

# WHITHER PERSPECTIVAL SCIENCE?

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**Abstract.** Are scientific laws objective truths that reveal the way the world is, or subjective generalisations that merely reveal a way we happen to see it? I treat this question as turning on the issue: are scientific laws non-perspectival or perspectival? It seems we hope for the first yet find ourselves pulled towards the second. Is there a viable compromise? In this paper I address a particular argument that scientific laws must be non-perspectival because only non-perspectival claims are truth-functional. I first discuss the logical structure of the argument and its possible weak points, specifically the possibility that perspectival claims are truth-functional. I then present John Halpin's Perspectival Best System Account (PBSA) in support of this possibility. It is argued that scientific laws can be satisfactorily understood as perspectival without undermining our sense of their objectivity.

“**S**CIENTIFIC inquiry should result in only non-perspectival facts, while perspectival claims are the province of other (albeit no less important) forms of inquiry.” Call this the non-perspectival thesis (NPT). An argument in putative support of the NPT goes as follows: (1) proper scientific inquiry should result in only truth-functional

claims; (2) only non-perspectival claims are truth-functional; therefore, (3) proper scientific inquiry should result in only non-perspectival claims. While this argument is valid as it stands, one might reasonably question the truth of the premises. I will examine possible criticisms of both premise (1) and premise (2). Against premise (1), it could be asserted that proper scientific inquiry does not have to restrict itself to only truth-functional propositions. Rejecting this criticism, it could still be asserted against premise (2) that either: (A) non-perspectival claims, as well as perspectival claims, are not truth-functional; (B) only perspectival claims are truth-functional; or (C) both non-perspectival and perspectival claims are truth-functional.

Each of these three possibilities, if true, would refute the argument. I will argue that we should reject (A) as its truth would preclude the existence of any truth-functional claims, which seems absurd. Moreover, it seems reasonable to accept that non-perspectival claims are truth-functional. Thus we can reject (B). (C), however, presents a much more interesting and complex challenge. The bulk of the rest of this paper will be used to explicate how (C) can be defended as a legitimate position. I will present John Halpin's (2003) Perspectival Best System Account (PBSA) of scientific laws as a viable way to sustain a robust version of (C) and thus refute the putative NPT.

To begin, (1) might be defended as follows: scientific discourse is a form of human activity that, at the very least, takes itself to be asserting claims which are true or false, in some sense. A scientist asserting a claim about some putative fact in the world is making an assertion which, while possibly false, stakes a claim to some truth-value. Of course, not all assertions made by scientists in the context of scientific discourse will be truth-functional.<sup>2</sup> Notably, the assertion made by a given scientist, or anyone for that matter, "I believe that P", is not truth functional because its truth-value is not uniquely specified by "that P". That is,

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<sup>2</sup>By a truth-function, I simply mean a function that, for every well-formed proposition, gives a unique mapping,  $M: true, false \rightarrow true, false$ . "Well-formed" means, as in classical truth-functional propositional calculus, that every logical connective used in the construction of a proposition (or sentence formula) is truth-functional, with values given by their respective truth-tables.

for a speaker who believes a false P and does not believe a true P, the statement “Speaker X believes that P” will give different truth-values. This means that the operator “X believes” is not truth-functional, unlike the familiar logical connectives: disjunction, conjunction, material implication, negation, etc. It must be emphasised that the basic truth-functionality of a claim does not commit us, necessarily, to semantic realism or any other realist thesis. Those positions, as well as any other anti-realist, nominalist, or deflationary positions, must be motivated on entirely separate grounds.

Nonetheless, it seems reasonable to maintain that, at the end of the day, the propositions that come out of our fundamental scientific theories will be truth-functional. This may not be immediately apparent via the surface grammar of the sentences of the theory. It can, however, be reasonably expected that for every seriously considered physical theory, there is a constructible axiomatisation that will make the truth-functionality explicit. History has shown this to be case: while the initial formulations of special relativity may not have been logically transparent in 1905, much of the immediate follow up work produced a strict axiomatisation of the theory that was explicitly truth-functional.

