Thank You for Misunderstanding!

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This paper examines cases in which an individual's misunderstanding improves the scientific community's understanding via "corrective" processes that produce understanding from poor epistemic inputs. To highlight the unique features of valuable misunderstandings and corrective processes, we contrast them with other social-epistemological phenomena including testimonial understanding, collective understanding, Longino's critical contextual empiricism, and knowledge from falsehoods.

1. Introduction

Insight often emerges from the misunderstandings of others. One person's confusing metaphor can lead to another's fruitful analogy. An interlocutor's misinterpretation can point us toward the deeper meanings of poems, paintings, or relationships. Spotting flaws in fellow scholars' arguments can spark deeper changes in our own views. Science provides further examples. Better theories correct their predecessors' errors. More reliable detectors emerge from noisy measurements. The line between building and repairing a model is blurrier than one might think.

Philosophers have undertheorized these "valuable misunderstandings," as we will call them. Perhaps this is because they initially appear unremarkable—little more than an epistemological spin on the hackneyed platitude to make lemonade out of lemons. Dig deeper, however, and the most interesting of these misunderstandings feature *corrective processes*, in which poor epistemic inputs from one inquirer (misunderstanding) are transformed into good epistemic outputs for another (understanding). These corrective processes stand in stark contrast to epistemologists' focus on "preservative" processes, in which the goodness of an epistemic input (truth, justification, etc.) is transmitted to its output. Analyzing the details of these valuable

misunderstandings thus promises to improve philosophical accounts of the nature of misunderstanding, understanding, and the social epistemic processes that sometimes mediate them.

We see this paper as highlighting these neglected topics in epistemology and as an invitation to explore them further. For instance, we only identify three corrective processes; further research is likely to several more. Specifically, this paper focuses only on corrective processes that transform misunderstanding into understanding. However, future research could undoubtedly identify corrective processes with different kinds of epistemically bad inputs (falsehoods, unjustified beliefs, ignorance, etc.) and/or different kinds of epistemically good outputs (truths, justified beliefs, knowledge, etc.). Moreover, once corrective processes are made salient, several further social epistemological questions are raised. For instance, an epistemic community with a robust set of corrective processes might be more tolerant of diverse opinions, as it has reason to expect that even the opinions that betray misunderstandings hold some promise of yielding fruitful understandings over time. Consequently, while misunderstanding is an epistemic liability for *individuals*, *groups* with well-established corrective responses might productively benefit by having members (and non-members) that misunderstand.

We proceed as follows. Section 2 provides three examples of valuable misunderstandings in science. Using these cases, Section 3 then provides a more general framework for valuable misunderstandings by describing how scientific communities' corrective responses to misunderstanding can subsequently improve their understanding. To foreground our approach's distinctiveness, the remainder of our paper then contrasts valuable misunderstandings with more familiar social-epistemological phenomena (Sections 4 through 7). In doing so, we highlight

some of valuable misunderstandings' unique features that make them worthy of further philosophical investigation.

2. Three Examples from Science

While valuable misunderstandings are widespread, science provides especially vivid examples. We begin by presenting three cases in which an individual scientist's misunderstanding improves the scientific community's understanding.

2.1. Kelvin *Contra* Darwin

One striking example of valuable misunderstanding is Lord Kelvin's objection to evolutionary theory. Darwin believed that hundreds of millions of years were required for evolution to produce the kinds of biological diversity and complexity that he observed. Kelvin argued that the second law of thermodynamics showed that the earth was between 20-100 million years old. So, Kelvin argued, according to thermodynamics, the earth was insufficiently old for evolution to occur. This objection sparked spirited debate. Indeed, Darwin (1872, 409) remarked:

> With respect to the lapse of time not having been sufficient since our planet was consolidated for the assumed amount of organic change, and this objection, as urged by Sir William Thompson [Lord Kelvin] is probably one of the gravest as yet advanced, I can only say, firstly that we do not know at what rate species change as measured in years, and secondly that many philosophers are not yet willing to admit that we know enough of the constitution of the universe and of the interior of our globe to speculate with safety on its past duration.

Strikingly, although Kelvin ultimately misunderstood the cooling of the earth, his misunderstanding sparked many theoretical and methodological innovations focused on discovering the true age of the earth. First, Kelvin tested a range of hypotheses regarding the heat and age of the earth (Hattiangadi 1971). Second, paleontologists began to more precisely date fossils using new methods for measuring radioactive decay and half-life explicitly designed to determine the age of the earth. Radioactive decay highlighted two gaps in Kelvin's calculations: heat within the earth and heat from the sun (Kitcher 1983, 101). Third, the discovery of radioactivity also sparked numerous geological discoveries; e.g., being able to date fossils. Fourth, partially in response to Kelvin's calculations, other scientists, such as Huxley and Wallace, explored various counterfactual situations regarding rates of evolutionary change that were consistent with Kelvin's estimates of the earth's age (Gould 2002, 69-70). Among other things, this sparked Darwin's thinking about sexual selection as one process that could expedite evolution (Goodman 2019). Finally, several physicists, including one of Kelvin's assistants, John Perry (1895), showed that by relaxing Kelvin's assumption that the earth is rigid and homogenous, Kelvin's estimates could be off by a factor of 100, thereby shifting the upper limit to billions of years. Thus, the community's responses to Kelvin's misunderstanding generated myriad new hypotheses, tests, methods, and empirical data that significantly enhanced understanding of various phenomena. Therefore, an individual scientist who *misunderstood* a phenomenon greatly increased the scientific community's *understanding*.

2.2. Intelligent Design

Kelvin was an accomplished physicist, particularly in the area of thermodynamics.[1] Hence, it's tempting to think that valuable misunderstandings require their advocates to have significant epistemic authority. However, even theories advocated by "fringe" scientists can generate valuable misunderstandings. Consider creationists and intelligent design (ID) theorists.[2] ID proposes a mistaken explanation: the complexity and diversity of species are due to an intelligent designer's independent creation of species via 'supernatural' processes that are quite different from the processes which now operate in the universe (Ruse 1982). One of ID theorists' most infamous claims concerns so-called irreducible complexity. An irreducibly complex structure is defined as "a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning" (Behe 1996, 39). ID theorists allege that evolutionary theory cannot account for such systems because it requires more complex systems to evolve through "random" incremental changes to simpler systems (Sober 2000).

