Referential and Perspectival Realism

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Ronald Giere (2006) has argued that at its best science gives us knowledge only from different "perspectives," but that this knowledge still counts as scientific realism. Others have noted that his "perspectival realism" is in tension with scientific realism as traditionally understood: How can different, even conflicting, perspectives give us what there is *really*? This essay outlines a program (some published, much forthcoming) that makes good on Giere's idea with a fresh understanding of "realism" that eases this tension.

I. AGENDA

This essay addresses two problems in the scientific realism debate. First, Giere (2006) proposes what he calls "perspectival realism." He gives analogies, suggesting that scientific measurement and theory bring us into contact with the world in the kind of way done by visual perspective and colour vision. But he never quite tells us what perspectival realism is. Second, we all recognize that the world is too complicated for us to get its representation exactly right. But I've seen no discussion of ramifications for the referential side of realism. In response to the second issue I will argue that our referential practices, at the level of perception just as much as for theory, function to provide simplifications—or idealizations[1]—of a vastly more complex reality. I will then apply this reconstrual of our referential practices to a fresh understanding of realism along the lines that I think Giere had in mind. This short essay will give only an overview of how the whole project is supposed to work. Details are in other publications and much work in progress.

Contemporary realists agree that even the best of contemporary science is at best "close to the truth." Where, then, is the realism? Laudan put it succinctly:

[1] I will use "idealization" very broadly.

> [A] necessary condition—especially for a realist—for a theory being close to the truth is that its central explanatory terms must genuinely refer. (1981, 33)

This is an attitude reflected in much writing on realism, including some other essays in this collection.

Here is a quick way to Laudan's conclusion: To say that atoms are real is just to say that there are atoms. Restatement in the formal mode gives: To say that atoms are real is just to say that "atom" has a non-empty extension. Thus contemporary scientific realism, in a formulation that I call "referential realism," comprises two parts:

1) Terms in mature scientific theories typically refer.[2]

2) Our theories of these referents are "close to the truth."

Here "referents" is understood broadly to include extensions of predicates, the characteristics that determine extensions, and properties and quantities generally. I will argue that, because the world is too complex, 1) fails. Instrumentalism is no fallback because worldly complexity ensures that reference fails also for the perceptual. What, then, could count as realism? My response will be: All human knowledge is inexact. When our inexact knowledge is deployed with the tools of reference,[3] it merits our interpreting it as knowledge of what there is.[4]

II. Two guiding principles and a practical consideration.

Inaccuracy and imprecision are two forms of representational imperfection. (I use "imprecise" for vagueness in a general sense and in accord with the wide use of "precise" as the antonym of "vague.") For example, consider the statement that John is six feet tall. This can be heard as "John is six feet tall exactly, which is inaccurate (and so strictly speaking false) when John is 5′ 11 1/2″. But the statement can also be heard as "John is six feet tall 'close enough,' " which will count as true when John's height is sufficiently close to six feet that the difference makes no present practical difference. Some terminology: I will use "exact" for "both (completely) accurate and (completely) precise." By an imprecise representation that is free of inaccuracy I understand one that cannot be improved in accuracy

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[2] This is Putnam's wording (1975, 73).

[3] This covers singular terms as having referents, general terms as having extensions, supplemented with quantification and identity.

[4] This is a conclusion that Kantians will embrace with greater comfort than others.

without also making it more precise. I will refer to such representations as "completely accurate within their level of precision."

The imperfections of inaccuracy and imprecision are not independent. Given a sufficiently but not completely accurate representation, we can transform it into one with no inaccuracy by "absorbing" the inaccuracy into imprecision. (John, who is 5′ 11 1/2″, counts as six feet "'close enough.'") Conversely, given an imprecise representation that is completely accurate within its level of precision, if we make it more and more precise, doing our best to retain accuracy, eventually we lose complete accuracy. (You'll never nail a person's height to the nearest nanometer.) Saying that John is six feet "close enough" and that he is six feet exactly are different statements; in particular, the first can be true even though the second is false. But when the false statement that John is six feet exactly will, for present practical purposes, function as a truth, this statement and the statement that John is six feet "close enough" can be used to accomplish the same representational work. In such circumstances I will say that the two statements are "semantic alter egos" (of one another). This summarizes the idea of the duality of the imperfections of inaccuracy and imprecision. It can be expressed as a principle:

