [Psillos 1999, 294]. Thus in terms of continuity through theory change, he suggests that:

> Two terms t and t' denote the same entity if and only if (a) their putative referents play the same causal role with respect to a network of phenomena; and (b) the core causal description of t' takes up the kind-constitutive properties of the core causal description associated with t. [Psillos 1999, 294]

Psilllos is clear that the core causal description of an entity for which referential continuity is stated must remain preserved when the theory within which it is captured changes [Psillos 1999, 295–297]. He writes:

> As their causal give-and-take with the world advances, the posited entity is invested with yet more properties which feature in more detailed explanations of the production of its effects. Insofar as these descriptions are mere additions to, and specifications of, the core causal description, there is no change of reference. [Psillos 1999, 295]

But, what if these descriptions are not just mere additions? Surely in most cases, at some point in the history of a posited entity, there are also revisions, which may already be implied by "specifications". Surely descriptions of the fundamental properties of ether must somehow have been revised through all the depictions of the ether from Maxwell's model, to FitzGerald's through Thomson's, to Larmor's and Lorentz's portrayal of the ether (e.g., [Whittaker 1951, 292 ff.]). If neither the kind-constitutive properties of the causal agent in question, nor the causal role it plays in virtue of these properties, change, to what degree can there really have been theory change and a causal-give-and-take?

The naturalised realist suggests, a discussion of referential continuity makes more sense if the emphasis is on the causal role an entity plays in virtue of an *empirically adapted* core causal description associated with the term denoting the entity. Taking Psillos' example of "luminiferous ether" referring to "electromagnetic field" [Psillos 1999, 296–298], the naturalised realist broadly agrees that the term "electromagnetic field" plays the same causal role as "luminiferous ether" had been posited to play with regards to light phenomena [Psillos 1999, 296], but she does not state that referential stability is the result of these terms playing the same role in virtue of a basically static (in the sense of absorbing refinements) core of kind-constitutive properties which are the causal origin of both "luminiferous ether" and "electromagnetic field". Rather she states that it is the result of the respective putative entities—however they are described by current empirical and experimental work—playing the *same* causal role in virtue of the core set of properties of "luminiferous ether" having been empirically *adapted* such that they are the properties in virtue of which "electromagnetic field" plays the same causal role as "luminiferous ether" was purported to play.

Specifically, the naturalised realist suggests an account of reference according to which a term t "refers" to a posited entity iff it satisfies a "core causal description" (CCD) of "identifying" properties associated with term t such that

1. the CCD in question has been adapted to fit the current experimental situation and thus describes properties currently thought to belong to the postulated entity and
2. the properties in question are such that the posited entity plays its putative causal role in virtue of these properties (i.e., these properties are the causal origin of claims associated with the putative entity).

Note that "identifying" properties are properties that can be described according to the current experimental situation—so "core" properties are properties that have been revised, and are determined by current evidence. Implication: what is "core" can change. What about checking referential stability? This is far less of a frantic issue on this account than traditional insistence on accumulation, because of the fact that realist claims are based on "total" knowledge of an aspect of reality at a given time and thus many more than just one

relation of reference is at issue, and moreover the emphasis in terms of "fixing" reference is on revision rather than on exclusively preserving some kind of property. Reference for the naturalised realist is an epistemic issue and is about tracking the development of knowledge concerning a particular target system, phenomenon or event, rather than about establishing the metaphysical existence of a real system, phenomenon or event. In terms of referential continuity of terms through theory change, the naturalised realist thus suggests that terms t and t' denote "the same" posited entity within the same theoretical system iff

1. both t and t' each respectively satisfies a CCD of properties associated with them that has been adapted to fit the experimental situations in which the theories containing t and t' respectively have been formulated, and;
2. the description of the properties in the CCD of t' has been adapted from the CCD of t, and;
3. the referents of t' and t play the same causal role with respect to a certain set of phenomena in virtue of the properties described in their respective CCD's.

