



# Probing ‘operational coherence’ in Hasok Chang’s pragmatic realism

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Received: 2 February 2021 / Accepted: 13 October 2021 / Published online: 20 November 2021  
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## Abstract

Hasok Chang is developing a new form of pragmatic scientific realism that aims to reorient the debate away from truth and towards practice. Central to his project is replacing truth as correspondence with his new notion of ‘operational coherence’, which is introduced as: 1) A success term with probative value to judge and guide epistemic activities. 2) A more useful alternative than truth as correspondence in guiding scientific practice. I argue that, given its current construal as neither necessary nor sufficient for success, operational coherence is too weak and fails to satisfy both 1) and 2). I offer a stronger construal of operational coherence which aims to improve on Chang’s account by tying it to systematic success. This makes operational coherence necessary and sufficient for (systematic) success. This new account, if successful, rescues 1) but not 2). I then take a step back and try to locate Chang’s pragmatic realism within the broader pragmatist tradition by comparing his views to the founding fathers Peirce, James and Dewey. I also assess to what extent we should consider Chang’s position ‘realist’, arguing that despite the many relativists threads running through it, Chang’s pragmatic realism is deserving of the realist label because its aims to maximize our learning from reality, even if it falls short of what many traditional realist are happy to accept as realism. I finish with comments on the epistemology of science pointing out that there is nothing intrinsic about a practice-based philosophy of science that precludes having both operational coherence and correspondence and highlighting that given a proper understanding these two notions could, in fact, be understood as complementary. I suggest one way this could be done.

**Keywords** Philosophy of science in practice · Scientific realism · Pragmatic realism · Hasok Chang · Epistemology of science · Operational coherence

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## 1 Introduction

Hasok Chang is developing a new form of scientific realism that he calls ‘pragmatic scientific realism’. He aims to reorient the debate away from truth and towards practice. Central to his project is replacing truth as correspondence with his new notion of ‘operational coherence’, which is introduced as:

- 1) A success term with probative value to judge and guide epistemic activities.
- 2) A more useful alternative than truth as correspondence in guiding scientific practice.

I argue that, given its current construal as neither necessary nor sufficient for success, operational coherence is too weak and fails to satisfy both 1) and 2). I offer a stronger construal of operational coherence which aims to improve on Chang’s account by tying it to systematic success. This makes operational coherence necessary and sufficient for (systematic) success. This new account, if successful, rescues 1) but not 2). This paper is divided into two parts.

In the first part, I introduce Chang’s pragmatic realism. I explain the motivations underlying his reorientation from truth to practice, which Chang does by replacing the current proposition-based framework with a practice-based alternative. The latter is cashed out in terms of ‘epistemic activities’ and ‘systems of practice’ and I explain these in turn. ‘Reality’ and ‘truth’ take on new meanings given this new framework. I explain these new notions. The upshot of Chang’s position is a scientific pluralism according to which *prima facie* contradictory theories can be true.

In the second part, I borrow the notion of ‘probative value’ from legal context where it is used to denote the power of a piece of evidence to support an alleged proposition and use it in the context of philosophy of science to denote the power of whatever it is a power of to support that we are minimally ‘getting things right’ in the world. I use probative value to assess ‘operational coherence’. I argue that operational coherence, construed by Chang as neither necessary nor sufficient for success, lacks the probative value that correspondence truth has, thereby failing to satisfy 1). Truth as correspondence, I maintain, even if it is construed in a liberal sense that allows for pluralism, wears its probative value on its sleeve in virtue of being a correspondence relation between propositions and the mind-independent world. I also show that the same route taken to defend the usefulness of operational coherence in guiding practice is available for proponents of correspondence. Operational coherence thereby fails to satisfy 2). I offer a stronger notion of coherence which ties it to systematic success. This rescues the probative value of coherence while leaving the question of its superiority over correspondence in practice open.

Then, I take step back and try to locate Chang’s pragmatic realism within the bigger philosophical picture by taking on two questions. First, in what sense is Chang’s pragmatic realism pragmatic? I answer that by comparing his views to the founding fathers of pragmatism, Peirce, James and Dewey. Second, in what

sense, if at all, is it a form of realism? I answer that Chang's position is a form of deep perspectival realism, which is a (weak) form of realism nonetheless, despite the many threads of relativism running through it.

Finally, I provide some remarks on the epistemology of science pointing out that, although no current philosophy of science offers both, there is nothing intrinsic about a practice-based philosophy of science that precludes having operational coherence as well correspondence. I argue that given a proper understanding these two notions could, in fact, be understood as complementary. I suggest one way this could be done.

## 2 New framework

Chang wants to take the scientific realism debate beyond foot-stamping. He wants scientific realism to be relevant and useful to scientific practice. That is why he finds construing scientific realism merely as a descriptive thesis about the aims of science to be underwhelming and suggests a more 'active' alternative. In this sense, Chang takes realism to be a policy, better yet, an ideology that commit us to maximize our learning from reality (Chang, 2018, 31). Given his pragmatic slant, Chang tends to blur the line between knowing and doing. As such, maximizing our learning from reality, for him, can be achieved by maximizing our successful doing in reality. It is for this reason that he is interested in reviving "useful ideas and facts lost in the record of past science" (Chang, 2004, 237). For these can help us do things we cannot do with our current science.

To that end, Chang holds that we need a framework that would help us to make sense of successful scientific practice past and present. But he hastens to add that the current *proposition-based framework* is not fit for purpose (Chang, 2017a). For Chang, Kuhn has shown that at crucial moments in the history of science, scientists were choosing not between theories but between entire paradigms (Kuhn, 1962). Practice-oriented philosophers of science have convincingly argued that emphasis on theories, understood as bodies of propositions, leads to a distorted analysis of science as it neglects all the non-propositional aspects such as experimentation and other non-verbal activities which are constitutive of science (Chang, 2014). As a remedy, Chang proposes an *action-based framework* in terms of "epistemic activity" (EA) and "system of practice" (SP).

### 2.1 Epistemic activities

Chang characterizes an EA as:

a more-or-less coherent set of mental or physical operations that are intended to contribute to the production or improvement of knowledge in a particular way, in accordance with some discernible rules (though the rules may be unarticulated) (Chang, 2012, 15).

An EA is then:

- A coherent set of operations.
- Abstractly characterized but concretely realized.
- Partly defined by aims. (This distinguishes them from ‘mere physical happenings’ involving bodily movement, e.g. purposelessly moving one’s arms.)

Chang uses ‘epistemic’ broadly to mean ‘in relation to knowledge’ without tying this notion to the notion of truth in strict realist sense (Chang, 2009, 80). This he does by taking that kind of knowledge that EA is concerned with to be non-propositional, i.e. know-*how* instead of know-*that* (Chang, 2012, 215). Examples of EA include measurements, detections, DNA extraction, and also simpler and more day-to-day activities such as match-lighting.

In the context of a SP, an EA has at least two kinds of epistemic aims – although it may have other kinds of aims (e.g. sociological aims):

1. “Inherent purpose” which is the aim partly defining the EA
2. “External function” which unite different EAs under a SP.

## 2.2 Systems of Practice

A SP is characterized by Chang as:

[a] coherent set of epistemic activities performed with a view to achieve certain aims. . . . Similarly as with the coherence of each activity, it is the overall aims of a system of practice that define what it means for the system to be coherent (Chang, 2012, 16).

A SP is then:

- A coherent set of EAs
- Whose coherence is partly defined by the *overall* aims.

The following example helps to illustrate how EAs and their aims come together under the rubric of SP and its overall aims:

Consider the EA of DNA extraction. It is a procedure of isolating DNA from the nuclei of cells. If we ask “what is the aim of this activity?” a straightforward answer would be to extract DNA from nuclei of cells. This is the *inherent purpose* of the DNA extraction. But we can extract DNA for all sorts of purposes, such as to determine the characteristics of a certain gene including its structure and function, or to purify it and use it in gene-based vaccination, or to use it to transfect other cells in experimental contexts, etc., and we cannot, by simply observing someone performing a DNA extraction, decide what that person intends to do with the extracted DNA. That is because there is nothing intrinsic about DNA extraction which says what the extracted DNA is going to be used for. The latter aim is called the *external function* (of DNA extraction). It is determined, according to Chang, by the role the EA plays along with other EAs in achieving the overall aims of the SP in which it is imbedded. So if we take, for instance, one overall aim of the SP to be to perform

gene-therapy, then the external function of DNA extraction would be to develop a gene-based vaccine.