> The Principle of Semantic Alter Egos: Inaccuracy and imprecision constitute two exchangeable facets of representational imperfection, and the two members of a semantic alter-ego pair do the same representational work.[5]

In work in progress I apply this principle to the problem of understanding content and truth for imprecise (remember, vague, in a general sense) statements. With the ubiquitous failure of referential realism for which I will argue below, standard referential semantics provides a highly idealized (but still most useful) account of content and truth. My application suggests a less idealized account by understanding content and truth for an imprecise statement in terms of the capacity of a precise semantic alter ego that, though strictly speaking is false, nonetheless functions broadly as a truth as we conventionally understand truth. I will apply this idea in section 6.

Here is a second principle:

> The Complex World Constraint: The world is too complicated (relative to our perceptual and cognitive powers) for us to get representations exactly right.

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[5] In Teller (2017) I develop in considerable detail the ideas that I have here briefly suggested.

With one systematic exception—combinatorial facts, broadly finite mathematics—*all* human knowledge is inexact.

No doubt the world is exceedingly complex. But is it complex in ways that defeat our efforts to attach terms to referents and extensions, the problem that defeats referential realism? That has to be independently argued, in ways outlined below. The Complex World Constraint then functions as a summary and way of understanding how referential realism goes wrong.

The practical consideration begins with the Lewis-Stalnaker notion of conversational presupposition.[6] In practice, participants in a conversation must tacitly agree to treat certain statements as, without qualification, true, and I add, without any imprecision. Conversationalists adopt such presuppositions even when, privately, they have reservations, as long as they are confident that suspected failures in accuracy or precision will make no difference for present conversational purposes. Thinking in terms of such presuppositions applies much more broadly than local conversations. For example, this is a leading idea in Kuhn's notion of a disciplinary matrix, the body of material that a student learns to take for granted when working within a discipline. The idea also applies at the personal level. When confident that cutting corners will make no practical difference, we treat our individual beliefs as exact, providing what I call "personal platforms."

In what follows I apply the foregoing in an argument sketch showing how to interpret as knowledge representation that is inexact yet exact enough broadly to meet our needs, in particular how to understand the idealized use of tools of reference as telling us what there is in the world.

III.   The inexactness of perceptual representation.

I take perceptual states to be representations or constitutively to involve representation. Perception has the marks of representation: Perception carries and facilitates manipulation of information. It has "aboutness," intentionality. Representations can misrepresent—they have correctness conditions. This does not mean that our "percepts" are mental states that we somehow "observe." Rather, perceptual states are themselves, or constitutively involve, representations.[7]

Perception of properties, or their instances, is inexact. To illustrate, our perceptual experience of something being red is as of an object having an intrinsic colour property. The relevant problem is not that red comes in indefinitely many shades. Colour science tells us that, rather than perceptual access to intrinsic colour properties, colour perception is a complex relational affair, involving properties of the perceived object, relations to the

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[6] See Teller (2017, 157-59) for references and more detail.

[7] See Burge (2010, 379-419) for exhaustive arguments.

perceiver, the state of the perceiver, and the state of the environment.[8] So colour representations must be taken either to be imprecise, or insofar as considered to be perception of specific intrinsic property instances, far from completely accurate. Perception of other perceived properties and relations fares similarly.

Likewise there is ubiquitous inexactness of perception as of specific objects—the perceived stone, table, etc. We draw this conclusion already from the familiar sticking point of indeterminate physical and temporal boundaries. Because perceptual representation and correlative language are inexact, these fail to pick out as specific referents any one collection of parts as opposed to many others. In particular, "the table in front of me" and "John" are imprecise, qualitatively, in the same way as is "the middle class." Referential realism fails for ordinary objects of perception.[9]

These conclusions hold with great generality. The sciences of perceptual physiology and psychology show that perception is hardly simple transcription of retinal images. Perceptual access to the world is mediated by an exceedingly complex transduction of input information. In our perceptual apparatus nature has equipped us with mechanisms for building models of the perceived world, mechanisms that compromise between efficiency and getting things precise and accurate enough to meet our practical needs.

IV.   The inexactness of theoretical representation.

Where nature's perceptual apparatus provides us with perceptual models, science provides us with models of the sub- (and super-) perceptual. These, like perceptual models, are ubiquitously inexact. I will sketch reasons for thinking that at the theoretical level tools of reference apply only as idealizations.

