Promoting Scientific Progress

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Abstract

In the philosophical debate about scientific progress, several authors appeal to a distinction between what *constitutes* scientific progress and what *promotes* it (e.g., Bird, 2008; Rowbottom, 2008; Dellsén, 2016). However, the extant literature is almost completely silent on what exactly it is for scientific progress to be promoted. Here I provide a precise account of progress promotion on which it consists, roughly, in *increasing expected progress*. This account may be combined with any of the major theories of what constitutes scientific progress, such as the truthlikeness, problem-solving, epistemic, and noetic accounts. However, I will also suggest that once we have this account of progress promotion up and running, some accounts of what constitutes progress become harder to motivate by the sorts of considerations often adduced in their favor, while others turn out to be easier to defend against common objections.

1 Introduction

Recent years have seen a robust revival of philosophical work on scientific progress. The two previously dominant accounts of scientific progress pioneered by Popper (1963) and Kuhn (1970), respectively, have been pitted against several new accounts that depart, in various ways, from their predecessors. For example, Popper's account, on which progress consists in increasing verisimilitude or truthlikeness, has been influentially criticized by Bird (2007), who argues that justification is necessary for progress. Accordingly, Bird proposes an account on which progress consists in the accumulation of knowledge, which is understood to entail both truth and justification (see also Bird, 2022). However, Bird's

argument and account has in turn been criticized, among others by Rowbottom (2008), Niiniluoto (2014), and Dellsén (2016); indeed, the latter uses Bird's account as a foil to argue for an understanding-based account of scientific progress (see also Dellsén, 2021).

In this more recent debate about scientific progress, several authors have at various points appealed to a distinction between what *constitutes* scientific progress and what merely *promotes* it. The distinction seems to stem from Rowbottom, who at one point argued that a particular hypothetical event might "... only have been *responsible* for progress—and not *constituted* progress" (Rowbottom, 2008, 278). In a direct response to Rowbottom, Bird expresses his agreement on this point by saying that "we must distinguish what *constitutes* progress from what *promotes* it" (Bird, 2008, 280); indeed, Bird goes on to use this distinction in a rebuttal of one of Rowbottom's objections to his account. Dellsén similarly commits to the distinction by saying that "since nearly anything can promote progress, we must be careful not to confuse scientific progress itself with the promotion of such progress" (Dellsén, 2016, 73).

But what exactly is it for something to promote rather than constitute scientific progress? Somewhat surprisingly, the extant literature contains little guidance on this issue. For example, while Dellsén (2018) suggests that promotion of progress can be understood as something that "facilitates or leads to" progress, this simply raises the follow-up question of what it is for something to *facilitate or lead to* progress. Ideally, we should like to have an account of *progress promotion* which defines it in terms that are themselves more precise and better understood than the term itself. That is what I hope to do in the current paper. Broadly speaking, the account I'll offer defines progress promotion as *increasing expected progress*. As we shall see, this provides a richer and more precise understanding of progress promotion than is contained in the extant literature.

The account of progress promotion offered below may be combined with any of the major theories of what constitutes scientific progress, such as those proposed by Popper, Kuhn, and Bird. With that said, however, I will also suggest that once we have this account of progress promotion up and running, some accounts of what constitutes progress become harder to motivate by the sorts of considerations often adduced in their favor,

while others turn out to be easier to defend against common objections. For example, it has been thought that non-epistemic accounts of scientific progress, on which justification is not a necessary condition for progress, cannot explain how scientific evidence generally contributes to scientific progress. Given the proposed account of progress promotion, however, we shall see that a range of non-epistemic accounts can easily explain the importance of evidence in scientific progress. In this way, the account of progress promotion offered below undermines a common argument for epistemic accounts of scientific progress, on which epistemic justification is a necessary condition for progress (e.g., Bird, 2007, 2022; Stegenga, 2023).

2 Scientific Progress: Accounts and Challenges

In this section, I provide a brief overview of the recent debate about scientific progress. I'll start by making several preliminary points about how the debate should be understood; I'll then briefly describe the most influential accounts currently on offer; and finally I'll discuss three distinct challenges faced by some or all of these accounts.

Let me start by noting that the notion of scientific progress concerns a type of improvement, as opposed to mere change, in or of science. Consequently, accounts of scientific progress ultimately make normative claims about how science ought to develop in various circumstances, rather than merely descriptive claims about how science in fact did, does, or will develop. For example, if an account of scientific progress implies that a certain research project wouldn't contribute to scientific progress even if successful, then, all else being equal, scientists should prioritize other projects on which there is at least some chance that progress will

[1]Superficially, there may seem to be some disagreement on this point. Dellsén (2021, 2022) explicitly eschews linguistic intuitions as evidence for or against accounts of scientific progress, arguing that the philosophical questions about progress could be stated without even referring to the term 'progress'. By contrast, Bird (2022, 19) takes the linguistic similarities between the words for 'science' and 'knowledge' in several languages to be "highly suggestive" even if it "provides no knock-down argument" for the view that knowledge is the aim of science. However, if Bird was merely engaged in the project of analyzing ordinary language, it seems that linguistic similarities of this type should be more than merely suggestive; indeed, linguistic considerations should be the only sorts of considerations that are relevant.

be made. Furthermore, since scientific progress is clearly a matter of degree, a complete account of scientific progress should offer normative assessments of how much progress a given research project would yield if successful. These assessments, combined with scientists' beliefs about a project's likelihood of success, can then inform decisions about which research projects to pursue.

A second preliminary point is that accounts of scientific progress are not intended to explain the meaning or usage of terms like 'scientific progress' in English or any other natural language.[1] Indeed, given the normative implications of an account of scientific progress, the primary role of such an account should surely be to guide plausible normative evaluations of different actual or counterfactual developments in science. If this means that an account counts an episode as progressive that would rarely be described as such in ordinary linguistic usage, then so much the worse for ordinary usage. In this respect, 'scientific progress' is no different from other philosophical terms of art, such as 'confirmation', 'explanation', or 'prediction', for which ordinary linguistic usage is generally not considered particularly relevant. What really matters, rather, is whether an account of scientific progress is able to provide compelling explanations of how different scientific developments are positively and negatively evaluated, especially by those most who are most knowledgeable (such as scientists themselves).