Against this neat picture it is important to note a certain ambiguity in Chang's notion of SP. On the one hand we have the clear characterization of what a SP is laid out above. It tells us that a SP is characterized by a set of EAs and overall aims. But elsewhere we find Chang noting that his SP is similar to Kuhn's 'paradigm', where the latter is understood as 'disciplinary matrix' that includes "all kinds of elements ranging from fundamental metaphysical principles to institutional structures" (Chang, 2012, 18).

Chang notes that Kuhn's notion of paradigm qua disciplinary matrix is similar to what he had in mind when he was developing his new framework but decided not to use it and introduced his own terminology of SP for two reasons. One is that he finds that 'paradigm' is tightly linked to Kuhn's view of scientific development which Chang does not share. Two, Kuhn does not provide a clear indication of how the different elements in a 'disciplinary matrix' are held together, whereas the notion of SP is 'more definite and are more orderly'.

The Ambiguity here lies in the fact that elements such as 'metaphysical principles' and 'institutional structures' which Chang takes to belong to SP seem to have no place on Chang's first characterization SP in terms of EAs and overall aims. Hence it seems that Chang is using SP in at least two different senses a *narrow* sense as characterized above and a *broad 'Kuhnian' sense, which captures the narrow sense and includes all the other elements that belong to Kuhn's disciplinary matrix. For my own purposes when I use SP in the discussions below, I mean it in the broader sense.* Having introduced the broad framework I now consider the new meaning that Chang gives to 'reality' and 'truth'.

### 2.3 Pragmatic reality

Chang distinguishes *uppercase R* Reality and *lowercase r* reality. By 'Reality' he means the mind-independent reality. About it, he holds, similarly to Kant, "we can and should say nothing" (Chang, 2018, 32). Sparing Chang a contradiction, we can say that Chang thinks that mind-independent reality is in a sense *thinkable*, i.e. we can affirm its existence even if we are unable to meaningfully talk about it. This is why he says that we cannot learn *about* Reality but can only learn *from* it (Chang, 2017b, 181).

By 'reality', which he also calls 'real-ness', he offers conditions which when satisfied entitles entities involved in EAs to deserve our realistic confidence – this is further explained below. Chang arrives at this new notion starting from Ian Hacking's (1983) 'experimental realism', which takes the manipulation of an entity to give us warrant for taking it as real. Chang transforms Hacking's criterion into a generalized theory of what entities should be counted as 'real', which he calls the *coherence theory of reality* according to which:

*A putative entity should be considered real if it is employed in a coherent epistemic activity that relies on its existence and its basic properties (by which we identify it)* (Chang, 2016, 116).

By ‘relies’ Chang is invoking necessity, a ‘pragmatic necessity’, which he describes elsewhere as a “necessity arising from the requirements of action” (Chang, 2009, 70), and this necessity we can only learn about empirically (Chang, 2017a). Accordingly, if accepting the existence of a postulated entity is pragmatically necessary for performing a coherent and successful EA, then we should take that entity as real.

In *Is Water H<sub>2</sub>O?* (2012) Chang provides a detailed study of ‘phlogiston’ which is characterized as “the principle that imparted combustibility to combustibles” (3). Phlogiston is considered not real by current light. Yet, given a phlogiston-based SP, Chang argues, Joseph Priestly and others chemists of the time were able to carry out numerous successful experiments whose coherence depends on their taking that there is an entity which is phlogiston which they are able to manipulate. One such experiment, for instance, is the revivification of mercury calx into its metallic form by allowing it to absorb the phlogiston from the air. This EA of de-phlogisticating air by exposing it to mercury calx has as inherent purpose the ‘de-phlogistication’ of air. The coherence of this EA would have been impossible without taking that there is phlogiston (4-5). Chang’s argument for the reality of Phlogiston can be summarized as:

1. Phlogiston being taken as real is necessary for the coherence of a bunch of successful EAs.
2. Success is our best indicator of truth. Therefore, phlogiston is real.

This is while keeping in mind that we are not to talk about (capital R) Reality but only what should count as real, i.e. (lowercase r) reality. So phlogiston should count as real –which for Chang is ‘really real’ in the only sense we can talk about.

#### 2.4. Pragmatic Truth

‘Truth as correspondence’ broadly characterizes truth as a relational property that a proposition has with a relevant portion of reality such as a fact, state of affairs, etc. It says that truth obtains when there is a correspondence, congruence, agreement, etc. between that proposition and that aspect of reality. Chang thinks that truth as correspondence is not useful in guiding practice but he does not entirely relinquish the notion of truth. Instead, he gives it a place subordinate to coherence in his framework. He characterizes truth as:

A statement is true in a given circumstance if (belief in) it is needed in a coherent activity (Chang, 2017a, 113).

Similarly to the case of reality, ‘needed’ above is also meant to convey ‘pragmatic necessity’ i.e. that belief in or assent to a statement is required for carrying out a coherent and successful EA. So in our DNA extraction example above, the statement that “cells contain DNA” is true—in Chang’s sense of pragmatic truth-- because it is necessary for the activity of DNA extraction to be coherent, so is the statement that “air contains phlogiston” in order to de-phlogisticate air. What our discussion so far reveals is that, according to Chang, entities and statements belonging to successful EAs can be real and true respectively. Yet, this raises the following important issue.

At certain points in history we may have competing SPs, each postulating different entities each successful at its related aims but not likely all to be real at once. How does that affect the metaphysical picture of the world that science, given pragmatic realism, gives us?

### 3 The case for metaphysical pluralism

Chang's response to the former question is that we should be 'metaphysical pluralist' – although a better wording would have been 'ontological pluralism' as he is concerned with having a multiplicity of objects or entities. Be that as it may, once we accept Chang's new practice-based framework along with his theories of pragmatic truth and reality, it follows that we should countenance a form of 'practice-based metaphysical pluralism' according to which we accept as real, in the pragmatic sense, entities that are pragmatically necessary for carrying out coherent and successful EAs.

But Chang thinks that we arrive at metaphysical pluralism even if we do not subscribe to his pragmatic realism. That is even if we were scientific realists in the traditional sense, Chang thinks, we would also end up in metaphysical pluralism so long as we pay close attention to 'success' in success-to-truth inferences. This conclusion, Chang holds, can be arrived at in a three-step fashion:

- I. Accept the traditional realist success-to-truth argument, famously known as the No Miracle Argument (NMA).
- II. Show that the success of science is multi-dimensional.
- III. Defend that plurality of success leads to a metaphysical pluralism (Chang, 2017b, 176)

Given that Chang is addressing scientific realists, most of whom already accept some form of NMA, he simply accepts the validity of the success-to-truth arguments. He notes, however, that 'success' in NMA is often used without precise characterization. Chang explains that success, understood in its broadest sense, is the achievement of aims of relevant agents who may have different, yet equally legitimate, epistemic aims. So we already have one kind of pluralism entering at the level of aims. These aims, however, Chang notes, are partially definable by the many epistemic values that we hold (177). But perhaps 'definable' is too strong, as aims are not always defined by values unless the person having certain aims intends for them to be so, such as "to explain *X* according to the *simplest* theory available", otherwise an aim can be simply "to explain *X*, according to any of the theories available". But, as will be discussed below, aims are intentional and given that we are not always aware of the values we subscribe to we cannot say that aims, epistemic or otherwise, are 'definable' by values.

This is not really a problem though as we can accept a more modest claim, namely that aims are always affected by or qualified with values. Such qualification needs not to be intentional and we need not even be aware of the values at play. One may wish to explain a certain state of affairs *X* using a particular theory, which is

simpler than other theories, although she was not aiming for or even thinking about simplicity. Here ‘simplicity’ qua an epistemic value of a theory affects or qualifies the aim of the explanatory activity.

