Meta-Empirical Confirmation: Addressing Three Points of Criticism

Richard Dawid

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Abstract

I respond to three points of criticism that have been raised against the concept of meta-empirical confirmation. I argue that meta-empirical confirmation can be set up in a coherent way and is sufficiently discriminating for rendering it a non-trivial indicator of a theory's viability. Moreover, I argue that acknowledging the significance of meta-empirical confirmation provides an argument for the pursuit of alternative research programs rather than for their suppression.

1 Introduction

It has been argued in Dawid (2013), Dawid (2006, 2007, 2009, 2016, 2018, 2019) and Dawid et al. (2015) that three arguments of *non-empirical confirmation* were capable of significantly increasing trust in a scientific theory's viability in the absence of empirical confirmation. In this discussion note, I respond to three points of criticism recently presented by Cristin Chall (2018), Lee Smolin (2014) and Daniele Oriti (2019), which are directed specifically at individual arguments of non-empirical confirmation. I will not be able to discuss all points made in the three papers. I will focus on one core point in each case, which in my understanding represents the most important issue raised in the given text.[1]

[1] Further critical discussion of the approach of non-empirical confirmation (some of which I have engaged with elsewhere) can be found for example in Ellis and Silk (2014), Ellis (2017), Cabrera (2018), Dardashti (2019), Hossenfelder (2019), Menon (2019) and Rovelli (2019).

2 Zooming in on Three Arguments of Meta-Empirical Confirmation

The concept of non-empirical theory assessment denotes lines of reasoning that aim to generate a significant degree of trust in a theory's viability in the absence of empirical confirmation. While Dawid (2013) singles out a small set of specific arguments that can be particularly powerful tools of non-empirical confirmation, it does not rule out the existence of other forms of significant non-empirical theory assessment. Recently, a wider range of such strategies has been addressed in the literature (see Peebles (2020)[2]). In this light, the present paper will use the more specific term "meta-empirical confirmation" to denote specifically the three arguments of non-empirical confirmation discussed in Dawid (2013) and closely related arguments. I define arguments of meta-empirical confirmation as arguments that increase the trust in a theory's viability by inferring limitations to scientific underdetermination from observations about the way the scientific research process has played out. Those observations are about the world but don't amount to empirical evidence for the theory because they are not of the kind that can be predicted by the theory in question.

Scientists deploy three specific arguments of meta-empirical confirmation when evaluating their theories in the absence of sufficient empirical confirmation: i) The no alternatives argument (NAA): Scientists tend to trust a theory if they observe that, despite considerable efforts, no alternative theory that can account for the corresponding empirical regime is forthcoming. ii) The unexpected explanation argument (UEA): Scientists tend to trust a theory if they observe that the theory turns out to be capable of explaining significantly more than what it was built to explain. iii) The meta-inductive argument (MIA): Scientists tend to have increased trust in a theory that fulfills the first or the first two criteria if it is their understanding that previous theories in their research field that satisfied those criteria had usually turned out empirically successful once tested.

As indicated above, these arguments are based on assessing the spectrum of possible alternatives to the theory in question. In each of the arguments, the meta-level observation about the research process serves as an indicator

[2]In his history of modern cosmology, James Peebles suggests that non-empirical theory assessment has been of substantial importance in the field. He identifies a number of cases where non-empirical theory assessment played an important role in endorsing cosmological theories and hypotheses. Peebles uses a broad notion of non-empirical assessment that can in part be related to the specific arguments discussed in Dawid (2013) but goes substantially beyond them, including arguments of conceptual cogency as well as arguments of elegance and simplicity.

that there is a scarcity of possible alternatives to the given theory. If a scientist has plausible reasons to infer from observations about the research process that possible conceptual alternatives to a known theory are probably very scarce or absent, this provides an epistemic basis for trusting that theory.

