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Role-Player Realism

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Abstract

In practice theoretical terms are open-ended in not being attached to anything completely specific. This raises a problem for scientific realism: If there is no one completely specific kind of thing that might be in the extension of "atom", what is it to claim that atoms exist? A realist's solution is to say that in theoretical contexts of mature atom-theories there are things that play the role of atoms as characterized in that theory-context. The paper closes with a laundry list of problems that this more careful statement of scientific realism still faces.

1. Referential realism. To be a scientific realist is to maintain that things that our mature theories appear to talk about in fact exist. Using atoms as a running example, a realist about atoms claims that atoms are real, that atoms exist.

I want to reexpress this claim in what Carnap called the 'formal mode".[1] To speak in the material mode is simply to make a claim. To make what we take to be the same claim in the formal mode is to cite as correctly applied the linguistic means used in the material mode. So, in the material mode we say that atoms exist. One makes the same claim in the formal mode by saying that the term, "atom", as used in our current mature theories, has a non-empty extension. By *referential realism* about x's I will understand the claim that the term, $\ulcorner x \urcorner$, has a non-empty extension. Referential realism about atoms is expressed by saying that the term "atom" has a non-empty extension. While material and formal mode statements make the same claim, we will see that expression of scientific realism in the formal mode brings certain considerations to our attention that too easily otherwise go unnoticed.

My introduction of referential realism for theoretical terms with the example of "atom" is far from completely general. What we may call general theoretical terms have the form of picking out extensions, terms such as "atom", "electron"," cell", "virus",…. Distinguish these from others – for lack of a better alternative I will refer to these as "singular theoretical terms"– such as "temperature", "chemical potential", "fitness",… that have the form of picking out some property, relation, quantity,…. While the issue of scientific realism arises for all of these terms, there are differences in the treatment for the two sorts, the issue of nominalism for the singular theoretical terms being just one. On the face of it, the issue of referential realism for singular theoretical terms seems straightforward: Temperature is real – there really is a physical quantity of temperature – just in case "temperature" has a referent. There are messy issues here, such as whether physical quantity terms have referents in the sort of way that "Meryl Streep" and "The Eifel Tower" have Meryl Streep and the Eifel Tower as referents. In this paper I will put singular theoretical terms to one side and restrict attention to general

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[1] See, e.g., Carnap (1934, p. 26). Quine also refers to this as "semantic ascent" (1960, p. 271)

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theoretical terms, the ones that a realist will think of as having an extension of concrete objects. I will refer to such terms as theoretical kind terms, and for brevity I will usually take the "theoretical" to be understood. Theoretical kind terms are to be distinguished from natural kind terms, though one expects there to be a lot of overlap. The contrast between theoretical and natural kinds and kind terms also corresponds to two very different notions of "realism" on which I will briefly comment below.

For the moment, keep in mind that "kind term" is short for "theoretical kind term", where the force of "kind" is that the term in question is a general one, such as "atom" and "virus" and that "(theoretical) kind term" is not to be equated with "natural kind term".

2. Determinate and open-ended kind terms. How we understand referential realism will depend on how we understand the function of – in a suitably informal sense, the meaning of – theoretical kind terms. Continuing with atoms and "atom" as our running example, the implications of " 'atom' does/does not have a non-empty extension" depends on how we understand the relation of "atom" to its purported extension. A term such as "atom" cannot be understood as being directly attached to an extension. There must be some mediating considerations in terms of which an extension gets picked out. A general term, such as " atom", when successfully introduced, will have an extension that may be empty, may have just one, or more than one member.[2] Just what is in the extension is determined as a joint product of the meaning of the term and relevant facts about the world – henceforth *environmental conditions*. Since the environmental conditions may have been relevantly different, for a fixed meaning for "atom", the extension may have been different. There may have been more/fewer atoms. There may have been different atoms. So the term, "atom" cannot have been attached directly, in a rigid way, to an extension.

Since the extension of "atom" can change with change in environmental factors, there must be some extension determining characteristic that will pick out different items for the extension in different situations. In this respect the extension of a general term, such as "atom" differs from the referent of a so-called rigidly designating singular term, such as "Meryl Streep".[3] The idea of rigid designation is that a prospective referent is somehow picked out, by ostension, description, or some other means, in a so called baptismal event. Then the term is assigned that referent which the term, in the usage in question, going forward always has. For rigidly designating singular terms, after the baptismal act there is no intervening referent determining characteristic associated with the term that does the work of picking out the referent.

