

Title: Theories of Truth and Consequences for Quantum Theory

Date: Apr 12, 2010 11:00 AM

URL: <http://pirsa.org/10040073>

Abstract: One might have hoped that philosophers had sorted out what $\hat{\sim}$ truth $\hat{\sim}^{\text{TM}}$ is supposed to be by now. After all, Aristotle offered what seems to be a clear and simple characterization in his *Metaphysics*. So perhaps it is surprising (and then again perhaps it isn't), that contemporary philosophers have not settled on a consensus regarding the nature of truth to this day. In fact, the most obvious theory of truth, that truth consists in correspondence to the facts, seems to be steadily waning in popularity in technical circles, replaced instead by a perhaps puzzlingly austere minimalist theory that restricts its characterization of truth to the familiar equivalence schema: $\langle p \rangle$ is true if and only if p . The differences between such deflationary theories and the $\hat{\sim}$ traditional $\hat{\sim}^{\text{TM}}$ correspondence theory of truth, and perhaps even more strikingly between these theories and epistemic theories of truth, call to mind counterpart features in different attitudes about the proper interpretation of quantum mechanics. By reviewing the most striking features of different theories of truth, as well as some of their most difficult objections, we can start to see where different interpretations seem to be reliant on (or at least quite congenial to) particular theories of truth and also where these theories begin to reveal themselves as variously helping and hindering the smooth functioning of different interpretations.

Theories of Truth

Part I: The Lay of the Land

Part II: Relevance to Quantum
Foundations?

Aristotle

TO SAY OF WHAT IS THAT IT IS NOT, OR OF WHAT IS NOT THAT IT IS, IS FALSE, WHILE TO SAY OF WHAT IS THAT IT IS, OR OF WHAT IS NOT THAT IT IS NOT, IS TRUE.

Truth: correspondence, deflationary, or epistemic?

- Accept or lean toward: **correspondence** 473 / 931 (50.8%)
- Accept or lean toward: **deflationary** 231 / 931 (24.8%)
- **Other** 163 / 931 (17.5%)
- Accept or lean toward: **epistemic** 64 / 931 (6.8%)

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The fallout of philosophical commitments

- **Does the language of a given interpretation seem to commit its advocates to an untoward theory of truth?** (Do effects of changing the way interpretations are expressed ripple towards the core of these interpretations?)
- **Is commitment to particular theories of truth another criterion on which the problem of interpreting quantum mechanics can/should be decided?** (If one is already committed to a particular theory of truth, can this be used as a foundation to pick out an interpretation?)
- In general: If we say 'QM is approximately true' what does this mean? Or, if we say that the statement 'The system is in a coherent superposition' is true, to what does this commit us?

For a language L...

- Names ('c1', 'c2', ...)
- One-place function symbols ('f1', 'f2', ...)
- One-place predicates ('p1', 'p2', ...)
- Sequence of objects $s = \langle s_1, s_2, \dots \rangle$ assigned to variables 'x1', 'x2', ... [a formula will then be true relative to the relevant assignment, in this case s)

...Field's Tarski*

Reducing truth...to *other* semantic terms (Field, 1972)

- (A)
 1. ' x_k ' denotes_s s_k .
 2. ' c_k ' denotes_s what it denotes.
 3. $\langle f_k(e) \rangle$ denotes_s an object a iff
 - (i) there is an object b that e denotes_s
 - and (ii) ' f_k ' is fulfilled by $\langle a, b \rangle$.
- (B)
 1. $\langle p_k(e) \rangle$ is true_s iff
 - (i) there is an object a that e denotes_s
 - and (ii) ' p_k ' applies to a .
 2. $\langle \sim e \rangle$ is true_s iff e is not true_s.
 3. $\langle e_1 \wedge e_2 \rangle$ is true_s iff e_1 is true_s and so is e_2 .
 4. $\langle \forall x_k(e) \rangle$ is true_s iff for each sequence s^* that differs from s at the k th place at most, e is true_{s*}.
- (C) A sentence is true iff it is true_s for some (or all) s .