3 First Criticism: Arguments of Non-empirical confirmation are structurally flawed.

Cristin Chall (2018) argues that UEA and MIA are structurally flawed. Chall starts his argument against UEA by claiming that "the UEA is essentially a non-empirical version of the no miracles argument" (Chall 2018, p132). On that basis, he argues that the significance of UEA is threatened by the possibility that unexpected explanatory interconnections could also be provided by a more fundamental theory than the one supposedly supported by UEA. Chall then asserts that Dawid (2013) counters the described threat in the case of string theory by recourse to a final theory claim: if the theory is final, no more fundamental theory exists. Based on this reconstruction of UEA, Chall argues against the argument's validity: UEA is deployed to establish a theory's viability; a final theory argument can only be established based on the assumption that the given theory is viable; therefore, if UEA itself relies on a final theory claim, the line of reasoning is viciously circular. Moreover, an UEA that is applicable only to theories that generate a final theory claim is irrelevant for most scientific reasoning.

With regard to MIA, Chall claims that the argument is incoherent if the alleged meta-inductive support is based on the success of theories to which the theory under scrutiny is a successor theory. Chall points out that the agreement of the predecessor theory's predictions with the data needs to be retained by any viable successor theory (in some low energy limit of that successor theory). Therefore, the agreement between that data and the predecessor theory always amounts to empirical confirmation (accommodation) of the successor theory. But if the agreement between the predecessor theory and the data has already been fully factored in as empirical confirmation, it cannot provide additional *meta-empirical* evidence for the successor theory's viability.

Given that string theory is a universal theory, any empirically viable theory in high energy physics deals with physics covered by string theory and thus must be its predecessor theory in Chall's sense. Therefore, Chall argues, MIA is in principle inapplicable to string theory. Moreover, he claims that most good cases of comparable theories that could enter an MIA argument are predecessor theories, which renders MIA mostly inapplicable.

Chall's criticisms are based on an insufficient appreciation of two core elements of meta-empirical confirmation: (i) the distinction between local and global underdetermination, and (ii) the distinction between the role of experimental data at the ground level and at the meta-level.

Chall's view of UEA as a non-empirical version of the no-miracles argument (NMA) ignores an important difference between the two arguments: they aim to support substantially different claims. NMA is deployed in support of scientific realism. In asserting a theory's approximate truth, scientific realism makes the global claim that the theory will *never* be replaced by a successor that contradicts the theory's core ontic commitments. UEA, to the contrary, is a local argument. It is deployed to support a theory's viability *within a given empirical horizon.* If the theory gets superseded at a higher energy scale that lies beyond that empirical horizon, the local viability claim supported by UEA remains intact. The possibility of a more fundamental theory whose characteristic empirical implications lie beyond the considered empirical horizon therefore does not threaten UEA. Thus no final theory claim is needed to block any such threat. UEA's viability does not depend on a final theory claim.

What does threaten UEA (see Dawid 2013, Chapter 3.1) is the possible existence of a principle that is more general than the theory under scrutiny and already delivers the unexpected explanation. If such an underlying principle is instantiated not only by the theory under scrutiny but also by a wider group of alternative theories about the given intended domain, the UEA for each of the individual theories that instantiate the principle falls apart. Only one of the alternative theories that instantiate the underlying principle will be viable. The explanatory success achieved by the others arises because they instantiate the same underlying principle as the viable theory.

As pointed out in Dawid (2013, Chapter 3.1), this threat cannot be countered within the context of UEA. It can be controlled, however, by deploying MIA and/or NAA in conjunction with UEA. NAA can indicate that the chances for an alternative theory that instantiates the same underlying principle are low. MIA can indicate that strong cases of UEA have worked well in the field despite the threat of underlying principles. None of these arguments can fully remove the problem underlying principles pose for UEA. But they can reduce the severity of the problem. This is one example of the ways in which mutual reinforcement between the three arguments of MEC can achieve significant confirmation while the individual arguments are of insufficient strength if viewed in isolation.