A third and final preliminary point is that the philosophical debate about scientific progress has concerned a quite specific kind of improvement in or of science, viz. what is often referred to as *cognitive* progress.[2] What exactly this involves is a matter of contention, but for our purposes we might follow Laudan in characterizing cognitive progress as "nothing more nor less than *progress with respect to the intellectual aspirations of science*" (Laudan, 1977, 7; see also Rowbottom, 2023, 3). In any case, this is not to deny that, in a very broad sense of the term, a particular science or science as a whole might be said to improve in various other ways as well, such as when it secures more funding, or when previously-marginalized groups are no longer excluded from employment and educational op-

[2]Another term for it would be *epistemic* progress, but that label is best avoided due to the fact that several theorists deny that this type of progress should be understood in terms of knowledge (episteme).

portunities (see Niiniluoto, 2019, §2.1). Although these are undoubtedly ways in which science progresses as well, these kinds of progress in or of science fall outside the scope of the extant debate about (cognitive) scientific progress. With that said, it is bound to be somewhat controversial where exactly to draw the line between the type of progress the debate is (or should be) concerned with and other kinds of progress in or of science (see, e.g., Douglas, 2014).

With these preliminary points in place, let us consider some of the most prominent accounts of scientific progress in the current literature. The *truthlikeness account*, also known as the verisimilitudinarian account, holds that scientific progress consists in moving closer to the truth, by increasing the truthlikeness or verisimilitude of accepted theories (Popper, 1963; Niiniluoto, 1984, 2014). The *problem-solving account*, initially proposed by Kuhn (1970) and later developed by Laudan (1977, 1981b), holds that progress consists in having fewer or less significant unsolved scientific problems than previously, either because scientists have solved existing problems or diminished their importance. The *epistemic account* holds that progress consists of accumulating knowledge, where 'knowledge' requires truth, belief, and some form of epistemic justification (Bird, 2007, 2022, chap. 3). Finally, the *noetic account* holds that progress on a given phenomenon consists in putting people in a position to increase their understanding of that phenomenon, where understanding does not require epistemic justification but does require a form of correctness in the models and theories on the basis of which one understands (Dellsén, 2021, 2022).[3]

These four accounts share some features and differ with respect to others. In the remainder of this section, I draw out three such features shared by some or all of these four accounts, viz. *monism*, *non-epistemicism*, and *factivity*, all of which have been argued to be highly problematic. I focus on these particular features because, in later sections, I will suggest that having a clearer understanding of what it is for something to promote, rather than constitute, scientific progress is of great help in meeting these challenges.

[3]An earlier version of the noetic account was proposed by Dellsén (2016); see also Dellsén (2023) for an extended discussion of a central main difference between the earlier and later accounts.

Note, firstly, that all of the above accounts of scientific progress are *monistic*. Each holds that there is a single type of cognitive achievement which constitutes scientific progress. A pluralistic account would instead hold that there are several distinct types of cognitive achievements which constitute progress (Rowbottom, 2019; Hendry, 2022).[4] For example, a pluralist might argue that accumulating knowledge and reducing the number or importance of unsolved problems both constitute scientific progress, even in cases where these achievements don't overlap. Indeed, it may seem obvious that science can improve in various different ways, e.g. through improvements in scientific methods, classifications, and formalisms, which casts doubt on whether all such improvements can be subsumed under a single type of cognitive achievement with which progress is identified. This raises a general challenge for monistic accounts of scientific progress:

> *The Pluralist Challenge:* Aren't there several distinct types of cognitive achievements, such as improvements in scientific methods, classifications, and formalisms, all of which contribute to scientific progress?

We will return to this challenge below (§4.1), where I'll argue that the account of progress promotion on offer in this paper helps monistic accounts address this challenge.

Secondly, a feature that distinguishes the epistemic account of progress from the truthlikeness, problem-solving, and noetic accounts is the requirement that scientists must have or obtain epistemic justification in cases of progress. Indeed, Bird's main argument against the truthlikeness account is that cases in which scientists lack epistemic justification are not intuitively cases of progress (Bird, 2007, 65-67). While Bird's argument is widely disputed (e.g., Rowbottom, 2008, 2015; Cevolani and Tambolo,

[4]I mention Rowbottom and Hendry here because they are the only authors of which I am aware that have explicitly endorsed pluralism about scientific progress in work that focuses on this topic specifically. With that said, anecdotally it seems to me that many philosophers of science are either committed, or at least sympathetic, to various forms of pluralism about scientific progress. For example, Chang's influential study of the invention of temperature as a scientific concept briefly mentions that he is, at least for the purposes of that study, "defining progress in a pluralistic way: the enhancement of any feature that is generally recognized as an epistemic virtue" (Chang, 2004, 227). Similarly, Potochnik's (2015; 2017) study of idealization science in argues that science has many aims – which, according to the common assumption that scientific progress is intimately linked to science's aim(s) (see, e.g., Bird, 2022, 40; although see also Rowbottom, 2023, ch.2; Dellsén, 2025), would entail a pluralistic account of scientific progress.

2013; Dellsén, 2016), it does suggest that the epistemic account is especially well placed to account for the importance of gathering evidence to scientific progress. After all, if scientific progress requires justification, which in turn requires evidence, the role of evidence to progress is clear enough.[5] By contrast, what we may refer to as *non-epistemic* accounts seem to face the following challenge:

> *The Evidential Challenge:* Doesn't the gathering of more and better scientific evidence, e.g. through reliable experiments, (also) contribute to scientific progress?

I'll argue below (§4.2) that this challenge can be met by non-epistemic accounts, given the account of progress promotion proposed in this paper.

A third and final feature of some accounts of scientific progress worth mentioning is *factivity*. This refers to whether, or the extent to which, scientific progress requires later mental states or representational devices to be more faithful to the facts than their earlier counterparts. The truthlikeness, epistemic, and noetic accounts are all factive in different ways and to different extents. The epistemic account, for example, holds that progress requires knowledge, which in turn requires true belief, so truth is a requirement for progress on the epistemic account. By contrast, Laudan's problem-solving account is explicitly designed not to require any form of factivity of scientific progress,[6] on the grounds that doing so would make scientific progress epistemically inaccessible to scientists themselves, in that they couldn't know for certain whether a given episode is progressive or not. On Laudan's view, however, scientific progress must be epistemically accessible in this sense if it is to be of any use in guiding rational decision making in science (Laudan, 1977, 125-128).[7] In sum, then, Laudan can be viewed as issuing the following challenge to factive accounts of scientific progress:

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[5]Another account that seems especially well placed to account for the value of evidence is Stegenga's justification-based account, on which progress consists of changes in justification (Stegenga, 2023); see also footnote 7.

