



Limits of conceivability in the study of the future. Lessons from philosophy of science[☆]

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ABSTRACT

In this paper, the epistemological and conceptual limits of our ability to conceive and reason about future possibilities are analyzed. It is argued that more attention should be paid in futures studies on these epistemological and conceptual limits. Drawing on three cases from philosophy of science, the paper argues that there are deep epistemological and conceptual limits in our ability to conceive and reason about alternatives to the current world. The nature and existence of these limits are far from obvious and become visible only through careful investigation. The cases establish that we often are unable to conceive relevant alternatives; that historical and counterfactual considerations are more limited than has been suggested; and that the present state of affairs reinforces its hegemony through multiple conceptual and epistemological mechanisms. The paper discusses the reasons behind the limits of the conceivability and the consequences that follow from the considerations that make the limits visible. The paper suggests that the epistemological and conceptual limits in our ability to conceive and reason about possible futures should be mapped systematically. The mapping would provide a better understanding of the creative and critical bite of futures studies.

1. Introduction

In futures studies, possible, probable, and preferable futures are studied (Amara 1974; Bell, 2009 [1997]). To formulate future scenarios and to vision alternative futures require that one is able to conceive and reason about states of affairs that differ from the current state of affairs. Much of the theoretical and methodological discussion in futures studies concern the nature, limits, and prospects of the processes that aim to produce the scenarios of the future. The question is usually how to systematically formulate and identify relevant and plausible scenarios. It is remarkable that the underlying ability to conceive and reason about possible futures is often taken for granted, and the main questions concerns how to tease out, resource, and encourage the ability. This assumption is well characterized when Bell writes that “[t]he exploration of possible futures includes trying to look at the present in new and different ways, often deliberately breaking out of the straitjacket of conventional, orthodox, or traditional thinking and taking unusual, even unpopular perspectives” (2009, p. 76–77) and his main warning concerns rejecting ideas out of hand (2009, 78). This taking-for-granted is true of even the most critical tones about the practices described by Bell. For example, when Groves argues that it can “be problematic to represent the future as empty, as open to being written” (Groves, 2017), the assumption is made that we can conceive a variety of alternative futures. It is, in fact, the source of the problem. Also, Slaughter’s eerie warning that “What [futures studies] cannot, and in this view, should not do in this historical moment is to imply that there are any generically alternative global

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macro-futures left to study and explore” (Slaughter, 2020) assumes the capacity to conceive futures that are far-fetched and wishful. Because our ability to conceive and reason about possible futures is taken for granted, the main problems associated with the study of possible/alternative futures are considered mainly as practical and ethical, not conceptual and epistemological. This paper goes beyond these surface debates and challenges the assumption that we can, in principle, conceive and reason about a variety of possible futures. The paper points out that there are important, nontrivial, and deep conceptual and epistemological limits to our ability to conceive nonbenign or interesting alternatives to the present states of affairs.

In this paper, it is argued that (i) our ability to conceive and justify possible futures is limited for fundamental conceptual and epistemological reasons, and (ii) rather than being trivial or abstract, these limitations have interesting and non-obvious consequences for futures studies. The limitations are not based on a single source but arise from different types of considerations. To establish the existence of such limitations, this paper discusses insights from three cases from philosophy of science concerning our ability to conceive and reason about alternative science.

The first case is *the problem of unconceived alternatives*. In philosophy of science, it has been argued that there are alternatives to the current science that we cannot conceive and this has widespread consequences for our understanding of how robust the current state of affairs is.

The second case is *the problem of leaking counterfactuals*. In philosophy of science, it has been argued that counterfactual histories of science cannot adequately tell how science could be different, as the current science shapes our narratives about the possible (counterfactual) histories of science. In the same way, our current understanding of the world limits how we can conceive possible futures.

The third case concerns the so called *put-up-or-shut-up argument* according to which the current science should be considered as inevitable as long as no serious alternative to it has been constructed. To justify that an alternative science is possible, we should construct the alternative. This would also mean that, in order to justify a future possibility, we should actualize that possibility, which is a rather strong demand.

As we will see, the philosophical cases provide interesting and generalizable insights into the fundamental difficulties we face when exploring future possibilities. Even though the discussion of the paper is centered around issues related to science and, therefore, to the future of science, the arguments are generalizable, and the philosophy of *science* only serves as a source of the more general insights (see also §6). Conceptual and epistemological considerations suggest that there might be (i) possible futures that cannot be conceived, (ii) conceivable futures whose plausibility or even possibility cannot be justified, and that (iii) the combination of (i) and (ii) have serious consequences on how we understand the present moment. In essence, our inability to conceive and justify alternative futures indicates, paradoxically, that the present state of affairs might be located in a much larger space of possibilities than we think.