Despite these incorrect explanations and misunderstandings of evolutionary theory,[3] in responding to ID hypotheses and arguments, scientists have recruited new methods and evidence to rebut these arguments. For example, they've shown that ID theorists' favorite examples involve *reducible* complexity (Young and Edis 2004). In addition, in responding to these objections, scientists have used developments in probability theory to clarify how "a mindless, random process *can* produce complex and useful devices" (Sober 2008, 116). The scientific community has also acquired a good deal of counterfactual information from these hypotheses; e.g., what kind of "thumb" an intelligent designer would have created for pandas (Gould 2010)

[1] Absolute temperatures are stated in units bearing Kelvin's name, largely because he correctly determined the value of absolute zero.
[2] For terminological ease, we refer to both creation science and intelligent design theory as "ID."
[3] See Kitcher (1983) and Sober (2008) for why these explanations are mistaken.

or what kinds traits we would expect to observe if there were an intelligent designer (Sober 2000, 2008). Finally, these challenges to evolutionary theory have resulted in a wealth of empirical data in support of the theory (Kitcher 1983; Sober 2008).[4] As with Kelvin, responding to ID theorists' misunderstandings has improved evolutionary theorists' understanding.

2.3. Vaccines and Autism

While the previous two cases involved scientists gaining understanding by responding to other scientists, valuable misunderstandings can also occur in response to *public* misunderstanding of science. For example, a significant segment of the public believed Wakefield et al.'s (1998) study, which suggested that the measles, mumps, and rubella (MMR) vaccine predisposes children to behavioral regression and pervasive developmental disorder. Specifically, in eight of the twelve cases considered, parents identified the onset of symptoms of autism, on average, six days after their children had received the MMR vaccine. The Wakefield team "postulated a causal sequence in which MMR causes persistent measles infection in the gut…which produces an enterocolitis that leads to the translocation of typically impermeable peptides into the bloodstream and, subsequently, into the brain, where they affect neurological development and could result in autism symptomology" (Goldenberg 2021, 23). A significant segment of the public believed the evidence supported a causal explanation that linked the MMR vaccine with symptoms of autism.

Wakefield's explanation is incorrect, and his original study was shown to be problematic (falsified data, small sample size, poor methods, etc.). However, most discussions of this case

[4] Interestingly, Kitcher (1983, 5) also notes that "philosophers of science owe the Creationists a debt. For the 'scientific' Creationists have constructed a glorious fake, which we can use to illustrate the differences between science and pseudoscience."

have focused on how Wakefield's study was later retracted for falsifying data, and how he was funded by lawyers in vaccine lawsuits (e.g., Deer 2011). That is, most descriptions of this case have focused on establishing that Wakefield's explanation is unsupported by his original study. Yet, almost immediately after Wakefield's publication, numerous epidemiological studies were conducted and published, aimed at correcting the mistaken link between MMR vaccination and autism (e.g., Dales, Hammer, and Smith 2001; Farrington, Miller, and Taylor 2001; Madsen et al. 2002; Taylor et al. 2002). This response generated a plethora of new empirical evidence. For example, explicitly responding to Wakefield's study, Hornig et al. (2008) found that the measles vaccine virus genome was no more common in children with or without autism. Additionally, many epidemiological studies were conducted to address parental fears created by Wakefield's publication.[5] These studies led to a scientific consensus concerning the safety of vaccines, and enabled scientists to more accurately assess some of the counterfactual scenarios that parents found most pressing when considering whether to vaccinate their children. Finally, much of the data used to determine the spurious correlation between vaccines and autism also pointed toward suggestive alternative hypotheses about autism's causes. For example, some studies aimed to show no "new variant" pathway to autism via developmental regression and gastrointestinal symptoms. Others showed that thimerosal in vaccines does not cause autism (Plotkin, Gerber, and Offit 2009, 457-458). In response to these failures, alternative hypotheses emerged suggesting that the simultaneous administration of multiple vaccines overwhelms the immune system and makes the host susceptible to autism. However, this alternative explanation has likewise been shown to be empirically unsupported (Plotkin, Gerber, and Offit 2009, 460). Thus,

[5] See Plotkin, Gerber, and Offit (2009, 456) for references.

responding to the public misunderstanding caused by Wakefield's work has improved scientists' understanding of vaccines and autism.

3. Unpacking Valuable Misunderstandings

Drawing on the three cases above, we propose the following account of valuable misunderstandings:

(VM) S_1's misunderstanding possesses some epistemic value if at least one other agent S_2's understanding is a reliably formed corrective response to S_1's misunderstanding.[6]

VM only provides sufficient conditions for when misunderstandings possess *some* epistemic value. Moreover, we do not assume that these misunderstandings are epistemically valuable all things considered.[7] Crucially, VM rests on clarifying the concepts of *misunderstanding*, *understanding,* and *reliably formed corrective response*.[8] The balance of this section develops these ideas.

3.1. Misunderstanding

While virtually every theorist of understanding grants that *deliberate* departures from the truth, such as idealizations, can produce understanding, little is said about how to distinguish these "felicitous falsehoods" (Elgin 2017) from inaccuracies that produce *mis*understanding. For the

[6] We will frequently refer to agents in S_1's position as "misunderstanders" and those in S_2's position as "responders."
[7] Thanks to an anonymous reviewer for pressing us to clarify this distinction.
[8] More precisely, we define a corrective *response* as the product of a corrective *process*. Section 3.3 defines the latter.

purposes of this paper, we take misunderstanding to mean that some central *beliefs* about why the phenomenon occurred are false ("mistaken explanation" for short). This is at least a sufficient—though not necessary—condition for misunderstanding. This is partly to make the connections to mainstream epistemology, which focuses on beliefs, more explicit, but also because it appears to be a plausible interpretation of the cases discussed above.

For example, while Kelvin was not mistaken about the second law of thermodynamics, he was mistaken about the rigidity and homogeneity of the earth, which in turn undermined his explanations of how the earth cooled and why species did not evolve through natural selection. Similarly, many of ID's defenders believe a mistaken explanation of the diversity and history of organisms. While Wakefield's beliefs are unclear, his research produced mistaken beliefs concerning the causes of autism among members of the public. Thus, all three cases involve misunderstanding according to our characterization of mistaken explanations.

Crucially, this shows that misunderstanding is different from mere acceptance of a useful fiction. In particular, when proceeding as if a falsehood is true achieves certain context-specific purposes, it can be correct to accept that felicitous falsehood. Acceptance of this sort is typically apt for idealizations. By contrast, Kelvin's commitment to the earth's being rigid, homogeneous, and 20-100 million years old was more substantial than this. Similarly, ID theorists do not merely accept their assumptions as tentative hypotheses; they firmly believe those explanations are true (Ruse 1982). Finally, Wakefield's followers believe (rather than merely accept) that vaccines cause autism. Hence, misunderstanding differs from the purposeful acceptance of falsehoods involved in idealization.

Furthermore, our view outperforms the only sustained discussion of misunderstanding (Yu and Petkov 2024). Specifically, we more plausibly distinguish misunderstanding from

lacking understanding. Yu and Petkov (2024, 64) claim that grasping incorrect explanations results in a *lack* of understanding, while we argue that believing an incorrect explanation results in *mis*understanding. In many cases, one lacks understanding because one has *no* beliefs about an explanation of a phenomenon. For example, many middle-aged men feign no hypotheses about Taylor Swift's latest fashion choices. It seems more plausible to say that they lack understanding of Swift's wardrobe preferences than that they misunderstand these preferences.

