Do Scientific Communities Understand? A Fictionalist Account

Forthcoming in *Philosophical Studies*. Please cite final version.

DOI: 10.1007/s11098-025-02356-2

Kareem Khalifa (UCLA)

Sanford Goldberg (Northwestern)

Abstract: Scientific understanding typically involves multiple specialists performing interdependent tasks. According to several social-epistemological accounts, this suggests that scientific communities are collective epistemic subjects. We argue instead that the data does not warrant the postulation of a collective subject. Our position, rather, is fictionalist: we argue that the use of sentences attributing understanding to scientific communities amounts to loose talk which is best construed as indicating how social environments associated with a scientific community promote individual scientists' understanding.

1. Introduction

It's commonplace to read about how a given scientific community understands some phenomenon. Consider the following remark on COVID-19 during the first year of the pandemic:

> While the medical community understands the mode of viral transmission, less is known about how long viral shedding occurs once viral symptoms have resolved (Hartman, Hess, and Connor 2020, 2189).

Typically, several interdependent individuals operate in coordinated ways to produce scientific understanding such as this. For many, this suggests *collectivism*, the thesis that scientific communities are collective epistemic subjects in their own right and that it is these collective subjects who understand phenomena.[1] We believe that the case for collectivism is underwhelming. In particular, we will argue that *fictionalism* about collective epistemic subjects provides a highly plausible social epistemology of scientific understanding. On such a view, ascribing understanding to scientific communities is best construed as loose talk devoid of any commitment to collective epistemic subjects. Rather, such sentences point to the complicated ways in which the division of intellectual labor in science enables *individual* scientists to acquire scientific understanding. From this perspective, postulating collective subjects is unnecessary and incurs additional burdens of proof.

Section 2 presents, in broad outlines, the central epistemological ideas informing our fictionalism. Section 3 then presents our fictionalism's main ideas. Section 4 presents what we regard as a central challenge confronting our position, according to which we have merely succeeded in defending a non-standard version of collectivism rather than avoiding it altogether. Sections 5 through 8 then answer this challenge by showing how our fictionalism captures central social dimensions of

[1] Most of the work done in collective epistemology has focused on knowledge and justified belief (Bird 2010, 2022; Gilbert 2004; Hakli 2007, 2011; Lackey 2021; Mathiesen 2006; Schmitt 1994; Tollefsen 2002, 2004; Tuomela 2004). Still, some work has already been done on communal understanding (Boyd 2021; Delarivière 2020; Kuorikoski 2023a, 2023b; Malfatti 2022; Rice 2023). Owing to limited space, we postpone comparisons with these works, and only briefly touch upon the vexed issue of acquiring understanding from testimony in Sections 5 and 6.

scientific understanding without collapsing into collectivism. As such, fictionalism is distinct from its central competitor.

Before proceeding, we offer three words of caution. First, we focus only on whether *scientific communities* must be treated as collective epistemic subjects. We take these to be the kinds of scientific groups associated with whole disciplines and fields, such as the medical community or the neuroscientific community. As such, we are silent as to whether fictionalism or collectivism is apt for either non-scientific groups or smaller scientific groups, such as co-authors and laboratory groups. Second, we are only concerned with collectivism regarding *understanding*. As such, we will discuss collectivism about other epistemic statuses, such as knowledge or justified belief, only insofar as they bear on understanding. Third, we only aim to show that fictionalism does at least as well as collectivism in accounting for the nature of scientific understanding. Consequently, it suffices for our purposes if we have shown that fictionalism deserves further consideration. To vindicate the claim that fictionalism *outperforms* collectivism, we would need detailed comparisons with the most developed collectivist positions. Space prohibits us from doing that here, so we postpone those arguments for future work. These caveats notwithstanding, the arguments offered here hold the potential to extrapolate to other kinds of groups and other kinds of epistemic statuses, and suggest a general template for raising collectivists' burden of proof.

2. Epistemological Preliminaries

Traditional epistemology can be seen as subscribing to two distinct individualistic theses:

- *Environmental Individualism*: insofar as they are relevant to epistemic assessment, social factors are no different in principle than any other environmental condition (in that their social nature is irrelevant to the epistemic role they play).
- *Subject Individualism*: The only subjects who can possess epistemic statuses (e.g., knowledge, justified belief, understanding) are individuals.

Our position is guided by two ideas: accounts of scientific understanding should reject Environmental Individualism, and doing so obviates a rejection of Subject Individualism.

According to Environmental Individualism, social factors are no different, epistemically speaking, than any other environmental factor. This claim can be understood in terms of the four roles traditional epistemological theory has ascribed to environmental factors; as: (1) evidence, (2) background determinants of (the conditions in which we compute) the reliability of a subject's cognitive processes, (3) potential (anti-)Gettier conditions, and (4) determinants of the truth-value of the subject's belief. Accordingly, Environmental Individualism is the view that insofar as social factors are relevant to epistemic assessment, their relevance can be captured in one of these four ways—rendering their distinctly social nature epistemically irrelevant. Contrast this with *environmentally anti-individualistic*

theories, on which the epistemic assessment of an individual subject *S*'s belief is determined, in part, by factors involved in prevailing social practices or norms, or by epistemic features of a subject other than *S* herself.[2]

Recent developments in the epistemology of testimony have called Environmental Individualism into question. Some authors (e.g., Burge 1993; Faulkner 2000; Welbourne 1981) have targeted Environmental Individualism regarding testimonial *knowledge*, arguing that a belief 's qualifying as testimonial knowledge depends on distinctly social factors—for example, on whether the testifier had the knowledge to pass on to her. Others (e.g., Goldberg 2010; Hardwig 1991; Schmitt 2006; Lackey 2006, 2008) have gone further, questioning Environmental Individualism regarding the *justification* of testimonial belief. They have argued that whether a testimonial belief is justified depends on distinctly social factors—in particular, on whether the testimony itself (or the testimonial chain) was suitably reliable.

While the testimony literature has largely left Subject Individualism intact,[3] those working in the epistemology of groups have challenged this doctrine.[4] A common (but controversial) view is that some groups or collectives are epistemic subjects—bearers of epistemic properties. Views of this sort, which deny Subject Individualism, are natural in connection with scientific understanding. Call this *collectivism about scientific understanding* or 'collectivism' for short:

[2] See Goldberg (2010: Chapters 1 and 2) for discussion.
[3] Welbourne (1981) is a rare exception.
[4] See note 1 for key contributors.

Some scientific communities are collective subjects who sometimes possess scientific understanding of phenomena.

As stated, collectivism is neutral on the following proposals:

- *Summativism*: The scientific community *C* understands phenomenon *P* if and only if some significant portion of *C*'s members understand *P*.[5]
- *Non-Summativism*: At least one of the following is possible:
    - *C* understands *P* but no significant portion of *C*'s members understand *P*, or
    - *C* does not understand *P* but some significant portion of *C*'s members understand *P*.[6]

Despite their obvious differences, these two collectivist positions share two important commonalities. First, since both are formulated independently of Environmental Individualism, neither is committed to any particular view regarding how social factors bear on *C's* understanding of *P*. Second, both are collectivist precisely because of their commitment to the scientific community *as a subject who understands P*.

Collectivism (so understood) will be our main foil throughout this paper. We will show that once one rejects Environmental Individualism, one has all the

[5] Summativist views come in many flavors, but their basic commitments are that: (1) the truth of claims of the form 'Community *C* bears epistemic property *E*' is a function of the truth of claims regarding *C*'s individual members (and their instantiation of *E*); and (2) some claims of this form are true. Our formulation is meant to be neutral on the different functions that have been proposed by summativists in (1), and our fictionalism avoids commitment to (2).

[6] Non-summativist positions are typically not formulated in this way. However, the formulation above ensures a logical partition.

resources one needs to account for scientific understanding. Positing collective subjects is unnecessary.

3. Fictionalism about Collective Scientific Understanding

Our claim is metaphysically deflationary: we hold that the nature of scientific understanding does not require postulating collective subjects.[7] We defend this claim on linguistic grounds. We claim that the use of sentences ascribing understanding to scientific collectives—"target sentences" hereafter—is best construed as a kind of "loose talk" which enables speakers to highlight how *individual* scientists' understanding arises in and contributes to social environments.

