Understanding Progress, in Science and Beyond

A project generously funded by the Icelandic Research 2019-2022

Principal Investigator: Finnur Dellsén (U. of Iceland & INNUAS)

Co-Investigator: Insa Lawler (UNC-Greensboro)

International collaborators: Alexander Bird (KCL), Henk de Regt (Radboud University Nijmegen), Catherine Elgin (Harvard), Alison Hills (Oxford), Milena Ivanova (Cambridge), Kareem Khalifa (Middlebury), Ilkka Niiniluoto (Helsinki), Daniel Stoljar (ANU), Michael Strevens (NYU)
RESEARCH QUESTIONS/HYPOTHESES

OVERALL AIMS. One of the most common and least controversial ideas about science is that it tends to make cognitive progress. For example, it is uncontroversial that scientific progress was made when Thomson’s plum-pudding model of the atom was superseded by Rutherford’s planetary-orbit model, and also when Rutherford’s model was in turn replaced by Bohr’s energy-level model. But what exactly is scientific progress of this cognitive kind? Does such progress require that scientific theories approximate a correct representation of reality, or does it simply consist in an increased potential for using scientific theories to achieve practical goals, such as useful technologies? And is progress in humanistic disciplines such as philosophy fundamentally different from the kind of progress achieved in the sciences? Is there a distinctively ‘scientific’ kind of progress that philosophy and related humanistic disciplines are somehow unable to achieve?

This project will offer a new approach to these issues by incorporating insights from recent work on scientific understanding as well as the researchers’ own recent contributions. We have two main objectives. The first objective is to develop and evaluate a new understanding-based approach to cognitive progress in science, based on ‘the noetic account’. In short, this account holds that scientific progress can be analyzed in terms of whether an episode increases our understanding of relevant aspects of the natural world, for instance, by virtue of proposing new explanations of given phenomena. While it is often noted that gaining understanding is an important type of scientific achievement (see, e.g. Strevens 2013; Elgin 2017; de Regt 2017), this understanding-based noetic account was only recently proposed and briefly defended by the project’s PI (Dellsén 2016a). The noetic account will serve as the first of two central working hypotheses for the proposed project; accordingly, the somewhat schematic arguments in (Dellsén 2016a) can be seen as preliminary results on which the proposed project will build an in-depth and systematic understanding-based account of scientific progress.
The proposed account differs fundamentally from the three currently dominant accounts of scientific progress, which respectively explicate scientific progress in terms of accumulation of knowledge (the epistemic account, see Bird 2007, 2008, 2015, MS), increasing verisimilitude or truthlikeness (the verisimilitudinarian account, see Popper 1963, 1979; Niiniluoto 1980, 2014), and increasing problem-solving abilities (the problem solving account, see Kuhn 1970; Laudan 1977, 1984). In contrast, the noetic account appeals to the notion of scientific understanding, which we roughly define as grasping a complex representation with which one can, e.g., correctly explain or reliably predict facts about the understood phenomenon. For example, physicists increased their understanding of the atom when Rutherford’s model was replaced by Bohr’s energy-level model, since the latter is a complex representation of the atom that allowed physicists to correctly explain the spectral lines of hydrogen for the first time.

The second objective of the project is to explore the prospects for extending the noetic account to progress in a humanistic discipline, viz. philosophy itself. Our guiding thought is that progress in philosophy, and perhaps many other humanistic disciplines, is not fundamentally different from progress in the natural sciences, despite substantial differences in methodology. Specifically, our working hypothesis is that just as scientific progress consists in increased scientific understanding, philosophical progress consists in increased philosophical understanding. The project will seek to develop and evaluate this proposal with an eye towards providing a unified account of progress in science and philosophy. In this part of the project, we will connect with burgeoning research into philosophical methods, distinctively philosophical explanations, normative understanding, and with Michael Strevens’s Guggenheim-supported research on understanding in the humanities.

**SUBPROJECT 1: UNDERSTANDING SCIENTIFIC PROGRESS.** As noted, the first main objective of the project is to develop and defend a new type of account of scientific progress, the understanding-based noetic account. As a first step in developing this account, we will seek to explicate the notion of scientific
understanding – building on an already extensive literature by ourselves and others (see section b for references). However, our main objective is to put this notion to use within the debate about the nature of scientific progress. Specifically, we aim to flesh out the following potential advantages of the noetic account:

A1. Systematicity: Many noteworthy scientific achievements are not merely characterized by an increase in the number of known or true propositions, or solved scientific problems; rather, they often involve gaining a systematic or holistic grasp of reality (see Hoyningen-Huene 2013). This can be effortlessly explained by the noetic account since it is widely acknowledged that understanding involves a more cohesive grasp of phenomena than knowledge, verisimilitude, or even the ability to solve problems (e.g., Kvanvig 2003; Elgin 2004; Pritchard 2009; Grimm 2011; Strevens 2013; Greco 2014; Hills 2016).