Conversely, Yu and Petkov (2024, 67) claim that misunderstanding only occurs via "the rejection of a correct explanation, in the presence of the cognitive abilities and skills to grasp it." This seems overly restrictive, as individuals can misunderstand even if no correct explanation is available. For example, both Kelvin and Wakefield's followers misunderstood due to their belief in incorrect explanations even when no correct explanations of the phenomena had been developed.

3.2. Understanding

We argue that belief in these mistaken explanations can improve be of epistemic value when, in responding to misunderstanding through various corrective processes, one or more members of the community improve their understanding in one of three[9] ways:

(1) They consider mistaken explanations only as *potential* explanations (3.2.1).

(2) They draw true *counterfactual* claims from investigating mistaken explanations (3.2.2).

(3) They develop methods and discover evidence that enable them to discern which explanations are mistaken and hence only *possible*, and which explanations are not mistaken and hence *actual* (3.2.3).

[9] This list is not exhaustive.

Importantly, these responses are apt even when the responders do not (yet) know whether the misunderstander's explanations are mistaken. As such, verdicts that an individual misunderstood a phenomenon may only be revealed later in time—indeed, often *because* of these responses. In the rest of this section, we illustrate each of these contributions and explain why they enhance understanding.

3.2.1. Considering Alternative Explanations. Valuable misunderstandings leverage the diversity of views in a scientific community to foster more expansive consideration of explanatory hypotheses. For instance, whereas Kelvin (mistakenly) *believed* that the earth was 20-100 million years old (partly) because it was rigid and homogeneous, his interlocutors only *considered* this as a *potential* explanation. In other words, they thought it (only) *possible* that the earth was 20-100 million years old partly because it was rigid and homogeneous. Similarly, scientists have considered ID as a potential explanation of the origin of species. For example, Darwin took the hypothesis of independent creation very seriously and it structured much of the evidence and argumentation presented in *Origin* (Waters 2003). Finally, the scientific community responded to Wakefield's claims by considering vaccines as a potential cause of autism and proposing several alternative hypotheses that might account for the results (e.g., poor sample size or spurious correlation).

According to some accounts, consideration of plausible[10] potential explanations is an important feature of understanding (Khalifa 2017). Such consideration is most apparent in choosing independent variables to include in a (putatively) explanatory model or in testing multiple competing explanatory models. In this regard, theories of understanding that place a

[10] For discussion of what makes a potential explanation plausible, see Lipton (2004, Ch. 9), Psillos (2007), and Khalifa (2023).

premium on constructing explanatory models, e.g., De Regt (2017), will also place a high value on explanatory consideration.[11] Additionally, consideration of additional explanations frequently increases the reliability of explanatory inferences, and these inferences improve understanding in several ways (Khalifa 2017, Ch. 7).

Furthermore, since plausible potential explanations are possibility-claims, other accounts of understanding that prioritize modal information more broadly also assign value to explanatory consideration (e.g., Grimm 2010; Le Bihan 2016; Rice 2021). In short, considering more explanations of a phenomenon—even when those explanations are mistaken—expands scientists' sense of what is possible. Hence, misunderstanding can be valuable when scientists consider its attendant explanation as a possibility, even when its originator mistakes it for a correct (i.e., actual) explanation.

Finally, comparing several possible explanations can deepen understanding in a variety of ways. For example, biologists can deepen their understanding of how traits evolved by tracking the crucial differences between ID and Darwinian evolution (Sober 2000, Ch. 2; Rice 2021, forthcoming). In such cases, the community can deepen their understanding by bringing multiple alternative explanations into conversation with one another—even if some of those explanations are incorrect.

3.2.2. Counterfactual Information. Many hold that understanding requires the ability to correctly answer what Woodward (2003) calls 'what-if-things-had-been-different' questions (Grimm 2010; Hills 2015; Khalifa 2017; Le Bihan 2016; Rice 2021). Among other things, this is typically used to distinguish explanatory understanding from prediction by showing how changing certain

[11] See Khalifa (2023) for further discussion.

features of the explanans would change the explanandum; i.e., had the explanans been different, then the explanandum would also have been different. Other authors have noted that non-difference-making features also contribute to explanations (Batterman and Rice 2014; Khalifa, Doble, and Millson 2020; Rice 2021). Evaluating this lack of difference-making is also explicated in counterfactual terms; e.g., even if features within the system had been different, the explanandum would have remain unchanged. As a result, understanding why a phenomenon occurs—via the grasping of an explanation—frequently involves correctly assessing what would happen in counterfactual situations.

Once again, valuable misunderstanding can leverage the diversity of opinions in a community to gain knowledge of this counterfactual information. Even while rejecting Kelvin's mistaken explanation, his peers gained insight into how old the earth *would* be if it *were* rigid and homogeneous. Moreover, both Kelvin and his contemporaries considered what would happen to the temperature of the earth if it were of different ages, and as new theories entered the scene, additional counterfactuals were considered, e.g., what would happen to the heat of the earth if it were of different ages *while holding radioactive decay fixed.* Kelvin's objections also prompted Darwin to consider how evolution could proceed at a faster pace than he anticipated if the earth were less than 100 million years old. Similarly, by evaluating ID explanations, biologists considered how the complexity of a system would change had there been intelligent design, as well as how that complexity would change if there had been no intelligent design while altering and holding fixed different evolutionary factors.[12] Thus, responding to misunderstandings can expand the range of counterfactual information that scientists grasp (Rice

[12] Similarly, responding to ID theories' mistaken explanations of the formation of the Grand Canyon can demonstrate that how the Great Flood would have created the Grand Canyon only if geological history were very different (Verreault-Julien 2019, 15).

forthcoming). Finally, autism researchers considered three mechanisms whereby vaccines might cause autism: encephalopathic proteins caused by damaged intestinal lining; neurotoxicity of certain preservatives found in vaccines; and overwhelming the immune system (Plotkin, Gerber, and Offit 2009). Each proposed mechanism supports several counterfactuals. As just one example, the first proposed mechanism supports the counterfactual claim that autism would be likelier if vaccines were to increase the number of encephalopathic proteins by damaging the intestinal lining.

In short, when a misunderstanding raises an "interesting possibility," it's natural to think about what would follow from that possibility, and what would follow from other, related possibilities. This seems to promote understanding in a community, even if the misunderstander mistakes these possibilities for actualities.

3.2.3. Distinguishing Actuality from Possibility. As noted above, scientists responded to Kelvin's challenge by developing new methods for calculating radioactive decay and gathering novel kinds of geological data. Similarly, biologists conducted new empirical tests to show that natural selection could explain away irreducible complexity, and epidemiologists conducted longitudinal studies to track the degree to which vaccination rates and the prevalence of autism correlated.