[6]Kuhn is less explicit about his motivations for eschewing factivity, although Bird (2007, 79-83; see also Bird, 2000, ch. 6) suggests that Kuhn's eschewal of factivity is motivated by similar considerations as Laudan's.

[7]Stegenga (2023) refers to this as the *epistemic accessibility desideratum* on scientific progress, and takes it to motivate a non-factive account of scientific progress on which progress is linked to justification but not truth.

The Accessibility Challenge: Doesn't scientific progress have to be epistemically accessible to scientists themselves in order for it to guide rational decision making in science?

I will later suggest (§4.3) that this challenge can be met by factive accounts given an account of when scientists are rational in expecting a given episode to promote progress, an account which itself builds on the account of progress promotion to be developed below.

Taking stock, we have seen that each of the three challenges discussed above targets accounts with specific features. The Pluralist Challenge targets monistic accounts; the Evidential Challenge targets non-epistemic accounts; and the Accessibility Challenge targets factive accounts. Note that this means that two of the four main accounts of scientific progress – the truthlikeness account and the noetic account – are targeted by all three of these challenges. However, things are not looking much better for the remaining two accounts – the problem-solving account and the epistemic account – since each of these is targeted by two challenges.[8] So, proponents of all four accounts should take an interest in an account of progress promotion that promises to help them address these challenges. I will now spell out such an account.

3 An Expectationist Account of Promotion

3.1 The Role of Promotion in Progress

Before we delve into formulating an account of progress promotion, let us briefly consider in more detail how the promotion of progress is meant to differ from its constitution, and what role an account of promotion would play in philosophical theorizing about scientific progress generally.

A straightforward way to distinguish what constitutes progress from what promotes it invokes the idea that scientific progress should be thought of, or perhaps even defined, in terms of the aim(s) of science (see, e.g., Niiniluoto, 2019, §2.4). If the aim of science is A (or if its aims are

[8]The Pluralist Challenge targets both these accounts, while the Evidential Challenge targets the problem-solving account but not the epistemic account, and *vice versa* for the Accessibility Challenge.

A_1,...,A_n), then we may say that partially or wholly achieving A (or any of A_1,...,A_n) constitutes scientific progress.[9] If, by contrast, some event does not directly achieve, even partially, any aim of science, but still in some yet-to-be-specified sense brings about its (partial) achievement, then we may say that it promotes progress instead.

Alternatively, one may instead distinguish constitution from promotion in roughly the way intrinsic value is distinguished from instrumental value (see, e.g., Dellsén, 2022, 11250; Dellsén, 2025). In particular, one might say that an episode constitutes scientific progress in so far as the changes therein are, in and of themselves, improvements on what came before – regardless of what other changes are thereby brought about. By contrast, an episode would promote progress in so far as the changes therein are scientific improvements to the extent that they bring about other changes which themselves constitute scientific progress. In short, then, promotion of progress stands to the constitution of progress as instrumental value stands to intrinsic value.

For the purposes of this paper, one may opt for either of these two ways of distinguishing constitution of progress from its promotion. Either way, more needs to be said about what it is, exactly, to *bring about* either the partial achievement of science's aim (as per the first way of distinguishing promotion from constitution of progress), or other episodes that themselves constitute progress (as per the second). This is the task of an account of progress promotion.

At this point it is worth mentioning a different way of conceiving of the relationship between constitution and promotion, expressed most clearly in Bird's most recent contribution to the debate (Bird, 2022, 40; see also Park, 2017, 570). Instead of thinking of constitution and promotion of progress as two distinct categories, Bird suggests that anything that promotes the aim of science also constitutes progress.[10] On this way of carving things up, promoting and achieving (in part or whole) the

[9]From now on, I will write as if science, if it has any aim at all, has only a single aim A rather than multiple aims A_1,...,A_n. This is merely a matter of streamlining the discussion, however, so readers who are inclined towards pluralism about the aims of science (à la Potochnik, 2015) may mentally replace 'aim A' with 'aims A_1,...,A_n' throughout the subsequent discussion.

[10]As noted in the introduction, however, Bird's (2008) response to Rowbottom suggests that he thinks that constitution and promotion are quite distinct categories.

aim of science are both ways for scientific progress to be constituted. Given Bird's thesis that the aim of science is knowledge, this implies that anything that promotes the accumulation of knowledge constitutes (rather than promotes) progress.[11] Accordingly, I take it that Bird's intention here is to do away with the separate category of promoting progress by instead including promotion of the aim of science as a species of what constitutes scientific progress.

Note, however, that even on this way of carving things up, there is still an urgent need to clarify what *promotion* amounts to in the context of accounts of progress. After all, promoting the achievement of the aim of science would now be one of the two ways in which scientific progress is made, along with (partially) achieving this aim. We may refer to these two ways of making progress as $progress_a$ (achievement-based progress) and $progress_p$ (promotion-based progress). Extant accounts of progress have focused almost exclusively on what this terminology would classify as progress_a, with preciously little discussion of progress_p.[12] Since progress_p would be no less progress than progress_a on this picture, this is a significant theoretical lacuna.

Fortunately, the account of progress promotion I will offer below can be straightforwardly transformed, for those who prefer to think of the relationship between progress and promotion in this latter way, into an account of progress_p. Indeed, as far as I can tell, there is no substantive issue between those who prefer to think of the promotion of progress as distinct from the constitution of progress, and those who take promotion of the aim of science to be a way of constituting progress, progress_p. In both cases, episodes that *promote progress*/*are* $progress_p$ are scientifically valuable or important precisely because, and in so far as, they bring about

[11] Indeed, it is not clear what it would be to promote rather than constitute progress on this way of carving things up. To see why, note that promoting progress would variously amount to (i) promoting the achievement of knowledge, which would constitute progress; or (ii) promoting the promotion of knowledge, which – assuming 'promotion' is transitive – collapses into promotion of knowledge, which again constitutes progress. Either way, then, there can be no way of promoting progress without constituting progress.

