Perspectivism, Concrete and Abstract

Abstract

Perspectivist positions have been proposed in physics, notably in order to address the interpretive difficulties of quantum mechanics. Recently, some versions of perspectivism have also been proposed in general philosophy of science to account for the plurality of scientific practice. Both kinds of views share the rejection of what they metaphorically call the "view from nowhere". However, beyond this superficial similarity, they are very different: while quantum perspectivism entertains a concrete notion of perspective associated with individual agents or systems or concrete contexts, perspectival realism adopts a more abstract notion associated with explanatory aims or conceptual schemes. The aim of this paper is to clarify what is at stake with perspectivism *in general*. The general notion of a perspective, as well as the various attitudes one can entertained towards them, are characterised using the concepts of harmless contradiction and cross-perspectival accessibility. A taxonomy of positions ranging from absolutism to relativism is proposed on this basis. Then the framework is applied to quantum perspectivism and perspectival realism to show its fruitfulness. Finally, I argue that abstract versions of perspectivism are bound to be metaphysically weaker than concrete versions.

1 Two kinds of perspectivism

This paper is an attempt to understand perspectivism *in general*.

Various interpretations of quantum mechanics can be described as perspectival. This includes Relational Quantum Mechanics [1, 2], QBism [3–5], the Perspectival Modal Interpretation [6, 7], as well as pragmatist and neo-Copenhaguen approaches [8–10]. What these interpretations have in common

is that they attempt to solve the interpretive problems of quantum mechanics by introducing some kind of relativity of quantum representations: either relativity to a human agent, to a physical system of reference, to a modelling choice or to an experimental context. They thus reject the idea that quantum mechanical models would describe an absolute and complete "view from nowhere". However, at a more abstract level, they all accept the universal validity of the quantum mechanical framework, which makes this kind of view a priori distinct from radical versions of relativism. Perspectival interpretations have also been considered in special relativity [11] and about the arrow of time [12], and they also take for granted the theoretical framework in which they are expressed. In a first approach, we can thus characterise perspectivism *in general* as an attempt to find a middle way between absolutist realism and radical relativism: siding with relativism when it comes to the rejection of the view from nowhere, but without committing to the same level of incommensurability.

A recent trend in general philosophy of science that has been called *perspectival realism* or *scientific perspectivism* also fits this characterisation (I will use "perspectival realism" in what follows, since the term has become more prominent). It was initially proposed by Ronald Giere [13], and has been developed more recently by Michela Massimi, Sandra Mitchell, Paul Teller, and others [14, 15]. The idea is, again, to warn against the "view from nowhere", and to emphasise that scientific knowledge and representation are situated, but this time in a socio-historical sense of "situated". The kind of relativity that is introduced is relativity to such things as experimental methods, epistemic standards, explanatory aims or conceptual schemes. This approach aims at shedding light on a form of pluralism that would be involved in scientific practice. However, most of these authors claim to be realist: they don't subscribe to any strong incommensurability, and they often emphasise the possibility of integrating various perspectives to achieve more complete representations of reality. So, again, we apparently have some kind of middle way between absolutism and relativism.

On the surface of it, it could seem that these two families of approach, the quantum and the epistemological versions of perspectivism, are congruent (and they have sometimes been associated [16, 17]). However, whereas quantum perspectivism entertains a concrete understanding of perspectives associated with particular spacetime locations, observers or contexts and individual objects, perspectival realism entertains a much more metaphorical notion associated with abstract entities such as conceptual schemes. If any-

thing, the fact that quantum perspectivists accept the universal validity of quantum mechanics, and do not need nor ever attempt to make it relative to a socio-historical context, just like the fact that most perspectival realists explicitly deny the existence of observer-relative facts, should set us thinking that the two positions are not the same. This doesn't mean that they could not be combined and benefit from one another, but such cooperation is certainly not as straightforward as it seems.

In order to move forward and assess the actual congruence and possible combination of these two families of approach, I believe that we should first clarify what is at stake with perspectivism *in general*, and in particular what kind of thing is a perspective, what it means to be a perspectivist, what are the various ways of being one, and what are the typical motivations for it. This will allow us to understand what quantum perspectivism and perspectival realism have in common and where they differ. Then maybe we can start inquiring into whether and how these two families of perspectivism could be articulated. In other words, I believe that what is needed is an analytical framework for understanding perspectivism *in general*.

My aim, in this article, is to sketch such a framework, by analysing the notion of a perspective on the basis of the concepts of *harmless contradiction* and *cross-perspectival accessibility* (section 2), from which one can provide a systematic taxonomy of various attitudes regarding perspectival content and accessibility, ranging from absolutism to relativism, with different versions of perspectivism in between (section 3). I will then explain how it can help analyse quantum perspectivism and perspectival realism in relation to alternative views (section 4). In conclusion, I will briefly draw some consequences concerning the relationship between these two forms of perspectivism, arguing in particular that strong versions of perspectivism make more sense at the concrete level than at the abstract one (section 5).

2 Characterising Perspectives

2.1 Perspectives and perspectival Content

A good starting point in order to get a grip on perspectives is the familiar notion of *visual perspective* from which other notions derive (at least etymologically: "perspective" comes from latin *perspicere* meaning *seeing through*). A visual perspective corresponds to the way something is visually presented

to an observer, and in particular the angle and direction that this observer uses to look at an object. It thus characterises a certain asymmetric relation between an object and a subject representing this object. We can say in this respect that a perspective is *of* a subject (the subject *has* or *adopts* the perspective), and that it is *on* an object. Vehicles of representation, such as pictures, or instruments such as telescopes, *offer* or *provide* a certain perspective on an object to one or more (actual or potential) subjects.

Note that a perspective should not be identified with the content that is viewed from that perspective. For example, I can have a downward perspective on someone from a balcony, which allows me to see the top of her head: in this case, the downward aspect concerns the perspective itself, but the top of the head as I see it is part of the content of my representation. There are many ways of cashing out this notion of content: it can be propositional, mental or pictorial for example. I'm assuming that the notion of perspective can concern any of them. In any case, content is part of a representation: it is generally about some aspect of an object and can be evaluated in terms of truth, accuracy or correspondence to it. The perspective, on the other hand, is better thought of as a relation between the holder of a representation and the world. It isn't part of the representation, but characterises it. Having said that, the whole interest of this notion of perspective is that they supposedly affect, frame or shape the content of our representations in some way. This is what makes this content *perspectival*, and distinct from the content of an hypothetical "view from nowhere".

We can distinguish two different manifestations of the way in which perspective affects content:

Partiality: the subject is only sensitive to some objects, and only to some aspects of these objects (for example, the colour and shape of one of their side), with a given level of grain.

Inconsistency: there can be apparent contradictions between the content from different perspectives.

Perspectival realists often put much emphasis on partiality [see for example ref. 13, p. 35], while it is generally left implicit by quantum perspectivists. As for inconsistency, they also handle it differently, but I think that they share a certain notion of *harmless contradiction*.