With these minor qualifications in place, we continue with Chang’s argument which says that epistemic values – which we now say qualify or affect agents’ aims, are various and they are thought by realists to be truth-conducive. This opens the door for different criteria of success and as such for different success-to-truth arguments, leading eventually to metaphysical pluralism. A pertinent example of the kinds of metaphysical pluralism that ensues from accepting success-to-truth arguments is having to accept as representative multiple successful models that make fundamentally incompatible assumptions about the underlying states of affairs (e.g. models of the atomic nucleus, see Morrison (2015)).

This pluralism, Chang notes, is inescapable even if we were value monists and took for instance, empirical adequacy as the sole value of science and decided to infer from empirical adequacy to truth. That is because, Chang explains, in practice there is no ‘perfect empirical adequacy’. Empirical success, he notes, is multi-dimensional and Kuhn’s (1977, 322) famous list of accuracy, consistency, scope, simplicity, and fruitfulness, which often pull in opposite directions, are best understood as capturing different dimensions of empirical success. Also here pluralism ensues (Chang, 2017b, 177).

Having accepted I. and II., what stands in the face of metaphysical pluralism, Chang explains, is a deep-seated belief, held by traditional realists, in metaphysical monism according to which the world comprises one fixed set of objects with one fixed set of properties. Chang finds this belief unsupported. He adds that if we accept success-to-truth arguments and realize that success is multidimensional then metaphysical pluralism is inescapable. What follows from metaphysical pluralism is that mutually contradictory theories can both be true (179).

Recall the case for the reality of phlogiston: its being pragmatically necessary for the coherence of successful EAs. Chang notes that there is nothing special about phlogiston that makes it an anomaly in the history of science. Indeed, a host of other entities that are abandoned by current science such as caloric, ‘frigorific’ radiation, etc. have also been pragmatically necessary for the coherence of a host of other successful EAs given different SPs. He adds, that the same Hacking-type inference can be made for those as well, leading us to conclude that these are also real.

The existence of such cases in history is not news for philosophers engaged in the realism debate. After all, the claim that terms such as ‘phlogiston’ and ‘caloric’, which were central to successful but discarded theories, are non-referring is what feeds Larry Laudan’s now notorious pessimistic meta-induction (PMI) (Laudan, 1981). However, what’s new about Chang’s position is that it shines new light on PMI, showing that understanding PMI as an argument against realism is premised on the hidden assumption of metaphysical monism. Once monism is given up, PMI is instantly transformed into a positive argument for metaphysical pluralism. What follows is that phlogiston and caloric can be equally as real as electrons and positrons (Chang, 2017b, 181).



It is worth mentioning at this point that many more traditional realists may find Chang's claims unconvincing not because they disagree with him on the claim that there are different criteria of success. They don't. But because they hold that these different criteria give the realist room to qualify the kind of success that they consider to warrant a success-to-truth inference (see Vickers, 2019). The challenge this approach faces is in being able to provide criteria which answer the historical challenge in a way that is not question-begging.

#### 4 Operational coherence

Central to Chang's pragmatic realism is his notion of operational coherence which figures in his characterization of EA, SP, truth and reality. Operational coherence is introduced as:

- 1) A success term with probative value to judge and guide epistemic activities.
- 2) A more useful alternative than truth as correspondence in guiding scientific practice

Before we proceed, we need to get one thing out of the way: Chang thinks that the notion of truth as correspondence is empty but nothing in the above two claims hangs on that. In fact, what the two claims above say, particularly 2), is that coherence can do whatever proponents of correspondence think their notion does for them in guiding practice, and coherence can do it even better. So Chang is promising a practical added-value, over and above what correspondence claims to offer. Before trying to assess whether coherence does offer that added view, we should ask ourselves whether coherence succeeds in preserving the initial value that proponents of correspondence claim their notion possesses, that being the 'probative value'. I borrow 'probative value' from the legal context and transform it for my own purpose.

In law, the 'probative value' of a piece of evidence, sometimes called 'probative force', is meant to capture the power of this piece of evidence to support an alleged proposition. Unlike in philosophy where 'evidence' is often identified with beliefs, mental states, statements, etc. all of which have a propositional form – even evidence as relation also broadly falls under the same heading in virtue of being a relation between propositions (Kelly, 2006), what counts as 'evidence' in law includes the propositional, e.g. testimony, as well as the non-propositional, e.g. a physical objects (Garner, 2009, 835). So the 'probative value' of a piece of evidence is in this sense *indifferent* as to the nature of what it is a power of, be that propositional or non-propositional. Let us call this *conceptual indifference*.

This is pertinent because Chang is clear that, with his action-based framework, he wants to distance himself from propositions, so we want a way to appraise his notion of 'operational coherence' in a non-question-begging fashion. Hence, appraisal using the usual notions of truth and justification will not do. We need something that would countenance, but is not committed to, either the

propositional or the non-propositional, i.e. we need this *conceptual indifference* which, I believe, is what ‘probative value’ offers. At least, this is the aspect of the notion that I want to hold onto.

Alternatively, I do not want ‘probative value’ to be a power to support *propositions*, at least operational coherence is not meant to do that for Chang so we cannot use probative value as such. Hence, In the context of philosophy of science, I want, while maintaining its *conceptual indifference*, that probative value denote the power of whatever it is a power of – be that a proposition, a relation, physical object etc., to support that we are minimally ‘getting things right’ in the world.

Following this characterization, it should be clear that truth as correspondence, granting that the notion makes sense, wears its probative value on its sleeves in virtue of being a correspondence relation between proposition and mind-independent world. But we have the right to ask where does ‘operational coherence’ get its value from? This will be the focus of the remainder of this essay, beginning with Chang’s characterization of it.

In characterizing operational coherence Chang writes:

...an activity is operationally coherent if and only if there is a harmonious relationship among the operations that constitute the activity; the concrete realization of a coherent activity is successful, *ceteris paribus*; the latter condition serves as an indirect criterion for the judgement of coherence (2017a, 111).

Elsewhere he writes that

It may be best to take ‘harmony’ (or ‘harmonious’) as a primitive in its meaning, *and verifiable in the end only through the achievement of the aim of the activity* (110, my emphasis).

From this and other explanations Chang gives we learn that operational coherence is:

- a. a harmonious fitting-together of operations, where harmony is taken as primitive in meaning, and verifiable in the end only through the achievement of the aim of the activity.
- b. concerned with *actions*, thereby going beyond mere logical consistency of propositions – which makes it unlike proposition-based accounts of coherence such as Davidson (1986).

Concerning the question of criteria offered by Chang for judging coherence we get two answers:

- iii. It follows from a. that coherence itself is also verifiable in the end only through the achievement of the aim of the activity.
- iv. The concrete realization of a coherent EA will generally, *ceteris paribus*, lead to success.

For a start we can say that characterizing operational coherence in terms of harmony where harmony is taken as a primitive notion does not help in the right way in clarifying what coherence is supposed to mean. This perhaps can somewhat be remedied by providing many concrete examples of what are taken to be coherent and successful EAs and pointing out how different operations therein harmonise. Nonetheless, this still does not tell us where coherence gets its probative value from.

We get a hint at that when we look at the criteria suggested for judging coherence. What c. and d. capture is that there is a positive relation between coherence and success. So depending on the kind and strength of the relation, it may be that *success is what gives coherence its probative value*. In what follows I explore the relation that exists between coherence and success.

#### 4.1 The relation between coherence and success

I begin with the suggestion that coherence is a *sufficient* condition for success. That is if the EA is concretely realized we get success. Consider the activity of match-lighting, which is one of Chang's examples. This involves holding the matchbox firmly with one hand and holding the match firmly with the other, pulling the head of the matchstick across the rough strip on the box at an appropriate angle and at the right speed, then, finally, stopping the movement of that hand once the flame appears. As things stand, this EA once concretely realized leads to success, and, following Chang's claim that success is a good indicator of coherence, we say that the EA of match-lighting is coherent.

Now consider a very similar scenario to the one mentioned earlier where a gust of wind blows at the last instant and upsets the lighting of the match (2017a, 111). If we had performed the EA the same way we did before then we cannot, on pain of inconsistency, but say that the EA was coherent. Yet, in this example we had coherence but not success, so we cannot say that coherence is sufficient for success. But perhaps it is *necessary*?

