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Justification, Creativity, and Discoverability in Science

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Realism, scientific creativity, and theory justification

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Abstract. Scientific realists generally interpret novel empirical success and scientific fecundity as indicators that at least some of the assumed theoretical content is true. However, an influential anti-realist argument, revived by Kyle Stanford (2015, 2019, 2021), challenges this 'conservative' expectation. This presentation discusses the argument and concludes that its premises do not apply to methodologically reflexive versions of selective scientific realism.

1 Scientific realism

I will focus on realist positions emphasizing the epistemic value of novel empirical success and scientific fecundity (disclosure of new phenomena or previously unnoticed relationships between already known phenomena). That stress has a broad following in science. As Ernan McMullin (1984) noted at the start of the contemporary debate, "The near-invincible belief of scientists is that we come to discover more and more of the entities of which the world is composed through the constructs around which scientific theory is built." To McMullin's generation of realists, the expected benefit of the approach was to explain theoretical success in ways that reveal general indicators we can use to select parts of empirically successful theories that offer persistent epistemic achievements in science. Thinkers as varied as Putnam, McMullin, and Maddy, among others, linked the truth of empirical theories to empirical success. With clarifications and modifications, this expectation remains firm in contemporary projects. Realists argue that when theories show strong empirical success, it is reasonable to attribute the success to a systematic relationship or connection between the theory's representation of how things are in a certain part of the world and that part of the world. We thus have the following realist thesis:

> **Thesis $\mathbf{R}^{o}$:** A hypothesis's empirical success and fertility indicate that at least some of the theoretical ideas it assumes are true.

$\mathbf{R}^{o}$ rests on daily experience and the history of theories methodologically focused on novel prediction. In many branches of science, successions of theories commonly exhibit retentions (effective if not exact) of theoretical parts, many of which "persist" robustly. This phenomenon is particularly apparent in the modern natural sciences. One sterling example is the

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retention of classical mechanical equations found as special cases in ordinary quantum mechanics, an outcome strengthened in recent decades by realist efforts to track classical ontology to the quantum mechanical evolution of the quantum state under particular regimes of scale and energy. (See, e.g., Wallace 2012, and section 5 below).

Why do elucidations of the effective working-level emergence of earlier ontologies matter to the noted thinkers? Realism postulates a link between empirical success and truth content, one allegedly strong enough for successful theories to give us more than mathematical constructs. Hence, there is an expectation that successful theories, even when destined to be superseded, yield correct representations of at least part of the unobservable world to which they refer—ones that somehow survive theory change. Importantly, in scientific practice, theoretical retention is not just a philosophical idea but a practical reality in the natural sciences. For instance, despite the stark ontological differences between General Relativity and Newtonian theory, they share working-level (functional) descriptions of specific physical regimes. This agreement gives us some understanding of why Newton's gravitational theory remains successful under specific energy and scale conditions, demonstrating the continuity and evolution of scientific theories. To realists, the details of the intertheoretical relationships between successor and predecessor descriptions *explain* why the latter work so well under specifiable regimes. From their perspective, it is in this "working/effective" sense that radical theoretical change is compatible with the truth of selected parts of the earlier theory.

In the opposite interpretive camp, non-realist thinkers emphasize the existence of a multitude of historical episodes of radical revolution at the level of theoretical foundations. In response, realists attentive to the last half-century of philosophical analyses of the history of science recognize the need to compromise. One concession they make is the expectation of new drastic discontinuities in scientific ideas to come. Successful empirical theories are usually wrong about some aspects of their intended domains. As whole constructs, empirical theories are probably false. However, reformed realists stress that a false theory may contain truthful parts, pointing out that, despite the recurrence of radical conceptual change, there are substantial continuities between the dominant theories in the classical period and the contemporary ones. This emphasis on conservation of content is the hallmark of "Selective Realism," a family of projects variously developed in the last decades of the previous century, especially by John Worrall (1989), Philip Kitcher (1993), and Stathis Psillos (1999), and subsequently furthered by, e.g., Mario Ala (2021), Alberto Cordero (2017), Matthias Egg (2016, 2017), and Peter Vickers (2019), among many others. The new selective projects moderate the traditional realist expectations but maintain the idea that diachronic inter-theoretical relations will continue to support truth attributions for selected parts, especially in the case of theories rich in corroborated novel predictions.