The aim of this paper is not to exhaust the space of fundamental conceptual and epistemological limitations in our ability to conceive and reason about future possibilities but to argue, on the grounds of three illustrative cases, that such limitations require systematic attention. This is due to the fact that the limitations are not obvious or a priori but become visible only in deep and careful analyses. The paper focuses on the three philosophical cases exactly because they are not, perhaps surprisingly, based on abstract considerations concerning human cognitive faculties but on historical and structural insights. In this way, the paper suggests that the mapping of conceptual and epistemological limits in our ability to conceive and reason about alternative futures that arise in many contexts and through multiple mechanisms has not received enough attention in futures studies that has mainly focused on more straightforward methodological issues.

While the three cases from philosophy of science are tightly intertwined with each other in the philosophical debates, this paper discusses them somewhat independently from each other, as the interest is not in philosophy per se but in extracting consequences for futures studies. The paper proceeds as follows. In §2, the paper contextualizes the philosophical cases on the theoretical and methodological discussion on the relationships between history, counterfactual scenarios, and future studies. In §3, the paper discusses the problem of unconceived alternatives (Stanford, 2006) according to which there are historical reasons to believe that science has alternatives that we cannot conceive. In §4, the paper discusses the problem of leaking counterfactual scenarios according to which there are epistemic limitations in our ability to see how the world could have developed in a different way (Tambolo, 2020). In §5, the paper discusses the “put-up-or-shut-up” argument according to which alternative science remains epistemically unsound speculation until one creates an actual alternative science (Hacking, 2000; Soler, 2015). Throughout the sections, I discuss how the insights concerning science and its possible futures can be generalized beyond science as general insights concerning our ability to conceive possible futures. In Conclusion, I point out some common themes in the three cases and suggest what general consequences they have in futures studies.

2. History, future, and conceivability

The three cases from philosophy of science draw conceptual and epistemological insights from considerations that are intimately related to history and historiography. They are related to *history* when they are based on events and patterns in the past, and they are related to *historiography* when they are based on how history can be understood and reasoned about. This is interesting since the relationships between history, historiography, and futures studies have been discussed widely, and the connections between history, historiography, and futures studies have been deemed relevant in recent discussions.

Bradley et al. have focused on the “use of history to aid causal analysis of the future” (2016, 57). They argue that we “can learn from the past even while acknowledging that it does not repeat itself in the same way every time similar events occur” (Bradfield et al., 2016, 65). We can compare, contrast and debate possible future changes against the causal framework of the past (Bradfield et al., 2016, 61), and “history’s value to consideration of the future lies in its ability to tease out conflicting viewpoints, misunderstandings and biases”

(Bradfield et al., 2016, 64). We will see that this analysis by Bradley et al. corresponds to the type of understanding that the philosophical cases provide. The cases establish future-relevant historical patterns but are also essentially related to considerations about conflicting viewpoints and biases in our reasoning about historical phenomena. However, the cases also show how our historical reasoning is conceptually and epistemologically limited and, therefore, shed some critical light on to what extent historical consideration – or any considerations, for that matter, – may clarify issues concerning the future.

Moreover, Staley argues that historical thinking is useful in the study of the future: “Thinking about the future, like thinking about the past, requires contextual thinking. [...] the historian of the future draws high-context, ampliative, nondemonstrative inferences from the evidence” (Staley, 2010, p. 62). Staley (2002) also argues that important questions in historiographical analysis require that we study and track *counterfactual histories*, i.e., histories that did not happen but would have happened, had some historical event or process been different. Staley claims that the basic strategies that are used in tracking counterfactual histories can be used in creating scenarios: if we are able to track down alternative histories, we are also able to track down alternative futures. This view has been shared by others. Booth et al. 2009 have argued that “it may be hoped that the extensive theoretical literature on counterfactuals and other forms of modal narrative may help to shed some light on certain important questions concerning the philosophical underpinning of [a] type of foresight methodology” (2009, 88). Also, Green has studied “the affinities between the cognitive approaches of historical study and those of strategic foresight, specifically” (2012, 174) and noted the connection between historical counterfactuals and future scenarios (2012, 175).

As we will see, historical counterfactuals and counterfactual considerations are at the very heart of two philosophical cases that will be analyzed in this paper. In §4, it is argued that counterfactual narratives might necessarily converge towards the actual state of the world and thus be unhelpful in imaging how things could be different. In §5, it is argued that counterfactual considerations, no matter how well produced, may not have enough power to force us to accept the plausibility of alternative states of affairs. By studying these cases, we can understand better the epistemological and conceptual limits of conceivability. The cases do not support the optimism that the past-facing approaches can straightforwardly “reject determinism by multiplying and pluralizing possibility” (Bendor et al., 2021, p. 3) or “expand the futurological imagination and open it up to new possibilities for knowledge and action” by “applying counterfactual thinking in and through congruent ‘what if?’ questions” (Bendor et al., 2021, p. 11).