A2. Demandingness: Understanding-based accounts have an advantage over at least knowledge-based accounts in that understanding is in some ways less epistemically demanding than knowledge. For example, understanding has been argued to be compatible with epistemic luck (e.g., Kvanvig 2003, 2009; Pritchard 2009, 2010; Morris 2012; Lawler 2016), lack of epistemic justification (e.g., Hills 2016; Dellsén 2016b), and absence of outright belief (e.g., Dellsén 2016b; Wilkenfeld 2017). Accordingly, the noetic account of progress is arguably in a better position to account for the full range of cases of scientific progress, e.g. where scientists do not outright believe their theories (see, e.g., Cohen 1992; Dicken 2010; Dellsén 2017a, 2017b; Fleisher 2017).

A3. Epistemic value: Understanding is widely considered to have a kind of epistemic value that goes beyond that of knowledge or any of its constitutive parts (e.g., Zagzebski 2001; Kvanvig 2003, 2009; Riggs 2003, 2009; Elgin 2004, 2006; Pritchard 2009, 2010; Grimm 2012; Grimm and Ahlstrom-Vij 2013; Hills 2016). Accordingly, the noetic account is arguably in a better position to explain the value of scientific progress than competing accounts, e.g., the epistemic account.
A4. Gradability: Understanding is clearly a gradable cognitive achievement, unlike, e.g., knowledge (e.g., Kvanvig 2003; Grimm 2014; Pritchard 2014; Sliwa 2015; Riaz 2015; Hills 2016; Lawler 2016, MSb). Since progress is also clearly a matter of degree, this may favor the noetic account of scientific progress against Bird’s epistemic account.

A5. Reference-failure: Relatedly, since a low but non-zero degree of understanding is arguably compatible with reference-failure of central theoretical terms (e.g., Elgin 2009a, 2009b; de Regt 2015; Wilkenfeld 2015), the noetic account allows us to recognize scientific progress even over periods of theory-change in which both earlier and later theories centrally contain non-referring terms.

A6. Idealizations: Recent decades have seen a surge of interest in the topic of idealizations in science (e.g., Cartwright 1983; McMullin 1985; Weisberg 2007, 2013; Potochnik 2017). Interestingly, it is widely acknowledged that some idealizations serve to increase scientific understanding (e.g., Elgin 2004, 2009a, 2017; Mizrahi 2012; Strevens 2013, 2017; Lawler MSd, Lawler and Sullivan MSa). Accordingly, the noetic account is well-equipped to account for the role of idealizations in scientific progress.

A7. Non-propositionality: It has been extensively argued that understanding involves a kind of cognitive insight – often referred to as ‘grasping’ – that goes beyond mere belief or acceptance of propositions or explanations (e.g., Grimm 2006, 2011, 2014; de Regt 2009a; Lipton 2009; Strevens 2013; Bourget 2015; Hills 2016; Sullivan 2017). If so, the noetic account may be able to account for scientific achievements that are not plausibly characterized in terms of changes in propositional content, e.g., new formulations of already existing theories and thought experiments (see Stuart 2016).

A8. Aesthetic values: Relatedly, the noetic account of scientific progress may have the resources to explain the frequent appeal to aesthetic values in scientific theory-choice (McAllister 1996; Kuipers 2002). It has been argued that aesthetic features of theories, as well as aesthetic devices such as exemplification,

It bears emphasizing that it remains unclear at this stage which of these considerations will feature most prominently as considerations in favor of the noetic account. Even at this preliminary stage, however, these considerations indicate that developing and defending an understanding-based account should significantly advance the current research on scientific progress and understanding. Having developed the account in detail, we will take stock and carefully evaluate it by comparing it to rival accounts, i.e. the epistemic, verisimilitudinarian, and problem-solving accounts.

SUBPROJECT 2: UNDERSTANDING PHILOSOPHICAL PROGRESS. The second main objective of the project is to explore the prospects for extending the noetic account to philosophical progress. Arguably, philosophy is a paradigmatic example of a humanistic and (mostly) non-empirical discipline – it relies on sharpened intuitions and careful reasoning, but usually not on empirical studies. Largely for this reason, some have questioned whether philosophy is capable of making genuine progress at all (e.g., Dietrich 2011). Others have argued that progress is much less common in philosophy than in natural science (e.g., Chalmers 2015) or more difficult to achieve (e.g., Papineau 2017; although see Stoljar 2017). However, the aforementioned discussions rarely deploy a clear and independently-motivated definition of philosophical progress, which makes it difficult to evaluate these claims.