What I call a harmless contradiction is a contradiction that is only apparent, but dissolves on scrutiny. This idea is easy to illustrate in the case

of visual perspectives. At the restaurant, I can see my fork being on the left of my plate, but you, sitting in front of me, would see it on the right of it. This is apparently contradictory: the fork cannot be both on the left and on the right of the plate. However, this apparent contradiction can be dissolved by saying that the fork is on the left *relative to my point of view* (from my perspective), and on the right *relative to yours*.

Relativity is often mentioned explicitly by quantum perspectivists. Some perspectival realists also do, for example Giere ("For a perspectivist, truth claims are always relative to a perspective" [13, p. 81]). However, others, such as Massimi, only cite any form of ontological or semantic relativity to actually distance themselves from relativists [14].

What perspectival realists do mention quite often is the idea that a perspective *distorts* its content, in the sense that what is viewed from a perspective does not reflect how the object really is. Examples of this are Giere's discussion of the distortions introduced by map projections [13, p. 79-80], or David Danks [15, ch. 7], arguing that concepts are perspectival in nature because they "do not simply filter information about the world but rather actively influence and transform that information. That is, concepts distort the world" (p. 129). Distortions can concern visual perspectives as well. For example, the image of objects viewed from far away appears smaller than that of closer objects of the same size, or a round shape can appear as an oval from an angle.

Distortions constitute one way of analysing inconsistency. It assumes that some perspectives, the ones that are *not* distorted, offer more faithful representations than others in some respects (which seems to imply that there is a "view from nowhere" that sets the standard after all, even if it is not accessible). Distortions generate potential contradictions between perspectives, but according to perspectival realists, these contradictions can be made harmless (or even play a positive role [15, ch. 7]) once we become aware of the perspectival nature of representation and of the way they distort content. Perspectival realists thus tolerate a form of representational pluralism that sets them apart from absolutists. They often reject metaphysical relativity explicitly, but the pluralism they advocate still points to a form of epistemic relativity where things appear such and such *relative to a perspective* in a way that generates harmless contradictions.

2.2 Relations between perspectives

The notion of harmless contradiction that I take to characterise perspectivism is close to that of *faultless disagreement* that is often taken to be one of the hallmarks of relativism [18]. However, the two are different: harmless contradictions can be quite mundane, as illustrated by our fork and plate example above, and they do not imply an actual disagreement. I believe that what sets apart the perspectivist from the relativist in this respect is a certain notion of accessibility.

Accessibility: it is possible for a subject to know, at least partially, the content of different perspectives without enduring any irreversible conversion that would affect their identity.

Accessibility is an epistemic notion. It is clearly illustrated in the case of visual perspectives by the fact that I *know*, if I see my fork on the left of my plate and if you sit in front of me, that you see it on the right. I have inferential access to part of the content of your visual perspective. I can also move and change my perspective if I want, so as to know by direct experience what one sees from another point of view, without thereby becoming another person. Accessibility is the general idea that a subject can freely navigate between different perspectives by adopting them, comparing their content, or by reliably inferring the content of other perspectives than their own.

Accessibility guarantees the existence of an absolute realm, even assuming that content can be relative to the perspective: maybe the fact that the fork is on the right is relative to your point of view, but if this content is accessible to anyone in principle, then arguably, the higher-order fact that *for you* the fork is on the right is itself an absolute fact. There is no infinite regress of relativity. This can be contrasted with incommensurability theses: cultural relativism, for example, could be the idea that we don't really have access to what members of other cultures "see" (their moral reasons, etc.), at least not without some kind of conversion that would alter our own identity (conversions also being considered one of the hallmarks of relativism [18]). Cultural perspectives, on this view, are *incommensurable*, which can imply genuine disagreements between different cultures.

Many perspectivists explicitly endorse some form of accessibility thesis so as to distance themselves from relativism. This is the case in particular of Massimi's notion of cross-perspectival assessment, whereby "claims must be

assessable from the point of view of other (subsequent or synchronous) scientific perspectives" [14, p. 178]. Giere explicitly rejects incommensurability, claiming that "[c]omparing perspectives and switching from one to another are a normal part of scientific practice" [13, p. 83]. This is also the case of Rovelli's relational quantum mechanics, at least in its more recent developments, with the notion of cross-perspectival links, which guarantees that various perspectives will cohere when they are about the same physical variable. Such links allow subjects to make partial inferences about the content of other perspectives than their own. A "Copernican principle", according to which no epistemic agent ("user of the theory") should be privileged, has been proposed to play a similar role in the context of QBism [19]. All this supports the idea that accessibility is one of the main defining features of perspectivism. And this opens a challenge: how to understand this notion in such a way that perspectivism doesn't collapse into absolutism?

2.3 Attitudes towards perspectives

I take it to be undeniable that there are perspectives associated with representational content. That much is not up for discussion. However, we can have different attitudes towards them. Those attitudes will differ mainly regarding how apparent contradictions are handled, whether (and how) relativity is involved, and how, accordingly, cross-perspectival accessibility is analysed. Our options range from plain absolutism, which denies relativity and trivialises accessibility, to radical relativism, which, on the contrary, assumes relativity but denies all forms of accessibility and of absoluteness. In between can be found various brands of perspectivism. The taxonomy that I propose is the following:

Absolutism (eliminativism about relative content)
: There are no relative facts.

Epistemic Perspectivism (reductionism about relative content)
: Relative facts supervene on (or are grounded in) absolute facts.

Ontic perspectivism (non-reductionism about relative content)
: Relative facts exist on a par with (and possibly ground) absolute facts.

Radical Relativism:
: There are no absolute facts, at least no accessible ones.

When talking about absolute facts, I will be mostly interested in absolute facts to which we have epistemic access, at least in principle. I won't distinguish between views that deny their existence and views that deny that they are ever accessible or cognisable (like Kant's noumena).

Needless to say that these positions can be restricted to a specific domain of discourse, for example visual perspectives (and visual facts), theoretical perspectives (and theoretical facts), or moral perspectives (and moral facts). One can be an absolutist in a domain and a relativist in another. So, what is presented here is only one dimension of perspectivism. Another important dimension that will be analysed later is abstractness: whether the perspectives considered and their objects, and associated domain of discourse, are situated in spacetime or not, or whether they are instance-level or type-level entities. Visual perspectives are situated in spacetime, but theoretical and moral perspectives are not (even if their holders are). However, in the next section, I will focus on the first dimension only and examine the various positions that constitute it in more detail.