The presumption of theoretical content conservation has critics who think selectivists often oversimplify existing historical counterexamples. Here are two influential objections: (1) the proposed criteria for selecting theoretical parts are seriously defective, and (2) the expectation of retention of theoretical parts tends to weaken the imagination and bias the planning of future research. Objection (1) has a point. Many of the selection criteria proposed have allowed for unfortunate choices. For example, Saatsi and Vickers (2011) point to seriously incorrect theoretical components that, they claim, have played a crucial role in generating scientific successes, for instance, the luminiferous aether and Kirchhoff's diffraction theory. As noted, ongoing responses to these warnings include working-level (functional) selective approaches developed in recent years. The resulting projects seem promising, but the debate remains in full swing.

With this background in mind, let us move to my main topic, not objection (1) but an antirealist argument within (2) that allegedly devalues theoretical retention epistemologically and methodologically. It's important to note that retention is a feature central to working-level realism and other reformed projects of selective realism.

2 A tempting argument

The argument I wish to discuss builds on a complaint revived in recent years by Kyle Stanford in "hard" (2015) and "softer" (2019, 2021) versions that seek to exhibit the scientifically impoverishing character of realist commitment. The argument has two central premises.

> P1: Realist commitment to successful theories encourages skepticism towards proposals incompatible with the commitments adopted.
>
> P2: In contrast, not being committed to theoretical content makes scientists systematically more open to radical novelty and correspondingly more creative—with more modest convictions than those of "committed" scientists, but also better justified.

The conclusion is that realist commitment limits scientific imagination and creativity counterproductively. Stanford believes this shows how realism and antirealism differ regarding how we should plan scientific investigations. In a similar vein, Brement (2007) argues that, at least concerning successful theories, realists tend not to see the need for what funding agencies like the NSF call "transformative science" (e.g., the discovery of metallic glasses) and "revolutionary disciplines" (e.g., plate tectonics), or the need to create entirely new fields or disturb established theories. According to Stanford

(2015), even the most tolerant realists tend to react suspiciously to research projects that contradict the scientific theories' elements, aspects, or features to which they are committed. Realists act like this—he affirms—because they believe they have an epistemic basis to favor research that preserves "well-established" content at the expense of revisionist theories.

For non-realists, the practical impact of the retention thesis differs significantly from that for realists. Stanford stresses that realists have reasons that non-realists lack for disfavoring proposals that violate existing theoretical orthodoxy. As a result, realists tend to be more satisfied than non-realists with evaluation committees that reject theoretical proposals that contradict current theories. He suggests that non-realists are more open to theories that challenge their own without being willing to accept any theory. For instance, constructive empiricists limit their belief to the empirical consequences of the best scientific theories, casting doubt on proposals that contradict the best-established observable consequences of received theories. They are, however, open to promoting proposals that challenge the parts least accessible to observation in current theories (e.g., about the nature of dark matter).

3 Backing up the argument

Stanford's thesis is initially plausible. Realist commitment has encouraged disregard for the evidence and derision of alternative approaches in the past, while a lack of theoretical preference has benefited the exploration of novel theoretical frameworks. These observations fit with numerous scientific episodes, highlighting the potential relevance of the thesis.

(a) Many illustrative episodes are from when the sciences operated under supposed "undeniable truths." For instance, the traditional conception of uniform circular motion in astronomy as the natural motion of heavenly bodies; the doctrine of natural places in pre-modern physics and biology (including ideas of rigid natural hierarchies in human groups, e.g., men and women); and the Cartesian conception of ontological dependence in wave physics, among many other ideas. We now appreciate that many of them hindered the scientific imagination, a fact that should intrigue and pique the curiosity of scientific realists. Analogously, in pre-Darwinian biology, there is the approach of natural theology, according to which complex systems in nature show the existence of intelligent design in the world, a view compellingly articulated by the Reverend William Paley (1746–1805)[1]. According to Paley,

[1]As Paley put it: "*Suppose I [found] a watch upon the ground, and it should be inquired how the watch happened to be in that place [...] When we come to inspect the watch, we perceive [...] that its several parts are framed and put together for a purpose, e.g. that they are so formed and adjusted as to produce motion, and that motion so regulated as to point out the hour of the day; that, if the different parts had been differently shaped from what they are, of a different size from what they are, or placed after any other manner, or in any other order, than that in which they are placed, either no motion at all would*

the human eye provided an incontestable example of nature's purpose and design toward perfection. It proved, he thought, the existence of a Designer. In principle, the eye could have developed cumulatively at random, as David Hume had already admitted in his *Dialogues concerning natural religion*. But such gradual aggregation required the availability of an indefinitely long time, against all imaginable expectations then. Until the mid-nineteenth century, intelligent design seemed the only conceivable explanation.