Do we need a theory of truth go beyond these 'mere Lists'?

- It would have been easy for a chemist to have given a 'valence definition' of the following form: $(\forall E)(\forall n)E$ has valence n iff E is potassium and n is +1, or ... or E is sulphur and n is -2) (Field, 1972)
- Does this properly explain 'valence'?
- Does a similar list-like account of truth explain all that needs explaining about that concept?

Epistemic theories

- Pragmatist
- Verificationist
- Coherentist
- ...

William James: truths *pay*

- “The possession of truth, so far from being here an end in itself, is only a preliminary means towards other vital satisfactions. If I am lost in the woods and starved, and find what looks like a cow-path, it is of the utmost importance that I should think of a human habitation at the end of it, for if I do so and follow it, I save myself....I may on another occasion have no use for the house; and then my idea of it, however verifiable, will be practically irrelevant, and had better remain latent. Yet...the advantage of having a general stock of extra truths, of ideas that shall be true of merely possible situations, is obvious.” (James, 1907)

...James continued

- “Truth for us is simply a collective name for verification-processes connected with life, and also pursued because it pays to pursue them. Truth is *made*, just as health, wealth, and strength are made, in the course of experience.”
- “It is only thus that ‘scientific’ ideas, flying as they do beyond common sense, can be said to agree with their realities. It is, as I have already said, *as if* reality were made of ether, atoms or electrons, but we mustn’t think so literally. The term ‘energy’ doesn’t even pretend to stand for anything ‘objective’. It is only a way of measuring the surface of phenomena so as to string their changes on a simple formula.”

Objections

- “If, to avoid disputes about words, we agree to accept the pragmatic definition of the word ‘truth’, we find that the belief that A exists may be ‘true’ even when A does not exist.”
- “Take the question of whether other people exist. It seems perfectly possible to suppose that the hypothesis that they exist will always work, even if they do not in fact exist...Hence the belief that other people exist is, pragmatically, a true belief. But if I am troubled by solipsism, the discovery that a belief in the existence of others is ‘true’ in the pragmatist’s sense is not enough to allay my sense of loneliness...For what I desire is not that the belief in solipsism should be false in the pragmatic sense, but that other people should in fact exist.” (Russell, 1908)

Verificationism

- Truth just is verifiability, there is a verification procedure we could in principle carry out which would yield the answer that the claim in question was verified. “Truth is not, to this view, a fully objective matter, independent of us or our thoughts. Instead, **truth is constrained by our abilities to verify, and is thus constrained by our epistemic situation.**” (SEP) As a result, claims that are in principle unverifiable will be neither true nor false (and thus not support bivalence).
- Note: there are other epistemic theories that focus on e.g. warranted assertability, superassertability, etc...

Coherence

- “The view that the truth of a proposition consists in its being a member of some suitably defined body of other propositions: a body that is consistent, coherent, and possible endowed with other virtues, provided these are not defined in terms of truth.” (ODP)
- Objection: **“What has seemed wrong with this point of view is its refusal to endorse an apparently central feature of our conception of truth, namely the possibility of there being some discrepancy between what really is true and what we will (or should, given all possible evidence) believe to be true.”** (Horwich, 1990)
- Response: “The history of science is replete with highly coherent theories that have turned out to be false, which may suggest that coherence with empirical evidence is a poor guide to truth. [I argue] for a more optimistic conclusion, that coherence of the right kind leads to approximate truth. The right kind is explanatory coherence that involves theories that progressively broaden and deepen over time, where broadening is explanation of new facts and deepening is explanation of why the theory works.” (Thagard, 2007)