Before moving on, let's make a brief terminological remark. The terms "relativism" and "perspectivism" are somehow nebulous. Some might understand relativism in a broader sense than what I am implying here, as referring to any kind of position that involves relative content, and conceive of perspectivism as a moderate version of relativism. Different authors also employ "perspectivism" differently, in a more or less metaphorical way. The fact that the same terms are employed differently by various authors, and that it isn't always clearly defined, is problematic. One of the aims of this paper is to provide a clear terminology that draws systematic distinctions between families of related philosophical positions in various areas of inquiry. It should also match common usage as much as possible, but not at the cost of systematicity. In this respect, I find it more useful to reserve the term "relativism" for the kind of view that denies accessibility in the domain of discourse where one is a relativist, and to associate "perspectivism" with the kind of view that accepts both relativity and in principle accessibility. As we have seen, this fits with many uses of these words, but some authors who self-identify as perspectivists or relativists might not be classified as such in this terminology.

3 A Taxonomy of Positions

3.1 Absolutism

I define absolutism, or eliminativism about relative content, as the idea that there are no relative facts. This entails that the content of representations that is relative to a perspective is either non-existent or non-factive.

The assumption that relative content is non-existent entails that apparent contradictions are never harmless: when two perspectives disagree, this is simply because at least one of them is wrong. Its content is inaccurate, illusory, or, as we have seen, distorted. By contrast, non-factivity is the idea that relative content exists, but doesn't bear on reality at all (it isn't really *content*), and that all perspectives are on a par in this respect. This provides a different way of handling apparent contradictions, by assuming that part of the content viewed from a perspective is artefactual, "merely" pragmatic, or a matter of mode of presentation, and that this explains away these apparent contradictions.

Let's illustrate this difference with theoretical symmetries in physics. Theoretical symmetries relate models that are considered equivalent, for example ones that represent the same system translated in space and time. Such models, when used to represent the same physical system from different viewpoints, generate apparent contradictions, since they attribute different positions to the same objects for example. A first absolutist approach towards symmetries is to consider that one specific perspective (one position assignment) is more faithful to reality than all the others: there is an absolute spacetime with an objective centre and objective directions from which "true" positions can be assigned. This corresponds to the idea that relative content is non-existent. However, it is much more common nowadays to adopt what has been called a *symmetry-to-reality inference* [20]. This is the idea that the quantities that vary by symmetry transformations are non-representational: only the content of our representations that is invariant should be considered factive. In practice, this means adopting coordinate-free formulations of our theories as faithful representations of reality, and considering that position assignments in a coordinate system are *merely* pragmatic, or, as is often say, that they constitute "surplus structure". This illustrates our two absolutist options (we will see perspectivist options later).

In all cases, according to the absolutist, the content that is shared between representations adopting different perspectives (distances between objects in

classical physics, or, at the restaurant, that my fork has four tines and that my plate is full of salad) can be considered factive and accurate.

We can see that absolutism trivialises the notion of accessibility between perspectives. The factive content viewed from other perspectives than my own is readily accessible in so far as it must coincide exactly with the content viewed from my own when they overlap (assuming both are accurate). Content relativity is ultimately discarded, and the focus is on partiality only: every perspective gives us access to part of the "view from nowhere". The latter can be reconstructed by juxtaposing the factive content viewed from all perspectives like a patchwork or jigsaw puzzle. If there is still disagreement between different views, this must be because one is correct and the other is wrong.

There is nothing particularly perspectivist in this kind of view: even the most stringent realist admits that we have partial access to reality, limited discrimination abilities and resources, and that our aims and interests make us focus on some aspects of the world to the detriment of others, so that our factual descriptions must be bounded in scope. Most realists also accept that our best physical theories are incomplete, approximate ("distorted") and probably only effective, since we haven't achieved a theory of everything yet. However, it is important to remember that in order to provide a genuine middle way between absolutism and relativism, perspectivism must distance itself explicitly from such absolutist views, for example by providing an original analysis of distortions. It is not always clear that they succeed, but one way of doing so is epistemic perspectivism.

3.2 Epistemic Perspectivism

Epistemic perspectivism is the idea that part of the content of a representation is in a sense relative to the perspective, which is what generates harmless contradictions between perspectives, but although this content is factive, the corresponding facts supervene on, or are grounded on absolute facts. There is no metaphysical relativity at the fundamental level.

The common way of understanding this grounding relation is the following: what appears as a unary property from a perspective is actually a binary relation between the subject of the perspective, or the instrument or vehicle of representation that provides it, and the object viewed from that perspective (and what appears as a binary relation between two objects is actually a ternary relation involving the subject or instrument, and so on). This is

a form of reductionism about perspectival facts: ultimately, there is an absolute "view from nowhere" that grounds all such facts, even if it is never accessed directly by epistemic agents.

This reinterpretation of perspectival content as relational presupposes that the subjects adopting the perspectives or the contexts, instruments or representational vehicles providing them are full part of the view from nowhere: they can be naturalised, and their relations to their objects as well. In the case of visual perspectives, for example, we could describe our visual apparatus as an element x of reality that interacts with other objects, and interpret "A is on the left of B for x" as a ternary relation between A, B and x. This kind of view is not very far from absolutism, in that relative content, taken at face value, is *somehow* illusory, but instead of being eliminated, it is reinterpreted. In consequence, the way various perspectives can be integrated is a bit more subtle than the mere juxtaposition of factive content described in the previous section. This can provide a finer treatment of distortions.

Here is how this integration works. There is, under this view, a two-way inferential link between relative and absolute facts:

- Relative facts can in principle be *deduced* from absolute facts by "projecting" them on a subject (for example, if the right relation holds between A, B and x, then A is on the left of B for x).
- Absolute facts can be *induced* (or *abduced*) from the relative content of various perspectives by hypothesising something that could generate this relative content by projection.

As an illustration of this two-way inferential link, consider the relationship between a three-dimensional object and various two-dimensional pictures of it taken from different viewpoints: on the one hand, if we had access to the three-dimensional shape, we could project it on any plane we want, so as to deduce what picture could be taken from this viewpoint; on the other hand, all pictures taken from a viewpoint can be integrated so as to reconstruct a hypothetical three-dimensional object that could cause these two-dimensional impressions (something naturally done by our visual apparatus, on the basis of the two slightly different perspectives provided by each of our eyes). This second, abductive process corresponds to the integration of various perspectives.

The epistemic perspectivist can put forth the following narrative: we only have direct epistemic access to relative content; we are inherently bound

to various perspectives; however, it is still possible to have a grasp of the "view from nowhere" (of absolute reality) by integrating the content from various perspectives and speculate about what could cause it. Or to say it differently, perspectival facts are epistemologically prior, while absolute facts are metaphysically prior, but the latter can be inferred from the former. Furthermore, knowledge of absolute facts ultimately provides an access to other perspectives than our own, in the same way as one could infer, by seeing a three-dimensional object from a few different points of view, first, what its *real* three-dimensional constitution is, and then, on this basis, how it must appear from other, yet non accessed points of view. We could say, taking inspiration from Wittgenstein, that perspectives are "epistemic ladders" that can be thrown away once they have been climbed.