[12] For example, Bird (2022, 40) does not offer any gloss on what it is to promote the achievement of the aim of science beyond mentioning a few examples and commenting that the activity in question must be "directly [rather than indirectly] connected to the cognitive goal of science" (with no further explanation of what a 'direct connection' would be).

some cognitive achievement, such as knowledge or understanding, at some later time. Whether we, as theorists, call this 'progress promotion', or instead 'progress$_p$', is a mere semantic issue that should be settled on the basis of linguistic convenience. Since the former terminology is in my view more straightforward, transparent, and entrenched, that is how I shall frame the discussion in the main text.[13]

One final point. To say that there is a distinction between constituting and promoting progress is not to say that these are categories are mutually exclusive.[14] A single episode may both constitute, and promote, scientific progress. Indeed, it is plausible that by the lights of most accounts, most episodes that constitute scientific progress to a significant extent also promote progress at least to some extent. Consider, for example, that a proponent of the epistemic account may argue, plausibly enough, that knowledge begets more knowledge: once scientists come to know an experimental result, for example, they may infer from that a theoretical claim, which may thus become known, and that theoretical claim may in turn be used as an assumption in a further inference, yields even more knowledge, and so forth. More generally, it seems that the type of achievements that constitute scientific progress will often promote more progress, especially on related issues.[15]

3.2 Promotion as Increasing Expected Progress

The question that I mean to address, then, concerns what exactly it is for some episode to promote rather than constitute scientific progress, i.e. to 'facilitate or lead to', or 'be responsible for', scientific progress.[16] Indeed, since much of the work I envision for the notion of promoting progress concerns comparisons in the *extent* to which different sorts of episodes

[13]In footnotes 16 and 20 below, I will briefly indicate how to formulate my account of promotion within the alternative framing used by Bird (2022).

[14]Nor is it to say that these categories are jointly exhaustive, but that should be obvious: clearly, some things neither constitute nor promote scientific progress.

[15]A similar point applies to intrinsic and instrumental value: these are not mutually exclusive categories. Happiness, for instance, is plausibly both intrinsically and instrumentally valuable.

[16]In the alternative terminology discussed above (§3.1), this amounts to asking: What is it for some episode to promote rather than constitute the (partial) achievement of the aim of science, i.e. to be progress$_p$ rather than progress$_a$?

promote progress (see §4), I will also propose a quasi-quantitative measure of progress with which such comparisons can, at least in principle, be made.

Let us start by noting that promoting progress is evidently a matter of causing more progress to occur in the future. But what exactly might this amount to? Note that this cannot simply be a matter of causing progressive episodes to occur in the future. For consider cases in which an episode causes future events in which there is a great deal of progress, but had the episode not occurred the amount of future progress would have been even greater still. For example, a botched experiment may cause scientists to fix the problems with the original experiment, run it again in a successful manner, and thus make a great deal of progress eventually. However, had the experiment been successfully run from the start, those very same scientists would have gone on to run another successful experiment, leading to an even greater amount of progress. In this case, although botching the experiment did cause future progressive events, it seems clear that it did not promote progress. After all, had the experiment not been botched, there would have been an even greater amount of progress in the near future.

This brings out two important points about how to construct an account of progress promotion. The first is that, in addition to considering the future developments that are caused by a given episode, one must also consider what sort of future development of science would occur if the episode had not occurred. To a first approximation, for a given episode E, one must consider not only the development D_E that results causally from E, but also the development D_O that would otherwise occur. (More below on why this is only a first approximation.) The second is that, in comparing these potential future developments, one must consider not only whether there is (some) progress in each case, but whether there is more progress in one case than in the other. Indeed, in order for an account of progress promotion to have anything to say about *the extent to which* some event promotes progress, it is also necessary to be able to measure the *amount* of progress that would result in each case.

Fortunately, any of the standard accounts of scientific progress can be thought of as providing such measures of the amount of progress in each future development. These accounts are meant to provide competing

answers to the question of how much progress there is in a given scientific episode E, in effect providing a *progress function* ρ from E to some suitable numerical scale, such as the real numbers. For example, the truthlikeness account of progress may be thought of as providing us with a progress function ρ_T such that $\rho_T(E)$ increases in proportion to the extent to which truthlikeness increases over E. With such a progress function in hand, one could then say, for example, that E is progressive just in case $\rho_T > 0$; that E_1 is more progressive than E_2 just in case $\rho_T(E_1) > \rho_T(E_2)$; and that E_1 is r times more progressive than E_2 just in case $r = \frac{\rho_T(E_1)}{\rho_T(E_2)}$. In short, the truthlikeness account's progress function ρ_T would simply be a way of encoding the truthlikeness account's various judgments about scientific progress. In this way, any complete account of scientific progress can be associated with such a progress function.

To handle potential future developments of science, such as D_E and D_O, we need only notice that these are also episodes of science, albeit ones that stretch very far – perhaps indefinitely – into the future. The progress function ρ can take these potential future developments as inputs no less than it can take past or present episodes as inputs. Thus, we can compare the amount of progress in a future development causally resulting from E, $\rho(D_E)$, to the amount of progress that we would have seen otherwise, $\rho(D_O)$. This suggests the following as a first pass at an account of progress promotion:

> Simple Promotion: An episode E *promotes scientific progress* to the extent that the future development of science it causes, D_E, is more progressive than the development that would otherwise have occurred, D_O; i.e. to the extent that $\rho(D_E)$ exceeds $\rho(D_O)$.

Here and in what follows, I will not take a stand on how to spell out 'to the extent that ... exceeds ...'. This could be done in a number of slightly different ways, e.g. in terms of the *difference* between the two terms $(x-y)$, their *ratio* (x/y), or their *log-ratio* $(\log(\frac{x}{y}))$. But nothing will turn on this in what follows, so I will leave this issue for another occasion.

In any case, Simple Promotion won't quite do as an account of progress promotion. This is because there will normally not be a single development D_E that definitely results causally from an event E; nor will there be a single development D_O that would definitely otherwise occur. Rather,

there will be many developments that might result causally from E, and many that might occur otherwise. Moreover, to complicate things further, some of these developments will be more likely to occur than others, and these more likely developments should presumably be given a greater weight in a comparison between the progress resulting from E versus otherwise.