These methodological and evidential improvements complement consideration of potential explanations and acquiring new counterfactual information. In particular, many counterfactuals generated predictions from the potential explanations that scientists considered. These methods and evidence allow these predictions to be tested. In turn, these predictive tests indicate which explanations are likeliest, and which ones are mere possibilities.

Depending on one's conception of understanding, these empirical tests help scientists to determine whether an explanation is empirically adequate (De Regt 2017), sufficiently tethered to the facts (Elgin 2017), or approximately true (Khalifa 2017).[13] Regardless of which of these routes are taken, explanations that pass these empirical tests improve our understanding (*ceteris paribus*). Hence, by attempting to empirically test a misunderstander's explanation, other members of a scientific community may come to identify which explanations are actual[14] and which are only possible. Importantly, this does not depend on the misunderstander coming to reject their original explanation as mistaken—e.g., Kelvin needn't abandon his preferred explanation. All that is required is that *other* scientists come to know which explanations are better supported by the empirical evidence than others.

In summary, the preceding suggests that an individual's misunderstanding is valuable when her peers' response to it improves the community's understanding. Moreover, we have identified three kinds of epistemic outputs that improve the community's understanding: consideration of alternative explanations, acquiring new counterfactual information, and distinguishing the actual from the possible.

3.3. Reliable Corrective Responses

We have now analyzed the relata of our account: individual misunderstanding and other individuals' improved understanding. To complete our account, we need to specify the *relation* between them: the *social processes* that take an individual's misunderstanding as their inputs and take other individuals' improved understanding as their outputs. We call these processes

[13] See Khalifa (2023) for some complications with these distinctions.
[14] What counts as "actual" depends on whether one takes correct explanations to be (approximately) true or merely empirically adequate. In the latter case, the acceptable explanations are actually empirically adequate, while the explanations that fail the predictive tests are possibly but not actually empirically adequate.

corrective, as they take epistemically bad inputs and convert them into epistemically good outputs. In this regard, corrective processes are the antithesis of "garbage-in, garbage-out" processes. If one likes, they are "garbage-in, goodies-out." These corrective processes are a key part of why valuable misunderstandings are epistemologically significant.

To begin, in a corrective process, the responder does not assume that the mistaken explanation is correct.[15] Of course, the process would not be corrective if it merely stopped there. Corrections require responders to reason with the aim of *transforming* what they (correctly) take to be a mistaken explanation so as to advance their understanding. This transformation process can be more or less *reliable*. For example, unreliable corrective processes frequently produce epistemically bad outputs in response to other epistemically bad inputs (i.e., they routinely fail to correct). By contrast, reliable corrective processes regularly produce epistemically good outputs in response to epistemically bad inputs. Despite the ease with which reliability can be wedded to corrective processes, they are undertheorized by reliabilist epistemologies.[16] For example, consider a standard formulation of conditional reliability:

> If *S*'s belief in *p* results from a *conditionally* reliable belief-dependent process, and if the beliefs on which this process operated in generating *S*'s belief in *p are themselves justified, then S*'s new *belief in p* is also *justified* (Goldman and Beddor 2021).

[15] This also distinguishes these cases from instances of knowledge from falsehoods; see Section 7.
[16] For this paper's purposes, we are agnostic as to how reliability is analyzed, e.g., in terms of objective probabilities, safety, or sensitivity.

Conditionally reliable belief processes seek to *preserve* the epistemic goodness (in this case, justification) of the beliefs that serve as their inputs. By contrast, corrective processes *convert* epistemically bad inputs into epistemically good outputs.

Given the preceding, we can see that the inputs of the corrective processes that figure in valuable misunderstandings will be the misunderstander's false belief in an explanation and the outputs will be the responders' true beliefs in modal, counterfactual, and explanatory claims. Insofar as these corrective processes are reliable and successful, the misunderstanding has been converted into something of epistemic value. Importantly, however, these three outputs call for different corrective processes.

First, to infer true claims about possibilities from false explanations is often a very straightforward corrective process. It only requires a "modal hedge." It will be reliable for any false explanation that is internally consistent. For example, it takes very little effort to convert Wakefield et al.'s false claim that *MMR vaccines cause autism* to the true claim that *it's possible that MMR vaccines cause autism*. Depending on the context, this may be a logical, physical, theoretical, or epistemic possibility.[17] Of course, a community may deem a proposed explanation as wholly unworthy of consideration—indeed calls to reject ID hypotheses as "not science" sometimes result in this kind of response. This would amount to a failure to engage in this kind of understanding-generating corrective process. So, while this process of introducing a modal hedge to consider another agent's misunderstanding as a mere alternative explanation is reliable and fairly simple to apply, it is not guaranteed.

[17] Here, we assume that the relevant modalities are not so exotic that something could be actual but not possible.

Second, since counterfactuals typically presuppose *ceteris paribus* clauses,[18] a reliable corrective process whereby true counterfactual claims are inferred from mistaken explanations typically requires that responders know a good deal of background information. This background information is sometimes driven by theory but often is acquired through empirical investigation. In scientific communities that divide their labor, this information is often acquired through other social processes, e.g., reading other scientists' published work or relying on instruments and techniques that others have developed. For example, Kelvin's mistaken explanation might be corrected by converting it into the true counterfactual that if the Earth were rigid, then species would not have evolved through natural selection. However, unlike modal hedging, this requires a wealth of background information, e.g., about thermodynamics and various geological data, in order to see how the consequent of this counterfactual follows from its antecedent.

Finally, in order to reliably determine which of the proposed explanations are actual and which are possible, responders must not only have background information, but must also possess sufficient empirical evidence. In the examples above, the responders are the ones gathering this evidence. This corrective process requires the ability (or skill) to determine which empirical evidence would differentiate between competing explanations, knowledge of the methods used to reliably acquire that evidence, and the ability to interpret results of empirical tests.

Thus, we see that these corrective processes involve not only individual misunderstandings as inputs, but also require a variety of other kinds of information depending on the output in question. When the understanding only involves expanding a community's compendium of possibilities, modal hedging suffices. However, both counterfactual reasoning

[18] In a Lewis-Stalnaker semantics for counterfactuals, a similar idea is expressed by the requirement to maximize similarity across possible worlds.

and explanatory discernment require diverse bodies of theoretical and empirical information. Because of this, valuable misunderstandings involve different kinds of corrective responses, which in turn depend on different auxiliary inputs.

3.4. VM's Sufficiency and Significance

With VM's core features unpacked, we turn to evaluating its veracity. A counterexample to VM would be one in which S_2's understanding is formed in response to S_1's misunderstanding, yet S_1's misunderstanding lacks epistemic value. Let's begin with a simple (but flawed) argument that blocks such counterexamples: since S_1's misunderstanding causally contributed to S_2's understanding through a reliable process, and because (S_2's) understanding is epistemically valuable, S_1's misunderstanding is of instrumental epistemic value.