Chall's argument thus goes wrong in two ways. His analysis of the mechanism of UEA ignores the important point that the significance of UEA cannot be argued for without reference to one or both other kinds of MEC. Moreover, his argument for the need of a final theory claim as a foundation for UEA is based on the erroneous understanding that UEA aims to support a global (realist) claim.[3]

Let us now move on to Chall's second argument, which is directed against MIA. In order to see why the argument fails, it is crucial to understand the structural difference between ground level observations E and meta-level observations F. E, if confirming, denotes empirical data that happen to be in agreement with theory H's predictions. The corresponding F (in the MIA case) denotes the observation that H had been without known alternatives for a considerable time despite intense search for alternatives and then ended up being empirically confirmed by data E.

Chall is right that the agreement between a predecessor theory's predictions and data E needs to be retained by a successor theory. Therefore, once one has checked that the successor theory can reproduce the empirical predictions of its empirically successful predecessor in some low energy limit, E indeed must not be counted a second time as independent evidence for the successor theory. Meta-level evidence F, however, is not of a kind that can be retained by the successor theory. F represents a contingent fact about the way in which the research process played out with respect to the development and testing of the predecessor theory. That contingent fact is neither predicted by the predecessor nor by the successor theory. The fact that the successor theory has its predecessor as an effective theory is entirely independent from the question whether or not the historical contingencies of the development and testing of that predecessor amount to F-type evidence. Therefore, F can have confirmation value for the successor theory beyond the observation that the predecessor theory is consistent with data E. Contrary to Chall's claim, MIA thus can very well be applied to successor theories.

To conclude, neither of Chall's two criticisms poses problems for meta-empirical confirmation once one adequately accounts for the full structure of the argument.

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[3] One should note that final theory claims can indeed further strengthen meta-empirical confirmation (see Dawid 2013, p153f). They are not necessary, however, for making UEA+NAA+MIA significant and work in a different way than Chall suggests.

4 Second criticism: Meta-empirical confirmation is too easy to achieve

Lee Smolin (2014) raises a number of issues regarding the status of meta-empirical confirmation. I want to focus on one central point of criticism: according to Smolin, meta-empirical confirmation is so flexible that scientists with a sufficient degree of ingenuity can always use it to support the theory they prefer. As an example, Smolin aims to demonstrate that loop quantum gravity (LQG) can be confirmed meta-empirically just as well as string theory. He claims that all three arguments of meta-empirical theory confirmation can be deployed also for confirming LQG.

Smolin views LQG and string theory as rival approaches that can both be supported by a no-alternatives argument if one adds specific requirements: *being a fully unified description of all interactions* in the case of string theory and *manifest background independence* in the case of LQG. While the former requirement is not met by LQG, the latter is not met by a perturbative approach to string theory.

In order to develop his argument, Smolin needs to make two problematic steps, however. First, he shifts the level of analysis from the level of theories to the level of research programs. Second, he assumes that methodological preference can provide a basis for NAA.

A research program amounts to deploying a given set of principles and concepts in a given research field. Within the research program, theories are being developed that aim to make testable empirical predictions. It is fair to say that LQG and string theory represent rivaling research programs that choose different strategies for addressing the problem of quantum gravity. LQG focuses on the quantization of gravity while string physics approaches the question based on a universal theory of all interactions.

While research programs may be more or less successful, they don't get confirmed or disconfirmed, because no empirical predictions can be deduced from them. What can get confirmed is an individual theory. Therefore, a NAA in favor of string theory or LQG, must confirm them as theories. Even though neither LQG nor string theory have been fully developed and their spectra of empirical predictions are unknown, it seems possible to treat them as theories. In both cases, the posits that determine the approach seem specific enough to justify the expectation that, if the conceptual implications of those posits could be fully spelled out, this would specify a theory with a well defined class of empirical predictions in an unequivocal way.