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Deflationary theories

- $\langle p \rangle$ is true if and only if p
- “It is worthy of notice that the sentence ‘I smell the scent of violets’ has the same content as the sentence ‘it is true that I smell the scent of violets’. So it seems, then, that **nothing is added** to the thought by my ascribing to it the property of truth.” (Frege, 1918)
- “in fact nothing could be more mundane and less puzzling than the concept of truth” (Horwich, 1990)

Truth is at most a useful linguistic device

- Useful for ascent, descent, blind ascription, and generalizing tasks.
 - 1) from “Luca has pink socks.” get “The sentence ‘Luca has pink socks.’ is true.”
 - 2) from “The sentence ‘Luca has pink socks.’ is true.” get “Luca has pink socks.”
 - 3) “Whatever Luca said was true.”
 - 4) “Everything Luca says is true.”
- Consider the law of excluded middle: Every proposition of the form: <everything is F or not F> is true.
This proposition is equivalent to the (unwieldy because **infinite**) proposition: Everything is red or not red, and happy or not happy, and cheap or not cheap...and so on.

Minimal Theory

- The proposition *that quarks really exist* is true iff quarks really exist, the proposition *that lying is bad* is true iff lying is bad,...and so on. And nothing more about truth need be assumed. The entire conceptual and theoretical role of truth may be explained on this basis...the traditional attempt to discern the essence of truth—to analyze that special quality which all truths supposedly have in common—is just a pseudo-problem based on syntactic overgeneralization. [There is no ‘underlying nature’ to truth.] (Horwich, 1990)

Objections

- A theory of truth should go beyond mere lists (in order that truth may function in explanations)
- The truth conditions of some sentences seem to be best expressed by non-repeating truth conditions.
- **What about partial/approximate truth?** For a deflationist, a theory is partly true if some of its parts are strictly true, and a theory is approximately true if there is some other theory formulable in his language that is strictly true, which the present theory approximates. But...

Aren't QFT and GTR approximately true?

- “...we would like to say there is something right about the theory, but there is not one core piece of it, not even its overall structure in any unambiguous sense of ‘structure,’ that we can point to as the part we actually believe...Showing that we have reason to believe our theories approximately true is a project that requires a correspondence theory; a deflationist cannot so much as formulate the goal in a way that doesn’t immediately make us despair of success...[since there are many ways that GTR might be approximately true] we are forced to generalize; we must say ‘There is some true theory that GTR approximates.’ For a deflationist, the trouble with this is that, for him, a ‘true theory’ must mean a true theory formulable in his language: a deflationist can believe his theory approximately true only if he believes that some theory formulable in his language is strictly true. But none of us believes that, or should...With a correspondence theory of truth...[we can say] that a theory of course resembles some true theory in some unspecified language.” (Leeds, 2007)

NB: on approximate truth

- Why not? $\langle S \rangle$ is approximately true iff approximately S.
- A deflationary-friendly realist argument might be: For a given theory that we believe, if we have good reasons for this belief then by the T-schema, then we have good reasons for believing the theory is true. S disquotionally implies 'S' is true. Would we then argue: Apx there are virtual particles, therefore 'There are virtual particles' is apx true? The premise seems odd. (Leeds, 2007)
- But would this strategy work for (most) other sentences that we would want to call apx true? E.g. Spacetime is approximately flat, therefore 'Spacetime is flat' is apx true.
- But is 'flat' here a mathematical term? If so the above argument mixes physical and mathematical language. Can we do this in an argument involving truth? Aren't many of the propositions we are interested in mixed in this way? Won't this require a non-trivial explanation?

Correlation, Indication Relations etc...