Going back to the case of spacetime symmetries, we can illustrate epistemic perspectivism in this way: instead of merely eliminating the content that varies from one perspective to another, we should integrate it in a more subtle way by constructing a synthetic representation of reality that incorporates the observers or instruments and associated reference frames and their relations to the represented object. Then contradictions in, say, position assignments become harmless, because such assignments are understood as being relative to a reference frame associated with a reference system. This relative content can be deduced from the more encompassing representation by projection. In this respect, symmetry transformations are accessibility relations: they give us access to all perspectives (all equivalent models) from any given perspective, but such perspectival representations can be ultimately eliminated in favour of an absolute representation that displays no symmetry at all. This approach, which has attracted authors with structuralist leanings, can lead to radical relationism about spacetime, where spacetime points are entirely eliminated from the ontology in favour of distances between objects: what has been called quotientisation [21, 22].

As we will see later, versions of epistemic perspectivism are quite prominent among perspectival realists. However, quantum perspectivists tend to be more radical in their departure from absolutism.

3.3 Ontic Perspectivism

Ontic perspectivism is the idea that relative content is as much, or maybe even more real than absolute content. At any rate, perspectival facts cannot be reduced to absolute facts. One way of making sense of the view is to refuse

to naturalise subjects or their representational relation to objects. They should not be integrated as mere physical objects or relations on a par with others in an absolute "view from nowhere". In consequence, even if it is absolutely true that A is B for x, strictly speaking, this absolute truth cannot be said to correspond to an absolute fact, because a subject x or the locution "*for* x" (or both) remain unanalysable components of it. However, contrarily to relativism, there still are absolute facts that provide access between various perspectives.

It is quite natural, in this view, to assume that absolute and relative facts are different in nature, with relative facts being more concrete, concerning particulars, and absolute facts being more abstract and general and providing partial inferential bridges between perspectives rather than direct descriptions of what there is. For example one could conceive of absolute facts as quantifying over all actual or potential perspectives in order to express relations between the content that can be viewed from them (the bridges can only be partial, otherwise we would be back to the previous picture, where everything can be deduced from absolute facts). This way of pushing absolute content into the abstract realm is a way of rejecting the existence of a "view from nowhere", at least a concrete one, in line with the slogan of perspectivism.

Just as with epistemic perspectivism, absolute facts could be inferred by induction or abduction from perspectival facts. The main difference is that according to ontic perspectivists, the "ladder" cannot be thrown away, because absolute facts do not exhaust relative facts.

There are various (mutually compatible) ways of understanding the inherent incompleteness of absolute facts. One is to assume that absolute facts are conceptually dependent on perspectival facts because of their abstract nature. They cannot stand alone, because they only make sense relative to potential perspectival facts, as constraining perspectival possibilities for instance, in the same way as laws of nature only make sense relative to pre-defined categorical properties to which they apply. A second way of understanding their incompleteness is to assume that absolute facts provide incomplete information regarding which perspectives are instantiated or not, in the same way as laws of nature only provide partial constraints on what is actually the case, since they do not determine the initial state of the universe. The ontic perspectivist could claim that absolute facts determine all potential perspectives and their content, but that whether a perspective is instantiated or not can only be known by direct experience from said perspective. Finally, one can

understand absolute facts as being incomplete in that the content of other perspectives, even knowing that they are instantiated, can only be known partially (probabilistically perhaps), in the same way that indeterministic laws do not determine how a given system will evolve. In all cases, a good heuristic is to think of the relation between absolute and perspectival facts as analogous to the relation between laws of nature and what is actually the case: the former do not exhaust the latter.

Whether in the other direction perspectival facts exhaust or ground absolute facts is an interesting question, but it will not be addressed here (the idea could be that absolute facts are just facts about the distribution of perspectival facts, or patterns in a mosaic of perspectival facts: a transposition of the best system analysis of laws to ontic perspectivism).

A typical motivation for being an ontic perspectivist is the idea that perspectival content would be indispensable, either pragmatically, semantically or conceptually, and that attempting to reduce it to absolute facts is problematic or leads to an infinite regress. This is exemplified by Putnam's model-theoretical argument against metaphysical realism [23]. To simplify a bit, Putnam argues that there is always something missing if we want to fix the intended target of a set of axioms (what they are about) by merely putting in more axioms. The conclusion of the argument is that we should be "internal realists", and take our representations to be relative to our conceptual schemes: relative content cannot be reduced. Similar arguments have been mounted against radical structuralist views [24].

Another illuminating case is the literature on essential indexicality. Indexical terms, such as "I", "you", "now" and "here", generate harmless contradictions. For example, if I say "I am hungry", and you say "I'm not hungry", or if I say "Julia isn't tired now" and then a bit later "Julia is tired now", there seem to be a contradiction in content, but there is none, because "I" and "now" refer to two different people and instants in each occurrence. On one view, such content can be entirely translated into non-indexical content without loss [25], which corresponds to either absolutism (if the difference is one of mode of presentation) or epistemic perspectivism (if it is reinterpreted in terms of relation to a context). However, others have argued that there are irreducible centred beliefs that play an indispensable role, in particular when it comes to motivation to act [26–28]. Imagine that I am given a full qualitative description of someone at a particular time, and that I know that this person must stop working because a meeting starts very soon. I'm still missing something and I'm still unmotivated to act in consequence if I do

not know the purely non-qualitative fact that this person is *me*, *now*. This indispensability of centred beliefs would indicate that the relative facts they express are not entirely reducible to absolute facts. This kind of view corresponds to an ontic perspectivism, where other perspectives than our own are partly accessible (by translating "I" into "you" or "the speaker"), but still irreducible. All this is related to arguments in philosophy of mind against physicalism putting forth the non-reducibility of the "first-person perspective" to physical facts [29].

Similar argumentative strategies based on indispensability can be deployed to defend an ontic perspectivist approach towards symmetries and reference frames that would refuse to eliminate or reduce the corresponding "surplus structure" [30, 31], or, as we will see, in favour of perspectivism in the context of quantum mechanics. But as far as I can tell, this kind of view and associated arguments are absent from the literature on perspectival realism.

3.4 Relativism

To finish our review of the positions of the taxonomy, relativism is the view that there are no absolute facts, or that they are forever unknowable, that there is no real accessibility between various perspectives, that changing one's perspective is either impossible or requires an irreversible conversion that prevents from really comparing perspectives, and so on, at least in a domain of discourse. This generally concerns abstract perspectives, such as conceptual schemes or moral values. When it comes to concrete perspectives associated with agents situated in spacetime, relativism roughly amounts to solipsism.

We can understand in which sense perspectivism provides a middle way between realism and relativism. However, just as some perspectival realists sometimes struggle to distance themselves from absolutism, it should be noted that there are regular charges against relational quantum mechanics or QBism to the effect that they would lead to a problematic solipsism. Our taxonomy makes clear what they need to assume to avoid this, namely cross-perspectival accessibility.