Consider another scenario similar to the ones above, where the difference is that as soon as one holds the matchbox in one hand and the match in the other, lightning suddenly strikes the match causing it to light. Here, despite that we were not able to complete all the operations, success, i.e. getting the match lit, was achieved. Yet we cannot say that the EA was coherent because on almost any other occasion simply holding the match and the matchbox do not lead to success. Here, however, success was dependent on the lightning striking the match and not on the coherence of the activity itself. That means that coherence is not a necessary condition for success either.

Chang is well aware of situations similar to the ones just mentioned. Importantly, he accepts that coherence is neither necessary nor sufficient for success. Nonetheless, given his claim that the coherence of an activity *ceteris paribus* leads to the achievement of aims, he maintains that it is *a cause* of success. Yet, given that success can be appraised independently of coherence, and that coherence is dependent on success for its appraisal 'in the end' it seems that the notion of coherence is almost redundant. In fact, Chang comes close to admitting that when he says that coherence and success

may mean the same thing but later rejects that option because we may have coherence while failing to have success as in the case of the wind above. All of that makes answering the question concerning the source of coherence's probative value all the more difficult.

## 4.2 Coherence as guiding practice

But perhaps we got off on the wrong foot when we sought the probative value of coherence from without the notion and its function in EAs. Recall that according to 1) in the introduction, coherence was supposed to accomplish what *prima facie* looks like two tasks with respect to getting things right in the world.

- i. Judge EAs.
- ii. Guide EAs.

To illustrate the difference between i and ii, consider a case where we are assembling a high-tech device such as a smart phone. With respect to ii., we may be able use coherence to help adjust and assess the *process* of the assembly activity to get things right in that process if we are familiar enough with the ins and outs of the device including the roles of its component parts and how they fit together. Alternatively, with respect to i., we can wait *until after* the assimilation is done and the device is turned on to check if it works. So we have judgement *simpliciter* and guidance *for the process*.

Recall that I said this in aid of understanding what 'probative value' consists in: 'probative value denote[s] the power of whatever it is a power of – be that a proposition, a relation, physical object etc., to support that we are minimally 'getting things right' in the world. In this sense coherence can be said to have a probative value, which I said correspondence wears on its sleeves, when it is shown to help us judge EAs.

It is very likely that Chang, given his practice-based approach, would find the way I framed the question of assessing coherence in terms of probative value, which coherence is supposed to have in virtue of it helping us judge EAs and *additional* practical added-value which it virtue of it helping us guide EAs is misguided. He would probably add that this misconstrual is due to my failure to appreciate the real weight that practice has in his new framework.

The probative value of coherence, he would explain, is not restricted to it helping us judge EAs. Guiding EAs has probative value as well. Thus in response to our question Chang would say that *coherence acquires its probative value from its very ability to guide scientific practice*. If that is cogent then we can claim to have made progress in understanding Chang position which will eventually help us assess his claim that coherence is better than correspondence in practice. The question now becomes to what extent does coherence succeed in *guiding practice*?

As noted in c., it follows from Chang's claims that coherence is verifiable in the end *only* after the achievement of aims. Yet this limitation that Chang imposes on coherence actually defeats its aim in *guiding practice* as it blocks our ability to

assess EAs in the process so it is advisable to drop it. This goes well with Chang's later remarks that coherence, unlike correspondence which can be understood as an all or nothing concept, comes in degrees (2017a, 107).

This means that we can have coherence as well as incoherence in the same activity – this option, Chang may contend, is not available for proponents of correspondence. As such, he would maintain that *while assessing activities we can pick up signs or symptoms of incoherence. This allows the notion to be useful in guiding practice.* Examples of symptoms of incoherence that Chang gives include false beliefs, mutually incompatible beliefs and lack of ability i.e. muscular ability, inappropriate materials (109). But how useful are these symptoms of incoherence in practice? Let us test that with an example.

### 4.3 Testing coherence in practice: Locating the cellular nucleus

Consider the activity of locating cellular nuclei using fluorescent microscopy. In order to do that we must first stain the cells with 4',6-diamidino-2-phenylindole (DAPI). DAPI binds to the adenine and thymine (AT) region of double-stranded DNA (dsDNA) which, when the cell is not dividing, is located in the nuclei. Upon excitation, DAPI emits a blue colour which can be seen under a fluorescent microscope. All of this is presumably factual information. Now let us consider scenarios where we have false beliefs about some of the information above and see how they may affect the coherence of our epistemic activity.

Let us begin with the case where someone does not know that DAPI binds only to AT but instead believes that it binds to all nucleotides (A, T, C, G) indiscriminately. If someone with such a belief does stain the cell with DAPI and looks under fluorescent microscope, she will be able to very accurately locate the nuclei. Thus, this obviously *very relevant* yet false belief does not affect her nuclei-locating activity. Given that coherence comes in degrees and we are managing to achieve our aim, it doesn't seem unreasonable to say that in this case that the person is carrying out a coherent and successful activity. One may respond to this by saying that this false belief is not entirely false, indeed it could even be said to be 'approximately true' for the person has the approximate truth that DAPI binds to AT—along with partial falsehood that it binds to CG as well.

Now let us consider the case where someone believes that DAPI binds *only* to CG. This is a 'more serious' false belief because it lacks the 'approximately true' part which says that DAPI binds to AT. But as before, this false belief serious as it is, would still not affect her nuclei-locating activity which would also be 'coherent enough' and successful because at the end of the day she is achieving the aim of accurately locating the nucleus. But now some may grant that believing that DAPI binds *only* to CG is a relevant, serious, false belief which leads nonetheless to a coherent successful activity, but they may hold that there is still some truth to it. After all, when DAPI is binding to AT, it is binding to DNA and CG is DNA so in some stretched sense of approximate truth we can still make the argument that the falsity in the belief is really not *that* serious. But how much are we willing to stretch

the notion of approximate truth before it becomes empty? This brings me to my third and last case.

Consider someone who does not know that DAPI binds to DNA *at all*. Instead she believes that it binds to the nuclear membrane. How would that affect her nuclei-locating activity? To answer that we need to first note that the typical eukaryotic cell (which is basically a cell that has a nucleus) undergoes a cell cycle that lasts around 24 hours. This is divided into interphase and mitosis, which last around 23 hours and one hour respectively. During the interphase the cell has a nucleus and the chromosomes are contained within it. Only during mitosis does the nucleus disintegrate only to reintegrate again after around an hour. Thus a cell spends approximately 95% of its time in interphase wherein the chromosomes are contained in the nucleus. This means that roughly, if someone believes that DAPI stains the nuclear membrane she will be able to carry out a coherent, successful nuclei-locating activity roughly 95% of the time. In this case, the person performing the activity would be holding false as well as contradictory beliefs and still be able to carry out a coherent and successful activity. Let me explain.

A person who holds that DAPI stains the nuclear membrane would be holding a number of false beliefs and two contradictory beliefs. These include the belief that 1- DAPI does not bind to AT, 2- DAPI binds to the nuclear membrane, 3-DAPI has a low membrane permeability (otherwise it would not bind to the nuclear membrane, it would go directly inside it). However given that in order for the person to believe that DAPI does enter the cell – in order to stain the nucleus, she needs to believe DAPI has high membrane permeability – for it to cross the cytoplasmic membrane. Yet, both the cytoplasmic membrane and the nuclear membrane are roughly made of the same material which is a phospholipid bilayer. So the person would have to believe (whether she is aware or not) that DAPI has a high permeability and low permeability at once. Interestingly, that person would be holding all these false, some of which are contradictory, beliefs and still be able to carry out a successful nuclei-locating activity roughly 95% of the time. Such an activity with such a high success rate, given criteria supplied by Chang, I maintain should be considered operationally coherent.

Chang is likely to welcome this example and respond that it actually supports his account rather than challenges it. After all, the notion of operational coherence, he argues, comes in degrees. All of the activities above were more or less coherent evidenced by the fact that we are successfully achieving our aims of nuclei-location. I wish not to dispute that. But what I would like to do is to draw attention to two difficulties.