For purported referents and extensions of things larger than molecules the problems are essentially the same as for objects of perception. The hardest cases are "electron," "nucleus," and "molecule." The problems arise from the puzzles of superposition and quantum statistics from the quantum domain.

Difficulties begin with cases in which there is no fact of the matter whether, or just when, things are supposed to get into alleged extensions. Consider electron pair creation and annihilation. In the right circumstances a gamma ray will produce an electron and a positron. For an indefinite period quantum theory describes the situation as a superposition of a state with a gamma ray and no electron-positron pair superimposed with a state with

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[8] See Giere (2006, ch. 2).

[9] Ladyman et al (2007, 130) write, "We will argue that objects are pragmatic devices used by agents to orient themselves in regions of spacetime, and to construct approximate representations of the world." They support this in various places in chapters 3 and 4.

an electron-positron pair and no gamma ray. During this (not completely determinate) period there is no fact of the matter of just what electrons (and positrons) there are, and so no completely specific extension for "electron." I call the foregoing "the problem of superpositions for extensions."

Nuclei suffer their own version of this problem. When a nucleus is hit hard enough it will disintegrate. But for a (not completely determinate) period the state is of a superimposed intact and disintegrated nucleus. Molecules likewise succumb. Molecules are formed and destroyed in chemical processes that similarly suffer the problem of superposition.

Some will claim that the theory provides terms, "electron," "nucleus," and "molecule," that attach to characteristics that have instances when the problem of superposition does not apply. But just when the problem applies is itself not completely determinate. Thinking there is such a sharp line is also a simplification.

There is a second kind of difficulty: the alleged instances aren't "things" in any normal sense. I am here arguing against referential realism, namely that terms have non-empty extensions. But the theory of reference calls for extensions with elements over which we can quantify, as when talking about *all* or *some* of the electrons in a box. In turn the theory of reference includes the applicability of identity to the use of quantification, which conflicts with the facts of quantum statistics. Suppose that a were to refer to one electron while b referred to a second: $a \neq b$. If this were right there would be a fact of the matter which terms referred to which electron (already supposing that talk of "which electron" made sense). For example, it would make sense to distinguish the situation in which a is in the right-hand side of a box and b on the left, from that in which we had b on the right and a on the left. But this is just what quantum statistics rules out.[10]

Some will respond: But then the terms will concern (refer to?) "things" in some alternative, broader sense. Let's use a neutral terminology: No question, there are what we might call electron, nuclear, and molecular "phenomena." Such a move leaves it wide open just what kind of an ontology might in fact fall under our idealized theory. Some insist that there are only fields and no particles at all.

Terms for theoretical properties and quantities also fail to have specific extensions. I take this to be amply clear-cut in the life sciences. For example "cell" and "species" are open-ended notions. For the physical sciences the underlying problem is that all the relevant theories are highly idealized. I have made this out in great detail (Teller, forthcoming) for the case of physical quantities such as time, length, mass, velocity, etc. To give a taste of the argument for length: Length is an artifact of an idealized space-time theory

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[10]Teller (2001) gives a more detailed presentation of this argument.

that is assumed as background for quantum theories. But in quantum theories there is no determinate classical distance between two objects or events.

The complexity of the world ensures the failure of our theoretical terms to attach to specific extensions, extension-determining characteristics, and properties and quantities generally. Section 3 concluded that reference likewise fails at the level of perception. This ubiquitous failure of reference has important repercussions for thinking about idealization. To illustrate: In modelling the orbit of Mars one idealizes Mars as a point particle. But that need not mean that "Mars" as it occurs in the model has no referent. Often one will take "Mars" to refer to an extended object that the model then idealizes as a point particle. I urge that, instead, we take "Mars" never to have a referent. If there are physical objects this will be because there are too many objects that could be the referent—exactly which bits of matter get included? Or perhaps our thinking in terms of physical objects is itself a simplification, for example from a field-theoretic point of view. (See the discussion of Eddington's two tables below.) Broadly we think of idealization as simplified characterization of things successfully picked out with the tools of reference. I urge that, instead, the use of the tools of reference is itself an idealization, what I will call "idealized reference." Reference ubiquitously fails, but in ways that I will sketch below we often succeed well enough by treating reference as successful.