These considerations suggest a fix to the above account of progress promotion where we consider how much progress would occur in each of the developments D_i that might causally result from E, and weigh this by the respective probabilities of these developments causally resulting from E; and then compare this to a similar weighing where is E is not assumed to occur. More precisely:

> Expectationist Promotion: An episode E *promotes scientific progress* to the extent that the probability-weighted sum of the amount of progress in each subsequent development of science D_i is higher than it would have been otherwise, i.e. to the extent that $\sum_i \rho(D_i)\, Pr(E \mathrel{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Pr(D_i)$.

Where the relevant probabilities $Pr(E \mathrel{\square\!\!\rightarrow} D_i)$ are probabilities of subjunctive conditionals of the form *if E were to occur, then D_i would occur*.[17] Since the weighted sums $\sum_i \rho(D_i)\, Pr(E \mathrel{\square\!\!\rightarrow} D_i)$ and $\sum_i \rho(D_i)\, Pr(D_i)$ can be thought of as measuring the *expected* future progress that were to occur given E and otherwise, Expectationist Promotion can simply be described as the view that an episode promotes scientific progress to the extent that it *increases expected progress* in the future.

[17] A slight variation on this account would replace $Pr(E \mathrel{\square\!\!\rightarrow} D_i)$ with the conditional probability that D_i occurs given that E occurs, $Pr(D_i|E)$. Such a variation would make the account resemble *evidential* decision theory, while the account in the main text resembles *causal* decision theory. I had originally intended to remain neutral with respect to these two variations on Expectationist Promotion, but an anonymous reviewer for this journal pointed to a problem with the 'evidential' version which now makes me prefer the 'causal' version. The problem, in short, is that E might merely be highly correlated with a very progressive future development of science D_h, e.g. if both E and D_h have some common cause C. In that type of case, it seems clear that it would not be E – but rather, C – which promotes progress in virtue of the progress to occur in D_h. The 'causal' version of Expectationist Promotion in the main text gets this type of case right, since E's mere correlation with D_h would not make D_h more likely to occur if E were to occur than it would otherwise be, i.e. we'd have that $Pr(E \mathrel{\square\!\!\rightarrow} D_h) = Pr(D_h)$.

3.3 Objective and Subjective Expectation Increases

Although Expectationist Promotion is, in my view, correct as far as it goes, it is still not quite complete as an account of progress promotion. The reason is that this account fails to specify how to the interpret the probability function Pr with which it operates. In particular, one might wonder whether the probabilities in question are meant to be some agent's *rational credences* (subjective probabilities), or whether they are *objective chances* (objective probabilities).

To see why this matters, notice that a scientist S may *rationally believe* that some episode E_S will result in a great deal of scientific progress; while, in fact, E_S is more-or-less bound not to do so for some reason S does not know about. Specifically, let's assume that S's credences can be represented by a probabilistically coherent credence function Cr_S on the basis of which S rationally expects E_S to increase future progress: $\sum_i \rho(D_i)\, Cr_S(E_S \mathbin{\square\!\!\rightarrow} D_i) > \sum_i \rho(D_i)\, Cr_S(D_i)$. But let's also assume that the objective chances of E_S leading to developments that substantially increase future progress are very slim, and indeed that the chances are much higher that E_S will lead to developments that decrease future progress. More precisely, where the objective chances of different scenarios are represented by a chance function Ch, suppose that $\sum_i \rho(D_i)\, Ch(E_S \mathbin{\square\!\!\rightarrow} D_i) < \sum_i \rho(D_i)\, Ch(D_i)$. In this type of case, the natural thing to say is that while S *rationally expects* that E_S promotes progress, E_S in fact does not promote progress (indeed, it dispromotes progress).

This sort of case motivates a precisification of Expectationist Promotion in which the probabilities involved are interpreted as objective chances rather than rational credences:

> Objective Expectationist Promotion: An episode E *promotes scientific progress* to the extent that the chance-weighted sum of the amount of progress in each possible subsequent development of science D_i

[18] Another important way in which Objective Expectationist Promotion may be spelled out concerns the objective chance function Ch. This call for an objective interpretation of probability, i.e. an interpretation that is grounded in some objective features of the world. There are several different such objective interpretations available, including the frequency, propensity, and best-systems interpretations (see Hájek, 2023, §§3.4-3.6). I don't have a settled view on which of these interpretations should be preferred in the context of understanding the the objective chance function Ch in Objective Expectationist Promotion, so I'll leave this important issue to future work.

is higher than it would have been otherwise, i.e. to the extent that $\sum_i \rho(D_i)\, Ch(E \mathbin{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Ch(D_i)$.

This is, then, is the final and definitive version of the account of progress promotion that I'm proposing in this paper. This account may of course itself be refined, developed, and extended in various ways – e.g., in spelling out how to measure *the extent to which* $\sum_i \rho(D_i)\, Ch(E \mathbin{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Ch(D_i)$ – but I'm leaving that to future work.[18]

With that said, this account of progress promotion may be complemented with an account of when, and to what extent, it is *rational* for an agent to *expect* progress to be promoted by some episode E. Such an account is be needed, for instance, when evaluating whether a scientists whose aim is to contribute to as much progress as possible is rational in bringing about an episode E rather than some alternative episode E'. For that type of issue, it makes little sense to cite the objective chances of different future developments, since these objective chances may well be entirely unknown to S. Happily, a plausible account of the rational expectation of progress promotion may be obtained from the above account of progress promotion by simply replacing the objective chance function Ch with the relevant agent S's rational credence function Cr_S:[19]

> Rational Promotion Expectation: An agent S with a probabilistically coherent credence function Cr_S is rational in expecting an episode E to promote scientific progress to the extent that the credence-weighted sum of the amount of progress in each possible subsequent development of science D_i is higher than it would have been otherwise, i.e. to the extent that $\sum_i \rho(D_i)\, Cr_S(E \mathbin{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Cr_S(D_i)$.

Note that although Objective Expectationist Promotion and Rational Promotion Expectation are quite distinct accounts – indeed, accounts of quite distinct things – they form a unified whole in virtue of both being instantiations of the general idea that both progress promotion, and the rational estimation thereof, can be spelled out in terms of how the probabilistic expectations of progress differs depending on whether

[19]This account is in some ways similar to definitions of *estimated progress* provided by proponents of the truthlikeness account, such as (Niiniluoto, 1980, 444-445) and Cevolani and Tambolo (2013, 926). Note, however, that I'm offering here is an account of the rational estimation of the *promotion* of progress, which is an issue on which these definitions are strictly speaking silent.

an episode is assumed to occur or not. In what follows I will refer to this pair of accounts as *Expectationism*.