Moreover, the cases also indicate that, in crucial respects, the discussion concerning counterfactual histories in futures studies has been hopelessly naïve. As is well known, counterfactual histories have often been criticized as mere speculation. What counts as a plausible counterfactual scenario is a genuine question. We cannot have direct evidence of counterfactual scenarios because, by definition, they did not happen. If we are not able to distinguish between plausible and far-fetched counterfactual scenarios, there is little hope that counterfactual considerations provide any helpful insight in futures studies. Therefore, Staley asks “But how does the historian determine which alternatives are plausible, when one could imagine an infinite number of different scenarios?” (2002, 850) and cites a suggestion by Ferguson: “The answer to the question is very simple: We should consider as plausible or probable only those alternatives which we can show on the basis of contemporary evidence that contemporaries actually considered.” (Ferguson, 1997, 86.) Staley is not alone with the view that Ferguson’s approach is able to define plausible historical scenarios and to connect futures studies and historiography. Green has argued that “This [Ferguson’s approach] makes counterfactuals and scenarios ontologically similar” (2012, 175). Unfortunately, there are serious problems in the suggestion that plausible counterfactual scenarios are Ferguson-style counterfactual scenarios. That some historical agents thought that a scenario is possible (or plausible) is neither necessary nor sufficient for the scenario to be possible (or plausible). For example, at the end of the 19th century, some scientists thought that fundamental changes in physics were not possible, and, conversely, they thought that it is a plausible scenario that physics would improve only in a piecemeal manner. We know that fundamental changes were possible (as they happened) and that the piecemeal scenario was not plausible. If scenarios and counterfactuals (in Ferguson’s sense) were “ontologically” similar, then the value of scenario-work in analyzing the possible futures would be in great danger due to the naivety of Ferguson-style counterfactual reasoning. This means that while it is true that “scenarios and historical accounts involve a disciplined imagination of contexts about which we have imperfect knowledge” (Green, 2012, p. 175), there remains a serious question of what counts as disciplined imagination and what are its limits in capturing historical or future possibilities. The discussion of the philosophical cases will shed some light on these issues.

In general, the philosophical cases are useful because many important issues related to conceivability and alternative states of the world have been heavily analyzed in philosophy of science. For example, there has been discussion on what counts as a radical/interesting or benign/uninteresting alternative to some existing state of affairs (e.g., Soler, 2015; Virmajoki, 2018). It is important to steer clear on what kind of possibilities are within the range of conceivability. For example, if we can conceive only benign alternatives, the study of the future loses its creative and critical bite. Moreover, there have been debates about continuity in science through historical change (e.g., Laudan, 1981; Psillos, 1999; Stanford, 2006). It is important to understand on what our views concerning continuity and rupture are based. Recently, it has been argued, by Raskin and Swart, that “Global scenario assessments [...] tend to focus on a narrow bandwidth of possibilities: futures that unfold gradually from current patterns and trends. This ‘continuity bias’ downplays the real risks (and opportunities) of structural discontinuity” (Raskin and Swart, 2020). This type of problem has deep epistemological and conceptual roots. There have been discussions of why the present state of affairs, once in place, structures our thinking in a way that reinforces its hegemony and continuity through multiple mechanisms (e.g. Kidd, 2016; Soler, 2015; Tambolo, 2020). As we will see, philosophy of science has developed powerful conceptual tools to tackle the issues at the center of futures

studies' theoretical framing that were discussed above, and this paper extracts some of the central insight provided by those tools.¹ Let's now turn into the details of the cases.

3. The problem of unconceived alternatives

In philosophy of science, one of the main debates concerns *scientific realism*. According to scientific realism, successful and mature scientific theories are approximately true descriptions of mind-independent reality (Psillos, 1999, xvii). The debate concerning scientific realism is enormous and here we focus on one argumentative line within it. One of the standard arguments against scientific realism is the so-called argument from *underdetermination of theories by the evidence* (see Psillos, 1999; Stanford, 2006). According to this argument, there are, in principle, always mutually incompatible theories that make the same predictions and suggest the same interventions, i.e., are empirically equivalent. The choice between the theories is underdetermined by all available evidence and therefore we cannot conclude that our current theories are true in the realists' sense. While this problem is an old one and has produced valuable works on the logic of scientific confirmation, a standard argument against it is that, in reality, well-supported alternatives are extremely rare and therefore the possibility of such alternatives is nothing but an age-old skeptical hypothesis. Maybe there are alternatives to our scientific theories, but then again, an evil demon might deceive us. It is difficult to see how such skeptical possibilities should affect our attitude towards the current science.