This argument faces two challenges. First, it proves too much: any misunderstanding that causally contributes to understanding will be valuable. Even if one is willing to accept this consequence, it would seem to undermine the significance of valuable misunderstandings. Second, insofar as S_1's misunderstanding is part of a deviant causal chain leading to S_2's understanding, it becomes less clear that S_1's misunderstanding is of instrumental epistemic value.

Foregrounding corrective processes solves both problems. To see why, contrast our examples with the curious case of 20th-century entrepreneur Roger Babson, whose misunderstanding of gravity[19] led him to found the Gravity Research Foundation in 1948. The foundation recently celebrated its 75th anniversary and has funded research that has improved scientists' understanding of cosmological constants, planetary motion, and the stock market.

[19] Babson blamed gravity for his sister's tragic drowning and numerous other social problems.

However, it's primarily a *funding* process that connects Babson's misunderstanding of gravity to these understandings. By contrast, in our examples, VM's *corrective* processes connect misunderstandings to their resulting understandings. Consequently, mere causal dependence on another's misunderstanding is insufficient.

Reliable corrective processes strike us as uncontroversially epistemic: by definition, they tend to convert epistemically bad states (misunderstanding) to good ones (understanding). By contrast, funding only achieves this result contingently: Babson could have funded the Gravity Research Foundation with a clear understanding of gravity's effects, or that foundation could have funded research saturated with misunderstanding. Indeed, inputs of dubious epistemic significance, e.g., vanity to be recognized as a well-heeled patron of science, can generate good funding regimes. Because of their intrinsically epistemic characteristics, corrective processes generate additional epistemic value in at least two ways. First, if a misunderstanding occurs in a community, it's epistemically better to *correct* that misunderstanding than to let it persist. Second, all else being equal, it's epistemically better to correct a misunderstanding in a way that produces some understanding rather than in ways that produce no understanding. Babson-style cases guarantee neither of these avenues to epistemic value. Consequently, the epistemic value of corrective responses secures (at least) the instrumental epistemic value of valuable misunderstandings.

To further illustrate VM's importance and uniqueness, the remainder of this paper shows how several prominent strands in the existing social epistemology literature do not account for valuable misunderstandings (see Table 1). Social-epistemological discussions of understanding[20]

[20] Space prohibits more extensive discussions belief, justification, and knowledge as they relate to testimony and collective epistemic subjects. However, we suspect that many of our arguments targeted at their understanding-focused counterparts carry over. Moreover, since these discussions are not focused on understanding, their outputs

have largely focused on testimony and collective understanding. As we argue in Section 4, testimony clearly requires non-corrective social processes, so it is not the same as valuable misunderstanding. While collective understanding, especially in its non-summative forms, allows for community understanding without individual understanding, it need not do so through corrective processes; nor do valuable misunderstandings require collective understanders (Section 5). Third, we turn to work focused on corrective processes—namely Helen Longino's social epistemology—but we argue that valuable misunderstandings can occur in the absence of her requirements, and vice versa (Section 6). Finally, we turn to the literature on knowledge from falsehoods, arguing that it does not typically involve corrective processes, and even if they did, those corrective processes differ from those involved in valuable misunderstandings (Section 7). Taken together, these arguments show that what is unique about valuable misunderstandings are their inputs (misunderstanding), outputs (other's understanding), and the types of corrective social processes that mediate between them.

	Input	**Process**	**Output**
Valuable Misunderstandings	Misunderstander's mistaken explanation	Corrective	Responder's understanding
Testimonial Understanding	Speaker's understanding	Non-Corrective	Audience's understanding
Collective Understanding	Individual contributions	Summative/ Non-Summative	Group understanding
Longino	Community's criticisms of content	Corrective	Epistemically acceptable/ objective content
Knowledge from Falsehood	Individual's false belief	Non-Corrective	Same individual's knowledge

Table 1. Differences between valuable misunderstandings and adjacent social-epistemological phenomena

4. Testimony and Understanding

will automatically differ from valuable misunderstandings. *A fortiori*, this applies to social-epistemological discussions that do not engage the understanding literature.

Without question, *testimony* is the most extensively discussed social-epistemological topic concerning understanding.[21] The central question is whether testimony transmits understanding in the same way that it transmits knowledge. Understanding is transmitted via testimony when a speaker has understanding that she imparts to her audience through speech-acts such as asserting and explaining.[22] However, few of these discussions involve the *corrective* processes that characterize valuable misunderstandings. Transmitting understanding is a social process that *preserves* its input's epistemic good (the speaker's understanding) in its output (the hearer's understanding). By contrast, our corrective processes *convert* epistemically bad inputs (the speaker's *misunderstanding*) into epistemically good outputs (the responder's *understanding*).

Still, while arguments both for (Boyd 2017; Grimm 2019; Hazlett 2017; Malfatti 2020; Sliwa 2015) and against (Gordon 2016; Hills 2009, 2015; Pritchard 2014; Zagzebski 2009) understanding's transmissibility have been volleyed, nearly all agree that, at a minimum, one person can come to understand partly because of another's speech-acts through *non*-transmissive processes (Croce 2018; Gordon 2016; Hills 2020; Jäger 2016; Malfatti 2021). For example, a teacher's explanation may not be sufficient unto itself to generate understanding in students, but it can lead her students to engage in further reasoning that results in understanding.

Despite this, many extant discussions of these non-transmissive processes still focus on processes where the inputs are epistemic goods, e.g., when expert[23] testimony does not transmit understanding but at least puts an audience member in a better position to understand once she exerts sufficient cognitive effort (Croce 2018; Gordon 2016; Hills 2020; Jäger 2016; Malfatti 2021). Hence, these also deal with social processes that are not corrective.

[21] See Hazlett (2024) for a review of the relevant literatures.
[22] For discussion of these speech-acts, see, e.g., Turri (2015).
[23] Here we draw no firm distinction between experts and epistemic authorities.

To our knowledge, Federica Malfatti's (2019) discussion of testimony that "generates" understanding comes closest to discussing corrective processes that yield understanding. This is her chief example:

> Lilith teaches science in a high school… On the basis of [careful research], she asserts to her students that human activity and pollution are causally responsible for the rise in temperature on our planet, and she explains the details of the causal nexus between greenhouse gas emissions and global warming. The students judge Lilith to be an authority as far as science is concerned and do not hesitate to form corresponding beliefs on the basis of her testimony. Outside the classroom, Lilith is a climate change denier (Malfatti 2019, 480).

However, despite Lillith misunderstanding global warming, this process is non-corrective. The input is only an epistemic good (Lillith's correct understanding of what the science says). The epistemically bad thing (her misunderstanding of global warming) does not figure in the relevant social process (her testimony) nor in the output of that process (her students' understanding of global warming). Hence, even when testimony generates (rather than transmits) understanding, it does not engage corrective processes.