Specifically, we defend *revolutionary fictionalism* about the class of target sentences. Our view is *fictionalist* in that it proposes that target sentences can be apt even if what they say, interpreted as positing the existence of collective scientific subjects, is false. And it is *revolutionary* in that it aims to capture how we think these sentences *should* be used, rather than how they are actually used (Stanley 2001).[8] Roughly put, we claim that target sentences should be used as convenient but imprecise descriptions of situations in which at least one scientist understands a phenomenon partly as a result of (and as a contribution to) the scientific community of which she is a member. The scientific community, in turn, is

[7] We do not make the stronger claim that collective subjects do not exist; only that there is no need to posit their existence in our practices of attributing understanding to scientific communities.
[8] One might think of this as a species of conceptual engineering.

a collection of individuals operating in an environment involving certain social practices and norms.[9] More precisely, our revolutionary fictionalism states:

(RF) Any sentence that attributes some degree of understanding of a phenomenon *P* to a community *C* is loose talk for scenarios in which there is at least one individual member *M* of *C* such that*:*

(a) *M* understands *P* partly because of social factors associated with *C*, and

(b) this understanding is communicated in accordance with *C's* norms.

For our purposes, loose talk occurs when a speaker provides information that only approximates how things are in the actual world.[10] Thus, a target sentence such as:

(1) The neuroscientific community understands hunger's effects on aggression,

is merely an imprecise (but sometimes effective) way of communicating that:

(2) One or more neuroscientists understand hunger's effects on aggression partly because of social factors associated with the neuroscientific community, and this understanding has been communicated in accordance with the neuroscientific community's norms.

The fact that (2) involves no explicit commitment to scientific communities as epistemic subjects suggests that fictionalism departs from collectivism in both its

[9] This way of putting things might be taken to suggest that our position is a version of summativism. We address this worry, as well as non-summativist analogues to it, in Sections 5 through 8.
[10] For more detailed accounts of loose talk, see Armstrong (2024); Carter (2021); Lasersohn (1999) and Wilson and Sperber (2002). For a useful discussion tying together (individualistic) epistemology, loose talk, and fictionalism, see Chung (2022).

summativist and its non-summativist incarnations. Collectivists might argue that appearances are misleading here—that (2) in particular, and RF more generally, can be seen as a version of summativism or non-summativism in disguise. Sections 4 through 8 argue that this is mistaken. (Although we take RF to be a thesis about all kinds of target sentences, including many that attribute lesser degrees of understanding than what is attributed by an outright attribution, for simplicity's sake we will treat '*C* understands *P*' as our exemplar throughout.)

Before making the case for our revolutionary fictionalism, several features of the view are worth highlighting at the outset. These can be brought out by considering the difference between a target sentence such as our exemplar—a sentence of the form '*C* understands *P*', where '*C*' designates a community—and the corresponding sentence-type ascribing the same understanding to an individual—say, '*M* understands *P*,' where '*M*' designates an individual member of *C*.

First, we are not fictionalist regarding the latter. On the contrary, it is the (literal) truth of some sentence(s) ascribing understanding to an individual that is conveyed when we use a target sentence like '*C* understands *P*'. It's in this sense that target sentences are 'loose talk' about members of *C* who understand *P*.

Second, such loose talk serves several useful linguistic functions that are less easily achieved using sentences of the form '*M* understands *P*'. Perhaps one *does not know* which individual(s) have the relevant understanding, though one knows that some member(s) does/do so. Perhaps one wants to underscore the *socially distributed nature of the achievement* that is involved in the attained

understanding. Perhaps one wants to highlight the *availability* of the understanding to any of the members of the community: they are now each in a position to attain this understanding through reception of the sort of communication described in (b). Perhaps one wants to highlight the *social status* of the claim that such understanding has been attained, as when we are interested in taking an inventory of all of the things in a given domain that have been understood (and we are less interested in knowing by whom).

At the same time, for familiar Gricean reasons, the choice to use a sentence ascribing understanding to a community rather than a specific individual carries with it an important implicature.[11] Consider that the speaker's choice of '*C*' rather than some expression designating an individual will raise the question of motive: why did the speaker choose to attribute the understanding to *C*? We submit that in *any* context, the speaker's choice to do so will implicate something about the community—typically, one or more of the claims we presented above, in connection with the possible motives for using '*C*' rather than '*M*'. Furthermore, in a good many of these contexts, one candidate *implicatum* stands out: the understanding itself is available to members of the relevant community. We believe that this *implicatum* has a salience that makes it the most likely candidate.

[11] The sort of implicature we have in mind is what Grice called a 'generalized' implicature, the type that is carried by relatively context-invariant features of what is said. Grice thought that these implicatures were special in that they arise in a way that is independent of the speaker's communicative intentions. The examples he gave were 'I broke a finger,' which (unless the implicature is cancelled) implicates that the finger was one's own, and 'I walked into a house,' which (unless the implicature is cancelled) implicates that the house was not one's own. In our case, the generalized nature of the implicature has its source in the use of a term designating a community, rather than some specific individual(s), as the grammatical subject.

This generalized implicature highlights a virtue of our view: it enables us to explain the pressure that many theorists feel to embrace collectivism either in its summativist form or its non-summativist form. We can explain this pressure without committing ourselves to collectivism in either form.

Consider the pressure that encourages us towards endorsing a *summativist* collectivism about group understanding. Our view is that this pressure is generated, not by the semantic content of '*C* understands *P*,' but rather by the generalized implicature that is generated when sentences like this are used. To see this, suppose we are correct in our allegation that uses of '*C* understands *P*' do in fact carry a generalized implicature, as per our analysis. Then as theorists we can grant that the use of a target sentence communicates that the relevant understanding is available to members of a community, without assuming that some significant portion of *C*'s members understand *P*—and so without embracing a summativist reading of '*C* understands *P*.'[12]

Of course, a view on which the use of '*C* understands *P*' carries a generalized implicature would predict that there are possible cases in which the implicature can be *cancelled*, without affecting the felicity of that use of the target sentence. We believe that there are such cases.

Consider the following example. Copernicus published his heliocentric theory in 1543. Many of his contemporaries accepted geocentric theory, and this continued for

[12] Note that one member of *C* understanding *P* is logically independent of the relevant understanding being *available* to members of *C*. We return to this distinction briefly in Section 7.

some time (for some context: the trial of Galileo was in 1616). Despite this, target sentences such as:

(3) Copernicus's heliocentric theory advanced the astronomy community's understanding of planetary orbits in 1543.

and

(4) Heliocentric theory was part of the astronomy community's understanding of planetary orbits in 1543.

appear felicitous.

So far, so good for our revolutionary fictionalism, as such sentences are grist for RF—they're loose talk for describing how Copernicus understood planetary orbits partly because of social factors associated with the astronomy community, and this understanding has been communicated in accordance with the astronomy community's norms. However, trouble appears to loom when we consider a sentence such as:

(5) The astronomy community understood planetary orbits in 1543.

While RF predicts that (5) is felicitous,[13] it might seem that (5) should be rejected as false (or infelicitous), since the vast majority of Copernicus's colleagues in 1543 rejected his account of planetary orbits.[14]

We submit that this reaction is mistaken for two reasons. First, we submit that granting the felicity of sentences such as (3) and (4) while denying the felicitousness

[13] (RF)(a) is satisfied, owing to the fact that Copernicus's 1543 understanding of planetary orbits built on the work of a good deal or previous astronomy; and (RF)(b) is satisfied owing to Copernicus's 1543 publication.

[14] We thank an anonymous referee for pressing this objection.

of (5) appears somewhat arbitrary and requires some explanation. For example, if asked, "What did Copernicus advance in (3)?," a competent speaker would likely answer, "The understanding of the astronomy community in 1543," but this stands in tension with a rejection of (5).[15] Second, we claim that granting the felicitousness of (5) explains an even wider swath of linguistic data. This can be seen by noting the felicitousness of continuations of (5), such as:

(5*) The astronomy community understood planetary orbits in 1543, though few of the members of that community were in a position to appreciate this at the time.

or

(5**) The astronomy community understood planetary orbits in 1543, though this was not widely recognized at the time.

We submit that these sentences are not only intelligible but felicitous. One who produces them might be aiming to highlight the fact that the relevant understanding *did* exist "in the community" (so to speak), even as most members were not in a position to appreciate this in 1543. In effect, the use of (5*) or (5**) amounts to a cancellation of the relevant generalized implicature.