However, Stanford has put some historical flesh on the logical bones of underdetermination. In the book *Exceeding Our Grasp: Science, History, and the Problem of Unconceived Alternatives* (2006), Stanford argues that the problem of underdetermination is not solved by noting that empirically well-supported alternatives have not actually been present in the history of science. The problem remains as long as we have reasons to believe that there exist well-supported alternatives to our best scientific theories that are presently *unconceived* by us. This is the *problem of unconceived alternatives*. Remember that the mere possibility of such alternatives is not what we are looking for. We are looking for reasons to believe that such alternatives exist. Stanford argues that there is a reason to believe this. On the basis of the history of science, he performs what he calls the *New Induction*²:

"By contrast, I propose what I will call the new induction over the history of science: that we have, throughout the history of scientific inquiry and in virtually every scientific field, repeatedly occupied an epistemic position in which we could conceive of only one or a few theories that were well confirmed by the available evidence, while subsequent inquiry would routinely (if not invariably) reveal further, radically distinct alternatives as well confirmed by the previously available evidence as those we were inclined to accept on the strength of that evidence. For example, in the historical progression from Aristotelian to Cartesian to Newtonian to contemporary mechanical theories, the evidence available at the time each earlier theory was accepted offered equally strong support to each of the (then-unimagined) later alternatives" (2006, 19.).

It follows that there seem to be historical reasons to believe that there exist alternatives to the current science but we are not able to conceive those alternatives. These alternatives are not trivial or benign variations of the current science but fundamentally different ways of understanding the universe. This indicates that our ability to formulate scenarios of alternative futures might be seriously limited. The problem is not just that we do not have time and resources to formulate all possible variations of the current world – this would, of course, be practically impossible task no matter what – but that there are extremely important kinds of alternatives, i.e., fundamentally different alternatives, that we cannot conceive. In other words, even if we attempted to find only the most important alternatives, we would fail. There are several consequences from Stanford's line of argument.

First, because the argument is not based on mere skeptical fantasies but on the historical record, the evidence supporting the argument is (explicitly) fallible. While it seems an undeniable fact that there have been unconceived alternatives, the implications of this fact can be debated on historical grounds. For example, Psillos argues that historical record shows enough theoretical continuity to not challenge scientific realism (Psillos, 2009, 4.2). Thus, the unconceived alternatives might not be as radically different from the known ones as Stanford suggests.

A related issue is whether the past science is a good base for the induction. As Psillos points out, "one could argue that as science grows, theories acquire some stable characteristics (they become more precise; the evidence for them is richer and varied; they are more severely tested; they are incorporated into larger theoretical schemes and others) such that (a) they can no longer be grouped together with older theories that were much cruder or underdeveloped to form a uniform inductive basis for pessimism and (b) they constrain the space of alternative possibilities well enough to question the extent of the unconceived alternatives predicament" (2009, 73). The point here is that since (i) science is different today than it was in the past, (ii) most of the science has been produced in recent decades, and (iii) the science has been quite stable recently, it seems that the historical challenges do not apply to the current state. Again, we must remember that argument of unconceived alternatives gains its power from historical considerations. Even if (i)-(iii) do not exclude the logical possibility of unconceived alternatives, they could cut the link between the historical record and current science.

In response, Stanford has recently argued that "we have compelling reasons to believe that [current scientists] are actually less effective than those same predecessors in conceiving, exploring, or developing fundamentally novel theoretical conceptions of nature in the first place" (Stanford, 2019, §3). The funding structure, professional specialization and self-identity, and the social organization of "Big Science" have led to a situation where opening research paths that challenge the current theoretical "orthodoxy" is extremely

¹ For further discussion on the use of philosophy of science in understanding the future, see Virmajoki (2022).

² The old one being the pessimistic meta-induction: There have been false successful theories. Therefore, our successful theories may be false (see Laudan, 1981).

risky and difficult. In §4, we return to this type of reasoning. In essence, the limits of conceivability are, in this case at least, grounded on structural features of the current institutional and social systems.

This dynamic can be pushed even further. Rowbottom (2019) has analyzed different levels of science that can have unconceived alternatives. The title “Extending the argument from unconceived alternatives: observations, models, predictions, explanations, methods, instruments, experiments, and values” is a rather good summary of those levels. For example, Rowbottom points out that scientific theories often lack appropriate predictive force. Models need to be developed in order to achieve predictions. Sometimes the adequacy of a scientific theory to deal with phenomena remains an open question until sophisticated models are developed. This was the case in classical mechanics for over a hundred years. Sophisticated models can be initially unconceived and, given that models are responsible for predictions, there can be unconceived predictions. Given the importance of predictions in theory choice, the unconceived models can impact on our theory choices. *The consequences of unconceived alternatives at one level radiate through the whole system.*

While it is difficult to tell how much weight we should give to unconceived alternatives at different levels of science, Rowbottom’s analysis serves as a valuable reminder that the high-level theories are not the only area of science where unconceived alternatives are an issue. The point that “What’s conceived is nonetheless limited, for a variety of reasons; limitations on time and material resources, contingencies about where attention is directed, and so forth” (Rowbottom, 2019, 3957) is a good reminder of our historical predicament. However, the fact that unconceived alternatives exist in many levels of science does not automatically have any novel consequences. No one denies that science develops and science changes. Moreover, hardly anyone would suggest that all the future changes can be conceived now. The question is how fundamental these changes can be. We can never exhaust the space of all possibilities, and the question is how able we are to conceive radically and interestingly different possibilities.