Paley's work is an exemplar of realist natural philosophy. It discouraged exploring anti-teleological ideas in biology until, in the second half of the 19th century, discoveries about the character and scope of spontaneous change shadowed some of the dearest intellectual intuitions that had sustained biology for millennia. In keeping with Stanford's thesis, the ensuing revisions were primarily the work of empiricist thinkers—some moderate, like Darwin, and others radical, like Mach. However, a significant shift was brewing in the empiricist camp. And with it, a new era of open-mindedness was dawning in science, a change that would revolutionize our understanding of the world. Einstein's Special Theory of Relativity is a testament to this new mindset. Historical studies suggest that for Einstein and other scientists at the turn of the century, the winning philosophy was neither "anti-realism" nor realism but an explicit fallibilist new scientific realism, a trait reflected in the subsequent epistemologies, most influentially Karl Popper's (see, e.g., Howard 1993).

(b) Open-mindedness was not universally practiced, however (it isn't now). Blocking theories contrary to orthodoxy did not end with the devaluation of a priori intuitions at the beginning of the 20th century. An instance in point is the conservative blockade practiced against geological mobilism during the central part of the last century. Mobilists were reacting to *fixism*, a long-entrenched conception according to which the continental crust and ocean basins are stable (fixed). Mobilism claimed that continents undergo large-scale lateral movements, drifting through the seafloor and forming a more significant landmass. While some physical indications supported mobilism, the geological establishment rejected continental drift. Objectors argued that there was no proper evidence for continental movement, no feasible mechanism for it, and no predictable patterns to the proposed movements. They branded the theory as "immature" (Giller et al., 2004; Doppelt, 2007). Opposition to mobilism remained strong until the 1970s. System-

have been carried on in the machine [...] There must have existed, at some time, and at some place or other, an artificer or artificers, who formed [the watch] for the purpose which we find it actually to answer; who comprehended its construction, and designed its use. (...) Every indication of contrivance, every manifestation of design, which existed in the watch, exists in the works of nature; with the difference, on the side of nature, of being greater or more, and that in a degree which exceeds all computation." [*Natural Theology* (1802)] atic discrimination against mobilist proposals, it seems, fueled intransigent adherence to fixist positions (Gradowski 2022).

Nevertheless, as Gradowski points out, there was qualitative evidence for mobilism at the time. It included

1. the geographical complementary fit of the continents, recognized since the 16th century,
2. cross-continental fossils of the same extinct land species,
3. continuities and geographical correspondences in geomorphological and stratigraphic data,
4. Paleomagnetic data in which sets of nearby magnetic rocks recorded vastly different locations of the magnetic poles upon their cooling, and discrepancies between continental and seafloor radiometric data indicated that the seafloor was relatively young.

However, the case against mobilism had merit. The evidence mobilists used was open to multiple interpretations, allowing for various consistent views. Additionally, fixist theorists argued that mobilist theory lacked coherence, adding another layer of complexity to the debate. On the other hand, fixist invoked an array of ad hoc land bridges connecting the two continents to account for the fossil evidence that suggested the same species had lived on the now vastly separated coasts of eastern South America and western Africa—as many bridges as necessary to save the appearances (Bryson 2004, Chapter 12). So, fixist explanations were not better.

For present purposes, the case is one of many examples illustrating the dangers of realist overconfidence in mainstream scientific research (see, e.g., Gradowski 2024). However, we must note a relevant difference regarding the suggested danger over the last century. The realist stance in science has developed projects of greater sophistication, and institutional science has gained methodological refinement. While individual scientists still sometimes take unwarranted stances, there is a noticeable shift in scientific communities generally favor more reflective stances (a significant difference from earlier times).

With the above background in mind, let us now discuss the suggestion that fallibilist positions of selective realism tend to hinder rather than help scientific originality and creativity compared to instrumentalist or non-realist positions. I will deny that Stanford's argument applies to the more reflexive versions of contemporary realism.

4 The premises

I start with P2, the noted argument's second premise, according to which the ability to articulate radically novel theories benefits from not having theoretical commitments:

> P2: not being committed to theoretical content makes scientists systematically more open to radical novelty, and correspondingly more creative—with more modest convictions than those of "committed" scientists, but also better justified.