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[2] The following argument does not show the conclusion for all general terms, indeed does not identify just what will count as a "general term". But it suffices that what follows holds broadly for terms such as "atom".

[3] Nothing here turns on the account of rigid designation being correct. I mention the idea in order to draw the relevant contrast with general terms such as "atom".

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In contrast to rigidly designating singular terms, for a terms such as "atom" to have a variable extension there has to be some extension-determining characteristic that governs the term's applicability, a characteristic that some things will satisfy under some environmental circumstances, others things under other circumstances.[4] For our purposes it doesn't matter just what sort of a thing the relevant characteristic is – a condition, a property, a kind… So I'll use the terms "characteristic" and "kind". I will, however, take it to be understood that for any such characteristic and any item (physical object, event, property…) either the item has the characteristic or it does not. No "sort of". So for any such extension-determining characteristic and given environmental considerations the extension will be exactly determined. For each item in the furniture of the world there will be a fact of the matter whether that item is in the extension in question or not.

So far I have spoken of just one condition that functions to determine the extension of a kind term. But the condition might be constituted by a cluster of more specific conditions, none of which are either necessary or sufficient for extension membership. Such are known as "cluster concepts", or when the conditions are characterized in terms of laws, "law-cluster concepts". There are two importantly different ways in which such a cluster could be understood. The cluster could be comprised by a fixed collection of, perhaps, weighted conditions. Or there may be some underlying mechanism that determines just what conditions are in question and how they are organized. This is essentially the same as the original case, with the "condition" in question having a complex structure. So I won't differentiate it from the first alterative. Whether the extension determining characteristic is simple or complex, when it is fixed I will refer to the term in question as a *determinate kind term*.

But the collection of extension determining characteristics might be open-ended. Above I wrote of an extension being picked out by "mediating considerations." Rather than being some fixed simple or complex condition, the mediating considerations could be some collection of conditions that the language user is free to adjust depending on interests, theoretical needs, and the like. When a kind term's mediating considerations are in this way an adjustable collection of conditions I will call the term an *open-ended kind term*.

Here is a little more about how I want to understand the idea of open-ended kind terms and what governs their use. One gets the use of a term such as "atom" by learning a collection of atom-determining considerations. These might be specific properties or other characteristics. They might involve relations to other things. The considerations could concern the role played in some specific theory. We don't need to fix just what sorts of things get into this list. What is crucial is that the collection of considerations isn't fixed. One has some

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[4] For terms such as "atom" this characteristic itself might be attached to the term in analogy to the way that a referent is supposed to be directly attached to a rigid designator. I have examined this way of thinking about kind terms and the source of this idea in the work of Kripke and Putnam in detail in my ().

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latitude with just what to include, how to balance or otherwise combine the considerations. Not a lot of latitude – just a little.

Just how much latitude is allowed? It is crucial for the conception of open-ended kind terms that this is not exactly specified. Instead we provide some guidelines that enable us to answer this question in most concrete situations. The latitude allowed must not be so big as to compromise cooperative communication among users of the same term in the same language community. But within this constraint just how much latitude is allowed can vary with context: objectives, theoretical framing…. When individual fiddling with the details is small enough so that cooperative communicative use is supported, two users of the term will count as using the same concept.

Understanding "same" in "same concept" tells us what we need to know about how much latitude is allowed when a term is open-ended. "Same is not to be understood as numerically identical. Not as coinciding in all properties or in all relations besides spatial-temporal relations. Rather, "same" is to be understood qualitatively, as when we say that you and I drive the same car. There are two cars, yours and mine, parked in two garages. Both are 2014 Honda EX-Ls. These two cars can count as the same even if they are different colors. If the color is irrelevant to current concerns, the two still count as the same. If the color does matter, they are not the same.

What makes an open-ended kind term nonetheless function in successful communication is that the term has a stable use in a language. I want here to contrast "stable" with "fixed". A determinate kind term has a fixed use, fixed in the sense that there is some one characteristic, simple or complex, that once environmental conditions have been set determines the applicability of the term and so its extension. The use of an open-ended kind term is not completely fixed in this way. Instead I will speak of the term as having a stable use. Not just anything will go. The details of just what will go may shift with decisions of individual language users. But the flexibility has limits in the spirit of my illustration with talking of two car's "being the same".