If understood as theories in that sense, however, string theory and LQG do not constitute theories about the same class of phenomena. String theory is, in virtue of its core posits, a theory of all interactions. LQG, as it stands, is a theory about quantized gravity. LQG may some day in the future be developed into a theory that describes all interactions. If that can be done, the resulting theory would play out within the LQG research program but require additional posits and therefore constitute a different theory than the one investigated today. Such a theory, if it did not merge with string theory and covered the observed phenomenology of high energy physics in an explanatorily sufficiently satisfactory way, would indeed amount to a rival theory to string theory. But this prospect for a future theory within the LQG research program must not be mistaken for the theory of LQG that can be pinned down today. Viewed at the level of currently identifiable theories, string theory therefore has the more extensive intended domain than LQG.

It follows that, while string theory is an alternative to LQG as a theory of quantum gravity, LQG today does not constitute an alternative to string theory as a theory of all interactions. A no-alternatives argument therefore can be applied to string theory without relying on the requirement that the description of all interactions be *fully unified*. All that is needed is the specification of the theory's intended domain: string theory is claimed to be the only known theory that covers all known interactions.

While string theory therefore can find support from a NAA based on specifying the theory's intended empirical domain, LQG can only find such support based on an additional requirement that disqualifies string theory.[4] Smolin suggests the requirement of manifest background independence. In order to understand whether introducing a requirement of this kind is acceptable, we need to discuss an aspect of NAA that, though implicit in the way the argument has been presented in Dawid (2013), may not have been sufficiently emphasized.

An epistemically relevant no-alternatives claim needs to be based on a specified class of physical phenomena (such as the class of all known interactions in the case of string theory) that allegedly cannot be represented by an alternative theory. Once such a class of phenomena has been specified, a no-alternative claim can be justified in the following way: Assuming that science works at all in the given context, there must be a scientific theory that can account for the given class of phenomena. Therefore, if only one scientific theory can account for the given class of phenomena, that theory must be viable.

[4] For the sake of the argument, we set aside the point that LQG is just one of a range of approaches of quantizing gravity in a manifestly background independent way that haven't been shown to be physically equivalent.

Manifest background independence does not denote a class of phenomena. Rather, it constitutes a methodological choice. A class of phenomena that needs to be accounted for by a theory amounts to empirical data that, based on the scientists' understanding of the respective field, is significant and lies within the theory's intended domain. A methodological choice denotes a decision as to which conceptual characteristics a scientist wants her theory or her theory's construction method to have. If a scientist concedes that a theory does not account for a certain class of phenomena, she narrows down the theory's intended domain. If a scientist discards a methodological choice, she merely widens the spectrum of possible theories she is thinking about.

Manifest background independence denotes a prescription regarding the method of constructing a theory of quantum gravity. Perturbative string theory, by perturbing around a given spatiotemporal background, does not adhere to this prescription. It is clear, however, that - if there is a consistent string theory at all - i) spacetime fully emerges from the dynamics of string theory[5] and ii) no aspect of spacetime that would be accounted for by LQG lies outside the intended domain of string theory. Therefore, forsaking manifest background independence when analyzing string theory perturbatively amounts to a methodological choice and does not imply that string theory narrows down, in comparison to manifestly background independent LQG, the class of phenomena that fall into its intended domain.

Any attempt to build a no-alternatives case based on a methodological choice immediately faces a regress problem, however: in order to assess the significance of such a NAA, one needs to assess the probability that other theories can successfully represent the phenomena of quantum gravity without making the choice of manifest background independence. Since there is no good way of assigning probabilities to methodological choices, the corresponding no alternatives argument deflates to a mere statement of methodological preference and provides no basis for assessing the relevant spectrum of unconceived alternatives. Therefore, contrary to Smolin's claim, the condition of manifest background independence cannot be used fruitfully in a NAA.

The lack of a genuine NAA for LQG also substantially weakens the basis for a MIA for the theory, since a MIA acquires strength only in conjunction with a no-alternatives case.