It is necessary to specify that referential continuity should be considered in terms of "theoretical systems", as the unit for naturalised realist appraisal is a network of theories, i.e., the collection of all investigations of a particular target system, phenomenon or event over time. And, in this (broader) context, obviously it may the case that not all descriptions of the same posited entity have been adapted from previous descriptions, as there is the real possibility of incompatible descriptions of the same postulated entity—e.g., Thomson, Lorentz, Bohr, Millikan, et al on the properties of electrons—given that the network of investigations being evaluated may include more than one (in/compatible) theoretical system focused on the particular phenomenon or event at issue (e.g., the phlogiston system of theories vs. the oxygen system of theories). (For now, think of a system of theories as broadly a Kuhnian paradigm in the sense of a disciplinary matrix.) Thus the reference relations of every separate theoretical "genre" or system of theories must all be taken into account when a realist decision is made regarding the epistemic stance towards the content of knowledge concerning a particular real system, phenomenon or event at a given time.

Acknowledging that descriptions of the relevant properties in the core causal descriptions at issue may differ or change allows for the revision of theories and data typical of the course of science; while the fact that the putative causal entities must play the same causal role in virtue of the respective core causal descriptions associated with terms t and t', allows for referential stability. Note that the two core causal descriptions in the case of t and t' do not differ in any random manner, rather they differ on descriptions of properties that have been adapted according to new *current* empirical (and

appropriate background) evidence such that 1) it becomes clearer that it is in fact the entity these properties were and are purported to describe which actually plays the causal role it has been said to play, and 2) the core causal description of the putative entity becomes more accurate. Here is thus a true causal give-and-take in the sense that reference, and thus belief in the theoretical constituents at issue, is based on give-and-take between revision and what is preserved.

In naturalised realist terms, "referential stability" is actually a kind of methodological continuity. The issue is not so much identifying limiting cases of successor theories or the parts of theories that "persevere" through theory change, but rather the possibility of finding methodological continuity via revisions culminating in evolutionary progressive theories, which, *in virtue of their revision*, carry on in continuity with their predecessor theories. The naturalised realist account is the only current account of reference that actually deals with the fact that there is interaction between science and world resulting in revision of aspects of theories at issue in science. All other accounts—including Psillos'—focus on preserving somehow some aspect of theories through theory change, and in those terms, establish referential stability. The naturalised realist suggests discussion of the open-endedness of science makes more sense if one turns away from static kind-constitutive properties to ones adapted according to current experimental constraints, because the emphasis in terms of what "endures" in naturalised realism is not on a core description of *"central" properties* of an entity, but on the causal role an entity plays in virtue of an experimentally adapted core description of properties associated with the term denoting the entity.

This account of reference illustrates that both extremes of the realist continuum and, *most importantly the positions between them* are part of the history of science and must be dealt with by a realist account of science as it allows the full movement from heuristic continuity of terms (e.g., how the demise of phlogiston impacted on the discovery of oxygen) to the (rare) kind of referential stability classical realists would like. In this sense the naturalised realist account implies that those theoretical constituents that in the face of change in type or degree of evidence have been revised to various degrees (or, in the traditional ideal cases, have remained unrevised) can be justifiably believed. The fact that beliefs may have to be rejected at some point, or may become more firmly entrenched, is a matter of history and of the fallibilist nature of human knowledge, nothing more. Moreover as long as "available evidence" is a dynamic notion, revision of belief will be required.

4 Conclusion

This account of realism is called "naturalised", because it mimics the course of science, and continuously establishes or re-evaluates evidence for scientific

knowledge via relations of causal reference. In this sense realism is also, just as science, given the chance to state its limits of accuracy while at the same time there is a sense of consensus on the realist content (compare [Gilbert 1990]) carried by relations of reference establishing a collated view of a given aspect of reality over time. And, the naturalised realist believes it is this kind of action—evaluating, interpreting and re-interpreting the processes of science—which is what realism actually should be about, rather than supporting some idealistic view of theories always getting everything "right".

Thus science can be trusted *because* its theories are challengeable, not because they are invincible (compare [Ruttkamp-Bloem 2013]), and reality is constantly revealed in different guises as a result of science reacting to such challenges. It is concluded that a realism which focuses on science's ability to self-correct as the result of interacting with reality is preferable to one which focuses on convergence to the "truth" as the result of correct or unique representations. In this way realism can—perhaps for the first time—come into its own as an honest evaluation of science and its history because the focus is on following the trials and errors of science rather than on an empty glorification of science.