This example highlights the way in which RF enables us to diagnose the pressure to endorse a *non*-summativist view of group understanding. Consider: the felicitousness of (5*) and (5**) might incline one to non-summativism, since making

[15] We suspect that another reason that (5) seems infelicitous is because the degree of understanding is not specified. For example, "The astronomy community understood planetary orbits in 1543 *to some extent*" appears felicitous.

sense of these sentences appears to require us to postulate a group, over and above the collection of its members, as the subject of the understanding being ascribed. Our analysis also belies these appearances: on our view, the felicitousness of (5*) and (5**) only requires the relevant target sentence, (5), to serve as loose talk which, when employed, carries a generalized implicature; this implicature is precisely what the latter half of (5*) and (5**) effectively cancel.

In this way, RF enables us to capture the motivations for collectivism about group understanding in both its summativist and non-summativist forms, without having to commit ourselves to either. Importantly, the plausibility of a fictionalist view like ours rests on rejecting Environmental Individualism. Specifically, some of the understanding-promoting factors in RF are better characterized by reference to their social properties than as "mere" environmental factors.[16] Sections 5 through 8 discuss different social factors that play this role. Once these social factors' roles are appreciated, postulating collective epistemic subjects—whether these are construed summatively or non-summatively—becomes unnecessary.

3.1. Initial Attractions

In addition to the capturing the motivations behind summativism and non-summativism, fictionalism enjoys two further attractions. We do not take these attractions to be conclusive reasons in favor of fictionalism; rather, they are reasons to develop a fictionalist framework. Only after this framework has been developed

[16] See Section 2.

can more decisive reasons—say, in the form of careful comparisons with different collectivist proposals—be sought.

Fictionalism's first initial attraction is its explanation of target sentences' ubiquity. Recall that a common motivation for collectivism is that myriad target sentences are used in everyday discourse, e.g.,

(1) The neuroscientific community understands hunger's effects on aggression.

On our fictionalist account, the use of phrases that appear to denote collectives ("the neuroscientific community") is part of a practice of loose talk; it would simply be tedious (and pedantic) to insist on the more cumbersome but accurate claim about individuals from that community. In the case of (1), the claim is that individual scientists' understanding of hunger's effects on aggression partly result from and contribute to the social environment associated with the neuroscientific community. This suffices to explain how sentences such as (1) can be apt in the absence of collective subjects.

Moreover, it would seem that all parties agree that at least *one* function of target sentences is to point to the way in which multiple scientists and their social environments conspire to understand. The disagreement concerns how these scientists and environments must be structured (summatively, non-summatively, etc.) to effect that epistemic status. We now see that those differences don't matter for the purposes of explaining target sentences' felicitousness; their aptness as approximate descriptions of how individual scientists understand by way of their

social environments suffices. Hence, any abductive argument from the acceptability of these target sentences to collectivism will not be justified, since fictionalism can explain the same linguistic evidence without positing an idle social-ontological wheel.

A second motivation for fictionalism is metaphysical: fictionalism dispenses with collective epistemic subjects. Since metaphysical parsimony is a general virtue, and since collective epistemic subjects face special metaphysical liabilities of their own, this is a clear virtue of going fictionalist.

3.2. Individual Understanding

Before proceeding, we unpack RF's concept of individual understanding. Here, we use a liberalized[17] version of Khalifa's (2017, 2023) account of understanding.[18] Even for readers less sympathetic to Khalifa's account of understanding, many of our points about how understanding can be socialized should be exportable to other accounts. We adopt (and slightly revise) two of Khalifa's principles of understanding:

[17] The account is liberalized in the sense that Khalifa's chief *explicandum* is understanding *how* or *why* something is the case, whereas our account is of understanding *phenomena*. For reasons Khalifa (2017, Ch. 4) discusses, these two different ways of talking about understanding are easily translatable.

[18] Among accounts of explanatory understanding in science, Khalifa's (2022) account is among the most developed, and has the benefit of having synthesized his earlier work (Khalifa 2017) with another prominent account of scientific understanding, namely de Regt's (2017). Elsewhere, Khalifa (2019) argues that his view also replicates central ideas in several other prominent theories of understanding.

> ***The Nexus Principle:*** An individual's understanding of a phenomenon *P* improves in proportion to the amount of correct explanatory information about *P* that she possesses.
>
> ***Scientific Knowledge Principle*:** An individual's understanding of a phenomenon *P* improves as her possession of explanatory information about *P* bears greater resemblance to scientific knowledge of explanations of *P*.

As a toy illustration of the Nexus Principle, consider a person who already has identified one cause of a house fire, and then goes on to discover a second cause. *Ceteris paribus*, her understanding of the fire has improved. While there is certainly a good deal more to be said about what makes information explanatory and correct, our arguments below seem consonant with a wide variety of plausible interpretations of these terms, so we remain neutral on these issues. Importantly, explanatory information includes information about different *aspects* of a phenomenon, and different bits of explanatory information play different explanatory roles (explanandum, explanans, explanatory presupposition, explanatory consequence, etc.).[19]

Crucially, the Nexus Principle only requires individuals to *possess* explanatory information. For Khalifa (2023, 34), "explanatory possession is any representation of an explanation with a mind-to-world direction of fit," e.g., accepting or believing an explanation. However, we also expect understanders—and scientists in particular—to wield this information with cognitive ability and skill.

[19] See Khalifa (2017, 87-92) for further discussion.

This leads us to the Scientific Knowledge Principle, which holds that understanding improves as this "explanatory possession" bears greater resemblance to scientific knowledge of explanations. Khalifa analyzes this kind of knowledge as follows:

> *S* has scientific knowledge that *q explains why p* if and only if the safety of *S*'s belief that *q explains why p* is because of her scientific explanatory evaluation.

Here, a belief is safe if it could not easily have been false given the way in which it was formed (Pritchard 2009). Scientific explanatory evaluation (SEEing) then specifies a family of belief-forming processes that scientists typically use to arrive at explanatory commitments. SEEing consists of three stages. First, scientists *consider* plausible potential explanations that, if true, would explain the phenomenon of interest. Second, scientists use the best available methods and evidence to *compare* the plausible potential explanations that they have considered in the first stage. Finally, scientists undertake *commitments* to different explanatory hypotheses on the basis of the comparisons performed in the second stage. While each of these stages can assume many forms, in the simplest cases, scientists believe the "winners" of explanatory comparison and disbelieve the "losers". Clearly, in SEEing their way to a correct explanation, scientists must deploy a number of cognitive abilities/skills. We discuss several examples in Sections 5 through 8.

Importantly, both the Nexus and Scientific Knowledge Principles state how understanding *improves*. Frequently, however, we want attributions of *outright* understanding, e.g., "Julieta understands hunger's effects on aggression"

(Baumberger 2019; Kelp 2015; Khalifa 2017; Ross 2020). The preceding suggests that one must possess *enough* explanatory information and bear *adequate* resemblance to scientific knowledge of explanations to be attributed outright understanding. Here, "enough" and "adequate" are determined by context. We return to this in Section 8.3.

4. Collectivism in Disguise?

A key challenge for our fictionalism is explaining why our position is not "collectivism in disguise," i.e., why embedding individual scientists in the understanding-friendly social environments of science does not commit us to the existence of collective epistemic subjects. To sharpen this challenge, we will assume that a commitment to the existence of collective epistemic subjects is a commitment to the truth of one or more target sentences (for example, '*C* understands *P*'). We make this assumption for three reasons.

First, doing so highlights a core fictionalist claim: that *the felicitous use of target sentences does not require their truth*. This linguistic claim captures the central question on which fictionalists and collectivists differ: whether the use of target sentences is best represented as purporting to make assertions that are true on their literal interpretation. Collectivists—whether summativists or non-summativists—answer this question affirmatively, and then disagree about target sentences' truth conditions. Fictionalists, by contrast, answer this negatively: the use of these sentences is best construed as expressing a *useful fiction*, one which points to the role that social factors play in enabling *individuals* to acquire (and

contribute to) scientific understanding.[20] We speak of the use of a target sentence as *felicitous* iff social factors do in fact play this role.

Second, this assumption enables us to frame the challenge fictionalism faces in a perspicuous way. On this framing, the allegation that fictionalism is a version of collectivism in disguise can be understood as follows: whenever the conditions that, according to our revolutionary fictionalism (RF), capture the 'loose talk' of target sentences are satisfied, the truth conditions of the corresponding target sentence will be satisfied. Accordingly, those who allege that fictionalism is a version of collectivism in disguise are committed to the following:

(CID) If one or more individual members *M* of *C* understand *P* partly because of social factors associated with *C* and this understanding is communicated in accordance with *C's* norms, then *C* understands *P*.

For our part, if we can show that CID is false, then we will have shown that fictionalism is *not* a version of collectivism in disguise.