Of course, not everything that might be considered “science-talk” will likely be truth-functional. This stipulation only refers to the end result of scientific discourse, where the background theoretical structure putatively meets up and implies claims about specific facts true or not true of the world. It is these “contact points” that must have a truth-functional character. This stipulation can be loosened even further by replacing any talk about contact with the world by a specification for model-relative truth-functionality: the “laws” only hold within a given model and truth-functionality is construed as a bijective map between the logical structure of the laws and the conceptual structure of the model. In any given case there are likely many possible unique orderings for this mapping. A more specific interpretation of this will be given with respect to Halpin’s PBSA.

In general, of course, if we believe that any sort of human utterance might be classed as truth-functional, we would naturally include at least the assertions of scientific discourse and other forms of common speak-

ing expressed in the indicative or declarative mood. Rejecting this would leave the interpretation of assertions like “Homo sapiens are bipedal”, “Grass is green”, “Copper has low electrical resistivity”, “Annapolis is the state capital of Maryland”, etc. somewhat mysterious. Counterfactuals pose a slight problem here. They are not, strictly speaking, truth-functional, as a truth-functional conditional with a false antecedent is always true. David Lewis’ possible world semantics gives one way to analyse counterfactuals in science. While the details are mostly outside the scope of a paper this length, related issues will come up in the discussion of Halpin’s PBSA.

Now that we have given reasonable grounds in support of the truth of (1)—that the claims of science are, in fact, truth-functional with the open proviso about counterfactuals—we can move on to (2): are non-perspectival claims the only sort of claims that can be considered truth-functional? As we saw above, this premise may be challenged in three ways: either (A) non-perspectival claims, as well as perspectival claims, are not truth-functional, (B) only perspectival claims are truth-functional, or (C) both non-perspectival and perspectival claims are truth-functional.

It seems that we can reasonably suppose that there are claims that are truth-functional, lest the obvious interpretation of the above example sentences be somehow mistaken. It also seems clear that all claims are either perspectival or non-perspectival: I am hard pressed to see room for a third type of claim. Thus (A), which claims that neither perspectival nor non-perspectival claims are truth-functional, seems false and can be rejected.

Turning to (B), while it is by no means obvious that there are any non-perspectival claims that can be said to be true of the world, it does seem that non-perspectival claims can at least be sensibly expressed. Moreover, while it might be the case that science cannot establish a justified ground for the truth of irreducible non-perspectival claims in general, when we make a non-perspectival claim about the world it seems that what we assert is truth-functional, whether or not we are successful. For example, I might be wrong when I assert that “Silver is a liquid at room temperature”, but the statement itself is still truth-functional. Thus, (B) seems false and can be rejected.

We are left with the possibility that non-perspectival and perspectival claims are both truth-functional. As we have just seen, the truth-functionality of non-perspectival claims is not in itself problematic. Thus, the argument turns on the possibility that perspectival claims are truth-functional as well. To get a full handle on the challenge presented by this possibility we will have to examine exactly what is meant by “perspectival” and whether one can maintain a consistent perspectival position with respect to the central terms of scientific discourse. I take Halpin’s PBSA to be a rigorous attempt to defend exactly that sort of position. The following will be a critical exposition of the main elements of Halpin’s account. While his view is open to challenge, I will argue that it presents a plausible defence of (C) and that we, therefore, have good reason to reject the NPT.

First, a short primer on two-dimensional semantics.<sup>3</sup> Under this general approach to the semantic analysis of linguistic terms, two kinds of meaning are distinguished: extensions and intensions. The *extension* of a singular linguistic term is its direct referent and the extension of a sentence is its classical truth-value. For example, the extension of the sentence, “Barack Obama is the 44<sup>th</sup> President of the U.S.A.” is “true” taken from domain true, false. The *intension* of a singular linguistic term “maps a possible world to the referent of a term in that possible world” and the intension of a sentence is a “function that is true at a possible world if and only if the sentence is true there . . .” (Chalmers 2006 p.1). For example, the intension of “Barack Obama is the 44<sup>th</sup> President of the U.S.A.” is true at all and only those worlds where Barack Obama is the 44<sup>th</sup> President of the U.S.A. Thus, intensions are functions from possible worlds to extensions/truth-values.