First, coherence in guiding practice is meant to have a probative value, which I previously clarified as the power to prove that we are getting things right. As such, having all these false and contradictory beliefs which, Chang tells us, are symptoms of incoherence should warn us that the EA is likely going to fail. Yet if we take the last case, which is the most drastic, we still get success roughly 95% of the time, meaning that at least in this particular activity these signs of incoherence are helpful in neither judging the EA nor guiding practice.

Second, given the way Chang characterizes the truth of a claim in terms of the latter's being pragmatically necessary for carrying out an EA, then a claim such as

“DAPI binds to the nuclear membrane” should also count as true which is absurd given our current understanding. To this Chang may respond that such a claim is not *really* necessary for success. After all, what is necessary is in fact that “DAPI binds to AT”. But such a response seems to me to be a two-way street. That is I see no reason why someone cannot claim that that DAPI binds to AT is not really necessary because it could be said to bind to the nuclear membrane.

Here Chang can make the following move and claim that although the success of the activity given the claim that DAPI binds to the nuclear membrane is roughly 95%, its success given the claim that DAPI binds to AT is 100% and we should favour the claim which gives the highest success rate. Granted, but then the idea of the highest success rate would need to feature in Chang’s characterization of truth and as things stand it does not.

But even given this move, Chang is still not entirely off the hook. That is because an activity with the claim that DAPI binds to all nucleotides indiscriminately would have the same success rate as that featuring the claim that it binds to only AT. Hence, a similar argument to the one above can be run, however this time Chang does not have the turnover move to block it.

Chang could protest that the examples given above are far from typical and as such would not jeopardize his account but that would be missing the point. There is a reason why we are able to come up with such examples and dismiss them as being atypical. The reason is that we take the claim that DAPI binds to AT to be true, literally true and not pragmatically true relative to an EA. If the latter were the case, then we would have two ‘relative true claims’ which pull in opposite directions, neither of which can, given Chang’s current criteria at least, claim to be what really is the case. Here, the idea of activity or mind-independence that correspondence claims to offer seems to be playing an important role in giving us this much needed ‘fixed frame of reference’ which we use to tell the typical from the atypical, without it, malign relativism seems to loom – I qualify with ‘malign’ because I do not think that all forms of relativism are malign and this I further clarify in section 6.

There is also a response which I saved for last. This could arguably overcome the challenge above and its ilk, and claim Chang victor. But, this, as will be clear, would amount to a pyrrhic victory. In line with Chang’s counting his position a form of scientific realism, I have been, for the length of this chapter, trying to provide the most realistic reading possible of Chang’s pragmatic realism. Later we will seriously consider to what extent we can consider Chang’s pragmatic realism a form of realism. But for the time being, we will take for granted that it is a form of realism, that’s why I take the following response to amount to a pyrrhic victory of Chang’s pragmatic realism to the extent that it is a form of realism.

Given Chang’s practice-based framework, his notion of pragmatic truth and reality are dependent on the concrete realization of a coherent and successful EA. This dependence can be understood in two ways. One way, which I have been so far assuming, is to say that coherent and successful EAs warrant the pragmatic truth of the related statement and reality of the entity mentioned in it so long as we are dealing with *that* and relevantly similar, system. So the claim remains pragmatically true even after the activity has been carried out so long as we are wary of the context in which we are making such a claim. On this reading, within the same SP and under

relevantly similar conditions, a claim that we know to be false, given our current understanding, but which Chang's account allows to be true, causes us to seriously doubt the 'realism' of Chang's pragmatic realism.

However, the other way to understand the dependence of pragmatic truth and reality on activity is *indexical*. That is to understand the pragmatic truth of a statement and the reality of an entity strictly given *this* or *that* particular EA. In this sense the pragmatic truth of a statement and reality of an entity are *never* 'detached' from the *same* EA that warranted their truth and reality in the first place. So if we consider the objection above, for instance that DAPI binds to the nuclear membrane, that statement would count as pragmatically true *with respect to that particular EA* which was concretely realized by that particular agent in that particular place, at that particular time. On that reading none of what we took to be false beliefs above can be considered false, not even that DAPI binds to the nuclear membrane. Also accepting that a statement and its negation can both be true does not lead to a contradiction if each is used in a different EA. This response may salvage Chang's position but it makes very difficult, perhaps outright impossible, that anyone would seriously consider this to be a realist view, and this I believe is enough to rule out this interpretation.

It is worth noting that there may indeed be a way to give Chang's indexical reading a more realistic twist. That is if we introduce a distinction between 'type EAs' and 'token EAs'. Claims, given this distinction, could then be indexed to type EAs but not to the token EAs thereby maintaining a sense of projectibility and possibly allowing for a more credible sense of realism – I will use the notion of EA type below. Yet this option, I believe, is not open for Chang, at least given the way that he characterizes EAs, for there he insists that EAs are *concrete* and not abstract, and types are supposed to be abstract.

As such, given that none of possible responses considered seem satisfactory, what transpires is that operational coherence, for Chang,

- Turns out to be a modest concept that is neither necessary nor sufficient for success and criteria for assessing it are mere symptoms that it may fail.
- It is verifiable in the end, according to Chang, only once success is achieved (a condition which we suggested should be dropped if coherence is to guide practice) and
- Even then success is not a sure sign of coherence and
- In practice we may pick up signs of incoherence which may act as red flags although, as shown in the example above, they do not necessarily upset success.
- Given its current construal coherence allows for incompatible claims to be both true even within the same SP.

This is already an unhappy conclusion for the prospect of operational coherence being able to successfully guide practice. But, keeping in mind that Chang claims that coherence is supposed to be able to do that better than correspondence, it appears that proponents of truth as correspondence can make similar claims when it comes to the role of their notion guiding practice. That is, given the low bar that Chang has set, proponents of truth as correspondence can claim that



- like coherence, correspondence is also (more firmly) verifiable only once success is achieved.
- There are signs of lack of correspondence such as false beliefs and contradictory beliefs, just like there are signs of incoherence.
- These signs although not guaranteeing failure at success can act as red flags.

More importantly truth as correspondence does not allow for incompatible claims. So we would not have embarrassing conclusions such as that DAPI binds to the nuclear membrane and that DAPI binds to AT are both true.

At bottom, it seems that Chang's notion of coherence has two difficulties:

1. It is not clear that it is able to *reliably* guide practice (the examples given above, admittedly atypical, cannot be shown to be so given Chang's criteria).
2. It does not seem to fare better than correspondence at guiding practice.

Although both claims constitute difficulties for Chang's pragmatic realism, the first is more threatening. In what follows I try to strengthen Chang account of coherence so as to make it more fitting for realism.

#### 4.4 Strengthening operational coherence

Given the difficulties above, it is perhaps unsurprising that Chang is not entirely satisfied with his characterization of the relation between coherence and success. At one point he came close to conceding that success and coherence may amount to the same thing before he finally settled on coherence being a cause of success, in the sense explained above, which we have already shown is too weak. We can begin to improve on Chang's account by removing the *ceteris paribus* clause from his characterization. After all, it seems that the only role it is playing here is to protect Chang's characterization. What's more, I claim that in practice we do not use the *ceteris paribus* clause, instead we need to fill in local details – lots of local details, to bring about success.

Let us reconsider the example I gave earlier about the lightning lighting the match. It may not be entirely satisfactory for some, after all there is a reason why the saying goes “lightning never strikes the same place twice”. But perhaps this strange example is a sign that we should not aim for unqualified success, but for something more specific which is less susceptible to such counterexamples. Chang was already thinking along those lines when he maintained that he does not want his notion of coherence to be “tied to accidental successes and failures determined by case-by-case variations of fringe circumstances” (Chang, 2017a, 114).

That being said, I am not entirely sure what Chang means by ‘accidental success’. The two meanings that I can find, however, organically belong to scientific practice and should not, as such, be discounted. These are:

1. Accidental as unexpected.
2. Accidental as unintentional.

Let us first note that at any moment in time we are epistemically constrained by what we know. So, to achieve a particular aim, we may have more than one set of different, yet coherent, operations which can *ceteris paribus* lead to success. For instance, in the case of the match-lighting activity, we may pull the match against the match-strip but we may also push it. These operations are different and so are the sets that include them. It could be that we never expected the pushing to be conducive of success but find out that it actually is. What this is meant to show is that we may have different sets of operations all of which, however, lead to the success of the same activity-*type*. This is a case, and accordingly a sense, of accidental success which we would not want to disqualify. I now turn to the second sense which is accidental as unintentional.