I now turn to explaining how inexact representation, in particular idealized reference, when sufficiently successful in guiding us in pursuit of our interests, nonetheless gives us worldly knowledge.

V. Knowledge by inexact representation.

For the moment, put aside the Complex World Constraint. If our representational powers were unlimited there would still be an essential—Kantian—limitation on possible knowledge. We think of representation being, for the most part, representation of things independent of us. Naively we would like to think of a representation of a thing, for example a picture of a table, as something that we could put right up next to the thing represented to see how well they match. But that would be to see how well (our perception of) the picture matches (our perception of) the table. And our perceptions are just more representations! Ultimately, representations can only be compared with other representations. The idea of a "thing in itself" is of a thing apart from any representation of the thing. So a representation of a "thing in itself" is a representation of a thing apart from any representation, which is a contradiction in terms.

How then could perfectly exact representation be understood? Since (representational) comparison with something unrepresented makes no sense, the best surrogate would be a perfect representation, one that could not be

improved in precision, accuracy, or detail, a Peircean "limit of inquiry."

A Peircean limit is also problem-burdened. A perfect representation of the whole world could only be the world itself or a complete duplicate. How about a perfect representation of, for example, just one object and all its intrinsic properties? There are notorious problems in distinguishing intrinsic from relational properties, and however that distinction might be drawn, leaving out an object's substantive relations to the rest of the world leaves its description incomplete. It is also not clear that (a representation of) an ultimate ontology would be in terms of discrete objects. Any neat ontology of discrete referents would be compromised if there are no intrinsic properties or if there are relational properties that do not supervene on the non-relational. Quantum field theoretical considerations compound these difficulties. Most acutely there is Giere's problem.[11] A complete and completely accurate representation of some one object or space-time part of the world would have to represent it as causally isolated. But nothing is completely causally isolated.

Despite these problems I will, as a stepping stone, appeal to the idea of "ultimate" representations that admit of no improvement in precision, accuracy, or detail. While it is doubtful that there could be such representations, the idea does not suffer the internal conceptual incoherence suffered by the idea of a representation of "a thing in itself." I will apply the idea as part of an analogy, a part that will then be discharged. Since it is conceptually coherent, the idea can function in the analogy, and since it will then be discharged, worries about whether there could be such representations won't apply.

The subject of this section is knowledge by imperfect representation. Knowledge requires truth. We can accommodate the requirement of truth if we interpret truth as absence of any inaccuracy. An inexact representation can still count as true (or as accurate without qualification) if it is imprecise but suffers no inaccuracy within its level of precision, that is if it could not be made more accurate without also making it more precise.[12]

Now the analogy: To set things up, put aside the difficulties enumerated so far. You look through spectacles at a table. The spectacles slightly distort with respect to both shape and colour. If things go well, this can still count as perceptual knowledge. If the inaccuracies are irrelevant to any practical

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[11]I learned of this problem from Ronald Giere.

[12]The foregoing is a two-line summary of a much more detailed account of truth of imprecise statements. See Teller (2017). In particular, the requirement of no residual inaccuracy can be relaxed, but this controversial claim plays no role here and so will not be assumed. Yes, since my "imprecision" is a generalized notion of vagueness, what is in question is an approach to truth of vague statements that, as far as I know, is new to the literature. I have work in progress on this idea.

interest for anything that might reasonably be expected as a possible occurrence (henceforth: the representation is adequate in practice), swallow up the inaccuracies in a little imprecision in the representing perceptual state (the shape, the colour as represented "close enough"). Then the case can still respect the requirement of truth in perceptual knowledge, knowledge that there is a chair in front of you, its shape, its colour, etc.

Very broadly, knowledge by inexact representations, propositional as well as analogue,[13] can be understood in terms of this analogy.

Now to sanitize the analogy of its problematic elements:

Step 1: We let go of the spectacles as the source of inexactness. By the Complex World Constraint, inexact representations are the best that we can do. Such inexactness arises in a great many ways. There is nothing special in what follows for distortion by vision through spectacles. So for the spectacles substitute whatever the source of distortion might be.