An old objection to P2 stresses the intellectual stagnation encouraged by non-realist and instrumentalist positions in diverse areas. Critics of radical empiricism have repeatedly made this complaint over the past century. Popper lamented that instrumentalist representations omit "the universe of realities behind the various apparencies" (1962: 8–40). According to W.B. Bonnor (1958), for radical empiricists, prediction is the full extent of a theory's importance, belittling the fact that many theories have revolutionized our perspective on space, time, matter, and life. More categorically, Nicholas Rescher (1987) says, "In foresaking realism, we would lose any prospect of developing a naturalistic account of why the phenomena are as they are. And this is too great a price to pay. A weighty argument against skeptical instrumentalism is that it immediately blocks any prospect of explaining why the phenomena are as they are—an explanation that must, in the nature of things, itself proceed in ultimately non-phenomenal terms" (1987, Chapter Four). These critics complain that antirealist interpretations of science impoverish the theoretical quest. In their view, realist ontological narratives fertilize theories and scientific imagination.

A key question is: Do the more reflective projects of realism tend to impoverish the imagination, leading to scientific stagnation? Realists answer in the negative, pointing to episodes like Einstein's research on Brownian motion, a phenomenon that was explained by the kinetic theory of matter, leading to the argument for the existence of atoms and molecules, the development of the geology of plate tectonics, and numerous fruitful corroborations of Darwinian stories, among myriads of similarly guided achievements. Realists further note the absence of compelling evidence for the alleged systematic fostering of creativity and discoverability by anti-realist stances, as claimed. In particular, directing science toward empirical adequacy at the expense of ontological realism has been tried many times. Still, it has not consistently led to more creative insights or better-justified theoretical narratives. By contrast, realists stress, from Galileo to Einstein and then to the present, significant advances in theoretical physics have benefited from incorporating thought experiments that fly above the observable world. These experiments are not blind guesses but apply theoretical narratives to a hypothetical situation and explore the possible world in which said situation is real, deducing consequences from the proposed scenario. The guesswork involved is often remarkable for the ability to produce ideas (creativity) and imagination (ability to transform ideas into reality) they exhibit.

Let us turn now to premise Q1. Compared to non-realist positions, does realism discourage self-criticism, imagination, creativity, or the justification of theoretical descriptions? If so, how? What adverse effects follow from a realistic stance on a theory or selected parts? On the face of it, contemporary realist projects promote opening the mind to new possibilities. However, more than this preliminary observation is needed to suggest that Stanford et al.'s anti-conservative position lacks scientific evidence. As we have seen, many scientific advances have been prevented, delayed, or derailed by assumptions of achieved knowledge. Realists cannot combat Stanford's thesis simply by declaring it intrinsically counter-scientific.

Here is a more promising starting point. To vindicate the interest in theoretical content retention shared by realists, we can begin by noting how science has changed epistemologically since the end of the 19th century and how the changes impact the realist project. Contemporary disciplines generally embody fallibilism and avoid closing the mind to previously unexpected possibilities. They discourage the epistemic overconfidence displayed in previous centuries. Several relevant developments are in view. There is more philosophical awareness at ground-level science than before. And, in the philosophy of science, realist positions have gained considerable sophistication. A brief detour on these developments is in order.

5 Some relevant features of scientific theorizing today

(1) While individual scientists still display obstinate conservatism sometimes, attitudes at the communal level have grown fairer. Epistemological and methodological awareness have improved, prompted by knowledge gained over the last century. Scientific communities are now more aware of the epistemological limitations of their work, and philosophers are more appreciative of the scientific background to their ideas. Current realist positions generally incorporate fallibilism, naturalism, and selectivism.

(2) In numerous episodes of theorizing, realist commitment ostensively leads to feats of creativity and improved justification of the theories involved. One representative example is the rise of ontic theories in quantum mechanics, particularly the main proposals associated with David Bohm, Hugh Everett, and objective quantum state collapse theories. Initiated in the 1950s to seek alternatives to the anti-realist interpretations promoted by the then dominant "Copenhagen Interpretation," at least three proposals have developed considerably since the 1980s. All of them are realist projects that take the quantum state as a physical state (Brown 2019) and the vindication of classical physics in specific scale and energy regimes. Despite

their conservative nature, I argue that the mentioned theories can be termed "progressive" due to the originality and the fruitful openness of scientific imagination and creativity that they exhibit, inspiring further exploration and advancement in the field of quantum mechanics.