While the extension of “The 44<sup>th</sup> President of the U.S.A.” is Barack Obama in our world, the intension of that same designator could be anyone. The intension picks out the person who happens to be the 44<sup>th</sup> President in each possible world and this, assuming that it is not a law of nature that Obama is the 44<sup>th</sup> President, ranges across possible worlds with 44<sup>th</sup> Presidents of the U.S.A. Note that for every intension,

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<sup>3</sup>This short explication will mostly follow Chalmers 2006.

we can ask two distinct questions. First, for any world that we *happen to be in*, we can ask whether the proposition's intension is true in that world. This gives us Chalmers' *primary intension*. Second, for any world that we might be in, we can ask whether the proposition's intension *would* be true in that world. This gives us his *secondary intension*. Roughly, the primary intension picks out the indicative-factual sense of a proposition while the secondary intension picks out its subjunctive-counterfactual sense.<sup>4</sup> With this conceptual apparatus one can illuminate broader questions in the philosophy of language about apriority, counterfactual truth, a posteriori necessity and the like. Lest we get too deep in the weeds, I will pass over most of these issues here.

One more bit of groundwork concerns the theory of possible world semantics. Under this form of analysis, the *modal* nature of a proposition (that is, its necessity, contingency, or possibility) is interpreted as determined by its truth or falsity over a set of possible worlds, where a "possible world" is interpreted merely as a way our actual world could be or could have been.<sup>5</sup> A proposition is *necessary* if it is true in all possible worlds, *contingent* if it is true in some possible worlds and false in others, and *possible* if it is true in at least one possible world.

The last concept necessary before we proceed is the notion of a *centred world*. While there are other characterisations, Chalmers (2006 p. 16) defines a centred world as: "an ordered triple of a possible world along with an individual and a time in that world." A centred world is considered a possible world with a "marked" individual in a particular context making or assessing a claim at a specified time. This definition immediately suggests the notion of a perspective and of the general position of

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<sup>4</sup>This distinction finds its historical roots in Gottlob Frege's *On Sense and Reference* (1892) where, absent any talk of possible worlds, the referent of a proper name is the object it designates and the sense is, roughly, what is expressed by the name or how we refer, whether or not there is actually an object to which we can refer.

<sup>5</sup>Of course one might, depending on the sort of analysis one is performing, interpret "possible world" differently including but not limited to: logically possible, metaphysically possible, nomologically possible, morally possible, etc. The sense most relevant to this paper is the nomologically possible: that is, those possible worlds which are in some sense governed by physical laws which may be different, even radically, from those of our actual world.

Perspectivalism, which Berit Brogaard (2009 p.1) defines as:

a semantic theory according to which the contents of utterances and mental states (perhaps of a particular kind) have a truth-value only relative to a particular perspective (or standard) determined by the context of the speaker, assessor, or bearer of the mental state.

Construing the terms of a given discourse as perspectival thus requires establishing that the contents of that discourse's assertions only have a truth-value relative to some particular features of the context of the utterance. If we extend Chalmers' definition of centred world to include what may be called the *evaluative context*, the intension of a proposition uttered in a perspectival discourse is interpreted as a function from a *centred world* to the extension of that proposition in our actual world. More simply, the primary intension of a proposition, which may be loosely identified with its content as we usually understand the term, is perspectival just in case it only has a truth-value with respect to a centred world.