To summarize: the current literature on testimonial understanding focuses on preservative processes in which a speaker possesses some epistemic good that serves as the input to a social process that results in their audience understanding. By contrast, valuable misunderstandings involve corrective processes in which the speaker inputs misunderstanding. Hence, valuable misunderstandings are distinct from testimonial understandings.

5. Collective Understanding

It's natural to describe valuable misunderstandings as occurring when a scientific *community's* understanding improves in response to some of its member's misunderstandings. This suggests that valuable misunderstandings overlap with another topic in the social epistemology of understanding: collective understanding (Boyd 2021; Delarivière 2020; Harris 2024; Malfatti 2022). Collective understanding resembles valuable misunderstanding in that both allow groups to understand even when some of their members misunderstand. Despite this similarity, valuable misunderstandings differ from group understanding in three ways.

First, accounts of group understanding typically require groups to have mental states in order to understand.[24] By contrast, valuable misunderstandings do not require groups to have mental states. In the simplest case of valuable misunderstanding, one misunderstander and one responder are connected by a single corrective process. This does not require them to form a collective subject who understands (believes, endorses, etc.). Nor is it obvious why adding more respondents in the mix (as in our three examples in Section 2) thereby adds pressure to require collective subjects or collective mental states.

Second, groups consisting of members who all coordinated their understandings of different aspects of a single phenomenon to produce a more comprehensive understanding appear to be prime candidates for collective understanding. Thus, even if most accounts of collective understanding *allow* some group members to misunderstand, they do not *require* this. By contrast, valuable misunderstandings require at least one misunderstander.

[24] On this point, Boyd is the least committal among proponents of collective understanding. He only requires groups to "represent" the facts needed for understanding, but "leave[s] it open as to how, exactly, the relevant material is represented (one could, for instance, appeal to a theory of group belief)" (Boyd 2021, 6852). By contrast, Delariviére (2020, 1) requires group understanders to be grist for the "epistemic stance," in which they are attributed beliefs and other mental states; Harris (2024, 140) requires group understanders to possess "irreducibly collective mental states;" and Malfatti requires group understanders to collectively *endorse* the understanding-providing content.

Third, valuable misunderstandings and collective understandings differ in their characteristic social processes. A central debate concerning group understanding is how many of a group's individual members must understand for the group to understand. For example, summativists hold that a group understands a phenomenon Φ just in case all (or most) of its members understand Φ. Non-summativists argue that whether a group understands Φ does not depend solely on whether its members understand Φ.[25] As we'll now argue, valuable misunderstandings crosscut the summative/non-summative divide.

Some valuable misunderstandings occur when a single member responds to a widely held misunderstanding in a way that improves her understanding. Conversely, a majority of individuals may come to understand a phenomenon without responding to their peers' misunderstanding. Hence, if summativism is true, then collective understanding can occur in the absence of valuable misunderstandings and vice versa.

Additionally, valuable misunderstandings can occur without collective understanding even if *non*-summativism is true. As an illustration, consider Boyd's (2022) emphasis on how non-summative collective understanding requires *mutual reliance* between individual members. His examples of mutual reliance all involve three key features:

(1) Group members recognize that they are contributing to the collective goal of understanding some phenomenon Φ,

(2) This goal can be achieved if and only if each group member contributes their relevant skills and knowledge (given the current circumstances), and

[25] See Boyd (2021, 6847), Delarivière (2020, 12-13), and Malfatti (2022, 9). Harris (2024, 139-140) does not use these terms, but considers reductive and non-reductive accounts of collective understanding, which closely mirror summativism and non-summativism, respectively.

(3) Each group member recognizes (2).[26]

We contend that valuable understanding requires none of these features of mutual reliance. Since Boyd's is the most developed account of the kind of coordination typically associated with non-summativism about collective understanding, we take it as evidence that valuable misunderstandings can occur independently of non-summativist conditions.[27]

Regarding (1), it's possible for valuable misunderstanders to seek understanding of something different than their responders. Kelvin's goal was to know the age of the earth. In seeking this goal, he only highlighted his results' incompatibility with Darwinian theory; he did not seek to understand evolution.[28] However, for some of his critics, such as "Darwin's bulldog," Thomas Huxley, understanding evolution was paramount. Indeed, if we take a finer-grained approach to epistemic goals,[29] then many respondents' epistemic goals include identifying where the misunderstander has gone wrong, but this clearly isn't among the misunderstander's epistemic goals. For example, Perry sought to show that the Earth was much older than Kelvin thought. Furthermore, not all responders to the same misunderstanding must have the same epistemic goal. As a physicist and engineer interested in thermodynamics, Perry's epistemic goals differed from those of Boltwood (1907), a chemist whose development of radiometric dating techniques and application of those techniques to geological samples provided further

[26] Boyd's (2021, 6853) most prosaic characterization of conditions (2) and (3) is that group members "recognize… that they would not be able to achieve that goal on their own (given the circumstances)." However, that is consistent with them thinking that they would also not be able to achieve the goal of understanding *P* in concert with others, which does not seem sufficient for mutual reliance as typically understood. Our formulation avoids this problem.
[27] Harris (2024, 142) largely defers to Boyd's account of collective understanding. Delarivière (2020, 14) holds that group understanding is sometimes irreducible to individual understanding, but his chief example is a "highly implausible" thought experiment (9). Malfatti's (2022, 11) example involves group members agreeing on a theory that the group endorses but that no individual member endorses. Valuable misunderstandings don't require (and may preclude) this social arrangement.
[28] Quite independently from his work on the earth's age, Kelvin conjectured about life's origins (e.g., Thompson 1871).
[29] Indeed, coarse-grained epistemic goals (e.g., "seek truth" or "understand evolution-adjacent phenomena") will very easily multiply group understanders beyond plausibility.

evidence against Kelvin's claims. Neither had the same epistemic goals as biologists such as Huxley and Wallace.

Treating Boyd's second and third requirements in tandem, it should be clear that misunderstanders and respondents exhibit little mutual reliance. Responders needn't recognize misunderstanders' contributions as necessary or sufficient for understanding a phenomenon. Moreover, Responder *A* needn't recognize Responder *B* as necessary or sufficient for the particular modal, counterfactual, and explanatory claims that *A* extracts *from C*'s misunderstanding. For example, Boltwood and Huxley did not appear to rely on each other in any way.

Thus, valuable misunderstandings are distinct from collective understandings for two reasons. First, valuable misunderstanding doesn't *require* group subjects. Second, valuable misunderstandings also bypass summativist and non-summativist requirements. Nonetheless, our account *allows* for cases of valuable collective misunderstandings—a worthy topic for future research.