5.1 The Copenhagen interpretation

The "Copenhagen Interpretation" (CI) was a family of theories united by a core of radical ideas that functioned as the official guide to quantum physics until the 1970s. It postulated drastic limits to the intelligibility sought by physics. According to the most radical empiricist versions, (a) the physical world possesses only those properties that direct experience reveals, and (b) accepting a theory means only believing in what the theory says about observable things and events in the world and not in any hypothetical reality that may or may not lie beneath appearances.

On the positive side, CI demonstrated remarkable scientific fruitfulness in many physical applications, from quantum mechanics to quantum field theory, significantly advancing our understanding of the physical world. On the downside, however, CI's limits on intelligibility seemed arbitrary. A very dark aspect was the ontological status accorded to measurement processes. Instead of explaining what happens when physical systems enter into measurement situations, CI declared it "analyzable," giving it only "black box" representations through a quantum algorithm that glossed over the processes' detailed physical description. In the 1930s, Einstein and numerous physicists and thinkers declared this restriction gratuitous. It was not acceptable, they argued, to have anything like it in something presented as the most basic physical explanation of material systems. These critics saw a commitment to obscurantism in CI. In 1935, their intellectual discontent gained detailed expression in an argument formulated by Einstein, Podolsky, and Rosen (EPR argument), a significant milestone in the history of scientific critique. In now historical discussions with Niels Bohr (the patriarch of CI), Einstein and several physicists offered realist arguments to refute CI through thought experiments like the one presented in the EPR argument. However, their efforts were not convincing enough, and the controversy became "metaphysical," remaining in that state for decades.

5.2 Three ontic theories

Insurrection against CI revived in the 1950s, led by the development of intellectually more ambitious theories such as 1952's David Bohm's Mechanics and 1957's Hugh Everett's Many Worlds Theory. In the following decade, 1964's Bell's Theorem hinted at ways of empirically deciding whether nature fully follows the classical principles of determinacy, separability, and locality. Soon, experiments based on generalizations of Bell's theorem began to tilt the epistemological balance toward quantum mechanics against both classical metaphysics and the radical empiricist strictures of CI. Maintaining the three principles mentioned seemed impossible—at least one had to be set aside. The revival of interest in the foundations of quantum mechanics, particularly ontology, was encouraged from various directions, notably experimental results on quantum interference and diffraction, arguments from partial absorption experiments (e.g., in single neutron interferometry), fruitful explanations of the stability of ordinary matter, and more (Harvey Brown 2019). Crucially, in these efforts, the winning ontology is not classical physics. The quantum state seemed fundamentally incompatible with classical expectations in all the theories mentioned, presenting a significant challenge and complexity that realists needed to address.

One point of interest here is that ad hoc assumptions, lack of clarity, and conceptual incoherence hopelessly marred all the initial versions of the ontic theories. Nevertheless, critical revisions led to significant improvements in the respective projects. Since the 1990s, three direct descendants of the approaches have dominated the realistic rebellion: Bohmian mechanics, the Many Decohering Worlds Quantum Mechanics, and spontaneous collapse theories—for example, those developed by Giancarlo Ghirardi and his collaborators in the 1980s (see, e.g., Cordero 2011 and 2019). In the revised theories, ad hoc assumptions give way to theoretical derivations from arguably reasonable models of initial conditions (e.g., Valentini 1991). The leading proposals naturally recover the descriptions of classical mechanics in particular regimes in the quantum domain. Recent versions of the many worlds approach or "multiverse" significantly improve probabilistic discourse (David Wallace 2012). In the case of spontaneous collapse theories, the tension between stochastic change of quantum state and relativistic physics is reduced (e.g., Philip Pearle 2000). These achievements of imagination and internal coherence, which had seemed impossible a decade earlier, are truly inspiring. Recall, for example, Hilary Putnam's principled Rejection of the Many Worlds Approach in the 2000s because he could see no way for it to yield meaningful probabilities (Meir Hemmo and Itamar Pitowsky, 2007).

The ontological proposals mentioned are complex and describe different physical worlds, each making divergent predictions. This divergence enables us, in principle, to choose between them in the laboratory. Unfortunately, the disagreements occur in areas that are (and may long remain) empirically inaccessible, adding another layer of complexity to our understanding. The ongoing debate about the ontological proposals is engaging, as it prompts us to ask: is any of the proposals more convincing than the others? None wins in predictive power—all are 'effectively' equivalent. The proposed theories differ, however, concerning other virtues, mainly simplicity, epistemic modesty, range of application, fertility, and explanatory power, keeping the debate alive and engaging. These differences translate into divergent selections of the "best option" (Cordero 2001, Callender 2020). However, while comparing ontological proposals is a fascinating issue, space limitations force me to stick to our central theme here—the profound impact of realist projects on the opening of the human imagination.