3. Refinement of how referential realism, and its denial, are to be understood. First we must separate issues of how to understand the nature of kinds from that of realism about the subvisible. For the macroscopic one takes there to be no issue of realism about things in the extensions of kind terms, for example realism about cats and dogs and lumps of gold. For the macroscopic we take there only to be the issue of how to understand what are our prima facie natural groupings. In this respect there is an issue that has been called one of realism: Are there *natural* kinds that correspond to our kind terms? The kinds are said to be "real" if they are characteristic of the structure of the world, independently of us, if the terms "carve nature at its joints". They are said to be "not real" if understood as classifications that we impose on nature to suit our interests. (There is, of course, the third option, of the nature of the classification schemes being some kind of joint effort of us and nature.) What follows will have some repercussions for the debate about "realism for natural kinds" as just described. But

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what I will explicitly pursue are the ramifications for realism about the subvisible, often referred to as the "theoretical", understood referentially.[5]

Expressed in the formal mode, the issue is whether terms such as "atom" have a non-empty extension. Expression in the formal mode facilitates seeing that there are two entirely different ways in which atoms could fail to exist. On the first, the term, "atom", is attached to a determinate kind fixing characteristic, but the term is never exemplified. "Magnetic Monopole" might be an example, and in any case illustrates the idea.

On the other hand, suppose that a term such as "atom" has not been attached to any one extension determining characteristic. What one then should say will depend on ones view about kind terms. On a view that might be attributed to Kripke and Putnam, all kind terms are determinate in the sense that each kind term functions by being attached to its own specific extension determining characteristic. The idea is that the kind term gets attached to its extension determining characteristic in analogy to the way that a rigid designator gets attached to its referent.[6] Of course, attachment of a kind term to an extension determining characteristic might fail, in analogy to failure of introduction of a rigid designator by failure to attach it to a referent. On the view under consideration, if fixing a kind term such as "atom" to some extension determining characteristic has failed, there are, by default, no such things of that "kind" – for example no atoms. This isn't a very interesting way for realism about atoms to fail! This conclusion holds under the assumption that the kind term in question is supposed to be a determinate kind term. But if the kind term is open-ended, we have another option, what I will call "role-player realism". Before proceeding I want to have a case to illustrate the ideas.

4. Puzzles about atoms. Just what is supposed to be in the extension of "atom" as this term is used in our contemporary "mature" theories? The atoms of Dalton? Rutherforld? Perrin? Bohr? Contemporary chemists?? Some quantum field theorists insist that there are no particles of any kind![7] Realists claim that at some point in the foregoing progression there was successful attachment of "atom" to a kind of thing – to an extension determining characteristic - that thereafter has remained fixed. Our theories of these things are still - and may forever be

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[5] I will follow the frequent practice of waving the worry about what distinguishes the visible from the subvisible. Ultimately this worry is crucial. That there is no such context independent distinction forces extending the attitude explored here to the visible, something that is also strongly motivated on independent grounds. This facet of the larger view is developed in my (), also briefly introduced at the end of this paper.

[6] Again, detailed discussion and references can be found in my ()

[7] One hears this claim more often in conversation than reading it in print. Hobson (2013) forcefully expresses this attitude, with some further references to the literature. Reutsche, (2011, chs 9-10) provides a very careful and balanced examination of this fraught issue.

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– imperfect, but they are being progressively refined.

This convergence claim fails for "atom". Are ions, such as sodium chloride in solution, atoms? If yes, then we are under pressure to count a bare nucleus as an atom. But then do we count a nucleus as an atom when a free ion, but not when in a – what? – larger atom or molecule? Usually we want to count a nucleus as a part or component of an atom, not as itself an atom. On the other hand, if to be an atom the entity is supposed to have all its electrons, then sodium chloride – with an ionic bond – would not count as composed of atoms. Our usual idea of an atom is that of a nucleus of charge n with exactly n electrons bound to that nucleus. But on this conception, with rare exceptions, only noble gasses are in the extension of "atom". Molecules with ionic bonds are formed from ions, not atoms as characterized just above. In molecules with covalent bonds the electrons are "shared", so gain, not quite the above conception.