This brings us to our third and final reason for assuming that a commitment to collective epistemic subjects' existence entails a commitment to target sentences' truth. This assumption highlights how the 'collectivism-in-disguise challenge' can be given either a summativist or a non-summativist gloss, depending on how we interpret target sentences. Thus one might allege that CID is true on *a summativist* representation of '*C* understands *P*'; or alternatively one might allege that CID is true on a *non-summativist* representation of '*C* understands *P*'. An adequate

[20] In keeping with the *revolutionary* nature of our fictionalism, we might say that this is the most charitable construal, as this is how speakers ought to be using target sentences.

defense of fictionalism against CID, then, must show that CID is false on *both* of these glosses. It is to this task that we now turn.

4.1. Summativism in Disguise?

To begin our defense against CID, we consider a summativist interpretation of '*C* understands *P*'. We provide two rebuttals against the charge that fictionalism is summativism in disguise: first, CID is false when read summatively, and second, there are grounds to deny that fictionalism is a version of summativism *independent of* CID's truth.

First, we submit that scenarios are possible wherein CID's antecedent is true (so fictionalists will regard '*C* understands *P*' as felicitous), even though summativists will regard '*C* understands *P*' as false—thereby falsifying CID on a summativist construal. In these scenarios, *exactly one* member of *C* understands *P* (so summativism's requirement that some *significant portion* of *C*'s members understand *P* is not met), yet this understanding is communicated in accord with *C*'s norms.

These are also scenarios in which fictionalists and summativists will disagree about the target sentence's aptness. In these scenarios, fictionalists will regard the target sentences as felicitous whereas summativists will regard them as false. This is the first of two dissociations between fictionalist and summativist interpretations of target sentences. The second dissociation arises when fictionalists regard a target sentence as infelicitous but summativists regard it as true. While summativism's

truth conditions for target sentences turn on nothing beyond what some community member(s) understand, fictionalism requires the relevant understanding to be communicated in accordance with the relevant community's norms. So the relevant scenarios are ones in which a significant portion of the members of a community understand some phenomenon, but this understanding has not been communicated according to the community's norms.

To be sure, in such scenarios, CID's antecedent is not true, so they do not falsify CID. Nevertheless, these scenarios undercut attempts to recast our fictionalism as an *austere* form of summativism in which only *one* of *C*'s members needs to understand *P* for *C* to understand *P*. Since such an austere position does not require individual members' understanding to be communicated in accordance with community norms, this position is not equivalent to our fictionalism.

This suggests that those hoping to make the case for collectivism in disguise ought to construe CID's consequent ('*C* understands *P*') in *non*-summativist terms. However, the non-summativist construal of CID is also implausible. In what follows, our argument for this will be indirect. We will show that, having denied Environmental Individualism, we are in a position to account for the cases in which the use of '*C* understands *P*' is felicitous, without having to postulate collective subjects. Moreover, we will argue that such a postulation can be seen to be independently implausible. In particular, the sorts of social factors to which our fictionalism appeals—shared information, instrumentation, and norms (including norms of communication)—do not elicit any intuitions about collective subjects in

other domains in which their presence is paradigmatic. This places the burden of proof squarely on collectivists' shoulders: given that we can account for all of the relevant data without appeal to any collective subject, and that the social factors that enable us to do so do not elicit relevant collectivist intuitions in other paradigmatic cases, we are owed an argument for why we these factors require commitment to a collective subject who possesses scientific understanding. Absent some further argument that these social factors operate in some atypical way in the context of scientific understanding, our position is not collectivism in disguise.

With this in mind, Sections 5 through 8 provide some of the most detailed descriptions of how social factors contribute to scientific understanding. These descriptions do not invoke collectivist commitments. Hence, it behooves collectivists to show that something is missing from these descriptions which is both (a) necessary for groups to understand and (b) present in examples in which it is felicitious to speak of a scientific community's understanding. In this way, we raise collectivists' burden of proof.

5. Norms of Communication[21]

RF holds that target sentences' felicitousness hinges not only on social factors associated with their communities contributing to individual scientists' understanding, but also on the communication of that understanding in accordance

[21] We thank Alexander Bird for pressing us on the issues in this section.

with community norms. In science, the paradigmatic way of doing the latter is by publishing peer-reviewed articles. Since publications appear to be a chief way of individual understanding becoming a resource available to a larger group, it might be thought that this feature of RF supports collectivism in disguise.

However, more general reflections on the norms on scientific testimony and on scientific publications make clear that this thought is misplaced. Consider norms on intrascientific testimony in which one scientist (S_1) testifies to another (S_2) regarding some recent result p from S_1's subdiscipline.[22] Presumably, these norms will specify such things as when a result is adequately supported for the purpose of publication, what alternative hypotheses must be ruled out, what methods and techniques enjoy scientific sanction, and so forth.[23] Here, there should be no temptation to infer, from the fact that S_2 acquired the belief that p through S_1's testimony (published or otherwise), that the two of them (much less other members of their subdisciplines) constitute a collective who believes that p.[24] After all, simply communicating something in accordance with a community's norm (e.g. through publication) does not entail the existence of collective subjects. Rather, publication may be nothing more than an effective means for individual scientists to enrich the social-epistemological environment associated with a scientific community.

In sum, RF's "communication requirement" does not underwrite commitment to a collective epistemic subject, and so does not support CID. So, if CID stands a

[22] For details about norms of intrascientific testimony, see Gerken (2022).
[23] See Section 8, below, for more details.
[24] Recall that the epistemology of testimony has proceeded apace on the assumption of subject individualism.

chance, it must target RF's other condition—namely that individual scientists understand because of social factors associated with their community. The balance of this paper argues that the most significant of these social-environmental factors can be endorsed without any commitment to the truth of target sentences themselves—and so offer no support for CID.

6. Shared Information

We just argued that communicating in accordance with community norms does not support collectivism. We now present analogous arguments showing that *shared information*, one of the most important social-environmental factors that buttress individual understanding, is not a promising avenue for vindicating collectivism in disguise.[25]

6.1. Citation and the Nexus Principle

According to the Nexus Principle, individual understanding improves as one possesses more correct explanatory information. Frequently, shared information in a scientific community—whereby one member of a community acquires the sort of explanatory knowledge that underwrites scientific understanding via her peers' testimony—promotes this principle. This testimony underwrites scientific understanding when it attests to explanatory information acquired via safe SEEing.

[25] See Gerken (2022) for further discussion of information-sharing in science.

In science, such testimony typically comes in the form of peer-reviewed work; its uptake, through reading and citation of that work.[26]

As an illustration, consider a recent review article by Lischinsky and Lin (2020, 1326), who observe that "[t]he past decade has seen significant advances in our *understanding* of the neural mechanisms underlying the generation of aggression" and that "[a]dopting a cross-species comparative approach will be central to *revealing the general principles underlying* the generation of aggression, as well as the neural mechanisms that enable its unprecedented complexity in humans." Lischinsky and Lin's (2020, 1323) discussion of how hunger increases aggression across species provides several examples of this. Strikingly, Lischinsky and Lin's discussion of this phenomenon is only a single paragraph in length, yet it recruits twelve different scientific publications with a total of 67 co-authors (Figure 1).[27]

[26] In scientific communities, someone who possesses explanatory knowledge and who cites the appropriate SEEers is taken to bear sufficient resemblance to scientific knowledge of explanation that they can be attributed scientific understanding. Often, the methods section of an article puts them in a position to meet this threshold. As such, many of the concerns about the difficulties of acquiring understanding through passive testimonial uptake do not arise.

[27] The article cites 150 papers in total. If the co-authoring in these articles is comparable to the twelve in this one paragraph, over 830 authors would be cited in the article.