Initially, however, Stanford suggested that unconceivable alternatives are a problem in the fundamental domains of science, theoretical science. Stanley argues that eliminative inferences (where conclusions are reached by ruling out possibilities until only one remains) work in cases where we are able to conceive the plausible possibilities. However, the New Induction indicates that scientists have been unable to conceive the plausible theoretical possibilities and therefore the eliminative inferences have not worked in theoretical science (2006, 30–31). The idea that theoretical science cannot be trusted as “really true” is important in its own right, but one may wonder whether we can really separate different levels or aspects of science from each other (see Stanford, 2006, ch. 8, and Psillos, 2009, ch. 4, for competing views). *Prima facie*, theoretical changes could lead us to rethink our eliminative inferences (or inferences in general) in other areas of science as well. Moreover, we have seen that unconceived alternatives can be found below the highly theoretical level. It seems that if an unconceived theoretical change really is possible, then this possibility must be based on new and unexpected findings in other levels of science. In order to rethink our theories, new predictions, methods, or values need to be found. One could argue that if there are plausible unconceived alternatives at the theoretical level, there must be such alternatives at other levels of science as well. Theories and other aspects of science are so deeply intertwined that we perhaps should expect that the possible changes at each level are of a similar magnitude. Again, *the limits of conceivability radiate from one level to the whole system.*

Where does this take us with respect to the issue of limits of conceivability?

First, an obvious lesson is that an argument can be made that the future of science may be different in a now-unconceived way. At any given time, there have been changes that were not conceived earlier. The original argument was that these changes are fundamental, i.e., that is plausible that we have not conceived a theoretical science that is fundamentally different but equally well supported than our current theoretical science, but we have seen that the limits of conceivability tend to radiate from one level to the whole system. Our ability to conceive alternative futures with respect to one domain may essentially depend on our ability to conceive alternative futures in other domains.

Secondly, one of the most interesting dimensions of the debate is Stanford’s argument that even though science has changed and, therefore, the inductive base can be questioned, we have independent evidence that the current structures in science may hinder the search for unconceived alternatives. In this type of reasoning, we identify a possible problem in some activity by studying its history and then attempt to search for conditions in the present that could make the problem acute even if the present conditions differ from those of the past. This reasoning has the following structure: A was a problem in the past when B was the case. Now B is not the case anymore but C is, and C may lead to A. (For example, A = inability to grasp unconceived alternatives; B = limited number of scientists, C = conservative incentives in science.) This type of reasoning could be fruitful in other projects as well. We are not assuming that the past repeats itself but we can still use the problems of the past to ask whether we may face similar problems today.

Finally, the philosophical debate on unconceived alternatives has implications for futures studies. However, the implications are not straightforward. As we have seen, the problem of unconceived alternatives in science threatens our trust in the ontological truth of our current scientific theories. The problem is therefore about our epistemological underpinnings. In contrast, if there exists a problem of unconceived alternative in some other field, it is difficult to say what that problem concerns in addition to our ability to know the possible alternatives to the current world. The world is what it is, and unconceived alternatives do not automatically challenge it. Even if *Yesterday* could have been performed differently, this does not mean that we should not trust the actual *Yesterday* or that it might be ultimately erroneous version of the song. Such claims are nonsensical.

However, the problems that unconceived alternatives pose to futures studies are not trivial or benign. Surely, many of the problems in the study of the future go back to our inability to conceive and map events and processes that are novelties and affect the course of the future. Despite this – or even for this very reason – it would be important to analyze the different logics and causes that lead to inconceivability. Probably not all inconceivability has similar logic, causes, and consequences. I distinguish between *logic* and *causes* because we can say, in the case of unconceived alternatives in science, that the *logic of the problem* is that there have not been sufficient eliminative inferences in theoretical science, and this logical problem is *caused* by things like the cognitive limitations and incentive structure of science. To generalize this, we could ask, for example, whether there are unconceived alternatives for the society and how this affects futures studies. We could wonder whether political tensions *cause* a fragmentation of the space of future possibilities. Is it

possible that we miss some possible ways of organizing the society because only politically clear-cut visions of the future get their voice heard in the atmosphere of increasing political tensions? We could add that the *logic* of the problem in the politically fragmented futures is that if we cannot conceive a future in the middle of a political (n-dimensional) spectrum, it becomes difficult to answer normative questions on how people should live in a society. If there were unconceived alternatives that would have been better for many people, can we justify the reinforcement of the actual system? In this way, we can extend the thinking through unconceivable alternatives beyond science.

4. The problem of leaking counterfactuals

We have seen, in §2, that counterfactual histories are often considered as an important way to approach future possibilities. However, a recent argument by Tambolo (2020) puts this verdict in doubt. Tambolo discusses counterfactuals in the historiography of science. Tambolo argues that

“In the case of general history, it is often possible to imagine a consequent dramatically different from actual history, and yet plausible; in the case of history of science, imagining outcomes far removed from the results of actual science seems more complicated” (2020, 2012).