Smolin also discusses ways in which the argument of unexpected explanation (UEA) applies to LQG. There is no reason to deny that unexpected explanation can arise in LQG. To the extent it does, it amounts to non-empirical theory confirmation for LQG. Specific unexpected explanatory in-

[5]See (Huggett and Vistarini 2015) for a philosophical analysis of this point.

terconnections that arise for both string theory and LQG would only have reduced confirmation value for each theory, however, since their occurrence in different theoretical approaches would suggest that they are related to a deeper characteristic of theorizing about quantum gravity rather than to an individual theory.

Assessing the substance and significance of unexpected explanations provided by a specific theory, be it string theory or LQG, is a matter of careful analysis. This is not the place to carry out such an investigation. It is my understanding that the complex and far-reaching web of unexpected explanations encountered in the context of string theory is not matched by what one finds in the case of LQG. But be this as it may, the physicist's careful assessment of the extent of unexpected explanations must provide the basis for assessing UEA's significance. To the extent LQG justifies an UEA in its favor after careful consideration, this would indeed generate MEC support for LQG. It would not be easily won epistemic support, however.[6]

To conclude, NAA is not applicable to LQG, which in turn substantially weakens the basis for applying MIA. UEA might be applicable to some extent but it is doubtful whether its strength is comparable to the string theory case. Smolin's attempt to generate substantial MEC for LQG fails due to the specific requirements of epistemically significant MEC.

5 Third Criticism: The No Alternatives Argument Makes Scientific Thinking Narrower

Oriti (2019) argues that MEC is harmful to the breadth and multifaceted nature of scientific thinking. Oriti agrees that MEA is frequently used by scientists and plays a productive role in establishing trust in the stability of empirically well-confirmed theories. He argues, however, that NAA, which sits at the very center of MEA type reasoning, cannot be reliable in the

[6] As pointed out early in this paper, significant MEC requires at least two types of MEC. In the absence of an NAA argument in favor of LQG, the significance of UEA in the given case could be established in two ways. First, while the existence of one alternative to LQG (i. e. string theory) substantially weakens MIA, it does not fully destroy it. Second, MIA type reasoning could also be based on unexpected explanation rather than the number of known alternatives as a criterion for selecting the ensemble of theories based on which the meta-inductive argument is run. Due to the complexity of evaluating UEA in each individual case, it seems far more difficult to extract a powerful MIA on this basis, however. Any meaningful MIA on that basis would require very strong UEA indeed.

absence of empirical confirmation and merely serves as an ill-founded justification for abandoning the quest for alternative approaches.

Oriti's line of reasoning can be divided into two parts. First, he argues that there are no cases in the history of science where a theory remained absolutely without alternatives before empirical testing. Therefore, he claims, NAA is, strictly speaking, never applicable. In cases where no alternatives claims are actually being made, they are based on additional requirements, such as methodological preferences, criteria of rigor, or the extent to which alternatives are fully developed. These additional criteria, Oriti argues, cannot provide a reliable foundation for NAA because their epistemic relevance is questionable.

On that basis, Oriti argues in a second step that NAA is mainly deployed by dominating research programs to discredit their less well-established rivals. This mechanism, Oriti argues, threatens the flexibilty and width of scientific reasoning that is needed for finding and developing the most adequate theories. Oriti therefore proposes a methodological principle he takes to be opposed to NAA, which he calls the principle of proliferation: construct as many alternative theories as possible and use them together as the object of empirical testing. Oriti suggests that, rather than aiming for NAA, one should follow the principle of proliferation to optimize the process of scientific theory building.

I will respond to Oriti at three levels. At a conceptual level, I will argue that Oriti's distinction between "good" NAA in the presence of empirical confirmation and "bad" NAA without empirical confirmation is not tenable. At a historical level, I will argue that quite some cases of successful NAA can be found if one does not adhere to an idealized understanding of what real-life NAA looks like. At a strategic level, I will point out that NAA is more supportive of Oriti's core agenda of instigating pluralism than he takes it to be.