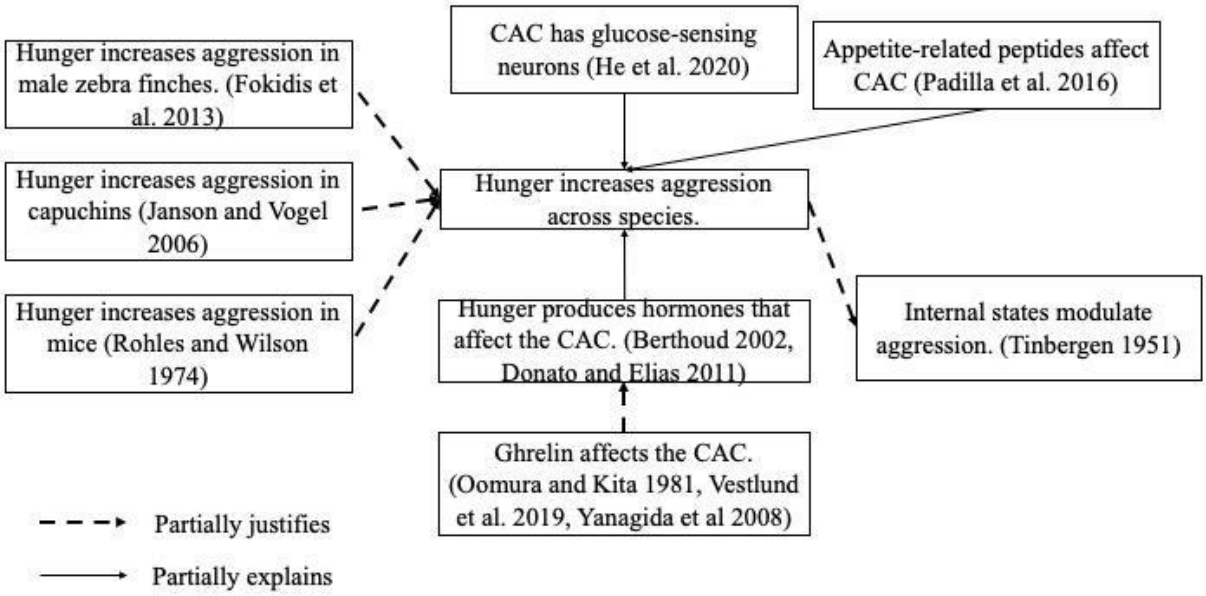

Figure 1. Current Understanding of Hunger's Effects on Aggression. Modeled on Lischinsky and Lin (2020, 1323)

The studies that Lischinsky and Lin cite in their discussion of hunger's effects on aggression serve two main purposes. First, some studies help to *justify* the claim that hunger affects aggression—with special emphasis on the robustness of these effects *across species*. These studies typically involve specific organisms in which this phenomenon has been observed, e.g., zebra finches (Fokidis, Prior, and Soma 2013), which we will focus on below. Second, other studies describe the mechanisms that *explain* this phenomenon, e.g., that the "central aggression circuit" (CAC)[28]

[28] The central aggression circuit consists of (i) the medial amygdla, (ii) the bed nucleus of stria terminalis, (iii) ventrolateral part of the ventromedial hypothalamus and (iv) ventral part of the premammarily nucleus or its homologs in birds.

common to rodents, primates, and birds has glucose-sensing neurons (He et al. 2020).[29]

However, these kinds of citation practices involve nothing more than one scientist coming to believe that *p* by reading another scientist's published result that *p*. As we argued in Section 5, this does not entail that the scientists involved constitute a collective subject who believes that *p*. Thus, scientists' citation practices leave collectivism in disguise unsubstantiated. As we'll now see, this same point applies to two other uses of shared information that improve understanding.

6.2. Motivating Explanations to be Considered

Shared information in the scientific social environment can also bolster understanding via the Scientific Knowledge Principle. At the first stage of SEEing, scientists *consider* plausible potential explanations of a phenomenon. Such explanations require motivations that establish their plausibility, and these motivations typically depend on already-published results. After all, if an explanation has enjoyed some success with an adjacent phenomenon or

[29] In some cases, Lischinsky and Lin's citations commingle these justificatory and explanatory sources. For instance, the last *explanation* mentioned—that hunger produces hormones that affect the CAC—is *justified* by studies showing that hunger produces ghrelin, and ghrelin is a hormone that affects the CAC (e.g., Oomura and Kita 1981). Moreover, the claim that hunger increases aggression across species partially justifies the broader theoretical claim that internal states modulate aggression—a venerable hypothesis first associated with Tinbergen (1951).

experimental setup, then it is worth ascertaining if this success can be extended to the phenomenon of interest.[30]

For example, in their study of male zebra finches, Fokidis, Prior, and Soma (2013) consider three plausible potential explanations of how hunger increases aggression:

- In male zebra finches, fasting increases the hormone dehydroepiandrosterone (DHEA) in the adrenal glands and liver, which in turn increases levels of the sex steroid estradiol (E_2) in three brain regions that regulate the expression of aggression.[31]
- In male zebra finches, fasting increases the sex steroids testosterone (T) and estriadol (E_2) in blood plasma, which in turn promote aggression.
- In male zebra finches, fasting increases corticosterone (CORT) in peripheral tissues in addition to the adrenal glands and liver—including the muscles, pancreas, small intestine, and testes.

Call these the *DHEA, sex steroid, and CORT hypotheses,* respectively. Fokidis *et al.* motivate these explanations using analogies with earlier studies—and very infrequently are these earlier studies of songbirds, much less male zebra finches.[32] The analogies generally highlight different potential endocrinological mechanisms of aggression in zebra finches. Thus, an explanation's motivation frequently recruits

[30] Importantly, the initial publication may entail something stronger, namely that the explanation *is* correct, but a scientist engaged in explanatory consideration only adopts the weaker claim that the explanation *could* be correct (even if it is subsequently shown to be incorrect).
[31] These regions are the periaqueductal gray, ventral tegmental area, and ventromedial nucleus of the hypothalamus.
[32] The analogies they mention are with humans, song sparrows, red squirrels, and mice.

aspects of the social environment in which it is being considered. Importantly, this is done through citation, which we have already seen does not support collectivism in disguise.

6.3. Justifying Methodological Choices in Comparison

Shared information in a social environment can enhance scientific understanding not only at the stage of consideration, but also at the next stage, where the best available evidence and methods are used to *compare* the plausible potential explanations considered at the first stage. At the broadest level, precisely what it means for evidence or methods to be *available* appears to be a social matter, and much of that availability depends on the extent to which evidence and methodologies are shared (Khalifa 2023).

As an illustration, recall that Fokidis *et al.* consider the sex steroid hypothesis. They disconfirm this hypothesis with an experiment in which male zebra finches in the experimental group fasted and those in the control ate regularly. Blood was then drawn from each bird, and steroid levels were measured. There were lower testosterone levels in the experimental group than the control group. The sex steroid hypothesis falsely predicted that fasting finches should be less aggressive.

A correlation was found that was consistent with another explanation they considered—the CORT hypothesis. However, Fokidis *et al.* discount it on the grounds that CORT is chiefly associated with increased locomotor activity (Lynn,

Breuner, and Wingfield 2003), mobilizing energy reserves, and increased food intake, but not with aggression *per se*. Specifically, Fokidis *et al.* (2013, 4336) take the lack of behavioral differences between the experimental and control groups prior to the introduction of food as evidence that "CORT… is unlikely to solely contribute to fasting effects on aggressive interactions."

By contrast, in similar experiments where hormone and steroid levels in various tissues were recorded, they found significant evidence that only the fasting birds had high levels of DHEA and only in the liver and adrenal glands, as well as higher levels of E_2 in the three aforementioned brain regions. Hence, the DHEA hypothesis emerges from Fokidis *et al.'s* comparisons as the best of the three explanations that they consider.

These comparisons are safer partly because of the shared information in the neuroscientific community. For instance, Fokidis *et al.* (2013, 4330) cite other authors to justify certain methodological choices. Consider their use of the Palkovits punch technique to sample brain tissues. This technique was originally developed for rat hypothalamuses (Palkovits 1973), but had already been extended to male zebra finches in several other brain regions (Charlier et al. 2010). Similarly, earlier work had discovered that blood drawn from the brachial vein accurately reflects systemic steroid levels, while blood drawn from the jugular vein accurately reflects the brain steroid levels (Newman, Pradhan, and Soma 2008). Since Fokidis et al. (2013, 4330) were interested in both kinds of steroid levels, they drew blood from both veins. Their justification for these choices is largely based on the earlier work

of their colleagues. As before, the bare fact that one scientist learns from other scientists' published work does not support collectivism in disguise.

7. Instruments

Instruments (and the scientific practices bound up with their use) are another factor in the scientific social environment that can enhance understanding. In this respect it is worth noting that the epistemology of instrument-based beliefs appears to reflect an important social dimension. Since an instrument's designers frequently differ from its users, epistemologists have excellent reason to think that beliefs based on the read-outs of an instrument are themselves epistemically dependent on the social practices involved in the production, dissemination, and certification of such instruments (Goldberg 2020).

Instruments chiefly contribute to understanding at the stage of comparison. Indeed, scientists' reliance on instruments strongly resembles the practices discussed above, for it is standard practice to simply *cite* the manufacturers and catalog number for each instrument; see Table 1 for Fokidis *et al.*'s citations of instrument manufacturers. For example, radioimmunoassays (RIAs) are the chief means of measuring the explanatory variables of the three hypotheses they consider. This is clearly needed if they are to perform the empirical tests characteristic of explanatory comparison.