The argument is, at its core, simple and elegant. A historical counterfactual needs to have a plausible antecedent and the consequent must follow from plausible principles concerning how the world works (see also §2). Given that the actual science is our source of knowledge of how the world works, the consequent must be derived by using the results of actual science. This use of the results of the actual science affects how a counterfactual narrative can develop. “In order to be plausible, the outcomes of counterfactual histories need to be appropriately continuous with [the] results [of actual science], which provide the yardstick for the assessment of the plausibility of counterfactuals” (Tambolo, 2020, 2113). “What [–] we view as a plausible alternative to actual history of science is influenced by our currently accepted knowledge” (Tambolo, 2020, 2123).

Tambolo discusses many studies from the existing counterfactual historiographies of science and points out that they all build a narrative that converges towards the actual results of science. Tambolo is making the following claims: 1. There exists a regularity in the historiography of science: Plausible counterfactual narratives converge towards the actual results of science, and 2. this convergence is dependent on the central role that actual results of science play in the building of plausible counterfactual narratives. 3. The results of actual science play a central role in the building of counterfactual narratives because each step in a counterfactual narrative is restricted by plausibility considerations, and these considerations are based on what we know about how the world works, i.e., on the actual science. The results of the actual science *leak* into the counterfactual narratives and guide them towards the present state.

This argument has a very important consequence that Tambolo points out: Counterfactual historiographies of science seem to be unable to tell how science could have been different. For example, (Virmajoki, 2018) has suggested that the contingency of (a feature of) science depends on how plausible a counterfactual scenario where we have a different (version) of science is. The more plausible the scenario is, the more contingent science is. Given Tambolo’s analysis, Virmajoki’s definition of contingency could force all historiographical inquiry to concede that science is inevitable: given that it is difficult to come by with plausible scenarios where science is different, science is judged to be inevitable. The existing scientific results guarantee their own inevitability through the backdoor. *Due to the problem of leaking counterfactuals, counterfactual narratives are unable to tell how science could have been plausibly different.*

Tambolo’s discussion points toward a fundamental epistemological problem in our ability to conceive alternative developments. No matter how much we want to challenge the present science by writing counterfactual histories, the task can never be epistemically robust: It is possible to write histories where different scientific evidence is found because different theories were at the table, but imagined evidence is not actual evidence. It is possible to look at the history in order to find blind spots and dubious turns in theory-choice, but this can only establish problems in the justification of the current theories and ideas, not an alternative science. It is possible to show historically that there are, in fact, evidential considerations that we have missed that confirm some alternative theory, but this would be a scientific breakthrough but not a counterfactual insight.³ It follows that a mere counterfactual scenario seem unable to establish that a successful alternative science could have been accepted. We will return to this topic in the next section where we discuss the consequences of the epistemic limitations of counterfactual considerations from another perspective. Here we need to investigate whether the problem of leaking counterfactuals concerns only counterfactual histories of science or whether it concerns all historiographical imagination.

We need to ask why the history-of-science counterfactuals seem to converge towards the actual state of affairs, but other historical counterfactuals seem not. In both cases, we need to apply our actual knowledge to the counterfactual past. First, notice that, in general, historical counterfactuals do not, in fact, diverge from what science says. There are no plausible counterfactuals of the form “had X been the case, Y would have been the case” where Y violates what science says (as long as we trust science). The difference between the history-of-science counterfactuals and other counterfactuals seems to concern the flexibility and repetitiveness of certain causal processes – or at least our conceptions of their flexibility and repetitiveness. In the case of science, we think that the uniform structure of entities, processes, and phenomena and their repetitive effect on the human cognitive system shapes the beliefs as time passes. In the case of other histories, we more easily think that situations are unique and if the actual effect had not been produced, there would not have been a similar opportunity again. We tend to think that there is more variability and less repeatability in the counterfactual scenarios outside the history of science. For example, one could argue that had Hitler not been in power, there would not have been a

³ Hason Chang’s idea of complementary science falls to the latter two categories. It has the explicit goal of contributing to the epistemic soundness of the current science (Chang, 2004, 3).

war in 1939. And given the changes after the counterfactual 1939, a possible war would have had different characters (armies would have been differently prepared, etc.) and maybe a different unfolding. On the other hand, had Millikan not measured the charge of electrons, someone else would have worked with identical electrons in the future and measured their charge. Electrons are more repeatable than the conditions in 1930's.