I suspect that when one looks at contemporary quantum chemistry the foregoing just scratches the surface.

Plasmas provide another sticking point. A plasma is a material in which electrons have dissociated from all nuclei. Plasmas differ from a collection of ions in having a density sufficient for the charged particles to interact with much more than their nearest neighbors. A volume of a gas at a temperature intermediate between a normal gas and a full plasma will be indeterminate in just what in it is atomic (or molecular) and what is in the plasma state. So the extension of "atom" in a borderline plasma will be indeterminate. But a well-behaved determinate kind term is supposed to have, for given environmental conditions, a determinate extension.

Readers will be impatient with this logic chopping. Clearly all this could be cleared up with a little terminological care. But, with one additional completely uncontroversial premise, this is just the point! The additional assumption is that there are many ways in which these terminologically tangles could be straightened out but that there is no one correct way of doing so. Just how we should talk has some element of personal decision, often guided by theoretical objectives and other interests, what one finds easiest or most convenient to use, all of which will shift from case to case. So we have the punch line: the term "atom" admits the flexibility of use that is exactly what it is to be an open-ended kind term.

Unqualified talk of "atoms" is a simplification. In these respects our *theories* are getting more and more accurate (in ways that we care about), but context independent talk of atoms has to be left behind as a simplification of what we know to be a more complex situation. Unfettered, context independent talk of atoms such as "Atoms are real," " 'Atom' has a non-empty extension," "Hydrogen atoms have one electron," "Water is composed of hydrogen and oxygen atoms," are all simplifications, in different ways and for different reasons, of more complex situations.

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To take stock of our conclusions about atoms and about "atom": The term "atom" is an open-ended kind term. It has not been attached to one specific, user independent extension determining characteristic. As such, "atom", even when environmental conditions are fixed, has no one specific extension. Rather "atom" is a term of art, usable with some flexibility in varying theoretical contexts. Context independent talk of atoms is a simplification, an idealization in a suitably broad sense.

But we have not concluded that there are no atoms!

5. Role-player realism. There is an option not at all ruled out by the foregoing. I have shown that there is no one kind of existent that counts as atoms, that there is no such thing as (always given fixed environmental conditions) *the* extension of "atom". But for all that, individual uses of "atom" may cover existing things. The point can be put in terms of a quantifier ordering distinction: The logically stronger statement fails: There is *one* kind of thing such that every successful[8] use of the term "atom" covers something or things of that kind. But everything said so far is consistent with the logically weaker: For every successful use of the term "atom" there is some thing or things that exist that count as an atom or atoms for that use. For reasons that will quickly become clear, I call the weaker claim, "role-player realism" for atoms.

For each successful use of the term "atom" the use takes place in some specific theoretical context. Role-player realism is the claim that in each such context there are things – existents – that are playing the role of atoms as required or characterized in that theoretical context. Ions in some contexts. Nuclei in others. Certain analyzable parts of molecules in yet others. And so on.

There is a way in which this situation could play out in which referential realism for atoms succeeds. Suppose that in each context of use of the term "atom", the atom role-players are covered for that use by some determinate kind term, or that there are characteristics, different ones for different roles, that could be attached to a determinate kind term even if we haven't formulated terms that have attached to the characteristics in question. In such an eventuality, referential realism for atoms would succeed, albeit in the formulation of the weaker quantifier ordering noted above.

Here is a general statement:

> *Role-Player Realism*: For any open-ended kind term, ⌜x⌝, to say that x's exist is to say that there is some, generally more than one, determinate characteristic, y, that could function as the characteristic for a determinate kind term. There are things with the characteristics, y. And for each successful use of the term, ⌜x⌝, one or

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[8] The insertion here of "successful" is to exclude cases in which, assuming that "atom" is functioning unproblematically, some other mistake has been made, such as asserting that atoms are present in what is fact a plasma.