Step 2: We let go of the table itself as the exemplar of the ultimate target of knowledge. We want a way of understanding how our inexact representations nonetheless provide knowledge of an independent reality. In the analogy we had perceptual knowledge of an independently existing table. But—the Kantian point—representation of a "thing in itself" makes no sense. So we substitute the idea of a representation at the Peircean limit as doing the work of an ultimate target. In the sanitized analogy we have knowledge if departure from the exact target, thus understood, does not matter for anything that might reasonably be expected as a possible occurrence. Again, if you like, reinterpret any residual inaccuracy as imprecision.

Step 3: We let go of the perfect representation as what does the work of the ultimate target. It is doubtful whether there could be any such representation, and even if there were, it is not clear how to understand comparison with an inaccessible perfect representation. Instead we apply a sense in which a representation can be understood as one that could be improved in accuracy and/or precision, to be explicated along the following lines: Representation R_2 is said to be a refinement of representation R_1 iff R_2 is in every respect at least as accurate and precise as R_1 and more so in some respects. "At least as accurate and precise as" in turn can be understood in terms of functioning at least as well in every relevant representational function, that is, as functioning the way one thinks that an exactly true or otherwise exact representation ought to work.[14]

To be discharged in step 3 was: Departure from exact representation

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[13]By an analogue representation I mean one that depends on similarity of form, as with pictures and maps.

[14]So this view, in addition to being deeply Kantian, is also a version of pragmatism, but one with essential differences from more familiar versions. See Teller (2012), section 5.

does not matter for anything considered important for anything that might reasonably be expected as a possible occurrence. For this we substitute: Departure from possible refinements does not matter for anything considered important for anything that might reasonably be expected as a possible occurrence. Thus, we've come to an understanding of what it means to say that an inexact representation is adequate in practice, an understanding that doesn't assume any role for an exact representation.

Pulling all this together: We understand inexact representation as representation that admits of some distortion and/or failure of precise focus. We understand distortion and/or failure of precise focus not in terms of comparison with some ultimate target as perfectly represented, but as admitting of potential improvement, improvement in turn understood in terms of representational functionality. If epistemic requirements for justification are also satisfied, such an inexact representation will still count as knowledge if it is adequate in practice.

VI. Knowledge by imperfect representation and realism.

In section 5 I sketched how imperfect representations can still count as knowledge. Realism in both science and perception is a central case. I have formulated contemporary realism as successful reference. The world is too complicated for reference to succeed. But treating unsuccessful reference as successful nevertheless allows us to function effectively when using imperfect representations in grappling with this complex world. The question now is how the idealization of treating our unsuccessful use of the tools of reference as if they did refer—what I have called "idealized reference"—functions in providing genuine knowledge of the world. Unwinding the analogy of section 5 in reverse illuminates how idealized reference is good enough for knowledge.

Start by understanding a representation as adequate in practice when refinement in accuracy or precision provides no practical improvement for anything that might reasonably be expected to come up. Think of that as: Practically speaking, we can treat this representation as exact, not permitting further refinement. Finally, think of this idealized representation as a representation of an independently existing target, "just as it is," including successful reference to this (purported) target, whether a table, a cell, electrons as a kind, etc. The sanitation of the analogy in section 5 provided a step-by-step explication of the function of such idealized reference.

Now apply this explication, using the Principle of Semantic Alter Egos, to the idealized use of the tools of reference. Start with the use of tools of reference in a practically adequate representation that counts as knowledge. Supposing that as knowledge this representation is true, and so fully accurate within its level of precision, its shortcomings must lie entirely in its imprecision. The corresponding ideal representation, thought of as

representing a target, will count as precise but not fully accurate since, in fact, reference fails. These two representations exhibit compensating imperfections, the tradeoff between imprecision and inaccuracy. So we may take them to constitute semantic alter egos of one another. The Principle of Semantic Alter Egos tells us that the two do the same representational work.[15]

The imprecise representation counted as knowledge, so its precise semantic alter ego, though false since reference in fact fails, nonetheless provides an alternative way of presenting the knowledge embodied by the imprecise representation. In this way the analogy's explication provides a way of seeing how, despite failure of reference strictly speaking, nonetheless use of the tools of reference can function in providing knowledge of the world, a real grip on how things are.