4 Concrete and Abstract Perspectivism

4.1 Quantum Perspectivism

In this section, I will apply the framework developed in the previous section to our two main cases: quantum perspectivism and perspectival realism, dividing the latter into two levels. My aim is to illustrate the usefulness of the framework, as well as shed light on these positions, and on an important difference between them that lies in the abstractness or concreteness of the notion of perspective involved.

In order to apply our framework, we should first identify inconsistencies between different representations, and then consider various possible treatments of these inconsistencies, from absolutism to relativism.

The cases that are typically invoked in order to motivate quantum perspectivism are Wigner's friend scenarios, where two agents hold apparently incompatible representations of the same system: one agent who just measured the system would describe it in a determinate state for the measured quantity, while the other would consider the same system entangled with the first agent, and view it in a superposition of states for the same quantity. It must be assumed that the second agent can "undo" the measurement of the first agent (which in effect removes any track of the measurement outcome, including in the agent's memory) and then measure something else on the same system. If so, then, for this second agent, to assume that the quantity measured by the first agent was determinate and to attribute well-defined probabilities to its possible values leads, together with textbook quantum mechanics, to contradictions. So, we have inconsistency, and also cross-perspectival accessibility: it is built into the case that Wigner *knows* that his friend represents the system as having a determinate value for the measured quantity. However, apart when agents decide to measure the same quantity, this accessibility is only partial, because the value that is obtained by the first agent can only be known probabilistically.

Wigner's friend thought experiment is in some sense an exacerbation of the measurement problem. It has recently been combined with Bell-type settings to argue directly against the absoluteness of measurement outcomes. No-go theorems have been demonstrated that imply that the only way to resolve inconsistencies without giving up on an intuitive notion of local agency (weaker than Bell-type locality) is to make measurement outcomes relative to the agent [see 32 for a review].

Note that what is relative here is not the value of a given quantity, but the *determinateness* of this quantity. What the second agent cannot do without contradiction is assume that some quantity has a determinate value, even unknown to her. Partiality and inconsistency, the two main features of perspectives mentioned in the first section, are therefore linked in an interesting way: representations are inconsistent *insofar as* they are partial, that is, insofar as some quantity can fail to have any determinate value in some perspectives while having one in others (which is not the same as having different values in each).

There is much leeway in how to frame a perspectival interpretation of quantum mechanics in relation to the theoretical framework, and in particular in deciding which representational structures (quantum states, eigenvalues, etc.) should be considered relative, and what they represent (continuous states, events, etc.). In order to bypass these interpretive choices as much as possible, I shall focus exclusively on measurement outcomes. We have seen that they play a central role in extended Wigner's friend scenarios, and they are considered relative or perspectival by most if not all quantum perspectivists (explicitly in [1, 6, 9]; ref. [5] identifies them with agent experiences).

Applying our taxonomy from the previous section to measurement outcomes gives us the following positions:

Absolutism: Measurement outcomes are either absolute or non-factive.
Epistemic Perspectivism: Measurement outcomes should be reinterpreted in relational terms.
Ontic Perspectivism and Relativism: Measurement outcomes are non-reducible perspectival properties of measured systems.

The absolutist option corresponds to standard realist interpretations of quantum mechanics. There are two ways of fleshing it out.

The first absolutist way is to assume that determinate measurement outcomes are absolute. If this is so, then one must find a way to counter the no-go theorems associated with extended Wigner's friend experiments. This can involve modifying the dynamics of the theory, as with collapse theories, or completing its ontology, as with Bohmian mechanics.

The second absolutist option is to assume that measurement outcomes are not factive at all. This option could seem hardly manageable, given that quantum theory is assessed by its capacity to predict measurement outcomes. However, it is possible to read many-world interpretations along these lines.

Before explaining this, it is easier to start with a reading of many-worlds interpretations (Everett's relative state formulation) as epistemic perspectivism. What is absolutely real in these interpretations is the wave-function of the universe, but decoherence is thought to provide a preferred basis that generates a branching structure where different eigenstates of this preferred basis, corresponding to different measurement outcomes in measurement situations, are "seen" in different branches. This looks very much like epistemic perspectivism: observers, instruments and their relations to their objects are entirely naturalised, and measurement outcomes are re-interpreted in terms of relations between measured systems and measuring apparatus or observers located in specific branches. The wave-function of the universe gives us full access to all perspectives by "projection" on a given branch. It represents the view from nowhere, and all perspectival facts, reinterpreted as relations, supervene on it.

The problem with this epistemic perspectivist reading is that decoherence always depends on an arbitrary system–environment cut associated with a descriptive level of grain, and is only ever achieved approximately [33]. In this respect, branches and measurement outcomes should be seen as a mere pragmatic way of talking, useful for macroscopic agents, but without any strict correspondence to reality: quantum state attributions should ultimately take prominence over the attribution of definite values to definite quantities (see David Wallace's discussion of the eigenstate–eigenvalue link in [34]). Partiality takes prominence over relativity: the "view from nowhere", the universal wave-function that is, is approached by juxtaposing partial wave-functions viewed from different perspectives, including from different branches of the multiverse, like a jigsaw puzzle. We reach an absolutist position where measurement outcomes are non-factive.

What characterises approaches such as QBism, relational quantum mechanics, the perspectivist modal interpretation or pragmatist interpretations is that they deny that perspectival facts supervene on a non-perspectival "view from nowhere", and so, they are versions of ontic perspectivism. According to the perspectival modal interpretation, for example, the value state of a system relative to another system (on which measurement outcomes depend) is one of the projectors of a spectral resolution that is given by bi-orthonormal decomposition. Which projector it is is specified at best probabilistically by the universal wave-function. Relational quantum mechanics or QBism do not even postulate that there is a wave-function of the universe. Wave-functions are mere "book-keeping device" that can be used by agents to make predic-

tions. Only theoretical laws and principles can be considered absolute: they give agents partial inferential access to the content of other perspectives, notably the perspectives of their future selves, thus allowing them to predict probabilities for future outcomes. This corresponds to our characterisation of ontic perspectivism, where the absolute realm functions as cross-perspectival bridge at a more abstract level instead of corresponding to concrete facts.

Ontic perspectivism avoids having to assume, as many-world interpretations do, that all potential perspectives compatible with a universal wavefunction exist in parallel worlds: since perspectival facts do not supervene on absolute facts, it is fair to assume that only some of them are instantiated, but the theory doesn't tell us which: only our perspectival experience does [8]. This could be motivated, in line with the kind of indispensability arguments mentioned in the previous section, by the thought that our experience of the determinacy of measurement outcomes is indispensable to science and that many-world theories does not take this experience seriously enough.