6. Scientific Criticism

Given that our view locates the value of a misunderstanding in corrective responses to mistaken explanations, turning from the social epistemology of understanding to Helen Longino's (1990, 2002) influential work may yield more fruitful comparisons. According to Longino (2002, 135):

> Some content *A* is *epistemically acceptable* in community *C* at time *t* if *A* is or is supported by data *d* evident to *C* at *t* in light of reasoning and background assumptions which have survived critical scrutiny from as many perspectives as are available to *C* at *t*,

and *C* is characterized by venues for criticism, uptake of criticism, public standards, and tempered equality of intellectual authority.

For Longino, critical scrutiny should have "transformative" potential (e.g., Longino 1990, 73-74; 2002, 134). Hence, like us, her social epistemology emphasizes interpersonal corrective processes. Thus, if misunderstandings are valuable only insofar as they function as criticisms in Longino's framework, then our claim that valuable misunderstandings are distinctive would be undermined. On such a view, Kelvin, Behe, and Wakefield's misunderstandings are criticisms embedded in a well-structured scientific community that scientists' respective understandings of evolution, complex adaptations, and autism survived. We will now argue that this proposal falls short in three ways.

First, the output of Longino's (2002, 136) corrective processes differ from ours. Longino's corrective processes produce claims that are *epistemically acceptable*, which she takes as "akin to justifiability," and elsewhere as a kind of *objectivity*, understood as "reliance upon nonarbitrary and nonsubjective criteria for developing, accepting, and rejecting the hypotheses and theories" (Longino 1990, 62). Yet, scientific claims that are merely descriptive, merely predictive, or "black-boxy" may be epistemically acceptable, justifiable, or objective without providing much understanding. For example, the claim that *MMR vaccines cause some things to occur* is epistemically acceptable, but does not improve contemporary scientists' understanding. Thus, some claims that fail to be informative about potential explanations, counterfactuals, or distinguish actual from possible explanations might well satisfy Longino's conditions without contributing to valuable misunderstandings.

Second, the inputs of our corrective processes differ from Longino's. Recall that the misunderstandings we discuss here are, at root, purported explanations. A purported explanation

aims to account for how or why phenomena behave as they do; a criticism alleges that a claim is either false or insufficiently justified. Sometimes, these two activities coincide. For instance, Kelvin and ID theorists' explanations also function as criticisms of Darwinian evolutionary theory. However, they can also come apart. This is especially clear in Wakefield et al.'s misunderstanding. They are proposing a mechanism for autism, but do not devote significant attention to challenging other hypothesized causes of autism. Indeed, their misunderstanding is valuable not because it *is a criticism* to be responded to, but because it *was criticized*. If Longino's conditions were necessary for valuable misunderstandings, the exact opposite would be required. Similarly, the criticisms *of* Kelvin and ID theorists' explanations are at least as important for generating understanding as are evolutionary theorists' responses to their criticisms. Zooming out, Longino's view is focused on how responding to criticisms of a particular hypothesis or background assumption renders that *same* hypothesis/assumption more epistemically acceptable or objective. By contrast, our account focuses on how responding to criticisms of a mistaken explanation generates understanding by means of *other* (modal, counterfactual, and explanatory) claims. In this way, both the inputs and outputs of our socially corrective processes significantly differ from their Longinoan counterparts.

Third, Longino's characteristic corrective processes differ from ours. According to Longino, an epistemically acceptable claim must have empirical support from data that is evident in light of reasoning and background assumptions which have survived critical scrutiny. In contrast, our account holds that understanding is a reliably formed corrective response to misunderstanding. Some reliable corrective processes that produce understanding do not require reasoning or background assumptions that have survived critical scrutiny. For example, the reasoning involved in considering misunderstandings as potential explanations ("modal

hedging") is highly reliable—largely because its conclusions are exceedingly modest possibility claims. We suspect that scientists frequently get to engage in this reasoning with no critical scrutiny whatsoever. It is also not obvious that someone who reliably infers a true counterfactual claim from a mistaken explanation in the ways we've suggested fails to improve their understanding of evolution simply because their background assumptions have not been vetted through scientific criticism. For instance, someone who infers that *species could not have evolved via natural selection had the earth been rigid* from Kelvin's misunderstanding improves their understanding simply because such reasoning is reliable, and not because that reasoning passes others' muster.[30]

If the preceding is correct, then virtually none of the Longinoan machinery is necessary for a valuable misunderstanding: if some valuable misunderstandings can be achieved without critical scrutiny, then, *a fortiori*, they can be achieved without critical scrutiny from multiple perspectives and in communities lacking venues for criticism, uptake of criticism, public standards, or tempered equality of intellectual authority. For example, valuable misunderstanders such as Kelvin, Behe, and Wakefield, often show insufficient uptake or responsiveness to criticism or lack the requisite intellectual authority. This has prompted some to dismiss them from the relevant scientific communities.[31] Regardless of whether such dismissals are justified, they point to how epistemic acceptability/objectivity in Longino's sense imposes more stringent demands on a scientific community than valuable misunderstandings do. We consider this to be theoretically advantageous, as it is often extremely difficult to determine what the shared

[30] This is consistent with a person's understanding on the basis of a hypothesis that fails to be epistemically acceptable or objective in Longino's sense. In this way, it only challenges the claim that we can *reduce* valuable misunderstandings to Longino's framework, but it does not challenge Longino's framework *per se*.
[31] de Melo-Martín and Intemann (2018, 170, n.9) cite Kitcher (2011), Longino (2002), and Solomon (2008) as sympathetic to this position.

standards of a community are, whether an individual agrees with those standards, whether a dissenter is adequately responsive to criticism, or where to draw the line between experts and non-experts (de Melo-Martín and Intemann 2018, Ch. 4). Fortunately, valuable misunderstandings do not require us to settle any of these issues since misunderstanders need not be experts or agree with the standards of the community that responds to them.

None of this is intended as a criticism of Longino. After all, she was not theorizing about valuable misunderstandings. Rather, our point is that valuable misunderstandings are *distinct* from the social-epistemological phenomena that are Longino's focus. This is because, while they both involve social-corrective responses, the inputs, outputs, and types of corrective processes are importantly different. As a result, understanding produced from misunderstanding via the corrective processes we've described above significantly differs from the objectivity (or epistemic acceptability) produced from critiquing reasoning and background assumptions by the social processes involved in Longino's account.

Still, it's worth closing this section by highlighting interesting points of intersection. While valuable misunderstandings *needn't* be the result of critical scrutiny in well-structured epistemic communities, they certainly *can* be. In such cases, it may be that the kind of corrective processes we've outlined above provide more concrete proposals for how community members can be responsive to each other. Forging these connections is a topic for further research.

7. Knowledge from Falsehood

Finally, let's consider the literature on knowledge from falsehood (KFF). It is motivated by examples such as the following:

> UTAH. CNN breaks in with a live report. The headline is 'The President is speaking now to supporters in Utah'. I reason: 'The President is in Utah; therefore he is not attending today's NATO talks in Brussels'. I know my conclusion but my premise is false: the President is in Nevada—he is speaking at a 'border rally' at the border of those two states and the speaking platform on which he is standing is in Nevada. The crowd listening to the speech is in Utah (Warfield 2005, 408).