*Prima facie*, it seems like ‘unintentional success’ is self-contradictory. After all if success is achieving one’s aim and unintentionality is lack of aim, then it seems that there is no way that we can have both. However, many successes in science have been unintentional. A scientist performs an EA to achieve a particular aim; she notices that her experiment yielded some striking results which are not conducive to her *initial* aim but which are nonetheless worth further exploring. As a result, she changes her aim to suit the new findings and ends up replicating the same activity so as to reach this new aim. This is prevalent throughout the history of science, from the discovery of penicillin to the production of the first plastic, etc., so discounting unintentional success in this sense is also undesirable.

I believe that Chang would not want to disqualify either sense of accidental above, although these are the only meanings of accidental that I could find. But perhaps it is a slip, perhaps Chang did not really mean accidental in the ordinary sense. The citation above shows that he is, I believe, less concerned about accidents and more about ‘fringe circumstances’. This sounds right, but then what we should do I believe is to aim not at eliminating ‘accidental success’ but at qualifying the kind of success that we are willing to tie coherence to.

My suggestion is that we should tie coherence to *systematic* success. But this only solves half of the problem. That is because introducing systematicity can make coherence a necessary and sufficient condition instead of it being merely a cause of success on Chang’s account. This, thereby, redeems its probative value and its ability to guide practice. However, it still leaves the possibility of having incompatible claims such as DAPI binding to AT and DAPI binds to all DNA indiscriminately being both true, which I said is something we do not want to have on a realist account. On closer inspection we will see that this also can be avoided.

Going back to Chang’s characterization of coherence, it seems that he was keen on making room for, *prima facie*, incompatibility *inter SP*, i.e. between incompatible SPs such a phlogiston-based SP vs an oxygen-based SP. This, however, has led him to overlook incompatibility *intra an SP*, i.e. between EAs within the same SP. If we discount what I called the indexical reading of Chang’s account, we can then say that, clearly, Chang does not want claims such as that DAPI binds to all DNA indiscriminately and that DAPI binds only to AT to be both true. But there is nothing in his criteria that preclude that.

A way to avoid this, I believe, is to introduce SP into the characterization of operational coherence. By that I mean that the coherence of the EA which Chang so focuses on should be subject to the coherence of the entire SP. So, for instance, in the case where we want to locate the nucleus it seems that both claims above can do. Yet, given that they are incompatible we want to suspend judgment and check how other EAs within the same SP go. It will turn out that in trying to stain a CG rich region with DAPI, the activity fails, yet when trying to stain an AT region the activity succeeds. This leads us to conclude that DAPI does not in fact bind indiscriminately to all DNA. Hence to ensure the overall coherence of the entire SP, we want to preserve compatible and mutually supportive claims and eliminate incompatible ones. As such we can characterize coherence as follows:

Given a system of practice *SP*, a certain aim *X*, and an epistemic activity *EA(X)* (as and where it is actually carried out), *EA(X)* is operationally coherent iff within *SP*, *EA(X)* is systematically conducive to *X*.

As for what we mean by systematic success, I offer the following characterization:

Given *SP*, *EA(X)* is systematically conducive to *X* iff the conditions *C* under which *EA(X)* is concretely realized are mutually supportive enough, given *EA*, to allow for the reliable achievement of *X*.

What I am aiming at here is to relax Chang's overemphasis on actions and to allow a place for propositions in the form of conditions. Chang, we should keep in mind, in challenging the proposition-based framework, he is not simply making way for 'action' in epistemology, which I take to be sensible. Instead, he is proposing a radical shift by denying propositions the fundamental conceptual role in epistemology, which I take to be extreme – I say more on that in section 7., where I provide some remarks on the epistemology of practice. For now, I content myself with saying that strengthening coherence requires linking it to systematic success, which in turn requires that we countenance conditions that must be satisfied. Many of these I take to be true in the correspondence sense – for reasons that go beyond this discussion, but Chang can still accept them as true in his own pragmatic sense.

Some of these conditions seem to exist together naturally while others hold only under regimented conditions. Consider again Chang's match-lighting example. He tells us about all the operations that must be coherently performed to bring about the lighting of the match. But what he fails to mention are the conditions that must also hold for our activities to lead to success. Such conditions include that the air be sufficiently oxygenated or dephlogisticated (bearing in mind Chang's pluralism), that the matches not be wet, that the air not be very damp, that there be friction etc. The conditions I have just mentioned are almost always there, they exist naturally and they allow for a systematically successful match-lighting activity. But how can we determine what conditions must be mutually present given a particular EA to arrive at systematic success? The answer to this question cannot be determined a priori, it must be determined in practice.

Generally, once systematic success is achieved, we can start to control for conditions to assess which conditions have a role to play, given EA, in the bringing about of the regular achievement of aims. Did my wearing my lucky green shirt play a role in the match-lighting activity? I change my shirt and find out. It is important to emphasize that assessment is bound to be contextual. Lightning may not be a condition that exists regularly enough to engender a systematic success in match-lighting activity in most places on earth, but in places like Lake Maracaibo in Venezuela, where Catatumbo lightning is a regular phenomenon, it may well be.

I believe that including SP in the characterization of coherence and tying the latter to systematic success where systematicity is characterized in terms of mutually supporting conditions given an EA has at least three advantages over Chang's. First, it allows for a stronger relation between coherence and success in a way that makes the former necessary and sufficient for the latter thereby salvaging its probative value. This is especially pertinent as Chang wants coherence to guide practice. Second, it blocks incompatible claims belonging to different EA but to the same SP from being both true. Third, it helps to relax Chang's overemphasis on action at the expense of propositions by giving each its due.

However, this, if successful, solves only the first problem, i.e. it gives a more robust construal of operational coherence, one which can be used to guide practice, but it does not support Chang's claim that coherence is better than correspondence in practice because, as we said earlier, Chang's appeal to *symptoms* such as false and incompatible beliefs as ways to guide practice is equally available to proponents of correspondence.

Importantly, proponents of correspondence who are sympathetic to Chang's pleas for a practice-based philosophy of science may agree with him on the central role of operational coherence in guiding practice almost down to the last detail without feeling the need to relinquish correspondence. They would allow that Chang makes it seem that coherence and correspondence are incompatible – they surely are on his account. But a minor conceptual shift would reveal that, pace Chang, not only can these be compatible, but more importantly they can be complementary. I consider how this can be done in the last section where I provide general remarks on what a realist epistemology of practice can be. But before I get to that I want to take a step back and consider two general questions, which I have postponed until after I presented the details of Chang's position. These are 1- broadly, in what sense is Chang's position pragmatist, i.e. how does his position relate to those of the classical pragmatists?, and 2- in what sense, if at all, is it realist? These two questions are important because 'pragmatic realism' seems to be an oxymoron, at least for those who, under the influence of Richard Rorty (1982, 2009), take pragmatism to be a form of antirealism. Hence, answering these two questions helps to remove this tension as well as to properly locate Chang's own position within these two camps.

## 5 Chang amongst the pragmatist

To answer the first question, I begin by considering Chang's own interpretation of pragmatism. He notes that

The most fundamental point about pragmatism, as I take it, is that knowledge is created and used by intelligent beings who engage in actions in order to live better in the material and social world (Chang, 2019, 11).

This remark broadly captures the zeitgeist of pragmatism as a tradition that emphasizes the central role of agency in the world (Legg & Hookay, 2008). The latter is highlighted in Chang's framework by making the aims of agents defining features of EAs and SPs and replacing the proposition-based framework with an action-based alternative. More specifically, pragmatism has been understood as a theory of meaning, a theory of truth, and as an overall method of learning. Chang subscribes to all three.