While there is, then, a difference in history-of-science counterfactuals and other historical counterfactuals, the conceptual nature of the difference is not very encouraging for the claim that counterfactual scenarios can tease out alternative possibilities for the future. In essence, the difference is based on our judgements of the possibility of variation in certain historical conditions and processes. Science leaks into plausible counterfactual scenarios because it provides knowledge of that variability. Given that plausible counterfactual scenarios are deemed plausible by our conceptions of the possibility of variation in certain conditions, *counterfactual scenarios cannot help us to exceed the limits of the conceivability of alternative states of affairs*. Plausible counterfactual scenarios and alternative futures are formulated on the basis of the same set of conceptions concerning possible variability in the domain of interest. Possible histories and alternative futures come in the same package, as it were. We are fundamentally trapped in our own epistemological and conceptual predicament concerning how the world works and what is possible to happen, as Tambolo's insight makes surprisingly clear. However, the mere fact that we cannot escape, *epistemologically speaking*, the present condition does not mean that it is an inevitable endpoint of history. On the contrary, we need to appreciate the fact that present leaks into what-if scenarios. Due to this flaw in our epistemological predicament, our inability to tell how history could have developed differently does not tell us much about the history itself. Our predicament is a problem exactly because the limits of possibilities do not match the limits of conceivability.

5. Put-up-or-shut-up argument

Both cases discussed in previous sections are related to the so-called *inevitability vs. contingentism debate* but, in this section, we discuss a set of considerations that have been at the heart of the debate. The debate concerns the possibility of equally successful but fundamentally different science (Hacking, 2000; Soler et al 2015; however, see Kidd, 2016 with a different approach). Contingentism claims that there could have been an equally successful but fundamentally different science, thus our science is contingent. Inevitabilism denies this. According to inevitabilism, our current science would develop whenever (i) there exist a genuine science that (ii) asks the same questions as the current one and (iii) is equally successful (Soler, 2015). In the literature, many specifications have been made concerning the positions (Kinzel, 2015). The degree of contingentism might depend on, for example, the level of science or the field of science. The details do not matter much here as we are not focusing on philosophical nuances. Rather, we will focus on one particular argument in the debate and the insights it has produced.

The so-called *put-up-or-shut-up argument* (or simply: *put-up argument*) says that "The only convincing way to make contingentism plausible would be to exhibit an *actual* (i.e., not just fictitious, but really existing) alternative science verifying the three conditions of genuine science, similar questions, and equal-value. [...] Until now, contingentists have been unable to provide any such alternative. [...] Until further notice, contingentism has no plausibility" (Soler, 2015; see also Hacking, 2000).

It is important to notice that the put-up argument requires that an *actual* alternative is developed. Why this is so reveals many important considerations concerning the conceivability of alternative developments. Contingentism is a claim about what *could be the case*. It seems that, *prima facie*, a counterfactual scenario that shows how an alternative science could have developed should be enough to defend contingentism. Why do counterfactual scenarios fail to convince us about the contingency of science?

Soler (2015) discusses two historiographical studies that have attempted to build plausible counterfactual scenarios leading to different science. The first one is Pickering's work (1984) on the historical episode of the so-called discovery of weak neutral currents in the mid-1970 s. Soler points out that "The same experimental data from neutrino experiments (for example the same visible tracks on films from bubble chambers) have been, in the *actual* history of science, *actually* interpreted in two *contradictory* ways" (2015, 58). There were two scientific symbioses (i.e., a robust fit between multiple ingredients of scientific practice) that had been proven fruitful. However, this does not convince inevitabilists. One of the symbioses is still assumed to hold today. Inevitabilists can argue that this symbiosis was better from the beginning. As the surrounding theoretical configuration and experimental means developed, only one of the symbioses was able to survive. Despite the first appearance, it was not plausible that the abandoned symbiosis could have developed to be the dominant theory of today. It seems rather impossible to establish that some historical alternative to currently accepted science would have been viable in the *long run* (Soler, 2015, 63–65).

The second case that Soler discusses is Cushing's study (1994) on the history of quantum theories. According to Cushing, the adoption of the standard quantum mechanics (SQM) instead of David Bohm's theory (BQM) was contingent. The difference between Cushing's and Pickering's cases is that "there is a sense in which we can say that SQM and BQM are two *living* coexistent contemporary theories" (Soler, 2015, 68). Moreover "there is a *clear* and *highly convincing* sense in which the two physical wholes (or robust fits) under discussion are *equally* good. BQM is as good as SQM, in the *clear* sense that the two theories make *exactly the same predictions*" (Soler, 2015, 69). Still, there are multiple ways of denying that this case speaks for contingentism. First, there are multiple ways in which inevitabilists can deny that BQM is an interesting/nonbenign alternative to SQM (Soler, 2015, 71–75). Secondly, and more importantly, inevitabilists can claim that "the current coexistence of the currently equally-good SQM and BQM [will] be resolved in the *future*" (Soler, 2015, 77). Soler concludes that "it must be stressed that the only-transiently-as-good inevitabilist reply is an *in-all-circumstances-usable strategy*. Whatever candidate contingentists put up as an actual, equally good, incompatible scientific alternative, inevitabilists will always have the possibility of dismissing this candidate as an alternative that is not *genuine*, by appealing to the temporary character of the situation." (2015, 78.).