We will add to this meta-philosophical debate by examining philosophical progress from the perspective of whether the noetic account can be applied to explicate progress in philosophy, in accordance with the broadly naturalistic dictum that philosophy is continuous with natural science (Quine 1957, 1981). Our working hypothesis is that philosophical progress can be explicated in terms of philosophical understanding, which can roughly be defined as grasping a complex representation with which one can, e.g., correctly explain or reliably infer facts about the relevant phenomenon. We will evaluate this proposal by comparing this understanding-based
account of philosophical progress with hypothetical accounts that instead explicate philosophical progress in terms of knowledge, verisimilitude, or problem-solving abilities.

While the value of this endeavor lies in part in systematically mapping out the conceptual space provided by these competing theories of philosophical progress for the first time, there are also several reasons to believe that an understanding-based account of philosophical progress is particularly promising. First, just as scientific explanation plays a crucial role in most sciences, so too does philosophical explanation play a key role in much of philosophy. Such philosophical explanations include metaphysical explanations that appeal to grounding (e.g., Schaffer 2009; Fine 2012; deRosset 2013), and moral explanations (e.g., Hills 2009, 2010). An understanding-based account is arguably well equipped to account for the centrality of such distinctively philosophical explanations in philosophy. Second, philosophical progress is often achieved by means of elaborate thought experiments, such as Putnam’s (1973) ‘twin-earth’, and recent work in philosophy of science has revealed that the same is true of the natural sciences (Elgin 2014; Stuart 2016, 2017). That such thought experiments often describe fictional or idealized situations does not pose a challenge to a noetic account of philosophical progress; by contrast, an account of philosophical progress in terms of knowledge or verisimilitude would struggle with this feature.

Most importantly, at least some of the potential advantages of a noetic account of scientific progress (A1-A8) can do double duty as considerations in favor of an understanding-based account of philosophical progress. For instance, note that philosophical progress is often achieved by means of explicit systematization of previously established truths (as per A1); is frequently taken to have special epistemic value over and above mere knowledge or true belief (as per A3); and is commonly obtained by virtue of significant idealization (as per A6), such as with the ‘Bayesian’ assumption that rational agents are logically omniscient or Rawl’s ‘veil of ignorance’. Finally, as recent discussions of philosophical methodology have brought out (e.g.,
Paul 2012; Williamson 2016), philosophical argumentation relies heavily on appeals to aesthetic values, such as simplicity and elegance (as per A8).

**FEASIBILITY**

While our understanding-based approach to scientific and philosophical progress constitutes a promising avenue for developing a unified account of progress, fleshing it out also involves overcoming several challenges. Most such challenges will arise during the project. However, not all such challenges are unforeseeable, and addressing three of them adequately will be central to the success of the project.

The first challenge is to identify or develop a notion (or family of notions) of scientific and philosophical understanding that is both clear and compelling, and yet sufficiently distinct from the central constituents of competing accounts, viz. knowledge, verisimilitude, or problem-solving ability. In particular, some extant accounts of understanding reduce it to causal or explanatory knowledge (e.g., Grimm 2006, 2014; Greco 2014; Khalifa 2017). If these accounts are on the right track, a worry is that all the benefits of the noetic account of scientific progress may be accommodated within the epistemic account (a point briefly discussed by Bird 2007).

While this is a serious worry that needs to be addressed as part of the project, we believe some progress has already been made on this front with arguments that understanding differs from knowledge in not requiring justification or belief (Dellsén 2016b; see also Hills 2016; Wilkenfeld 2017) and being compatible with (some kinds of) epistemic luck (Pritchard 2009, 2010; Hills 2009, 2016; Lawler 2016). In addition, it is important to distinguish different kinds of understanding that are often conflated in the literature, viz. *objectual understanding* and *understanding-why* (Kvanvig 2009; although see Pritchard 2010; Khalifa 2013a; Carter & Gordon 2014). Only the latter can plausibly be argued to reduce straightforwardly to a kind of causal knowledge; however, the noetic account is more plausible when it takes *objectual* understanding to be constitutive of scientific progress.
A second challenge for the proposed project concerns whether understanding is too specific an epistemic state for the noetic account to accommodate all instances of scientific or philosophical progress. With regard to scientific progress, one might worry that progress in biology or geology often involves a mere gathering of information, or better classifications of known phenomena, neither of which constitutes increased understanding (see Bird 2007, MS). Similarly, one could argue that progress in philosophy sometimes comes with clarifying concepts and drawing distinctions, neither of which intuitively has much to do with increased understanding. This might seem to undermine the noetic account in favor of competing accounts.