Pragmatism as a theory of meaning was first introduced by C. S. Peirce (1878) with his 'pragmatic maxim'. It has since received many formulations. A famous one due to William James is:

to attain perfect clearness in our thoughts of an object, then, we need only consider what conceivable effects of a practical kind the object may involve—what sensations we are to expect from it, and what reactions we must prepare. Our conception of these effects, whether immediate or remote, is then for us the whole of our conception of the object, so far as that conception has positive significance at all (James, 1907, 46-47).

This semantic interpretation of pragmatism was accepted by James as a "method for settling metaphysical disputes" (45). Chang also accepts this interpretation of pragmatism as broadly inviting us to get clear on the content of our concepts by identifying the practical consequences of their applications (Chang, 2019, 11). This, for him, makes semantic pragmatism in a sense continuous with the logical positivists' verificationism and Percy Bridgman's operationalism, the latter of which Chang is at pains to rehabilitate (see Chang, 2017c). But Chang is not content with restricting himself to the semantic interpretation, for that, he holds, following Philip Kitcher (2012), amounts to 'domesticating pragmatism'. Instead, he wants pragmatism to be "a philosophy that helps us think better about how to do things, not just about what our words mean" (Chang, 2019, 12). This brings us to the second understanding of pragmatism as a theory of truth.

I already said that Chang accepts a pragmatic theory of truth according to which a statement is taken to be true if belief in it is pragmatically necessary for carrying out a coherent and successful EA. Such an account of pragmatic truth could be said to either coincide with Peirce's account of truth as 'end of enquiry' or to significantly diverge from it. The ambiguity here lies in 'end' which can be understood either as the 'aim' or the 'final state' of enquiry (Haack, 1976).

On the former reading, Peirce's account and Chang's do seem to coincide. Suppose we understand Chang's EA to coincide with Peirce's 'inquiry', where the latter,

for Peirce, is understood as a “process that takes us from a state of doubt to a state of stable belief” (Legg & Hookay, 2008). Then achieving the aim of the activity would be reaching the end of enquiry, and on both accounts whatever beliefs required to reach our end are taken to be pragmatically true in that sense. But taking the end as the ‘final state’ of enquiry, which captures the more popular reading of Peirce, does not. This is especially the case when we note that, later in his life, Peirce took truth as the final stage of enquiry to be a ‘regulative ideal’ and nothing that we can confidently claim to be converging on.

This reading of Peirce on truth is inconsistent with what Chang wants of truth. For one of the most important reasons why Chang rejects the correspondence notion of truth is that he thinks we can never know whether we have arrived at it (Chang, 2018, 31). Chang wants truth that we can know when (or if) we arrive at it, one that is useful in the here and now of scientific practice (33), and not a regulative ideal that may not even exist.

Accordingly, Chang endorses James’s view that ‘the true is the expedient’ (James, 1907, 222). But he refuses to interpret ‘expedient’ as the merely ‘useful’ or ‘convenient’. Instead, Chang interprets James’s ‘expedient’ as whatever allows for successful experience when confronted by reality (2019, 13). In this sense James’s ‘expediency’ is quite similar to Chang’s ‘pragmatic necessity’ which is at the heart of both his theory of truth and reality. This brings me to the last sense of pragmatism that Chang endorses which is pragmatism as a method of learning.

Chang’s interpretation of James on ‘truth’ which makes experience in the empiricist sense *the source* of truth by holding that the true is whatever is required for successful experience in the face of reality, allows him to construe pragmatism as a form of ‘deep empiricism’ which says that experience is “the only ultimate source of learning” (13). For Chang, the next step for pragmatism *qua* deep empiricism is to develop a learning method that is fit for purpose. The seeds of such a project, Chang holds, are to be found in John Dewey’s (1938) *Logic- The Theory of Inquiry*, which tells us that the content of our learning along with our method of learning arises from successful habits of thinking, which we develop through the same process of enquiry. Chang considers his own pragmatic realism a development of the pragmatic method (2019, 15).

## 6 Realism, Perspectivism, and relativism

I noted at the outset the challenge that faces any attempt to assess whether and to what extent a self-proclaimed realist position is indeed realist. Ideally we would have a crisp definition of ‘scientific realism’ with certain necessary and sufficient conditions. But as anyone who is remotely familiar with the scientific realism debate knows, the situation is far from neat and tidy. In fact, attempts to understand what scientific realism amounts to have resulted in a definitional morass, leading a key player in the debate to maintain that

It is perhaps only a slight exaggeration to say that scientific realism is characterized differently by every author who discusses it (Chakravartty, 2011).

That being said, Chakravartty does end up providing what seems to be a minimalist criterion that every self-proclaimed realist position should meet, namely that, qua realism, it should adopt a ‘positive epistemic attitude’ towards science. On that account, Chang’s pragmatic realism is a form of scientific realism. But here we should keep in mind that, given Chang’s radical break with the traditional proposition-based framework and his development of his action-based alternative, what adopting a ‘positive epistemic attitude towards science’ means for Chang is significantly different than what was originally intended by traditional realists. Hence, fully committing to the claim that Chang is a realist in the sense intended by Chakravartty requires a more careful consideration.

Traditionally, the positive epistemic attitude towards science has been cashed out in terms of Stathis Psillos’s (1999) *metaphysical*, *semantic* and *epistemic* theses, which roughly say that there is a mind-independent world, that our scientific descriptions of this world, both the observable and unobservable domains, are truth-conditioned, and that these descriptions are approximately true more often than not. Almost all later qualifications of traditional realism accept some form of Psillos’s three theses.

Now if we compare Chang on realism to the more traditional account we realize that he only agrees with the traditional realists on the metaphysical thesis but disagrees with them on the rest. That is despite agreeing that there is a mind-independent world, Chang, I said, takes the mind-independent world to be akin to Kant’s noumena about which “we can and should say nothing”. This denies Chang a place amongst the traditional realists but it reserves him a place in the venerable tradition of neo-Kantianism, a recent variant of which, namely ‘perspectival realism’ is currently thriving in philosophy of science (See Massimi & McCoy, 2020).

Chang takes to heart the kernel of perspectivism, namely the ‘situatedness of our scientific knowledge’, which says that scientific knowledge is both historically situated, i.e. influenced by the practice of the historical period, and culturally situated, i.e. influenced by the prevailing cultural tradition (Massimi, 2017, 164). Moreover, he considers his pragmatic realism to be a form of perspectivism, albeit a ‘deep’ one, where a ‘perspective’ for him, in this context means a ‘conceptual framework’. Chang distinguishes his deep perspectivism from shallower or milder forms. This he does while warning against domesticating perspectivism in the same way he warns against domesticating pragmatism.

What unites mild or shallow forms of perspectivism, for Chang, is that they all assume that the world already comes pre-parsed into objects and properties, which bars having incommensurable perspectival knowledge. Conversely, deep perspectivism, which is the result and not the starting point of Chang’s pragmatic realism, denies the pre-parsing of the world, thereby denying the existence of perspective-transcendent ontological states of affairs, and accepting a plurality of perspectives which need not be connected, let alone, reduced to one another – although it does not reject that possibility outright either and considers it a question open for empirical investigation (Chang, 2019, 22).

Some may complain that Chang’s pragmatic realism is really disguised relativism. That is, with its deep perspectivism and metaphysical pluralism it cannot really be a form of realism. I think that Chang’s response to this charge would probably

be that his view is indeed relativist, but also that relativism is not incompatible with realism. So he is a realist and a relativist. To see how that is possible we need to look at what relativism is or can be.

Much recent work has been done to clarify what relativism means in general (Kusch, 2019) and in the context of philosophy of science (Kusch, 2021). What such works tell us is that relativism is a genus term under which many species fall. Kusch, following Susan Haack (2000), provides a general scheme to broach the question of relativism. This scheme is of the form 'x relative to y'. Kusch notes that depending on what 'x' and 'y' stand for we may end up with different forms of relativism, such as:

- Ontological relativism where 'x' stands for objects, properties.
- Alethic relativism where 'x' stands for truth(s).
- Semantic relativism where 'x' stands for classifications, concepts, or meanings
- Epistemic relativism where 'x' stands for epistemic justification.

And 'y' can range from individuals to cultures, to scientific paradigm, etc. (2021, 2).