As we can see, our framework allows us to understand different approaches towards quantum mechanics as different ways of dealing with inconsistencies. It can also help us understand how various versions of quantum perspectivism differ, in terms of different notions of perspective and associated accessibility relations. The most permissive view is the perspectival modal interpretation, where any physical system whatsoever continuously has a perspective on any other one. All such perspectives are accessible in principle with bi-orthonormal decomposition. Then comes RQM, where only systems in interaction can have perspectives on each other, and these perspectives are associated with discrete events and canonical quantities instead of continuously evolving quantum states. With pragmatist interpretations, perspectives are associated with decoherent physical situations only, which is more restrictive, but they need not be inhabited with epistemic agents. The most restrictive view is QBism, where only epistemic agents have perspectives. These interpretations might differ on other details, such as the ontology or the interpretation of probabilities, but they can all be considered ontic perspectival interpretations with a similar notion of perspectival content, associated with measurement outcomes, but different commitments towards the extension of the accessibility relation and the location of perspectives in the world. The less broad accessibility is considered, the closer we are, in effect, to relativism or solipsism.

4.2 Instrumental perspectivism

Quantum perspectivism shares similarities with the cases of indexicals and reference frames that were previously used as illustrations. In particular, the notion of perspective involved is always associated with a particular agent or local context at a particular time. The sole fact of considering a different agent or a different time or situation makes us move from a perspective to a different one. This marks an important difference with perspectival realism, where the notion of perspective that is entertained is such that the same perspective can be instantiated at several places and times, in different contexts, by different agents.

Giere used sensory modalities, such as vision and audition, and scientific instruments as a starting point to motivate his perspectival realism. Just as our sensory organs are used to produce mental representations of the world, measuring instruments, such as telescopes, spectroscopes or bubble chambers, are typically used to produce representations of an object: pictures, graphs or data models. These representations are partial, because measuring instruments and sensory organs are only sensitive to specific aspects of nature, for example the shape and reflectance properties of surfaces for vision, and even concerning these aspects, they have limited sensitivity, both in range and in precision. According to Giere, this partiality implies that the representations that they provide are perspectival. However, the notion of perspective involved is abstract: what experimental results are relative to is not a particular concrete measurement procedure instantiated in space and time, but a *type* of measurement or instrument that can be used by many people on many occasions on various objects. The associated perspective is often on a *kind* of object, since experimental results are generally taken to be informative not only about a particular object at a particular time, but also about the kind of object of which it is representative. What we are talking about are abstract perspectives, which can be understood as kinds of concrete perspectives.

Can we apply our framework to such cases? In order to do so, we need to find inconsistencies: we need to consider cases where distinct instruments give apparently conflicting information about the characteristics of a kind of object. This would give us the following possible resolutions of inconsistencies:

Absolutism: Experimental results are either absolute or non-factive.

Epistemic Perspectivism: Experimental results can be reinterpreted in relational terms.

Ontic Perspectivism and Relativism: Experimental results are irreducibly perspectival.

A prima facie reason to be absolutist regarding instruments and experimentation is that conflicts between various instrumental perspectives are not so common in mature science, and they tend to be eliminated rather than celebrated. Generally speaking, experimental techniques are developed so as to yield robust and reproducible results that strive to eliminate contextual features, such as noise or interference, and that do not depend on which particular instrument is being used. Distance measurements performed by means of a radar, a laser, a string or a ruler should all agree in so far as they are performed on the same objects, otherwise we would not claim that they measure the same property. And when they don't agree, then, as Giere himself puts: "[t]he relevant group of scientists confronted with this situation would draw the conclusion that one or the other instrument is malfunctioning and proceed to try to figure out what had gone wrong. They would not accept the result as simply a curiosity of nature." (p. 57)

So, if something is inconsistent, it should be considered to be due to a systematic *artefact* of one of the instrument or a *distortion* introduced by it, but once corrected, experimental results are absolutely true. Following our framework, it seems that contrarily to what he claims, Giere is an absolutist rather than a perspectivist about instruments. In the end, all he does is express the mundane fact that the measuring instruments by which we acquire knowledge of nature have limited sensibility: something nobody ever denied (see [35] and [36] for similar remarks).

Note, however, that conflict resolution when different instruments give incompatible results can be more subtle than what Giere describes (simply taking one of the instruments to be faulty). Relevant in this respect is Mitchell's discussion of two different instrumental perspectives on the structure of proteins (X-ray crystallography and NMR spectroscopy) [14, ch. 10.4]. She gives an account of how these different perspectives can be integrated in a way that allows to recover more than what they have in common, because they correct each other. This means that perspectival information (or distortions) is still informative somehow and should not be eliminated. We can presume that this correction involves modelling the instruments themselves or part of the measuring process, and the way they affect observed

entities in general (remember that we focus on the type-level here), so that measurement outcomes become relational (relative to a *kind* of instrument) rather than directly reflecting intrinsic properties. Mitchell also insists that we do not have access to a view from nowhere from which we could compare different methods: perspectives are epistemically (but not ontologically) fundamental.

All this seems to point to an epistemic version of perspectivism, where conflicting experimental results are reinterpreted as relational, but the aim is still to unveil the absolute structure of proteins, as it is, independently of various experimental procedures (see again [35] for a similar analysis applied to Giere's perspectivism, associated with a dispositionalist interpretation).

Is there room for ontic perspectivism? Remember that it is typically defended on the basis of indispensability arguments. The idea could be that experimental results are not entirely reducible to pure theoretical descriptions because they are based on practical abilities ("know-how") that are not reducible to theoretical knowledge ("know-that"). The latter can still be conceived of as allowing for partial inferential bridges between various experimental/practical perspectives. Potters's discussion of "experimental regress situations" seems to fit this characterisation [37]. According to Potters, "[in some cases] we can understand perspectives as embodied and situated ways of going about in experimental practice", and the process of *interpretation* he describes, which is an attempt to "construct a public account of the embodied and situated way in which the [experimenters] went about", looks very much like the establishment of partial inferential bridges between various perspectives (partial in so far as "this process of interpretation can never be settled once and for all"). This can be contrasted with a more radical instrumental relativism that would deny that any integration or correction between various instrumentations is possible, which seems to be the view of Harry Collins and his experimenter's regress [38].

4.3 Theoretical perspectivism

Although perspectival realism was grounded by Giere on an alleged instrumental perspectivism, it is generally cast in more abstract terms, with perspectives being close to Kuhnian disciplinary matrices (one sense of paradigm): a theoretical lexicon, epistemic and explanatory standards, metaphysical posits or epistemic values, among other things. This perspectivism can be developed along Kantian themes, the idea being that all

these elements somehow shape how we cognise the world, including how instrumentation is interpreted (even when the same experimental techniques are used across different theoretical and disciplinary contexts, as is often the case), and again, there is this idea that the *same* perspective can be instantiated at several places and time by different agents on different objects.