Oriti draws a fundamental distinction between the context of empirical confirmation, where NAA can be helpful by generating trust in the predictive reliability of the empirically confirmed theory, and the case of non-empirical confirmation, where this is not possible. This rigid distinction is problematic in a number of ways.

First, the exclusive focus on the value of pluralism in the absence of empirical confirmation disregards a substantial debate in the philosophy of science on the allegedly underrated importance of pluralism in contexts of strong empirical confirmation. Hasok Chang (see e.g. 2010) has made the case that the decision as to whether or not empirical confirmation licenses the full endorsement of a theory or research program and the conclusive rejection of its alternative often depends on a complex web of influences and considerations that reach far beyond the simple comparison between a theory's predictions and the data. Chang moreover argues that theory pluralism is conducive to scientific progress even at a stage when one theory seems decisively favored by the data.

Translated into the language of MEC, Chang in effect argues that the conclusiveness of NAA type reasoning in the presence of empirical confirmation has been overrated by scientists and philosophers of science alike. Whether or not one wants to fully subscribe to Chang's evaluation of the specific case studies he discusses[7], his analysis demonstrates that striking the balance between the merits of pluralism and the efficiency of focusing on one research program is a nontrivial process even in cases where empirical confirmation abounds.

Once one is willing to acknowledge this point, however, the difference between the role of NAA in cases of empirical confirmation and in cases of MEC looks decidedly less substantial. In neither case, the judgement that a theory or research program is not a serious alternative is absolute and clear cut. In both cases, concluding that a theory is without alternatives is productive and helpful for focusing research power on the most promising conceptual development, but also potentially damaging in discouraging investigations that in the end would be important and conducive to scientific progress after all. This does not mean that NAA is equally strong or equally justified in both contexts. It means, however, that acknowledging the productive role of NAA in cases of empirical confirmation makes it difficult to deny as a matter of principle that NAA can be conducive to scientific progress in specific circumstances where empirical confirmation is lacking.

This point is further strengthened by the fact that the distinction between cases of empirical confirmation and theory assessment without empirical confirmation is not a rigid dichotomy. One might rather speak of a slippery slope that leads from empirical to non-empirical confirmation. String theory is indeed the only case where a theory is supported by MEC that does not reproduce any specific quantitative empirical predictions that go beyond general characteristics such as the existence of gravity or signatures that reflect symmetry features of a gauge field theory. In more conventional cases of NAA, the theories under scrutiny do make predictions that agree with empirical data even though its core predictions remain empirically unconfirmed. Examples of such cases would be NAA type arguments for the Higgs particle before its discovery in 2012 (Dawid 2013), for inflation (Dawid and McCoy forthcoming), for dark matter (Allzèn forthcoming), or, as a historical exam-

[7]A core example of Chang is the endorsement of Lavoisier's theory of combustion of phlogiston theory.

ple, the arguments in favor of an atomist explanation of isomers in the 1870s (Dawid 2020).

In all those cases, there is empirical data that can be represented by the given theory: Flatness, Isotropy and CMB precision data in the case of inflation, rotation curves of galaxies and clusters in the case of dark matter, the existence of particle mass spectra that obey standard model symmetries in the case of the Higgs particle and the spectrum of isomers in 19th century chemistry. MEC applies because the theory's core posits, the Higgs particle,the fields that drive inflation, dark matter particles, or the individual molecules, have not been observed. On the other hand, there are cases of empirical confirmation where a considerable theoretical distance separates the observed data from the theory. A good example is the confirmation of the hypothesis of a cosmological constant by standard candle supernovae data (Perlmutter 1999, Riess 1999). In all those cases, whether they are cases of empirical or non-empirical confirmation, NAA generates trust in theories that, to some extent, are supported by empirical data. It seems arbitrary to confine the legitimate role of NAA only to the case of the cosmological constant that, on most accounts, qualifies as a case of empirical confirmation. Once the legitimacy of MEC has been accepted for all cases listed in this paragraph, however, it would seem arbitrary to block it only in the case of string theory.