Thus, I treat a *centred world* as a possible world with a "marked" individual or community making or assessing a claim with an *evaluative context*; where the evaluative context, for scientific discourse, includes the particular language, evaluative criteria, methodological predilections, and the overall culture or attitude of practicing scientists. I then say that a discourse is *perspectival* if the contents of its assertions only take a truth-value relative to this evaluative context. My claim will be that scientific laws, specifically physical laws, are perspectival in precisely this sense.

In contrast, a non-perspectival primary intension can be defined as a function from non-centred possible worlds to truth-values. The standard example that illustrates this and the primary/secondary distinction well is: "water is  $H_2O$ ". The primary intension of "water" is given by some description like "the most prevalent liquid on planet earth". This description, applied across possible worlds, would map the term "water" to any substance in those worlds that fits that description. As the various substances that fit the description might not be  $H_2O$ , the primary intension of "water" is considered modally *contingent*. The secondary

intension of “water”, however, is rigid: it picks out only what substance *in our actual world* we call “water”. This secondary intension of “water” is the same in every possible world and is thus necessary. However, the fact, in our world, that “water is  $H_2O$ ” is not a mere stipulation but an empirical discovery. Thus, this sort of secondary intension can be considered an *a posteriori necessity*. Note that the worlds we consider in analysing “water is  $H_2O$ ” are not centred; i.e. they contain no specification of any individuals making, or assessing the truth of, an utterance at any particular time. This feature will be modified below in our consideration of hypotheses deduced from perspectival laws within a model.

We move now to John Halpin’s Perspectival Best Systems Account (PBSA) of scientific laws. There are many subtleties and complexities to this account. Therefore, I will present a simplified version of his view that focuses on articulating a perspectival view of physical laws that can stand as a challenge to the non-perspectival thesis asserted at the beginning of this paper. Halpin first presents a basic kind of Humean empiricism. Under this view, the world is understood as merely the set of total occurrent facts. Halpin defines “occurrent facts” purely negatively as “non-modal, non-nomic, non-causal, non-dispositional” facts (Halpin 2003, p.139). That is, an empiricist, by his lights, should be skeptical about the truth of any *irreducibly* modal, nomic, causal, or dispositional propositions. These notions are rather a sort of psychological *projection* of “our interests, psychology, or context onto the realm of fundamental fact”. This amounts to the claim that the set of non-occurrent statements (which include physical laws<sup>6</sup>) supervenes on the set of total occurrent facts of this, or relevantly most similar possible,<sup>7</sup> world *given* the “social conventions, speaker and hearer’s interests, and other psychological states that are part of the context of evaluation” (p.140).

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<sup>6</sup>Non-occurrent truths include, importantly, statistical laws or probability statements. They also include anything asserted by science that is not a directly observable phenomenon. For example, while the statement “Particle X moved from A to B in time T” is an occurrent fact, the statement “Particle X, in a field of force, is in a potential gradient and thus will tend to move from A to B in time T” is a non-occurrent fact.

<sup>7</sup>See Lewis 1986. His counterfactual account is spelled out in terms of the occurrent facts of “nearby”, most similar, possible worlds.

Yet science manages to formulate strict modal laws that, taken on their face, purport the truth of facts about the world. Halpin sets himself the challenge of giving an empirical, perspectival account of scientific laws that, nevertheless, respects those laws as objective. Note that, for Halpin, a scientific law is *objective* just in case it is *discoverable*: i.e. under his PBSA, “laws exist (in agreement with Earman), they are “there” to be discovered, are independent of any actual theory, though their reality is relative to perspective” (Halpin 2003 p.163). Thus he rejects views, such as Bas van Fraassen’s, that see laws as hopelessly subjective—that science, rather than discovering facts about such laws, is merely concerned with establishing conventions or consistent fictions or attractive models that are acceptable to the community on shared reasonable grounds.

Physical laws, on the PBSA, are the result of our applying certain methodological principles (e.g. of statistical fit, predictive strength, simplicity, etc.) to the set of occurrent facts. A *best system*, as defined by John Earman, is just that set of laws which give the best systematisation or axiomatisation of all the facts at hand, where *best* means some optimal balance between our evaluative criteria (e.g. trading fit with predictive strength or simplicity). Halpin’s move is to recognise that these principles themselves and the relative merits in a given case of trading one off for another are determined by the perspective, or evaluative context, in which the scientist is embedded; thus, the “Perspectival” in PBSA.