To be clear, I don't intend for Expectationism to offer conceptual analyses of natural language terms of any sort. Rather, Expectationalism provides us with explications of two technical terms, viz. 'progress promotion' and 'rational expectation of progress promotion', which may then be employed in assessments and applications of accounts of scientific progress (see §1 above and §4 below). The proof of the pudding with respect to Expectationism, then, is in the extent to which these explications are well suited to being employed in these ways; not in the extent to which they conform to our intuitions concerning ordinary language. The fact that progress promotion and its rational expectation can clearly come apart strongly suggests that we need both notions in the conceptual repertoire with which to formulate, assess, and apply, accounts of scientific progress.

4 Putting Promotion to Work

In this section, I return to the three challenges surveyed in section 2. As we shall see, the account of progress promotion spelled out in the previous section, *Expectationism*, sheds light on the extent to which these challenges constitute a genuine threat to different accounts of scientific progress. To be clear, *Expectationism* does not by itself constitute a response to these challenges, but it does provide proponents of various targeted accounts with a general framework within which such responses can be situated.

4.1 The Pluralist Challenge Revisited

Recall the first of the three challenges to accounts of scientific progress:

> *The Pluralist Challenge:* Aren't there several distinct types of cognitive achievements, such as improvements in scientific methods, classifications, and formalisms, all of which contribute to scientific progress?

As previously noted, this challenge targets *monistic* accounts of scientific progress, on which there is a single type of cognitive achievement that

constitutes scientific progress. Monistic accounts include all of the most influential accounts on offer – viz., the truthlikeness, problem-solving, epistemic, and noetic accounts – as well as several other accounts recently proposed (e.g. Bangu, 2015; Shan, 2019; Stegenga, 2023). So the Pluralist Challenge, if it can be made to stick, would present a serious problem to current thinking about scientific progress.

My contention, however, is that the Pluralist Challenge can be met by proponents of most, perhaps all, monistic accounts – if they appeal to the distinction between scientific progress and its promotion,[20] and explicate the latter in the way suggested in the previous section, i.e. as per Expectationism. In short, this is because proponents of monistic account of scientific can plausibly argue that the various achievements that the pluralist suggests are distinct types of scientific progress are all ways in which scientific progress is typically promoted according to Expectationism. In particular, in so far as it is plausible that these achievements contribute to scientific progress, they do so in virtue of promoting scientific progress.

To flesh out this response to the Pluralist Challenge, let us start by noting that any plausible version of this challenge must employ a distinction between *improvements*, on the one hand, and mere *changes*, on the other, in the scientific methods, classifications, formalisms, and so on, which populate the pluralist's list of progress-constituting achievements in science. After all, not all changes in methods, classifications, formalisms, and so forth, contribute to scientific progress in any positive sense; indeed, some such changes are clearly impediments to progress. While any given example of the latter is likely to be controversial, it is at least plausible that the medieval method of consulting scripture, the biological classification of humans into supposedly distinct taxa called 'races', and the imperial system of measurement, are respectively instances of methods, classifications, formalisms have impeded scientific progress. So, not even the pluralist will want to say that *all* new methods, classifications, formalisms, and so forth, contribute to progress, much less that they all constitute progress.

[20] Or, if you prefer, between two different kinds of scientific progress, viz. progress_a and progress_p (see §3.1).

Accordingly, the first task facing any monist seeking to meet the Pluralist Challenge, as well as the pluralists themselves, is to come up with a plausible criterion with which to *distinguish* those methods, classifications, formalisms, and so forth, that contribute to progress from those that don't. Once that task has been completed, one can move on to the task of *explaining how* the methods, classifications, formalisms, and so forth, in the first category contribute to scientific progress.

Expectationism helps the monist with both tasks. With respect to the former, the monist may simply say that the methods, classifications, formalisms, and so forth, that contribute to scientific progress are those that *promote* scientific progress. Indeed, monists may precisify their answer by adding that these things promote progress *to the extent that* the chance-weighted sum of the amount of progress in each possible subsequent development of science is higher than it would have been otherwise. For example, developing and/or adopting some new system of measurement M_N contributes to progress if and only if, and to the extent that, $\sum_i \rho(D_i)\, Ch(M_N \mathbin{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Ch(D_i)$. To this the monist may also add a closely related (indeed, nearly identical) account of *how* the thus delineated methods, classifications, formalisms, and so forth, contribute to progress. Simply put, they do so by promoting progress, i.e. by increasing the chance-weighted sum of the amount of progress in each possible subsequent development of science from what it would have been otherwise.

Of course, monists do not all adhere to the same account of what (single) type of achievement constitutes progress, and may thus disagree on which exact methods, classifications, formalisms, and so forth, contribute to progress in this way. For example, a proponent of the epistemic account would presumably argue that methods that have no chance of delivering knowledge don't contribute anything progress; whereas proponents of the truthlikeness account, for example, might argue that such methods contribute to progress in some cases, provided that they increase the chance-weighted sum of truthlikeness in our accepted theories from what it would have been otherwise. So there will be a great deal of variation in how monists approach the two tasks specified above, even amongst those that are united in appealing to the notion of progress promotion defined in Objective Expectationist Promotion in their response to the Pluralist

Challenge.

Someone might at this point object that a satisfactory response to the Pluralist Challenge must go further than explaining how improvements in methods, classifications, formalisms, and so forth, *promote* progress; they must explain why these things *constitute* progress. Otherwise, so the objection goes, we cannot fully account for the immense contribution to progress that these sorts of improvements often involve.[21] For example, the method of randomized controlled trials (RCT) is surely of greater importance to scientific progress than any single scientific theory it has been used to establish. And yet, by the lights of prominent monistic accounts of progress, such as the truthlikeness account, the method of RCT merely promotes progress while many of the theories it has been used to establish instead constitute progress.