Consider semantic relativism when philosophers disagree as to whether whales are fish or mammals (Dupré, 1999). This kind of relativism seems benign with respect to realism. Or take the recent attempts by traditional realists to fortify their success-to-truth inference (Vickers, 2019). This falls under epistemic relativism, but we also would not say that this form of relativism is incompatible with realism. If anything it seeks to support it. I could go on, but the point I am trying to make should be clear by now: there is nothing intrinsic about relativism that makes all species of it incompatible with realism.

That being said, Chang's pragmatic realism perhaps includes all four kinds of relativism. His deep perspectivism makes him a semantic relativist, his denying that the world is pre-parsed makes him an ontological relativist, his emphasis that the truth of a claim is always given within a particular EA makes him an alethic relativist, and his claim that EAs take place within a SP which determine the methodological rules makes him an epistemic relativist. With all these forms of relativism one may be tempted to dismiss the claim that Chang's pragmatic realism is indeed realist but that would also be too quick.

What speaks in favour of Chang's realist case despite the many relativists threads running through it is his emphasis on practice and reality. After all, Chang's position is a practice-based one that aims to maximize our learning from reality. What is the tribunal for Chang is not individual taste, not culture and not scientific paradigms. It is successful scientific practice when confronted with reality which often refuses to cooperate and, in the words of James, forces us to correct our formulas. This, I believe, makes Chang pragmatic realism deserving of the realist label.

Many traditional realists will find this unsatisfactory. They will scoff at a realist position that not only fails to tell us anything about reality but also thinks it is impossible to do so. This for me is the Achilles heel of Chang's pragmatic realism, not his pluralism, not his relativism, but the failure of a purported realist position to tell us anything about reality. The middle ground then is not to deny that Chang's



position is realist but to highlight that it is *not realist enough*. Nonetheless, I believe that traditional scientific realists ought to benefit from Chang's position and overall practice-based framework by distilling some of the key insights of his that they can use to strengthen their own positions. In the following section I provide some reflections on Chang's epistemology of practice and point out how this can be done.

## 7 Remarks on epistemology of practice

At bottom, Chang's new framework is suggested as a response to the overemphasis on theory to the detriment of practice (similar worries have been voiced by other practice-oriented philosophers of science, more recently Waters (2019) and Boon (2017) and references therein). Yet, when motivating his framework, Chang carries over the criticism he levels against theories in order to discount propositions as well. This move, however, seems neither explicable nor warranted. Just because theories fail to be exhausted by sets of propositions, it does not follow that propositions need to be eliminated in a practice-centred approach. Here we are not concerned with Chang's criticism of correspondence as an account of truth, which is arguably the reason for his dissatisfaction with propositions. For the debate here is methodological. Chang's criticism is that a theory-based or even a proposition-based framework fails to do justice to scientific practice.

Dissatisfaction with theory is not really a peculiar feature of Chang's framework as in the last 30 years philosophy of science has seen theories lose hegemony, particularly to experiments (Hacking, 1983, Radder, 2003, Arabatzis, 2013), scientific models (Morgan & Morrison, 1999; Morrison, 2007, 2015; Cartwright, 1999, 2019; Suarez & Cartwright, 2008), and more recently measurement (Tal, 2013, 2015; Reiss, 2010, 2016) and even narrative (Morgan & Wise, 2017). This is taking place alongside pleas for 'theory eliminativism' (Vickers, 2014; French, 2020). What is peculiar is the way Chang transforms propositions. On Chang's account, in taking the backseat to actions propositions lose everything that makes them interesting from a realist standpoint, namely that they tell us *about* reality. This, I pointed out, is what I take to be the Achilles heel of Chang's pragmatic realism and, it is, arguably, this that makes traditional realists consider Chang's not to be a serious form of realism. But this I believe can be remedied. With few amendments, Chang's powerful framework I think can be given an equally powerful realist interpretation. In what follows I give a few pointers as to how this I think can be done.

An on-going, but perhaps implicit theme that runs through Chang's discussion is that simply explaining the success of science in terms of truth, as realists do, fails to appreciate all the complexity and interconnectedness of different practices that go into the bringing about of this success. Not to mention that these successes, just like the practices that bring them about, are local and so should be evaluated as such (See Cartwright, 2020). This in a sense echoes Alexander Bird's (2021) overall dissatisfaction with second-order arguments in the realism literature, such as NMA and PMI, for not bringing to the table new evidence for or against the truth of scientific claims. Notwithstanding Bird's claim, the point is that truth is not doing much

evidential work in explaining the success of science *in practice*. It is in light of these considerations that Chang introduces his notion of operational coherence.

Notice, however, that coherence here is playing a *justificatory* role. It is helping us to justify a set of practices. But truth and justification are two different things which Chang fails to properly distinguish throughout his discussions, especially when trying to show why coherence is better than correspondence. If my claim that coherence is playing a justificatory role is cogent – this may not be Chang’s favourite reading but his own work does lend itself to such an interpretation especially when it describes coherence as the *source* of truth (Chang, 2017a), then his comparison between correspondence truth and operational coherence is flawed from the get-go. That is because it is a comparison between a theory of truth in the form of correspondence with what may be taken as theory of justification in the form of operational coherence. But there is nothing problematic about a position that combines these two. In fact, Laurence Bonjour, for example, has defended a similar combination in his *Structure of Empirical Knowledge* (Bonjour, 1985).

Similarly, recalling my liberal construal of epistemic support in my discussion of probative value as being one that involves minimally ‘getting things right’ in the world and includes the propositional as well as the non-propositional, I think we can interpret Chang’s ‘operational coherence’ as a theory of epistemic justification within the domain of science – and if Chang wishes even outside science, without, however, relinquishing correspondence as an account of truth.

On that account, when an EA is deemed operationally coherent this lends support to the sum of both the propositional and non-propositional components that were relevant for the coherence of that EA. These include theories, laws, local claims, as well as concepts, experiments, instruments, measures (this is not exhaustive). Many of these are not candidates for truth and falsity so they are not directly relevant to the realism question, at least as traditionally construed.

As I am sympathetic to Cartwright (2019) with her suggestion that laws and theories do not express propositions and that they cannot be rendered to express propositions without either being false or losing universality, what I take to be relevant for realism are local models and the local claims that can be constructed from these models. When an EA is coherent as I have characterized coherence, then we have good enough reasons to accept that the local model is representative of the target system and that, pace Chang, local claims that we construct from these models are true in the correspondence sense so long as we do not take those claims beyond those and relevantly similar domains.

Arguably, Chang might think that reinterpretation defeats his original aim, which is to banish correspondence from philosophical discussions. But I believe that for realists who see virtue in Chang’s practice-based framework yet want to maintain that their claims are *about* reality in a more robust sense of reality than Chang’s ‘little r’ reality, a combination of operational coherence as the theory of justification and a correspondence theory of truth seems ideal. Working out the changes that must be made to accommodate this conceptual shift and how the framework will eventually end up looking is a task for another paper, but for now these minor points will suffice.

## 8 Conclusion

Pragmatic Realism is Chang's attempt to reorient the realism debate away from truth and towards practice. It replaces the common proposition-based framework by an action-based alternative. It does away with truth as correspondence for 'operational coherence' which Chang introduces as a success term with probative value to guide practice. It ultimately accepts a pragmatic theory of truth and reality, whereby a claim is considered true and an entity real if taking them as such is pragmatically necessary to carry out a coherent and successful epistemic activity. I argued that coherence construed as neither necessary nor sufficient is too weak and fails to guide practice. I offered a stronger notion of coherence which makes it necessary and sufficient for *systematic* success. This salvages the probative value of coherence but leaves the question of its superiority over correspondence in practice open. In the final analysis, I take Chang pragmatic realism to be worthy of realist label despite the many relativist threads going through it, since it aims to maximize our learning from reality, even if it falls short of telling us anything about it. I finished by questioning whether giving up correspondence is necessary to make way for practice, pointing out that a realist practice-based epistemology can have a place for both, and provided some pointers as to how this can be done.

**Data availability** Not applicable.

**Code availability** Not applicable

## Declarations

**Conflicts of interest/competing interests** Not applicable.

**Ethics approval** Not applicable.

**Consent to participate** Not applicable.

**Consent for publication** Not applicable.

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