I will focus here on theoretical frameworks. It can happen in science that several theoretical frameworks are in conflict: for example, the invariance of the velocity of light of electromagnetism is incompatible with the Galilean relativity that characterises classical mechanics, or combining quantum mechanics and general relativity leads to inconsistencies. Applying our framework to these apparent contradictions between various theoretical descriptions of the world leads to the following positions:

Absolutism: Theoretical descriptions are either absolute or non-factive.
Epistemic Perspectivism: Theoretical descriptions can be reinterpreted in relational terms.
Ontic Perspectivism and Relativism: Theoretical descriptions are irreducibly perspectival.

According to one version of absolutism, if there are inconsistencies, this must be because one or both theories are false, and indeed, a common lesson taken from the tension between Galilean relativity and electromagnetism is that the former must be replaced by special or general relativity. Another absolutist way of resolving theoretical conflicts is to assume that important parts of theoretical descriptions are actually non-factive, in particular their ontological posits: this is the path followed by structural realism. Theories only capture the relational (nomological) structure of reality. This is supposed to account for the empirical successes of past, now abandoned theories, as well as contemporary ones. The caloric fluid, for example, does not *really* exists, it is merely pragmatically useful to describe the nomological structure of heat propagation, and the same should be said of entities postulated by contemporary theories [39]. However, when ontological posits are reinterpreted as placeholders in a relational structure, we get to something closer to epistemic perspectivism.

A question is whether the strategy that we presented for defending instrumental perspectivism can be extended to theoretical representations, up to general theories, given that theories themselves seem to provide the cross-

perspectival bridges that are needed to integrate various instrumental perspectives. If these accessibility relations are themselves relative, we reach full blown relativism instead of perspectivism.

Here, the perspectivist can argue that theoretical conflicts are resolved by a subtle integration process similar to the one involved in the resolution of instrumental disagreements. Conflicting theoretical descriptions can then be reinterpreted as true relative to particular contexts: for example, Newtonian mechanics would be true relative to contexts where spacetime is flat and relative velocities are low. A similar strategy has been used by perspectivists to account for models that use incompatible idealisations, for example, different models of fluid dynamics [40]. The idea is that idealisations (notably taking the limit of a parameter) are used to focus on specific regimes or spatial or temporal scales, so as to account for emergent patterns, and the contradictions that they generate can be made harmless by relativisation to these regimes or scales. Since relevant contexts can be described explicitly from an overarching theory, we do not reach any form of relativism or ontic perspectivism: there is a "view from nowhere" towards which science converges, and from which the general validity of domain-specific theories and models could be deduced in principle by appropriately locating their domains of validity. This is a version of epistemic perspectivism.

Here again we need more general representations to provide for bridges between perspectives, and so, these more general theories must be taken to be absolute, or at least converging towards an absolute realm, if we don't want these views to collapse into relativism. This means that epistemic perspectivism is not a stable position when it comes to our most abstract representations.

Does ontic perspectivism fare better? We can reach an ontic version of perspectivism if we integrate into the perspective elements associated with the users of the theories, and reject attempts to naturalise them. In this respect, an idea that permeates the writing of many perspectivists is that theoretical vocabulary does not refer to perfectly natural divisions of the world, but depends at least in part on our aims, interests and position in the universe (see [13] p. 84–88, [15, ch. 3], [14 ch. 8]). Ontological posits can be thought of as underlying methodological and explanatory standards, in the way the Newtonian concept of force underpins mechanistic modes of explanation, for instance. This is a way of interpreting this idea that the way of classifying nature depends on a human context, including aims and interests, which also resonates with pragmatist themes [41].

However, we should be careful here: if our aims and interests are *merely* selective, perhaps because there is a plethora of equally valid ontological options to choose from depending on our interests (which seems to be Teller's view and perhaps Giere's), or if our ontological commitments are *merely* pragmatic, then we are back to some version of absolutism. In this respect, when Mitchell explains that different city maps are compatible, but always partial for obvious pragmatic reasons [15, p. 184], not much is said that a pure absolutist could not accept. It seems that Massimi is also definitely on the absolutist side, since she explicitly denies the existence of perspectival facts (according to her, only "justification principles" and "assertability conditions" are relative):

> Scientific perspectives do not offer perspectival facts. Nor should truth be understood in terms of perspectival truthmakers [...], or as indexed to a perspective or relative to a perspective. [14]

It is hard to find any explicit commitment towards a perspectival ontology in the writing of perspectival realists. Perhaps the problem is that if even theoretical perspectives do not supervene on an absolute realm, and if accessibility between them is only partial, then they cannot really be used to provide genuine cross-perspectival bridges for instrumental perspectives or for model perspectives. Should scientists be satisfied with a situation where various ways of integrating conflicting instruments or models are themselves in conflict, but simply cohabit? In the end, ontic perspectivism about abstract theories doesn't look like a very stable position either.

5 Prospects for Conciliation?

In this paper, I have suggested a taxonomy of families of philosophical positions that differ by the role played by relativity for handling inconsistencies between different representations: absolutism rejects relativity, epistemic perspectivism reduces it to relational facts, ontic perspectivism assumes it but makes room for cross-perspectival accessibility, and relativism rejects even such accessibility. This framework illuminates what different versions of quantum perspectivism have in common, and what sets them apart from realist interpretations, such as the many-world interpretation. It also accounts for the commonalities between perspectivism about instruments, models and

theories that have all been invoked by perspectival realism, and how such views differ from standard realism and relativism.

Quantum perspectivism is concrete: the perspectives it is about are associated with particular agents or contexts located in spacetime, while perspectival realism is abstract: we are talking about type-level entities such as conceptual schemes, experimental techniques or explanatory perspectives that can be shared by more than one agent. What comes out of these analyses, in my view, is that concrete versions of perspectivism are both more easy to express and more robust, in the sense that it is possible to articulate a clear middle way between absolutism and relativism, whereas the more abstract we go, the more perspectivism easily collapses into either plain relativism or absolutism.

The reason, I think, is the following: perspectivism assumes accessibility relations between perspectives that are absolute, and located at a more abstract or encompassing level than perspectival content. This implies that abstract facts are not irreducibly perspectival, which is incompatible with abstract perspectivism. We could conceive of a hierarchy of abstraction, from concrete descriptions of local facts up to purely mathematical frameworks, but at some point, we have to assume that the higher levels are in some sense *less* relative and *more* absolute than the lower levels (however we make sense of it) if we want these higher levels to provide bridges or integration between various potential perspectives of the lower levels and avoid a relativist regress "all the way up". This explains why quantum perspectivists are able to entertain views that are close in spirit to relativism, putting explicit emphasis on observer relativity, but without questioning the general validity of quantum theory, whereas perspectival realists are closer to the absolutist side, reserving epistemic perspectivism to concrete models and instrumentation that are integrated at a more abstract level, and rejecting metaphysical or semantic relativity.

In any case, the congruence between these two families of position, quantum perspectivism and perspectival realism, should not be overrated. It might be possible to combine them, but it is also possible *not* to do so: one can be a quantum perspectivist without thinking that scientific knowledge is situated, and conversely, one can be a perspectival realist without taking concrete measurements to be observer-relative.