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more things having one or another of the characteristics, y, are role players for that use of ⌜x⌝·

This role-player realism can be iterated. To illustrate the idea, suppose that cells have configurations of molecules as role players, that molecules have configurations of atoms as role-players, and that atoms have configurations of nuclei and electrons as role-players, Suppose further, for the sake of illustration, that "nucleus" and "electron" are determinate kind terms. Then I will say that nuclei and electrons constitute what I will call a *material basis* for atoms, molecules, and cells, where various configurations of nuclei and electrons are role-players for molecules and various configurations of molecules are role-players for cells. Stated generally (taking the needed "configurations of" to be understood):

Role-Player Realism Iterated: Suppose that we have a sequence of terms, ⌜u⌝, ⌜v⌝, ⌜w⌝, …,⌜x⌝, ⌜y⌝, ⌜z⌝, all of which except ⌜z⌝ are open-ended kind terms, such that v's are role players for u's, w's are role players for v's,…, y's are role players for x's, and z's are role players for y's. Suppose further that ⌜z⌝is a determinate kind term (with a non-empty extension). Then the z's constitute a material basis for all the open-ended kinds that come before

(A yet more complete statement would allow for multiple entries at each level, such as "electron" and "nucleus" at the level of ⌜z⌝ in the foregoing example.)

I need to make one more distinction. Role player realism as I have characterized it works in terms of some ultimate material basis of things that satisfy the conditions of referential realism, that there are, or could be, determinate kind terms attached to specific extension determining characteristics. I will contrast this role-player realism with what I will call *weak role-player realism*: There is no such ultimate material basis comprised by things satisfying the conditions of referential realism. Nonetheless, for each successful use of an open-ended kind term to which weak role-layer realism applies there are things that play the role picked out by that use of the open-ended kind term; things in the sense that each one is a potential referent for some use of a singular term but not in the sense of having any kind-specific material basis. While weak role-player realism has not been ruled out, I take its status to be tenuous at best. The problem is that the role players of weak role-player realism are cut off from any actual or potential theoretical underpinning. With no such underpinning it is hard to see how one would argue for their existence.

6. Is role-player realism correct? Is role-player realism correct? I don't know. I do not here have room to pursue this question in detail. Nor does the answer seem clear to me. But there are grounds for concern.

I am confident that for things larger than molecules there can be no determinate kind terms. In addition to the sorts of problem that we have seen illustrated in the case of atoms, there is the circumstance that such larger things will always have so called "borderline cases"; that is, for any candidate extension determining characteristic there will be cases for which

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there appears to be no fact of the matter whether or not the case falls under the characteristic or not. At least no humanly accessible characteristic. But these characteristics have been understood to be things such that for any candidate, either it falls under the characteristic or not. Consequently, for all things larger than molecules, kind terms will have to be open-ended.

That still leaves the possibility that electrons and nuclei, or smaller things, might provide the material basis for all the rest, which would put role-player realism on a firm foundation. Given the theoretical knowledge that we have at this point, we can chase candidates for an ultimate material basis down only as far as quarks, electrons, other leptons, and various bosons.
But we know that the theory of such creatures – the "standard model" – is itself an idealization, and so its creatures can be expected to be real, at best, in the sense of role-player realism. And it is a nice question what we should say in the circumstance that the "tower of effective field theories" has no top (here better described as no bottom).

If there is an ultimate material basis, it would provide material in an extremely strange sense. We are inclined to think of a material basis in classical terms. But any candidates for a material basis smaller than atoms suffer all the puzzles of "quantum stuff" about which we continue not to know just what to say. Quantum stuff is subject to superposition, to non-localization, to non-locality, and to quantum statistics. Then there are the measurement problem's puzzles about how quantum stuff connects with the more familiar macroscopic. In what way would the foregoing make atoms, molecules, cells and so on real, even in the sense of role-player realism? Also to note: the puzzles of quantum interpretation make the viability of weak role-layer realism especially tenuous. This is because of the requirement of weak role-player realism that the individual role-players be potential referents, and the problems of quantum interpretation make the subject matter of the quantum domain problematic material for individual reference.

All these questions require careful examination.

The puzzles are sufficiently systematic and deep that I feel that it is worth exploring a quite different approach.[9] The world is exceedingly complicated, so much so that the best that we can expect (this side of any currently visible intellectual horizon) is understanding the world in terms of always idealized and often complementary imperfect models. This attitude itself deserves to be considered a kind of scientific realism. When sufficiently accurate and successful, such models *do* inform us about the world. And they do so whether or not any ultimately correct and completely precise and accurate theory is humanly possible, even whether or not thinking in terms of such a Piercean limit even makes sense.

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[9] I have begun to sketch such an alternative in my ()

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(Two references removed for blinding)

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