This objection is based on a confusion about the distinction between promoting and constituting progress. From the fact that E_1 constitutes progress while E_2 'merely' promotes it, nothing immediately follows about whether E_1 contributes more or less to progress than E_2. After all, E_2 may promote much more progress than E_1 constitutes; indeed, this may be so even if part of the progress that E_2 promotes is that which is constituted by E_1. This is almost certainly the case when we compare the method of RCT with any single theory established through the use of RCT: the latter promotes much, much more progress than the former constitutes, even if part of the progress RCT promotes comes in the form

[21] A related but slightly different line of objection would be that the monist cannot count improvements in methods, classifications, formalisms, etc., as progressive *at the time these improvements occur*. At that time, these improvements would merely promote progress; they would not constitute it. (Thanks to an anonymous reviewer here.) But it seems to me that the monist has an easy response to this objection, viz. that it begs the very question at issue. Put differently, the monist will be happy to grant that improvements in methods, classifications, formalisms, etc. 'merely' promote progress at the time these improvements are made – that's precisely what the monist believes, and what the pluralist denies. Unless the monist's position can be shown to involve a problematic *devaluing* of these improvements, the pluralist's objection would be entirely circular. (So can it be shown to involve such a devaluing? That's what the objection in the main text is all about.)

of the theory in question.[22] Indeed, the semi-quantitative account of promotion spelled out in the previous section sheds light on how such comparisons can be made made more precise, viz. through a simple numerical comparison between the extent to which an account of scientific progress judges E_1 to be progressive (i.e., $\rho(E_1)$), on the one hand, and the extent to which that same account judges that E_2 promotes progress (i.e., the extent to which $\sum_i \rho(D_i)\, Ch(E_2 \mathrel{\square\!\!\rightarrow} D_i)$ exceeds $\sum_i \rho(D_i)\, Ch(D_i)$), on the other.

4.2 The Evidential Challenge Revisited

Recall the second of the three challenges:

> *The Evidential Challenge:* Doesn't the gathering of more and better scientific evidence, e.g. through reliable experiments, (also) contribute to scientific progress?

This challenge targets *non-epistemic* accounts of scientific progress, on which epistemic justification is not a necessary condition on scientific progress. The truthlikeness account, for example, does not require accepted theories to be epistemically justified: provided that accepted theories are more truthlike than their predecessors, there is scientific progress on this account, regardless of the epistemic status of the accepted theories. For this reason, it may seem as if the truthlikeness account cannot adequately explain how the gathering of scientific evidence contributes to scientific progress. The epistemic account, by contrast, makes epistemic justification a necessary condition on progress. Since gathering evidence is the main – if perhaps not the only (Dawid, 2013) – way to ensure that scientific theories are epistemically justified, it is quite clear how scientific evidence contributes to progress on the epistemic account.

Whether the Evidential Challenge is a serious problem for non-epistemic accounts of scientific progress depends on whether adequately explaining

[22] By way of analogy, note that even if money is desirable only in so far as it brings happiness, it does not follow that gaining money is always, or even generally, less desirable than increases in happiness. More generally, instrumentally valuable things are not somehow less valuable than intrinsically valuable things, for the distinction between instrumental and intrinsic value concerns the way in which something is valuable, not the extent to which it is valuable.

the contribution of scientific evidence to progress requires that epistemic justification be a necessary condition for progress. At this point, however, it should be clear that scientific evidence can positively contribute to scientific progress even if doesn't do so via helping to satisfy a necessary condition on progress. Consider, in particular, factive but non-epistemic accounts of scientific progress, such as the truthlikeness account and the noetic account. On these accounts, the gathering of scientific evidence may contribute to scientific progress via *promoting* scientific progress. Let's see if we can flesh out this response to the Evidential Challenge on behalf of factive accounts.[23]

Let us start by noting that scientific evidence – whatever else it may do – normally serves as a guide to the truth. (Scientific evidence doesn't *necessarily* lead one to truth, because even the most reliable type of empirical evidence is occasionally misleading – a point to which we'll return shortly.) Accordingly, gathering scientific evidence, such as that obtained through some suitably reliable experiment E_E, increases the chances on average that the theories that are subsequently accepted will be true (or increasingly truthlike). Given any factive account of what constitutes scientific progress, such as the truthlikeness account for instance, we thus have that $\sum_i \rho_T(D_i)\, Ch(E_E \mathrel{\square\!\!\rightarrow} D_i) > \sum_i \rho_T(D_i)\, Ch(D_i)$, so that E_E promotes progress according to that account. Note that it is perfectly plausible for the carrying out of such an experiment to promote more progress than any alternative course of action available to scientists at the time would constitute, e.g., in cases where further theorizing on the issue in question would be mere guesswork without the results of that experiment in place. Put differently, gathering evidence can be important for scientific progress even if it 'merely' promotes progress, as opposed

[23]Is some version of the following response also available to a non-factive, non-epistemic account of scientific progress, such as the problem-solving account? I suspect so, but the response would have to replace 'truth' and similar notions with the suitably non-factive sorts of achievements to which the account refers, and then argue that these non-factive achievements are promoted by the gathering of scientific evidence. I'll leave it to the defenders of non-factive accounts to spell out this sort of response in more detail.

to helping to satisfy a necessary condition for it.[24,25]

As I've noted parenthetically, scientific evidence is occasionally *misleading*. That is, the evidence in question supports a claim that is in fact false (and far from truthlike). A hackneyed example illustrates the point: In 17th century Europe, the observed abundance of white-feathered swans, combined with the complete absence of observations of black-feathered swans, was strong evidence for the theory that all swans are white-feathered. So did 17th century European evidence regarding swans promote progress? Not to the extent one may have hoped, since it led to a patently false theory being accepted, viz. that *all* swans are white-feathered (even if it also eventually led to the more nuanced theory we have today, on which there are six species of swans, only one of which is black-feathered). So not all evidence is equal, promotion-wise: misleading evidence either does not promote progress at all, or at the very least does so to a lesser extent than ordinary non-misleading evidence. This is an important upshot since it serves to explain why scientists should prefer to gather non-misleading evidence over misleading evidence (and why scientific methods and incentives should encourage the former over the latter).[26]

4.3 The Accessibility Challenge Revisited

Recall, finally, the third challenge:

The Accessibility Challenge: Doesn't scientific progress have to be epis-

[24]Recall the point made in footnote 22 and the paragraph to which it is attached.

[25]A proponent of the epistemic account may point out that their account implies that gathering evidence both promotes progress, via the route described in this paragraph, as well as partly constituting it, through helping to satisfy a necessary condition for knowledge. However, it is far from clear that this fact counts significantly, if indeed at all, in favor of the epistemic account as against non-epistemic but veritistic alternatives. For note that all of these accounts would be able to explain that gathering evidence contributes to progress; what the epistemic account adds to this is the claim that it does so in two quite separate ways (i.e., by both constituting and promoting progress). I don't see any reason, pre-theoretically or indeed on reflection, for thinking that gathering evidence contributes to progress twice over in this manner.