In response, we propose three strategies for addressing challenges of this sort. The first is to adopt an account of understanding on which various non-explanatory information can form the basis for understanding (e.g., Lipton 2009; Gijsbers 2013; Kelp 2015, 2017; de Regt and Gijsbers 2017; Dellsén forthcoming). Given such an account of understanding, classifications and conceptual clarity may well constitute understanding after all (see esp. Gijsbers 2013). Another strategy is to argue that the relevant instances of progress are cases in which understanding is not increased but facilitated, in which case the noetic account could accommodate them by modifying the account so as to claim that progress consists in increasing or facilitating scientific understanding (a strategy suggested in Dellsén 2016a, taking a cue from Bird 2007). A third and final strategy is to modify the noetic account so as to allow for different kinds of scientific and philosophical progress, while still maintaining that increases in understanding represent an important type of progress that differs from increases in verisimilitude, problem-solving abilities, or knowledge. (Of course, the best overall approach to the challenge might well employ a combination of these strategies.)

A third challenge concerns specifically our proposed extension of the noetic account to philosophical progress. Here, we anticipate the objection that philosophy is fundamentally different from natural science, not only in its supposedly distinctive methodology, but also in its constitutive criteria for success. One way to push this
objection can be traced back to (the later) Wittgenstein, who famously held that philosophy “just puts everything before us, and neither explains nor deduces anything” (Wittgenstein 2009: §126). Another way to push the objection is to insist that much of philosophy is normative, while science is descriptive.

Our primary strategy for dealing with the first version of this challenge will be to emphasize throughout that we are operating within a naturalistic framework in which philosophy is seen as continuous with science (Quine 1957, 1981). Our primary strategy for dealing with the second version of the challenge will be to argue that it’s possible to have understanding of normative as well as descriptive facts. Here, we will build on recent work on moral understanding (e.g. Hills 2009, 2010; Riaz 2015). Moreover, our suggestion to define progress in humanistic disciplines in terms of understanding is compatible with the claim that humanistic understanding is not identical to scientific understanding, provided that progress could be defined in terms of understanding in both cases.

**ORIGINALITY AND IMPACT**

Both research objectives promise to lead to highly original results. The noetic account differs fundamentally from the three accounts of scientific progress that dominate the literature today, i.e. the epistemic account, the verisimilitudinarian account, and the problem solving account. Presumably due to the fact that understanding has not been recognized as a legitimate distinct topic for philosophical research until relatively recently, the noetic account is so far the only attempt to present an understanding-based account of scientific progress that serves as an alternative to these other accounts. Moreover, the suggested extension of the noetic account to philosophical research would explore a cluster of topics of meta-philosophical interest that have so far not been discussed systematically at all.

The predicted impact of the proposed project is multifaceted. First of all, the project will significantly advance the field itself by developing promising new
accounts about scientific and philosophical progress and by addressing a set of central problems in meta-philosophy and philosophy of science from a novel perspective. Second, the project will shed light on the nature and alleged distinctiveness of philosophy and humanistic disciplines more generally by proposing and evaluating a unified account of progress in science and philosophy. Since philosophy is a paradigmatic example of a humanistic discipline, this part of the project will also shed new light on alleged differences between humanities and the natural sciences, and on the value of research in humanities. Third, the project will bring together researchers from different areas of philosophy working on topics such as scientific progress, the nature of understanding, philosophical progress, and humanistic understanding. In doing so, the project hopes to initiate collaboration between researchers from distinct and sparsely connected research topics in epistemology, philosophy of science, and meta-philosophy.

In addition to these direct points of impact within academic philosophy, we hope that the project will also lay the groundwork for wider impact in the long-term (although we acknowledge that estimations of long-term impact from philosophical research will inevitably be somewhat speculative). In particular, we believe that the project may influence historical studies of science and philosophy in so far as it enables us to better understand and evaluate the development of the history of science from the perspective of a novel account of what it is for these fields to progress. We hope that the noetic account of progress may provide for a plausible middle-ground – a ‘best of both worlds’ – between the two opposing views that are often in the background of historical discussions of science, viz. the verisimilitudinarian account and the problem-solving account. Furthermore, we hope that the project of defining scientific progress will have implications for science policy in the long term. Specifically, the outcome of the proposed project could well be relevant for decisions as to what kind of scientific (and philosophical) research should be supported and funded through universities and funding agencies, at least in so far as we are concerned with maximizing cognitive progress.
PRESENT STATE OF KNOWLEDGE IN THE FIELD