Oriti makes the point that, even in cases where NAA is used by exponents of a theory, the claim that there are no viable alternatives will not be universally accepted. This seems to be a fair point. But, once again, the situation differs only gradually from many cases of empirically confirmed hypotheses. Supernovae data is by a majority of physicists today taken to provide empirical confirmation of accelerated expansion and, on that basis, for a cosmological constant. Nevertheless, more than 20 years after the data has been gathered, alternative hypotheses to the cosmological constant are being upheld (such as quintessence (see e.g. Tsujikawa 213) or modified gravity (see e.g. Baker et al. 2013)) and even papers doubting accelerated expansion (Nielsen et al. 2016)) are being published. It would be an inadequate to claim that data can empirically confirm a hypothesis only once the last scientific supporter of an alternative hypothesis has changed her mind or died. Rather, it is up to the individual scientist to make a judgement, based on applying scientific methodology, whether the given data should be acknowledged as substantial confirmation of a hypothesis or not.

The very same assessment is applicable to the use of of NAA in the case of MEC. Oriti correctly points out that methodological preferences (see Section 4) or judgements of elegance or simplicity are no reliable basis for MEC. However, other complex issues require individual assessment as well and are of crucial importance for the question as to whether or not a theory should be viewed as a genuine scientific alternative at a given point. Important examples are a theory's prospects of internal consistency or its prospects to be consistent with empirical data. Scientists may differ in their judgements of those issues, which may legitimately lead them towards different views on a NAA in a given case. Obviously, science should strive to find convergence on those issues to the extent possible. It would not be justified, however, to conclude that a failure to find full agreement implies that the arguments involved lack all epistemic merit.

Finally, Oriti argues that NAA has a detrimental effect on the research process by reducing theory pluralism. Oriti is no doubt right that widespread NAA-based trust in a theory can discourage research work on alternative research programs. As discussed above, this effect can be constructive in bundling efforts where research seems most promising but can also be detrimental to scientific progress by discouraging alternative research strategies that could be successful in the end.

The following point is important to emphasize, however. Developing a full understanding of the mechanism of MEC does not devaluate the push towards theory proliferation but actually provides an additional powerful reason for pursuing alternative research programs. NAA depends on the observation that scientists have extensively and over long periods of time searched for alternatives but did not come up with any. Only on that basis can a NAA be significant. The more energy has been invested in alternative research programs without success, the more powerful a NAA can become. In this light, it is in the epistemic interest of the dominant research program that alternative research programs are pursued with vigor and in sufficient breadth. This is particularly true in research contexts where prospects of empirical confirmation are scarce and theory assessment must be expected to depend on MEC for many years to come.

Working on alternative research programs in a context of scarce or inconclusive empirical evidence thus is of crucial importance irrespectively of the eventual success of that program. If the program ends up being successful, it directly contributes to scientific progress. If it is unsuccessful and another research program ends up being supported by MEC, the unsuccessful programs are essential for developing a NAA in support of the successful theory, thereby making an epistemically important contribution to the scientific process as well. Proliferation in this light is not the enemy of NAA but an essential ally.

6 Conclusion

All three lines of criticism addressed in this note raise relevant and important issues. Answering them was based on pointing out that significant meta-empirical confirmation involves a number of conceptually non-trivial elements. All three arguments of meta-empirical confirmation rely on the careful distinction between local and global claims and on the specific status of meta-level observations. The NAA needs to be based on the specification of the intended empirical domain rather than on methodological or conceptual requirements. Finally, NAA crucially depends on a powerful push towards theory proliferation. Whether and to what extent significant MEC can be achieved in the end depends on the specific characteristics of the individual scientific case. I hope to have demonstrated, though, that none of the lines of criticism discussed threaten the conceptual core of meta-empirical confirmation.

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