- Do we need 'truth' and 'reference' to explain how language functions and the word-world relations involved? No, we can tell the whole story in terms of indication relations, directivities, supports, façades...
- What notions of 'truth' and 'reference' do we need to say what we want to say? Just those exhausted by the T-sentences and the R-sentences, those employed for linguistic ascent, descent, and generalizing tasks. (Maddy, 2007)

Examples

- “..ancient Japanese would quench a sword by stabbing it into the body of a prisoner! We have here a grisly directivity—part of determining that ‘is a well-made sword’ applied to a given sample involved verifying that it had been ‘plunged into the belly of a noble foe’—whose support is now easy to find: it serves as a satellite for the core directivity ‘quickly lower outer temperature to lock in ferrite grain’.”
- “Some of Priestley’s claims [about phlogiston] correlated with facts about oxygen.” (Maddy, 2007 on Wilson, 2006)

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Correspondence theories

- Extreme naive version: the truth of our thoughts consists in their mirroring raw, unmediated, mind-independent reality
- Modest Correspondence Theory (Marino, 2006) The connections between these five features tie truth to questions in ontology, epistemology, objectivity and justification.
 - Correspondence Platitude: True sentence, statements, and beliefs correspond to the way things are in the world.
 - Cleavage: There is a gap between a sentence and the fact it expresses. As a result, sometimes the worldly conditions that make a sentence true aren't always best expressed by that sentence and there is a non-trivial explanation of the connection between a sentence and the worldly conditions that make it true.
 - Propertyhood: Truth is a property. Different truths must be considered in a connected analysis.
 - **Content-Implication: True sentences, if not true in virtue of form, must be true of something. Thus, sentences whose subject matter we have doubts over can't be both true and taken at face-value. They are either not true, or not assertions at all, or must be reinterpreted to have different content.**
 - Descriptiveness: True statements function descriptively, in ways that can go wrong small-scale and wholesale; when they succeed, we can explain why and how

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Objections

- (For the naïve version): We can't possibly compare our thoughts/sentences/propositions to unconceptualized reality.
- There doesn't seem to be a "single mechanism of reference" grounding all of the various ways that we use truth.
- What is 'correspondence' anyway? What are 'facts' (or does it really help to give a correspondence theory in terms of objects, properties, and relations instead of facts)? Isn't this unnecessarily complicated?
- The problems that correspondence theories purport to explain have nothing to do with truth. (Establishing e.g. 'X exists' is true is only as hard as establishing that X exists.)
- Note: If e.g. moral facts or mathematical objects do not exist in the world, the correspondence theorist seems hard-pressed to call moral or mathematical propositions *true*.

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Is there really a difference?

- Deflationists and correspondence theorists agree that truths do correspond to the facts, but deflationists will insist that truth does not *consist in* this correspondence (and can make use the causal links between bits of world and bits of language to explain our reliability and success in navigating the world)
- Both kinds of theorist may also make use of the T-schema and Tarskian recursion

Other

- Rortian 'pragmatism': We ought to abandon the appearance/reality distinction and the search for the One True Account of How Things Really Are, a God's-Eye-View, or a View from Nowhere. ...We ought to substitute 'solidarity' in place of 'objectivity'.

INTERMISSION

Realism vs. Anti-realism

- **To be a realist, you need not be a correspondence theorist!** “So, even if holding a correspondence theory isn’t the same thing as being a realist, it might seem that realism requires a correspondence theory. But this only follows on the assumption that these two candidates for a theory of truth—correspondence and verificationism—exhaust the field. They do not.” (Maddy, 1990)
- Realism: Our best scientific theories are true
- Realism: Certain objects etc. exist
- Realism?: Answers ontological questions

Realism...

- Realism (Wright, 1992): Modesty and Presumption “It modestly allows that humankind confronts an objective world, something almost entirely not of our making, possessing a host of occasional features which may pass altogether unnoticed by human consciousness and whose innermost nomological secrets may remain forever hidden from us. However, it presumes that we are, by and large and in favorable circumstances, capable of acquiring knowledge of the world and of understanding it. Two sorts of ability are thereby credited to us: the ability to form the right concepts for the classification of genuine, objective features of the world; and the ability to come to know, or at least reasonably to believe, true statements about the world whose expression those concepts make possible...in short, that some true statements which are fully intelligible to use may nevertheless be, as the point is widely expressed, evidence transcendent.”