References

1. Adlam, E., Rovelli, C.: Information is Physical: Cross-Perspective Links in Relational Quantum Mechanics. Philosophy of Physics. 1, 1 (2023). https://doi.org/10.31389/pop.8
2. Rovelli, C.: Relational Quantum Mechanics. International Journal of Theoretical Physics. 35, 1637–1678 (1996)
3. Bitbol, M., De La Tremblaye, L.: QBism. In: Phenomenology and QBism. pp. 215–266. Routledge, New York (2023)
4. Glick, D.: QBism and the limits of scientific realism. Euro Jnl Phil Sci. 11, 53 (2021). https://doi.org/10.1007/s13194-021-00366-5
5. Fuchs, C.A., Mermin, N.D., Schack, R.: An introduction to QBism with an Application to the Locality of Quantum Mechanics. American Journal of Physics. 82, 749–754 (2014). https://doi.org/10.1119/1.4874855
6. Dieks, D.: Perspectival Quantum Realism. Found Phys. 52, 95 (2022). https://doi.org/10.1007/s10701-022-00611-8
7. Bene, G., Dieks, D.: A Perspectival Version of the Modal Interpretation of Quantum Mechanics and the Origin of Macroscopic Behavior. Foundations of Physics. 32, 645–671 (2002)
8. Ruyant, Q.: Consistent histories through pragmatist lenses. Studies in History and Philosophy of Science. 98, 40–48 (2023). https://doi.org/10.1016/j.shpsa.2023.01.001
9. Healey, R.: Perspectives in and on Quantum Theory. Found Phys. 55, 25 (2025). https://doi.org/10.1007/s10701-025-00838-1
10. Healey, R.: Quantum Theory: A Pragmatist Approach. British Journal for the Philosophy of Science. 63, 729–771 (2012)
11. Khalili, M.: Perspectivism and Special Relativity. Theory of Science. (2021). https://doi.org/10.46938/tv.2021.516
12. Rovelli, C.: Is Time's Arrow Perspectival? In: Chamcham, K., Silk, J., Barrow, J.D., and Saunders, S. (eds.) The Philosophy of Cosmology. pp. 285–296. Cambridge University Press (2017)
13. Giere, R.: Scientific perspectivism. University of Chicago Press (2006)
14. Massimi, M.: Perspectival realism. Oxford University Press (2022)
15. Massimi, M., McCoy, C. eds: Understanding Perspectivism: Scientific Challenges and Methodological Prospects. Routledge, New York (2019)

16. Evans, P.W.: Perspectival objectivity: Or: how i learned to stop worrying and love observer-dependent reality. Euro Jnl Phil Sci. 10, 19 (2020). https://doi.org/10.1007/s13194-020-00286-w
17. French, S.: Phenomenology, Perspectivalism and (Quantum) Physics. Found Phys. 54, 34 (2024). https://doi.org/10.1007/s10701-024-00769-3
18. Kusch, M.: Relativism in the Philosophy of Science. Cambridge University Press (2021)
19. Cavalcanti, E.G.: The View from a Wigner Bubble. Found Phys. 51, 39 (2021). https://doi.org/10.1007/s10701-021-00417-0
20. Dasgupta, S.: Symmetry as an Epistemic Notion (Twice Over). Br J Philos Sci. 67, 837–878 (2016). https://doi.org/10.1093/bjps/axu049
21. Belot, G.: The Principle of Sufficient Reason. The Journal of Philosophy. 98, 55–74 (2001). https://doi.org/10.2307/2678482
22. Earman, J.: Thoroughly Modern McTaggart: Or, What McTaggart Would Have Said if He Had Read the General Theory of Relativity. Philosophers' Imprint. 2, 1–28 (2002)
23. Putnam, H.: Models and Reality. Journal of Symbolic Logic. 45, 464–482 (1980)
24. Ainsworth, P.: What is Ontic Structural Realism? Studies in History and Philosophy of Science Part B. 41, 50–57 (2010)
25. Cappelen, H., Dever, J.: The Inessential Indexical: on the Philosophical Insignificance of Perspective and the First Person. Oxford University Press (2013)
26. Perry, J.: The Problem of the Essential Indexical. Noûs. 13, 3–21 (1979). https://doi.org/10.2307/2214792
27. Lewis, D.: Attitudes De Dicto and De Se. The Philosophical Review. 88, 513--543 (1979). https://doi.org/10.2307/2184843
28. Ismael, J.: The situated self. Oxford University Press, Oxford ; New York (2007)
29. Nagel, T.: What Is It Like to Be a Bat? The Philosophical Review. 83, 435 (1974). https://doi.org/10.2307/2183914
30. Rovelli, C.: Why Gauge? Found Phys. 44, 91–104 (2014). https://doi.org/10.1007/s10701-013-9768-7
31. Ruyant, Q.: Symmetries, Indexicality and the Perspectivist Stance. International Studies in the Philosophy of Science. 34, 21–39 (2021). https://doi.org/10.1080/02698595.2021.2001723

32. Schmid, D., Yīng, Y., Leifer, M.: A review and analysis of six extended Wigner's friend arguments, https://arxiv.org/abs/2308.16220, (2023)
33. Wallace, D.: Decoherence and Ontology, or: How I Learned To Stop Worrying And Love FAPP. In: Saunders, S., Barrett, J., Kent, A., and Wallace, D. (eds.) Many Worlds? Everett, Quantum Theory, and Reality. Oxford University Press (2010)
34. Wallace, D.: A Prolegomenon to the Ontology of the Everett Interpretation*. In: Ney, A. and Albert, D.Z. (eds.) The Wave Function. pp. 203–222. Oxford University Press (2013)
35. Chakravartty, A.: Perspectivism, Inconsistent Models, and Contrastive Explanation. Studies in History and Philosophy of Science Part A. 41, 405–412 (2010). https://doi.org/10.1016/j.shpsa.2010.10.007
36. Baker, K.: Giere's instrumental Perspectivism. Euro Jnl Phil Sci. 10, 32 (2020). https://doi.org/10.1007/s13194-020-00296-8
37. Potters, J.: Perspectivism and the epistemology of experimentation: From the evaluation to the production of reliable experiments. Euro Jnl Phil Sci. 10, 24 (2020). https://doi.org/10.1007/s13194-020-00289-7
38. Collins, H.: Changing Order: Replication and Induction in Scientific Practice. University of Chicago Press (1985)
39. Ladyman, J., Ross, D.: Every Thing Must Go: Metaphysics Naturalized. Oxford University Press (2007)
40. Rueger, A.: Perspectival Models and Theory Unification. The British Journal for the Philosophy of Science. 56, 579--594 (2005). https://doi.org/10.1093/bjps/axi128
41. Chang, H.: Realism for realistic people: a new pragmatist philosophy of science. Cambridge University Press (2022)