Instruments should not inspire hope amongst collectivists. For example, just as (6) does not entail (7), (8) entails neither (9) nor (10):

(6) Charles knows that the temperature in his living room is 68 degrees Fahrenheit partly because of the thermometer designed by Tempcorp.

(7) Charles and Tempcorp collectively know that the temperature in Charles's living room is 68 degrees Fahrenheit.

(8) Fokidis, Prior, and Soma's understanding of hunger's effects on aggression in male zebra finches improved partly because of the RIAs designed by MP Biomedicals.

(9) Fokidis, Prior, Soma, and MP Biomedicals' collective understanding of hunger's effects on aggression in male zebra finches improved.

(10) The neuroscientific community's collective understanding of hunger's effects on aggression in male zebra finches improved.

These failures of entailment provide further counterexamples to CID.

Instrument/Technique	**Function**	**Company Information Cited**
Stainless steel cannulae	Brain tissue sampling	Brain Punch Set, catalog no. 57401, Stoelting Co
Double-antibody ^{125}I Radioimmunoassay (RIA)	Measures CORT	MP Biomedicals; catalog no. 07120103
	Measures testosterone	MP Biomedicals; catalog no. 07189102
	Measures DHEA	Beckman-Coulter; Immunotech DSL 8900
	Measures E_2	Beckman-Coulter; Immunotech DSL 4800
C-18 columns	Steroid extraction	Varian, Bond-Elut; catalog no. 12113045
Bead homogenizer	Homogenizes soft tissue samples	Omni Bead Ruptor 24, Omni
Vacuum centrifuge	Dries samples	Thermo Electron SPD111V Speedvac; Thermo Scientific

Table 1. Instruments used by Fokidis, Prior, and Soma (2013, 4330-4331)

Indeed, our discussion of instruments helps to shed light on an interesting collectivist argument raised by Bird (2022, 93):

> The collection and statistical analysis of scientific data is frequently automated. And when the resulting observations are also published automatically, on a reliable website for example, these can be a contribution to scientific knowledge in which no human had any part.

While Bird speaks of scientific *knowledge*, it is not hard to imagine how this might be recast so that the automation is a contribution to scientific *understanding* in which no human had any part. Consider the burgeoning machine learning algorithms that perform automated causal discovery and causal inference (Nogueira et al. 2022). These algorithms perform functions akin to those found in SEEing. If we imagine these automated systems publishing their results in the manner that Bird describes above, one might be tempted to infer collectivism about scientific understanding.

However, our fictionalism has resources for resisting this conclusion. We contend that these algorithms and their associated outputs are simply part of the social environment, but we deny that they produce scientific understanding in the absence of any uptake by individual epistemic subjects. Rather, these algorithms simply put these subjects *in a position to understand*. Consider an analogy. Suppose that there is a thermometer in a laboratory that measures a fluid's temperature, and constantly posts temperature readings on a website accessible to all members of the

laboratory team. The laboratory team does not *know* the fluid's temperature if no members ever visit the website or read the thermometer. At best, the thermometer and the website put the team members in a *position* to know the sample's temperature. *Mutatis mutandis*, the causal discovery and causal inference algorithms in our example do the same with respect to understanding.

This analysis can be defended further. Suppose that the machine learning algorithms that perform SEEing-like functions misfire. On Goldberg's (2020) epistemology of instruments, some epistemic subject should be held accountable; precisely who is accountable depends on the nature of the malfunctioning. At least as Bird describes the situation, the automated system lacks this kind of accountability. As such, it is better regarded as an instrument in a social environment than as a component of some collective epistemic subject.

8. Norms

Finally, we discuss three ways in which individual scientists understand phenomena partly because of epistemological norms in a social environment. For each, we show how to answer charges of collectivism in disguise.

In the last decade or so, norms have come to play an increasingly large role in social epistemology.[33] The view we adopt here roughly follows Goldberg (2017, 2018, 2020, 2021). According to this picture, epistemic subjects are answerable to a

[33] See e.g., Bicchieri (2005), Flores and Woodard (2023), Fricker (2017), Gerken (2022), Goldberg (2013, 2017, 2018, 2020, 2021), Graham (2012, 2020), Henderson and Graham (2017a, 2017b, 2019), and Simion (2019a, 2019b, 2021).

variety of normative expectations about their epistemic condition: the knowledge they should have, the information sources they should be consulting, the evidence they should have, and so forth. Some of these expectations reflect one's status as an epistemic subject: when under suitable environmental conditions, any cognitively mature subject is expected to be aware of the ordinary objects to which they perceptually attend. Other expectations reflect the social or institutional roles one plays, or the social practices in which one is a participant: doctors are expected to have certain medical knowledge, and to know which sources to consult for further guidance. A subject who fails to satisfy these expectations[34] is intellectually negligent; and when a subject's negligence explains their failure to have evidence that would have defeated the justification of a belief, this justification is normatively defeated (Goldberg 2017).

Scientific research is associated with norms pertaining to evidence gathering (Flores and Woodard 2023), norms of proper measurement (Mössner and Nordmann 2017), norms regarding proper acceptance of hypotheses (Longino 1990, 2002), and norms governing scientific testimony and its uptake among scientists (Gerken 2022), among others. When scientists fail to satisfy one or more of their normative expectations *qua* scientists, they are scientifically negligent; when their scientific negligence explains their failure to have evidence that would have defeated the justification of their beliefs, this justification suffers from normative defeat. In what follows, we highlight several of these kinds of norms operative within science.

[34] When they are legitimate; see Goldberg (2018).

8.1. Norms of Consideration

In Section 6.2, we looked at how shared information motivates the explanations deserving of consideration in SEEing. In addition to these "primary" explanations, there are a host of other *auxiliary* hypotheses that must be considered in the design of an experiment. For instance, it's well-known that finches will exhibit greater aggression during breeding season, and that the sex steroid hypothesis is a likely explanation of this pattern of behavior. If, however, one seeks to understand how *hunger* affects aggression, then one must design a study where differences in aggression can be attributed only to hunger and not to breeding. Fokidis *et al.* safeguard against this by only having male zebra finches in their study, and isolating them from female zebra finches. This is standard practice to control for breeding-season effects in zebra finches. Hence, the epistemic practices for consideration of auxiliary hypotheses appear to be part of the social environment. Importantly, *failure* to consider established auxiliary hypotheses such as this one will underwrite various forms of professional censure (e.g., criticisms after a presentation or rejection of a manuscript). As such, it is a kind of methodological negligence. When this negligence explains the scientist's failure to have evidence that would have defeated the justification of an hypothesis she has accepted, such justification is defeated (Goldberg 2017; Goldberg and Khalifa 2022).[35]

[35] Whether this is true of the main explanatory hypotheses that are considered is less clear. After all, one can only do so much in a single study, so there is often room to postpone consideration of further explanations to future research.

The relevance of norms of consideration points to the role of social factors in scientific understanding. Scientists operate in environments in which they expect each other to know which hypotheses they need to consider (and rule out) before coming to accept a given claim. Scientists who fail to live up to these expectations are negligent; and when their negligence is discovered by others, they fall short of the scientific community's standard of understanding. In such cases it would be apt for one scientist to say to another, "You don't understand how hunger affects aggression. For all you've shown, the correlations are due to breeding effects, not DHEA." Scientific research is reliable in producing results worthy of acceptance partly because this system of expectations is widely (if implicitly) known. This is a feature of the scientific environment, yet it does not commit us to treating the scientific community as a collective subject who understands. After all, it is individual scientists who are responsible for failures to know what sorts of auxiliary hypotheses need to be countenanced.

8.2. Norms of Commitment

If all has gone well at the end of the process of comparison described in Section 6.3, scientists are in a position to *rank* the plausible potential explanations they have considered, but they may not yet be in a position to *commit* to any of these explanations. But frequently, scientists aim for more than this comparative judgment. They aim for what Khalifa calls *commitment* to an explanation, which is an umbrella term designed to cover belief, and other cognitive or "belief-like"

attitudes, such as acceptance, high credence, and endorsement. (Commitments need not be comparative.)