This is not to say that reference succeeds in imprecise statements. We talk of John's height, but there is no such thing as *the* length that is John's height. We talk of the people who make up the middle class, but there is no such thing as *the* collection of people who make up the middle class. Reference fails, period. But the tools of reference nonetheless function in telling us, well enough, how things are. They do this by functioning in precise statements, or statements that are interpreted as precise, that succeed in an idealized way in informing us about the world. The success in question here is the practical success in guiding us through a very wide range of practical considerations.[16] Content and truth for imprecise statements, or statements that we appreciate are imprecise, are then understood in terms of the practical success of their precise semantic alter ego counterparts. Strictly speaking, reference fails also for imprecise statements, as in the two forgoing examples. But the successful function of the tools of reference in imprecise statements is understood in terms of the practical success of the idealized reference in the precise semantic alter egos. This is an application of the general approach to vague statements briefly mentioned in the third paragraph of section 2.

Remember that instrumentalism can provide no alternative, because it presupposes the unavailable reference at the level of perception that was supposed to fill the epistemic gap seen at the level of theory. Realism as successful reference fails. But once we recognize the repercussions of the Complex World Constraint, idealized reference, as explicated with the analogy, is the best realism we can have. And it is realism enough.

The practical consideration has also applied throughout this discussion in our treating referential tools as having referents, even though this is, when we

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[15]Teller (2017) presents much detail on the back and forth between inexact truths and the semantic alter egos that, though false, function as exact truths.

[16]For the connections with pragmatism, again, see Teller (2012), section 5.

are reflective, seen to be a simplification. One naturally supposes that it is, at least in part, because we are almost always working within some common ground or personal platform that we fail to notice that the referential tools that we are using apply, strictly speaking, only in an idealized way.

VII. Perspectival realism.

I have motivated retaining the epithet "realism" for knowledge embodied in idealized reference. Where is the perspectivalism? The quick answer is: in the different, even incompatible, modelling idealizations needed in practice for treatment of different aspects of a broader subject matter. This has little application at the level of perception since nature usually imposes a univocal modelling scheme in our perceptual experience.[17] But in science, the world's complexity requires us to use different modelling schemes—different "perspectives"—to get at different facets of one larger subject matter. This applies broadly, but I'll illustrate how it plays out for reference by revisiting Eddington's two tables.

Many foundational physicists insist that there are no particles, there are only fields.[18] Put yourself in that mindset. How, then, would you understand talk of ordinary objects of perception? Let us use the term "table phenomenon" for the kind of circumstance that we would ordinarily describe by saying that an agent (veridically) sees a table in front of her/himself. In our ordinary description of a table phenomenon we say that there is a table in front of the agent and that the agent perceives the table. We say that the table is a discrete physical object with identity conditions in the sense that it is a factual matter whether or not the table is the same as the one seen yesterday, and the like. On the field-theoretic description, much of this is incorrect.

I reject any suggestion that one of these "perspectives" is correct to the exclusion of the other. Yes, the field-theoretic description is "more accurate," but only in certain respects. Moreover, it has no humanly available applicability for virtually all the things about tables in which we are ordinarily interested. Each perspective provides representations that are adequate in practice for the domains for which they are intended, and our understanding of the world is richer by having both.

One more example will illustrate the point. Most will say that with general relativity we now know that there is no force of gravity, there is only the

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[17]More detailed development will refine this statement. Different visual perspectives, which gave us the ur-metaphor of scientific perspectivalism, provide some wiggle room. Also, contemporary perceptual psychology suggests that different perspectives get built right into individual percepts. See Noë (2006).

[18]See Hobson, (2013), and many further references therein.

curvature of space-time. No! Representations involving gravitational force and space-time curvature are *both* idealizations. By using both we have much richer access to the way things are. It's not just that Newton's gravity makes calculations easier when greater accuracy is not needed. Explanations that instil real understanding are at stake. Think of trying to explain the tides using general relativity.

Idealized use of the tools of reference within different inexact modelling schemes, when adequate in practice, provides a variegated grip on what there is and what it is like.

VIII. Referential and perspectival realism.

Contemporary realists take referential realism to be, in many cases, literally correct. I have argued that reference gives us only idealized access to what there is. When we take the idealization into account we see room for different perspectives. When one or another individual perspective gives representations that are adequate in practice—adequate for the purposes for which each is intended—they tell us how things, in those respects, are. If you like, say redundantly, they tell us how things in those respects are *really*.

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