[26]In a similar vein, Dellsén and Norton (2024) argue that Stegenga's justification-based account of scientific progress (Stegenga, 2023), which is an epistemic account *par excellence*, is unable to explain why scientists should prefer to gather non-misleading evidence.

temically accessible to scientists themselves in order for it to guide rational decision making in science?

As noted, this challenge targets *factive* accounts of scientific progress, on which scientific progress requires later theories (or other representational devices, mental states, etc.) to be more faithful to the facts than their earlier counterparts. The truthlikeness, epistemic, and noetic accounts are all factive accounts, albeit in slightly different ways. Laudan (1977, 125-128; see also Stegenga 2023) influentially argues that factive accounts make scientific progress epistemically inaccessible to scientists themselves, in that they couldn't themselves tell whether a given episode is, or will be, progressive. After all, one cannot always tell whether later theories are more faithful to the facts than their predecessors, e.g. because even the most empirically successful theories might well turn out to be entirely false (as the historical record of discarded theories allegedly demonstrates; see Laudan, 1981a). But if scientific progress is not epistemically accessible in this way, then it cannot, argues Laudan, guide rational decision making, such as regarding whether to pursue some hypothesis rather than another.

Is this is a serious challenge for factive accounts of scientific progress? Not, I suggest, if we distinguish an agent's rational expectation of progress being promoted from both what constitutes progress and what promotes it (see §3.3). To explain, let us grant Laudan's point that a given decision-making scientist S may not be able to tell – at least not for certain – whether later theories are more faithful to the facts than their predecessor. Given this, S won't necessarily be able to tell, on factive accounts, whether accepting some theory constitutes progress, whether gathering some evidence objectively promotes progress, and so forth. In short, then, there is a sense in which a factive account of progress will make it 'epistemically inaccessible' to scientists themselves whether, and indeed the extent to which, a given episode constitutes and objectively promotes scientific progress.

But does this imply that decision-making scientists cannot be rationally guided by considerations of scientific progress? Not at all. Although a scientist S cannot be expected to know for certain whether a given theory is more faithful to the facts than its predecessors, S can be expected to have or form some *opinions* about whether this is the case. In so far as

these opinions are rational, they are encoded in S's credence function, Cr_S. By Rational Promotion Expectation, this in turn determines whether, and indeed the extent to which, any given course of action available to S would subjectively promote scientific progress relative to a given progress function ρ. This holds regardless of whether the account of scientific progress associated with ρ is factive or non-factive, since – to repeat – Cr_S merely encodes S's (possibly mistaken) opinions in this respect. On the basis of these opinions, i.e. on the basis of Cr_S, S may then evaluate the various courses of actions available to her in terms of how much progress each would subjectively promote. In so far as S is concerned solely with contributing to scientific progress, the rational decision is to perform a course of action which maximizes subjective promotion of progress.[27]

If this story sounds familiar, it is presumably because it is a straightforward application of a standard decision theoretic framework, viz. expected utility theory, to the special case in which actions are evaluated only in terms of how much they contribute to scientific progress. In that framework, rationality does not require that decision-making agents are trying to achieve goals that are epistemically accessible, in the sense that the agents themselves can tell whether the goals have been, or will be, achieved in a given case. Rather, it requires only that the agent's fine-grained opinions – i.e., their credences – about whether this is the case be *rational*. What exactly is required for credences to be rational is of course a major issue in contemporary epistemology, but few – if any – theorists have argued that having rational credences requires any type of factivity of these credences, such as truth or truthlikeness in high-credence propositions.[28]

In sum, then, the Accessibility Challenge presents no special difficulty

[27] In so far as S has competing goals, such as improving their own well-being through other means, S will have to balance these goals with the goal of maximizing, as far as possible, their contribution to scientific progress. This is a familiar sort of tradeoff between different goals that we all unfortunately have to make on a daily basis.

[28] As far as I am aware, the only person that comes close to arguing for something in this vicinity is Littlejohn (2012). In short, Littlejohn argues that a full belief only counts as fully justified if the belief is true. However, this is an account of the (full) *justification* of (full) *belief*; not an account of the *rationality* of *credence* (i.e., partial belief). Moreover, Littlejohn's view can't be straightforwardly extended to rational credence, since one can clearly have rational credences in contrary propositions, P and $\neg P$, even if they cannot both be true.

for factive accounts of scientific progress once we realize that a scientist's rational decisions aren't, and indeed cannot be, based directly on what constitutes or objectively promotes scientific progress. Rather, such decisions – if rational, and to the extent they aim only at contributing to progress – will be based on how much the actions available to the agent subjectively promote progress as defined by Rational Promotion Expectation, i.e. on the extent to which these actions would increase future progress in the agent's own subjective estimation. While this requires the agent's credences to be rational to begin with, it does not require any sort of factivity of these credences. Thus, even if scientists are gravely mistaken about the extent to which later theories are more faithful to the facts than their predecessors, they may still be perfectly rational in their scientific decision-making.

5 Conclusion

As we have seen, the distinction between what promotes, rather than constitutes, scientific progress has played an important role in the debate about the nature of scientific progress. Indeed, I have suggested that this distinction should, if anything, play an even greater role in the debate, in so far as a clearer view of it helps proponents of prominent accounts meet three common challenges to these accounts. And yet nearly nothing has been said in the extant literature about what it would be to for something to promote progress. This paper has been an extended attempt to rectify this situation, by providing a detailed account of progress promotion and its rational expectation, *Expectationism*, and by demonstrating its relevance for the debate about the nature of scientific progress.

There is surely more work to be done on this topic. Expectationism is merely one among many accounts of progress promotion and its rational expectation that could be developed, and some aspects of the account may seem objectionable to some readers in ways that I have not addressed in this paper. In response, I ask only that Expectationism be compared to alternative accounts that has been fleshed at a similar level of detail; unfortunately, however, there are no such accounts currently in the literature. I thus invite those readers who are skeptical of Expectationism to develop their own accounts of progress promotion and its rational

expectation such that these accounts may fruitfully compared and their respective merits publicly debated.

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