While the basis of such commitments are the explanatory comparisons at the prior stage of SEEing, there are certain factors that go beyond comparison that can figure in a commitment. An obvious one is when the stage of comparison is too anemic to warrant belief, e.g., when the best-supported hypothesis is merely the best of a bad lot. However, other factors also affect the appropriateness of certain kinds of commitment. For example, some have argued that acceptance is sensitive to pragmatic factors that figure prominently in scientific models (Elgin 2017); others, that endorsement is sensitive to the division of scientific labor (Fleisher 2018). Having said all of this, scientific publication—and scientific practice more generally—does not often provide much insight into *which* species of explanatory commitment scientists undertake. From our perspective, it suffices that the epistemic practices of a scientific community deem at least some of these commitments to bear sufficient resemblance to belief. In this way, when they result from safe SEEing, commitments to an explanatory hypothesis bear sufficient resemblance to scientific knowledge of an explanation.

Many scientific communities have clear epistemic norms for how to transition from comparison to commitment. Perhaps the best-known examples are rules of hypothesis acceptance based on statistical significance, e.g., reject the null when $p \leq 0.05$. Additionally, these norms of commitment often include further methodological constraints. As Fokidis *et al.*'s (2013, 4331-4332) discussion of their statistical

analysis makes clear, the appropriate statistical tests (ANOVA, chi-square, etc.) depend on the distribution of the data, kinds and number of variables, etc. Many of these tests provide evidence that the hypothesis could not easily have been false (Gardiner and Zaharatos 2022; Mayo 1996), as Khalifa's account of understanding requires. Methodological norms can vary significantly even among researchers working in adjacent fields. For instance, although both are studying the effects of hunger on aggression, Fokidis *et al.* conduct a controlled experiment on finches, whereas another study cited by Lin and Lischinsky, by Janson and Vogel (2006), studies capuchins in the wild and must thereby forgo many controls. These methodological considerations can also influence norms of commitment.

Obviously, the fact that there's a norm in the neuroscientific community to reject the null when $p \leq 0.05$ doesn't entail that the neuroscientific community understands anything about hunger's effects on aggression. Hence, norms of commitment do not support collectivism in disguise.

8.3. Standards of Outright Understanding

As noted above, attributions of outright understanding are context-sensitive. Specifically, context determines how much explanatory information one must possess and how much one's possession of explanatory information must resemble scientific knowledge to understand a phenomenon outright. It is also plausible that context determines *which* explanatory information is relevant and *which* aspects of

scientific knowledge must be most closely approximated for these kinds of attributions.

Social environments often provide the contextual parameters that determine when one has done "enough" to be attributed to understanding. For instance, owing to its epistemic practices, one likely needs to possess more explanatory information and exercise more demanding feats of SEEing to possess *scientific* understanding than *lay* understanding of the same phenomenon.[36] Moreover, in different scientific communities, one may have to consider different explanations and use different methods and evidence to compare those explanations in order to be attributed understanding of the same phenomenon. Finally, when dealing with attributions of understanding, a community's epistemic standards may dictate that certain propositions about the phenomenon of interest P must meet certain explanatory and epistemic thresholds.

We conclude this section by emphasizing that our previous points about norms apply here. Even if social norms determine when an individual scientist has enough explanatory information or bears sufficient resemblance to scientific knowledge of an explanation to understand, it is the individual scientist who understands.

9. Conclusion

In this paper, we have presented a fictionalist treatment of sentences that ascribe understanding to scientific communities. At its core, our fictionalism contends that

[36] Compare Gerken (2022) on the different epistemic norms in play in scientific and non-scientific settings.

talk of scientific communities as understanding epistemic subjects is loose talk. Scrutinized more carefully, this talk is merely an imprecise but felicitous way of describing how individual scientists recruit and contribute to their social environments to better understand. Moreover, our neuroscientific example provides highly detailed descriptions of how social factors contribute to scientific understanding, yet our discussion posits no collectivist commitments. Hence, collectivists must show that whatever is missing from our story is necessary for the neuroscientific community to understand how hunger affects aggression. In this way, scientific examples provide a valuable resource for collective epistemologists, and we encourage more case studies in these discussions.

This is the beginning of a further-reaching research program. As noted in the introduction, we have focused on a small subset of interesting topics concerning collective epistemology. First, we have focused only on scientific communities. An interesting question for further research is whether fictionalism can be extended to non-scientific groups and to scientific groups that are smaller than scientific communities, such as co-authors and laboratory groups. Second, we have focused only on understanding, though as noted above, far more ink has been spilled on collectivism about knowledge and justified belief. As before, it would be an interesting question to explore the extent to which our fictionalism can be extended to these other epistemic statuses. Finally, this paper only aimed to show that our fictionalism is plausible, and that it does not entail collectivism. We have not attempted to show that our fictionalism outperforms collectivism. To do so, we

would examine how fictionalism puts pressure on certain premises in the leading arguments for various collectivist positions (including collectivist positions about knowledge and justified belief recast as theses about understanding). In all of these endeavors, we would follow this paper's methodology of treating comportment with scientific practice as an important tribunal of evidence for different social-epistemological proposals wherever applicable. More generally, we hope that those who are sympathetic to Environmental Anti-Individualism but averse to Subject Anti-Individualism find fictionalism to be a promising framework.

Armstrong, Josh. 2024. "Truth and Imprecision." *Analytic Philosophy* 00: 1-17.
Baumberger, Christoph. 2019. "Explicating Objectual Understanding: Taking Degrees Seriously." *Journal for General Philosophy of Science* 50 (5): 367-388.
Bicchieri, Cristina. 2005. *The Grammar of Society: The Nature and Dynamics of Social Norms*. Cambridge: Cambridge University Press.
Bird, Alexander. 2010. "Social Knowing: The Social Sense of 'Scientific Knowledge'." *Philosophical Perspectives* 24: 23-56.
---. 2022. *Knowing Science*. New York: Oxford University Press.
Boyd, Kenneth. 2021. "Group Understanding." *Synthese* 198 (7): 6837-6858.
Burge, Tyler. 1993. "Content Preservation." *Philosophical Review* 102 (4): 457-488.
Carter, Sam. 2021. "The Dynamics of Loose Talk." *Noûs* 55 (1): 171-198.
Charlier, Thierry D., Kelvin W. L. Po, Amy E. M. Newman, Amit H. Shah, Colin J. Saldanha, and Kiran K. Soma. 2010. "17ß-Estradiol Levels in Male Zebra Finch Brain: Combining Palkovits Punch and an Ultrasensitive Radioimmunoassay." *General and Comparative Endocrinology* 167 (1): 18-26.
Chung, Julianne. 2022. "Three Kinds of fictionalism About Knowledge-Talk." In *Mental fictionalism*, edited by Tamás Demeter, T. Parent and Adam Toon, 253-274. Routledge.
De Regt, Henk W. 2017. *Understanding Scientific Understanding*. New York: Oxford University Press.
Delarivière, Sven. 2020. "Collective Understanding-a Conceptual Defense for When Groups Should Be Regarded as Epistemic Agents with Understanding." *AVANT. Pismo Awangardy Filozoficzno-Naukowej* (2): 1-20.
Elgin, Catherine Z. 2017. *True Enough*. Cambridge, MA: MIT Press.
Faulkner, Paul. 2000. "The Social Character of Testimonial Knowledge." *Journal of Philosophy* 97 (11): 581-601.