Stances on truth

- There is a separation between epistemology and ontology (independence of knowledge and reality...leads to skepticism if taken too seriously)
 - truth does not consist in a relation between our beliefs and the world, but is merely a linguistic device (deflationism , realism)
 - truth *consists in* correspondence to the facts (correspondence, realism)
- Truth is a properly epistemic notion (anti-realism or idealism or internal realism...at any rate a denial of modesty)
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Natural Affinities?

- A kind of **Deflationary** Expressivism...
- “‘true’ has no explanatory use, but merely the following uses:
 - (a) an endorsing use
 - (b) a cautionary use, in such remarks as ‘Your belief that S is perfectly justified, but perhaps not true’—reminding ourselves that justification is relative to , and no better than, the belief cited as grounds for S, and that such justification is no guarantee that things will go well if we take S as a ‘rule for action’ (Pierce’s definition of belief)
 - (c) A disquotational use: to say metalinguistic things of the form ‘S is true iff –’.” (Rorty, 1986)
- ...friendly to word-world *correlations* (between say my bets and the outcomes of various measurements) and e.g. **Quantum Bayesianism?**

Bohr

- “. . . a subsequent measurement to a certain degree deprives the information given by a previous measurement of its significance for predicting the future course of the phenomena. Obviously, these facts not only set a limit to the extent of the information obtainable by measurements, but they also set a limit to the meaning which we may attribute to such information. We meet here in a new light the old truth that **in our description of nature the purpose is not to disclose the real essence of the phenomena but only to track down , so far as it is possible, relations between the manifold aspects of our experience.**”
(Bohr, 1934)

Challenges for deflationism?

- Coherent superposition, wave-particle duality: If we are restricted by the principle of bivalence, perhaps there are some things that the deflationist cannot say.
- Indeterminism: “Now it sometimes happens that the underlying information is insufficient: although we do have all the facts designated as relevant by the nature of the proposition in question, those facts aren’t enough; for the prescribed evaluation procedure yields no answer. In that case the proposition’s truth value is indeterminate; otherwise it is determinate.” (Horwich, 1990) We may then say both:
 - <It’s a heap> is true or false
 - <It’s a heap> is not determinately true and not determinately false

Interpretations driven by a correspondence theory of truth?

- Orthodox interpretation
- Bohmian mechanics
- Collapse theories
- Lev Vaidman (SEP, 2002): “The basis for the **correspondence** between the quantum state (the wave function) of the Universe and our experience is the description that physicists give in the framework of standard quantum theory for objects composed of elementary particles.” “The wave function of all particles in the Universe **corresponding** to any particular world will be a product of states of sets of particles **corresponding** to all objects in the world multiplied by the quantum state Φ of all the particles that do not constitute "objects".”

Challenges for correspondence?

- Measurement: If there *is* a special role for measurement or the observer renders “gaining knowledge” and “worldly conditions” coincident, does this violate Cleavage (that there is a gap between a sentence/belief and the fact that it expresses)?

Truth and probability

- “I think of truth as Frank Ramsey thought of probability. He convinced himself, not irrationally, that the concept of probability applies in the first instance to propositional attitudes; it is a measure of degree of belief...A brilliant strategy! (Whether or not it gives a correct analysis of probability.) The concept of probability—or at least degree of belief—unobservable by the agent who has it and by his watchers, linked to an equally theoretical concept of cardinal utility, or subjective evaluation, and both tied to simple preference by the axiomatic structure. Simple preference in turn provides the crucial empirical basis through its manifestations in actual choice behavior.

We should think of a theory of truth for a speaker in the same way we think of a theory of rational decision: both describe structures we can find, with an allowable degree of fitting and fudging, in the behavior of more or less rational creatures gifted with speech. It is in the fitting and fudging that we give content to the undefined concepts of subjective probability and subjective values—belief and desire, as we briefly call them; and, by way of theories like Tarski’s, to the undefined concept of truth.” (Davidson, 1996)