Thus, like valuable misunderstandings, KFF involves epistemically bad inputs (falsehoods) generating epistemically good outputs (knowledge). Moreover, we might think that this example involves a mistaken explanation. The protagonist might falsely believe that the President's being in Utah *explains why* he's not attending the NATO talks.[32] Furthermore, while not necessary for KFF, this example involves a social interaction between the reporters at CNN and the protagonist. However, beyond these superficial similarities, valuable misunderstandings differ from KFF in three ways.

First, unlike valuable misunderstandings, KFF does not require corrective processes. In typical cases of KFF, falsehoods are treated as premises in the knower's reasoning. For example, UTAH'S protagonist assumes that the President is in Utah. By contrast, corrective processes require responders *not to* assume misunderstanders' mistaken explanations. If they did, they would not be *correcting* anything. Relatedly, valuable misunderstandings require responders to reason with the aim of *transforming* the mistaken information they receive into an epistemic good. For instance, Kelvin's responders sought to revise his claim about the earth's age. Nothing analogous is required with KFF; UTAH's protagonist isn't aiming to revise CNN's report.

[32] Most canonical examples of KFF can be recast as explanations with false *explanantia* and true *explananda*. Whether this is integral to KFF exceeds this paper's scope.

Furthermore, even if KFF sometimes involve corrective processes, they differ from the corrective processes involved in valuable misunderstandings. Unlike valuable misunderstandings, neither the inputs nor the outputs of KFF-conducive processes need to satisfy VM's requirements, which suggests that any corrective processes characteristic of KFF differ from VM's corrective processes. In UTAH, the input is only CNN's reporting that the President is in Utah; the reporters don't proffer the explanation that the President won't attend the NATO meetings *because* he's in Utah. Rather, that mistaken explanation is a product of the protagonist's reasoning. Similarly, while the outputs of valuable misunderstanding are understanding, the outputs of KFF are knowledge. For instance, the protagonist of UTAH *knows that* the President won't attend the NATO talks, but precisely because of his mistaken explanation, he appears to *misunderstand* why this is so. Finally, most cases of KFF involve falsehoods that are *close approximations* to the truth, e.g., "the President is in Utah" is a close approximation of the fact that the President is just across the Utah border in Nevada. This approximation is close enough given the aim of knowing whether he'll attend meetings in Brussels. Hence, we might think of the characteristic corrective process in KFF cases as converting the relevant falsehoods into approximations that are accurate enough to reach the (known) conclusions of interest. [33] However, even this construal does not comport with our examples. For example, Kelvin's explanation of the earth's age was not a close enough approximation to the earth's actual cooling processes for the purposes of evolutionary theorizing; ditto for the other cases. So, even if there are corrective processes in KFF, they are distinct from those involved in valuable misunderstandings.

[33] Here we remain neutral as to whether this appeal to approximation renders cases of KFF into cases of knowledge *despite* falsehood (Ball and Blome-Tillmann 2014; Montminy 2014). Regardless of one's position on that issue, our arguments entail that the relevant cases differ from valuable misunderstandings.

Third, KFF is controversial precisely because it contravenes plausible principles such as the counter-closure principle for knowledge:

> (CCK) If (i) *S* knows that *q*, and (ii) believes *q* solely on the basis of competent deduction from some premises including *p*, then (iii) S knows that *p* (Ball and Blome-Tillmann 2014).[34]

By contrast, valuable misunderstandings contravene no analogously plausible principle for understanding. Consider the following:

> If (i) *S* understands why *q*, and (ii) understands why *q* solely on the basis of competent deduction from some premises including *p*, then (iii) *p* is true.

Condition (iii) is the most plausible requirement one might put on the kind of inferentially acquired understanding characterized by conditions (i) and (ii). However, virtually every theory of understanding allows for situations in which a phenomenon (described by) *q* is understood only through a derivation in which at least one premise *p* is an idealization or an approximation. Idealizations and approximations are false. Indeed, scientists typically *know* that they are false. Hence, condition (iii) enjoys little consensus/plausibility as a requirement on inferentially acquired understanding. *A fortiori,* more demanding requirements on inferentially acquired understanding—e.g., that *S knows* that *p* will be even less plausible. Indeed, a proper counter-closure principle for understanding would replace (iii) with the requirement that *S* must *understand* why *p*. However, that seems both implausible and potentially regress-inducing. Hence, attending to valuable misunderstandings highlights an unappreciated way in which understanding differs from knowledge: its immunity to counter-closure principles.

[34] See Luzzi (2010) for a similar formulation.

As before, our point is only to highlight why valuable misunderstandings are distinct from KFF. Future research would examine how corrective processes in which the inputs are false beliefs and the outputs are knowledge bear on extant discussions of KFF, and how more plausible closure principles for understanding (e.g., Dellsén 2018) complicate or enrich our account of valuable misunderstandings.

8. Conclusion

Generally, epistemology has focused on good sources of information and "preservative" processes that turn good epistemic inputs (such as true beliefs) into good epistemic outputs (such as other true beliefs). In contrast, this paper has highlighted how *poor* epistemic inputs (such as misunderstanding) can be transformed via *corrective* processes into good epistemic outputs (such as others' understanding).

Moreover, by analyzing the distinctive inputs, outputs, and social processes involved in value misunderstandings, the above discussion provides a framework for future investigations into epistemically corrective processes and their importance to social epistemology. First, our account of valuable misunderstandings describes only a few corrective processes. Other corrective processes, including those with different inputs (e.g., ignorance, false/unjustified beliefs) and outputs (e.g., knowledge, true/justified beliefs) deserve further exploration. Second, these cases suggest that sometimes having members that misunderstand can improve the understanding of a group (or some members thereof). Furthermore, assessments of a community's epistemic health will often depend on various interactions between members that understand and misunderstand in various ways. Perhaps groups with well-established corrective responses will better understand when several of their members misunderstand. Third, these

cases complicate various assessments of when dissent/disagreement is epistemically valuable and refocuses our attention on the community's corrective responses to dissent rather than the motives or stubbornness of the dissenters. In these cases, unpacking the epistemic benefits of responding to misunderstanding in fruitful ways is of greater epistemological significance than identifying the epistemic failings of misunderstanders. Fourth, social epistemologists ought to analyze when the understanding generated for the group is worth potentially producing misunderstanding for others and whether certain epistemic norms lead to premature dismissal of others' misunderstandings.[35] Each of these implications provides interesting avenues for expanding discussions concerning epistemically corrective processes and the social epistemology of understanding.

[35] Thanks to an anonymous reviewer for suggesting this interesting implication of our view.

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