Fleisher, Will. 2018. "Rational Endorsement." *Philosophical Studies* 175 (10): 2649-2675.
Flores, Carolina, and Elise Woodard. 2023. "Epistemic Norms on Evidence-Gathering." *Philosophical Studies* 180 (9): 2547-2571.
Fokidis, H. Bobby, Nora H. Prior, and Kiran K. Soma. 2013. "Fasting Increases Aggression and Differentially Modulates Local and Systemic Steroid Levels in Male Zebra Finches." *Endocrinology* 154 (11): 4328-4339.
Fricker, Elizabeth. 2017. "Norms, Constitutive and Social, and Assertion." *American Philosophical Quarterly* 54 (4): 397-418.
Gardiner, Georgi, and Brian Zaharatos. 2022. "The Safe, the Sensitive, and the Severely Tested: A Unified Account." *Synthese* 200 (5): 369.
Gerken, Mikkel. 2022. *Scientific Testimony. Its Roles in Science and Society*. Oxford University Press.
Gilbert, Margaret. 2004. "Collective Epistemology." *Episteme* 1 (2): 95-107.
Goldberg, Sanford C. 2010. *Relying on Others: An Essay in Epistemology*. Oxford University Press.
---. 2013. "Analytic Social Epistemology." *Social Epistemology Review and Reply Collective (SERRC)* 2 (8): 26-48.
---. 2017. "Should Have Known." *Synthese* 194 (8): 2863-2894.
---. 2018. *To the Best of Our Knowledge : Social Expectations and Epistemic Normativity*. Oxford: Oxford University Press.
---. 2020. "Epistemically Engineered Environments." *Synthese* 197 (7): 2783-2802.
---. 2021. "Normative Expectations in Epistemology." *Philosophical Topics* 49 (2): 83-104.
Goldberg, Sanford C., and Kareem Khalifa. 2022. "Coherence in Science: A Social Approach." *Philosophical Studies* 179: 3489-3509.
Graham, Peter J. 2012. "Testimony, Trust, and Social Norms." *Abstracta* (VI): 92 - 116.
---. 2020. "Assertions, Handicaps, and Social Norms." *Episteme* 17 (5): 349-363.
Hakli, Raul. 2007. "On the Possibility of Group Knowledge without Belief." *Social Epistemology* 21 (5): 249-266.
---. 2011. "On Dialectical Justification of Group Beliefs." In *Collective Epistemology*, edited by Hans Bernhard Schmid, Daniel Sirtes and Marcel Weber, 119--153. Frankfurt: Ontos.
Hardwig, John. 1991. "The Role of Trust in Knowledge." *The Journal of Philosophy* 88 (12): 693-708.
Hartman, William R., Aaron S. Hess, and Joseph P. Connor. 2020. "Persistent Viral Rna Shedding after Covid-19 Symptom Resolution in Older Convalescent Plasma Donors." *Transfusion* 60 (10): 2189-2191.
He, Yanlin, Pingwen Xu, Chunmei Wang, Yan Xia, Meng Yu, Yongjie Yang, Kaifan Yu, Xing Cai, Na Qu, Kenji Saito, Julia Wang, Ilirjana Hyseni, Matthew Robertson, Badrajee Piyarathna, Min Gao, Sohaib A. Khan, Feng Liu, Rui Chen, Cristian Coarfa, Zhongming Zhao, Qingchun Tong, Zheng Sun, and Yong Xu. 2020. "Estrogen Receptor-A Expressing Neurons in the

Ventrolateral Vmh Regulate Glucose Balance." *Nature Communications* 11 (1): 2165.
Henderson, David, and Peter Graham. 2017a. "Epistemic Norms and the "Epistemic Game" They Regulate: The Basic Structured Epistemic Costs and Benefits." *American Philosophical Quarterly* 54 (4): 367-382.
---. 2017b. "A Refined Account of the "Epistemic Game": Epistemic Norms, Temptations, and Epistemic Coorperation." *American Philosophical Quarterly* 54 (4): 383-396.
---. 2019. "Epistemic Norms as Social Norms." In *The Routledge Handbook of Social Epistemology*, edited by Miranda Fricker, Peter Graham, David Henderson and Nikolaj Jang Lee Linding Pedersen, 425-436. Routledge.
Janson, Charles, and Erin Vogel. 2006. "Hunger and Aggression in Capuchin Monkeys." In *Feeding Ecology in Apes and Other Primates*, edited by G. Hohmann, M. M. Robbins and C. Boesch, 285-312. Cambridge: Cambridge University Press.
Kelp, Christoph. 2015. "Understanding Phenomena." *Synthese* 192 (12): 3799–3816.
Khalifa, Kareem. 2017. *Understanding, Explanation, and Scientific Knowledge*. Cambridge: Cambridge University Press.
---. 2019. "Is *Verstehen* Scientific Understanding?" *Philosophy of the Social Sciences* 49 (4): 282-306.
---. 2023. "Should Friends and Frenemies of Understanding Be Friends? Discussing De Regt." In *Scientific Understanding and Representation: Modeling in the Physical Sciences*, edited by Insa Lawler, Kareem Khalifa and Elay Shech, 33-50. London: Routledge.
Kuorikoski, Jaakko. 2023a. "Factivity, Pluralism, and the Inferential Account of Scientific Understanding." In *Scientific Understanding and Representation*, edited by Insa Lawler, Kareem Khalifa and Elay Shech, 217-233. London: Routledge.
---. 2023b. "Representation and Understanding Are Constitutively Communal but Not Constitutively Historical: A Reply to Rice." In *Scientific Understanding and Representation*, edited by Insa Lawler, Kareem Khalifa and Elay Shech, 251-255. London: Routledge.
Lackey, Jennifer. 2006. "It Takes Two to Tango: Beyond Reductionism and Non-Reductionism in the Epistemology of Testimony." In *The Epistemology of Testimony*, edited by Jennifer Lackey and Ernest Sosa, 160--89. Oxford University Press.
---. 2008. *Learning from Words: Testimony as a Source of Knowledge*. Vol. 88. Oxford University Press.
---. 2021. *The Epistemology of Groups*. New York: Oxford University Press.
Lasersohn, Peter. 1999. "Pragmatic Halos." *Language* 75 (5): 522-551.
Lischinsky, Julieta E., and Dayu Lin. 2020. "Neural Mechanisms of Aggression across Species." *Nature Neuroscience* 23 (11): 1317-1328.
Longino, Helen E. 1990. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton: Princeton University Press.

---. 2002. *The Fate of Knowledge*. Princeton: Princeton University Press.
Lynn, Sharon E., Creagh W. Breuner, and John C. Wingfield. 2003. "Short-Term Fasting Affects Locomotor Activity, Corticosterone, and Corticosterone Binding Globulin in a Migratory Songbird." *Hormones and Behavior* 43 (1): 150-157.
Malfatti, Federica Isabella. 2022. "Understanding Phenomena: From Social to Collective?" *Philosophical Issues* (1): 253-267.
Mathiesen, Kay. 2006. "The Epistemic Features of Group Belief." *Episteme* 2 (5): 161-175.
Mayo, Deborah G. 1996. *Error and the Growth of Experimental Knowledge*. Chicago: University of Chicago Press.
Mössner, Nicola, and Alfred Nordmann, eds. 2017. *Reasoning in Measurement*: Taylor & Francis.
Nogueira, Ana Rita, Andrea Pugnana, Salvatore Ruggieri, Dino Pedreschi, and João Gama. 2022. "Methods and Tools for Causal Discovery and Causal Inference." *WIREs Data Mining and Knowledge Discovery* 12 (2): e1449.
Oomura, Y., and H. Kita. 1981. "Insulin Acting as a Modulator of Feeding through the Hypothalamus." *Diabetologia* 20 (1): 290-298.
Palkovits, M. 1973. "Isolated Removal of Hypothalamic or Other Brain Nuclei of the Rat." *Brain research* 59: 449-450.
Rice, Collin. 2023. "Scientific Representation and Understanding: A Communal and Dynamical View." In *Scientific Understanding and Representation*, edited by Insa Lawler, Kareem Khalifa and Elay Shech, 234-250. London: Routledge.
Ross, Lewis D. 2020. "Is Understanding Reducible?" *Inquiry* 63 (2): 117-135.
Schmitt, Frederick F. 1994. "The Justification of Group Beliefs." In *Socializing Epistemology: The Social Dimensions of Knowledge*, edited by Frederick F. Schmitt, 257-287. Lanham: Rowman and Littlefield.
---. 2006. "Testimonial Justification and Transindividual Reasons." In *The Epistemology of Testimony*, edited by Jennifer Lackey and Ernest Sosa, 193--224. Oxford University Press.
Simion, Mona. 2019a. "Conceptual Engineering for Epistemic Norms." *Inquiry*: 1-17.
---. 2019b. "Knowledge-First Functionalism." *Philosophical Issues* 29 (1): 254-267.
---. 2021. "Testimonial Contractarianism: A Knowledge-First Social Epistemology." *Noûs* 55 (4): 891-916.
Stanley, Jason. 2001. "Hermeneutic fictionalism." *Midwest Studies in Philosophy* 25 (1): 36–71.
Tinbergen, Nikolaas. 1951. *The Study of Instinct*. Oxford Eng.: Clarendon Press.
Tollefsen, Deborah Perron. 2002. "Challenging Epistemic Individualism." *ProtoSociology* 16: 86-117.
---. 2004. "Collective Epistemic Agency." *Southwest Philosophy Review* 20 (1): 55-66.
Tuomela, Raimo. 2004. "Group Knowledge Analyzed." *Episteme* 1 (2): 109-127.
Welbourne, Michael. 1981. "The Community of Knowledge." *The Philosophical Quarterly (1950-)* 31 (125): 302-314.

Wilson, Deirdre, and Dan Sperber. 2002. "Truthfulness and Relevance." *Mind* 111 (443): 583-632.