The development of the three ontic theories has expanded the scientific imagination beyond what was thought possible, particularly in the field of quantum science. Current interpretations of Everett's project show how to think of identity, individuality, and separability within the multiverse of the quantum world. Quantum state collapse theories, in turn, suggest ways to reconcile, at working (functional) levels, descriptions from general relativity and quantum mechanical "counterparts" invoking chance and discontinuous transitions. These reformed proposals have significantly improved the justification of the approaches, primarily through the effective compatibilization of descriptions provided by disciplines that had seemed impossible to integrate at any level, like classical and quantum mechanics. In this way, realist projects have helped break down barriers that held back imagination and creativity, inspiring new ways of thinking. Analogous developments are apparent in many other scientific areas, notably in fundamental physics, chemistry, biology, and psychology. All the noted improvements overshadow Stanford's premises against content retention. The final section elaborates on this idea.

6 The scientific internalization of realism

I have suggested that Stanford's premises against ontological engagement underestimate the creativity of realist projects like the ontic theories highlighted in the previous section. A second complaint concerns the inapplicability of the premises to more sophisticated versions of contemporary scientific realism. The latter has significantly transformed since the 1960s when naive ambition guided the prevailing realist projects. As Robert Klee (1999 313–4) recalls, a widespread belief at the time was that "our mature scientific theories, the ones we use to ground our scientific projects and experiments, are mostly correct" and "the errors they contain are minor errors of detail." Today, virtually no informed realist is so bold. While there are still instances of individual scientists embracing hard-nosed realist views, the community has shifted towards more moderate views tied to stringent conditions on evidence. This shift in community views is a significant development in the field, impacting the perspectives of philosophers of realist persuasion and the direction of scientific naturalization projects initiated in the 1980s by Dudley Shapere, Ernan McMullin, Ronald Giere, and Kitcher and in recent decades by a host of selective realists.

I use the term "naturalization" methodologically, focusing on Shapere's (1984) view that it is science itself that, in its fallible ways, identifies the relevant factors for discussing the ends, scope, and limits of knowledge. In this epistemological option, the philosophical analyses and conclusions spring from reasons internal to scientific activity. They do so in the form of specific considerations (as opposed to global or metaphysical ones) that are scientifically successful and free of reasonable doubt (i.e., well-founded). All conclusions are open to revision in light of new reasons and discoveries—there is no room for absolute trust. This version of realism confines epistemic commitment to just those parts of theories tentatively deemed well-founded by extant public standards. The credible parts are those specifically invoked to articulate predictions that prove correct, not the whole theory. From this perspective, the realist significance of corroborated predictions of theory parts is underscored by the systematic and varied predictive success that grounds the realist claim here: the theory parts invoked in the derivation of initially improbable corroborated predictions have non-trivial truth content. The resulting realist stances, all broadly empiricist, are fallibilist and reject *ideological* conservatism (of the sort that discriminated against mobilist theories in the 1950s). Criteria of coherence and novel empirical support are crucial in strongly constraining the acceptance of a theoretical idea.

Bringing these considerations home, a key point against Stanford et al.'s anti-conservative argument is the significant role of fallibilism in preventing conservative excesses in the empirical sciences over the last century. In the more alert projects of naturalized realism, the awareness of fallibility, fortified by the criterion that theories without strong novel empirical backing have no place within the realist stance, acts as a safeguard against conservative excesses. I have suggested the case of ontic quantum mechanical theories as exemplars of projects attentive to the need to remain open-minded about the state of knowledge. The case suggests how, in reflective contemporary disciplines, realist commitment can (and often does) promote scientific imagination and creativity, thereby enhancing the quality of scientific discourse, while limiting the scope of its claims and improving the justification of realist proposals.

A final observation here is that making ontological commitments may or may not systematically foster scientific creativity or the justification of ontological commitments. I have challenged only the allegation of systematic connections suggested by Stanford et al. Scientific creativity and justification navigate a sea of ever-changing contingencies. My point is that adopting ontological commitments does not lead to a systematic impoverishment of imagination or the search for justification. The opposite outcome, where adopting ontological commitments leads to an enrichment of imagination and the search for justification, seems more frequent in many disciplines.

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