Historically, scientific progress has often been associated with advances in scientific knowledge, e.g., by Francis Bacon (1620/1900), George Sarton (1927), and William Bragg (1936). More recently, Alexander Bird has defended an influential version of this view, the epistemic account, according to which an episode in science constitutes progress precisely when there is more scientific knowledge at the end of the episode than at the beginning (Bird 2007, 2008, 2015, MS; although see also Rowbottom 2008, 2010; Mizrahi 2013; Mizrahi and Buckwalter 2014; Saatsi 2016). In doing so, Bird revived a largely dormant debate about scientific progress in which the two main accounts were the verisimilitudinarian account on which science makes progress when its theories come closer to the truth (Popper 1963, 1979; Niiniluoto 1980, 2014, 2015; Kuipers 2009; Cevolani and Tambolo 2013; for critiques, see Cohen 1980; Barnes 1991; Bird 2007, 2015; Rowbottom 2015), and the problem solving account, which holds that science makes progress by increasing its capacity for solving empirical and conceptual problems in a way that is recognizable by the scientific practitioners themselves (Kuhn 1970; Laudan 1977, 1984; Finocchiaro 1975, 1976; Douglas 2014).

As noted above, Dellsén (2016a) recently presented a new understanding-based account of scientific progress, the noetic account, which has already garnered some interest among researchers in the field. For example, Stuart (2016) appeals to the noetic account in arguing for a view of the epistemic role of thought-experiments, while Park (2017) and Bird (MS) defend the epistemic account against Dellsén’s arguments. The importance of scientific understanding in theorizing about scientific progress has also independently been suggested by Bangu (2015) and indirectly by Potochnik (2015, 2017). However, the noetic account presented in (Dellsén 2016a) is the only account in the literature that explicates scientific progress exclusively by appealing to the notion of understanding. While the noetic account is thus exciting and promising, the current status of the debate leaves a great deal of work to be done on the topic, e.g., in
developing the account further and contrasting it with the epistemic, verisimilitudinarian, and problem solving accounts.

The fact that an understanding-based account of scientific progress was only developed so recently is probably at least in part due to the fact that epistemologists and philosophers of science have only recently begun systematically studying the nature of scientific understanding. While understanding was frequently mentioned as the goal of scientific explanation (e.g., Friedman 1974; Salmon 1984, 1993; Kitcher 1989), understanding itself was not extensively studied by philosophers of science until relatively recently (e.g., Schurz and Lambert 1994; Trout 2002, 2005; de Regt 2004, 2009a, 2009b; de Regt and Dieks 2005; Kosso 2007; Lipton 2009). However, research on the topic has taken off in this decade, both in philosophy of science (e.g., Khalifa 2012, 2013a, 2013b, 2015, 2017; Newman 2012, 2013, 2014, 2015; Gijsbers 2013; Strevens 2013, 2017; de Regt 2013, 2015; Wilkenfeld 2013, 2015; van Camp 2014; de Regt and Gijsbers 2017; Le Bihan 2017), and also in epistemology (e.g., Cooper 1994, 1995; Elgin 1996, 2004, 2006, 2007, 2009a, 2009b, 2012, 2017; Zagzebski 2001; Kvanvig 2003, 2009; Grimm 2006, 2010, 2011, 2012, 2014; Pritchard 2009, 2010, 2014; Sliwa 2015; Riaz 2015; Hills 2016; Sullivan 2017).

Although the nature of scientific progress has received a fair share of attention, the same cannot be said for philosophical progress. To be sure, the question of whether philosophy can make progress at all has been addressed, especially in a small but rapidly growing recent literature (e.g., Rapaport 1982; Nielsen 1987; Dietrich 2011; Balcerak Jackson and Balcerak Jackson 2012; Balcerak Jackson 2013; Mironov 2013; Chalmers 2015; Blackford & Broderick 2017; Frances 2017; Shand 2017; Stoljar 2017; Wilson 2017). What has not been investigated in detail is the prior question of what philosophical progress would consist in. Only when equipped with an answer to that question can we really evaluate whether philosophical progress is rare or even impossible, as some claim (e.g., Dietrich 2011; Chalmers 2015). Our work on philosophical progress will also be informed by a recent and growing literature on philosophical methodology. For instance, the question of whether philosophical work
demands empirical evidence (e.g., Knobe and Nichols 2008; Griffiths & Stotz 2008; Horvath and Grundmann 2012; Machery 2016) or the question of what kinds of methods philosophers should use to analyze concepts has been of focal interest (e.g., Williamson 2007; Daly 2015; Lawler 2018).

**BIBLIOGRAPHY**