Again, it turns out that counterfactual scenarios might not be all that helpful in creating alternatives to the current state of affairs. Even if we could conceive a state of affairs, it can always be argued that it is not a *genuine* possibility. However, we should notice that

the put-up argument ultimately rests on historical considerations, not on the logic of counterfactuals. As Soler points out “*according to inevitabilists*, the actual history of physics does not provide any grounds for contingency. [...] When looking to the actual history of our physics, the striking fact is this *uniqueness*, and not the proliferation of alternatives that have looked equally good to practitioners” (2015, 82). However, there is a way to resist the conclusion that inevitabilists attempt to draw from the historical pattern. If we can find the reason for the historical pattern, we are in a better position to understand why the limits of genuine possibility appear so limited.

Soler (2015), 85; see also Trizio (2008)) argues that.

“As it so happens, our *actual way of conceiving and practicing science is monist*. It is monist in the sense that the development of a multiplicity of alternatives is *not valued and not socially encouraged and supported*—in any of the senses of “supported,” in particular financially and materially. Our physics, and more generally our epistemic activities, are governed by a *monist ideal* and a *uniqueness commitment* that seem deeply entrenched.”

Given this, the put-up-or-shut-up argument can perhaps never be answered due to the structural features of science. We saw that counterfactual scenarios do not satisfy the inevitabilists and now we know why they cannot be fought in the actual world. However, this does not mean that there are no genuine alternatives that could have been the case (or could be the case in the future), had the resources been distributed differently. Again, our inability to tell and justify how history could have developed otherwise might not tell us much about the history (or future) itself. Everything comes down to the question of whether inevitabilism is the default position that should be accepted as long as contingentism cannot be supported (Soler, 2015, 94–95). It is not obvious that it should be. However, it is difficult to tell how to assess which one, inevitabilism or contingentism, should be the default position. People with different intuitions and views on the range of genuine possibilities in human affairs probably have different answers. Inevitabilism limits the range of possible futures while contingentism opens it up. People who think that it is a good strategy to assume that the future is open will probably see methodological merit in contingentism, while people with a different intuitions and views might adopt inevitabilism. This means that *we cannot use contingentism or inevitabilism as arguments for or against the possibility of alternative futures because our take on the contingentism vs. inevitabilism issue depends on our views on how many alternatives are possible in the first place*. Again, as in the previous section, we see that even the most detailed historical and historiographical analysis cannot do much to help us to exceed the limits of conceivability.

6. Conclusion

In this paper, three cases from philosophy of science were discussed. The cases involve conceptual and epistemological considerations that suggest the following lessons. First, there are possible futures that cannot be conceived due to deep epistemological and conceptual reasons. At least in science, there have been unconceived alternatives and probably still are. Moreover, the unconceived alternatives at one level of a system radiate through the whole system which suggests that unconceived alternatives might have radical rather local consequences in the system. Secondly, there might be conceivable futures whose plausibility or even possibility cannot be justified for deep epistemological and conceptual reasons in contrast to more practical limitations in foresight practices. Our current epistemological and conceptual predicament prevents us from creating plausible scenarios that do not converge towards the current state. Moreover, even if we could provide an alternative scenario, there are always resources to deny that the alternative is genuinely possible or nonbenign. Thirdly, the range of possible histories and the range of alternative futures seem to depend on the same sets of rather contentious convictions about the space of possibilities for historical trajectories. One cannot find historical or future possibilities independently of the convictions and, vice versa, we cannot understand the robustness and inevitability of the present world independently of how we view historical and future possibilities. Other pasts, different presents, alternative futures, to use Black (2015) phrase, are entangled in a web of modal considerations.

It is interesting to note that the insights on conceivability discussed in this paper are far from obvious or a priori even though they are based on philosophical debates. Rather, the insights are based on historical, historiographical, epistemological, and conceptual considerations. They build on historical patterns but also on insights on how it is possible to study and understand history. It turns out that our ability to conceive and reason about possibilities has been historically limited. It is also limited by our ability to make sense of the history from the present point of view. There are many mechanisms by which the present state of the world reinforces its own hegemony, continuity, and inevitability.

In general, the cases discussed in this paper do not fully support the optimism that the past-facing approaches can in themselves reject determinism by multiplying and pluralizing possibility or open new possibilities by studying counterfactual scenarios. However, this should not demoralize us. As we have seen, even if we cannot fully escape our epistemological and conceptual predicament, we should not settle for accepting the present world as inevitable and continuous. For the very reason that the current state reinforces its hegemony, we should study the alternatives. In fact, too much optimism towards our ability to conceive possible futures makes us blind towards the possible futures that lay beyond conceivability, thus reinforcing the present even further. Only by understanding the limits, we can plan to overcome them. It is conceivable that the limits of conceivability are not historically immutable or nonnegotiable.

In essence, the paper suggests that the epistemological and conceptual limits of our ability to conceive and reason about possible futures should be mapped systematically and in connection with many different fields. This provides better understanding of the creative and critical bite of futures studies and reminds us of our epistemological and conceptual predicament with respect to future possibilities.

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