Bibliography

Alchourron, Carlos, Gärdenfors, Peter, & Makinson, David [1985], On the logic of theory change: Partial meet contraction functions and their associated revision functions, *Journal of Symbolic Logic*, 50, 510–530.

Boyd, Richard [1984], The current status of scientific realism, in: *Scientific Realism*, edited by J. Leplin, Berkeley: University of California Press, 41–82.

Devitt, Michael [1991], *Realism and Truth*, Princeton: Princeton University Press, 2nd edn.

Dougherty, Trent & Rysiew, Patrick [2009], Fallibilism, epistemic possibility, and concessive knowledge attributions, *Philosophy and Phenomenological Research*, 78(1), 123–132, doi:10.1111/j.1933-1592.2008.00234.x.

Gärdenfors, Peter [1990], The dynamic of belief systems: Foundations vs. coherence theories, *Revue Internationale de Philosophie*, 172, 24–46.

Gilbert, Alan [1990], *Democratic Individuality*, Cambridge: Cambridge University Press.

Greco, John [2008], What's wrong with contextualism?, *The Philosophical Quarterly*, 58(232), 416–436, doi:10.1111/j.1467-9213.2008.535.x.

HACKING, Ian [1983], *Representing and Intervening. Introductory Topics in the Philosophy of Natural Science*, Cambridge: Cambridge University Press.

KORNBLITH, Hilary [2000], The contextualist evasion of epistemology, *Philosophical Issues*, 10(1), 24–32, doi:10.1111/j.1758-2237.2000.tb00004.x.

LAUDAN, Larry [1981], A confutation of convergent realism, *Philosophy of Science*, 48, 19–48.

LEWIS, David [1996], Elusive knowledge, *Australasian Journal of Philosophy*, 74(4), 549–567, doi:10.1080/00048409612347521.

MÄKI, Uskali [2005], Reglobalizing realism by going local, or (how) should our formulations of scientific realism be informed about the sciences?, *Erkenntnis*, 63(2), 231–251, doi:10.1007/s10670-005-3227-6.

PSILLOS, Stathis [1999], *Scientific Realism. How Science Tracks Truth*, Boston: Routledge.

PUTNAM, Hilary [1984], What is realism?, in: *Scientific Realism*, edited by J. Leplin, Berkeley: University of California Press, 140–153.

RUTTKAMP, Emma [2011], Interactive realism, *South African Journal of Philosophy*, 30(1), 41–52, doi:10.4314/sajpem.v30i1.64410.

RUTTKAMP-BLOEM, Emma [2013], Re-enchanting realism in debate with Kyle Stanford, *Journal for General Philosophy of Science*, 44(1), 201–224, doi:10.1007/s10838-013-9220-x.

RYSIEW, Patrick [2001], The context-sensitivity of knowledge attributions, *Noûs*, 35(4), 477–514, doi:10.1111/0029-4624.00349.

—— [2011], Epistemic contextualism, in: *The Stanford Encyclopedia of Philosophy*, edited by E.N. Zalta, Winter 2011 edn., URL `http://plato.stanford.edu/archives/win2011/entries/contextualism-epistemology/`.

SCHAFFER, Jonathan [2004], From contextualism to contrastivism, *Philosophical Studies*, 119(1–2), 73–103, doi:10.1023/B:PHIL.0000029351.56460.8c.

SCHIFFER, Stephen [1996], Contextualist solutions to skepticism, *Proceedings of the Aristotelian Society*, 96, 317–333.

STANLEY, Jason [2004], On the linguistic basis for contextualism, *Philosophical Studies*, 119(1–2), 119–146, doi:10.1023/B:PHIL.0000029353.14987.34.

SUPPES, Patrick [1989], *Studies in the Methodology and Foundations of Science, Selected Papers from 1951 to 1969*, vol. Part I, Dordrecht: Reidel.

Weiner, Matthew [2005], Must we know what we say?, *Philosophical Review*, 114(2), 227–251, doi:10.1215/00318108-114-2-227.

Whittaker, Edmund T. [1951], *History of the Theories of Aether and Electricity*, London: Thomas Nelson and Sons, revised edn.