Most of science is concerned with formulating laws, not just for the entire set of actual occurrences that make up the world, but for understanding the mechanisms at work in subsystems of the world. It is for this purpose that science builds models. It is crucial that we account for the relationship between the laws of a theory and the specific deductive consequences those laws have for a given system. While the interpretation of models in science is a large fraught topic we can, for our purposes here, define a theoretical model, understood with respect to standard possible world semantics, as a possible world,  $W^*$ , defined over a subset of possible occurrences of the actual world,  $W$ .

This notion of “possible occurrence”, a modal notion, is cashed out in terms of the laws that we ascribe to  $W$ , laws that include a specification of our evaluative context (i.e. our particular language, evaluative

criteria, methodological predilections and the overall culture or attitude of practicing scientists). We project the laws formulated with respect to  $W$  onto  $W^*$  and employ those laws in specifying its dynamics and giving truth-values to our hypothesis concerning the model. The content of a hypothesis-statement relative to such a model is merely its secondary intention. The truth of such a statement is thus the truth of its secondary intention, considered as an a posteriori necessity, *relative* to a centred world. Under the PBSA, the truth of “water is  $H_2O$ ”, while still an empirical law, is now understood as such with respect to the perspectival context of evaluation.

The set of laws,  $L$ , that we take to be true of  $W$  are, then, the set of sentences that constitute the best system for describing the total set of occurrent facts,  $O$ , where the term “best system” is defined by the set of perspectival criteria,  $C$ , given by the specification of the evaluative context. As a formula:  $O + C \rightarrow L$ . We then form the set of hypotheses,  $H$ , as the set of deductive consequences of  $L$  applied to  $W^*$ :  $L + W^* \rightarrow H$ . These hypotheses will have been deduced from a set of perspectival laws, but can still be falsified by observation.

So far, we have given an argument that physical laws can be understood as essentially perspectival, but *must* they be so understood? Given some qualifications about the specific empiricist metaphysical assumption, I think the answer is yes. For it must be emphasised that the supervenience of the non-occurrent on the occurrent can only hold if we specify a context, or perspective, from which we evaluate the relevant similarities between possible worlds, or between our world and a slightly perturbed possible world. This is true because merely specifying the set of all occurrent facts about a given world  $W$  is consistent with an infinite number of possible counterfactual truths, which are really just laws, about  $W$ . More formally, for every world  $W$  defined as the total set of true occurrent facts,  $O$ , there exists a set  $C$  of counterfactual claims which could be true of  $W$  but are not determined by  $O$ . That is, the complete set of occurrent fact without any specification of perspective will fail to determine the truth-value of truth-functional counterfactual claims, claims which, in scientific discourse, we take to have specifiable truth-values. Thus, if the Humean assumptions about occurrent facts are

correct (and this is a sizable if), *then* physical laws must be necessarily perspectival.

It seems, then, that the brief sketch I've given of Halpin's Perspectival Best System Account provides a plausible counterargument to the non-perspectival thesis that began the paper. His analysis of scientific laws describes them as necessarily perspectival. This, as we have seen, however, does not imply that laws are merely subjective. We construct laws as the best available systematisation of the available occurrent facts. Laws, under this conception, are not seen as the generators of physical phenomenon. Rather, the set of observable physical phenomena determine, given a perspective, a unique set of laws.

The world presents us with a variety of occurrent facts that, in turn, we find can be explained systematically by general laws. What will count as a satisfactory explanation will depend on our evaluative context—i.e. perspective—but it is always open to us to modify our perspective in the search for new explanations. Scientific laws will always bear the mark of their creator, namely ourselves, yet they are, at the same time and in real sense, discoverable.

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