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The Public Understanding of What? Laypersons' Epistemic Needs, the Division of Cognitive Labor, and the Demarcation of Science

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Abstract

What must laypersons understand about science to allow them to make sound decisions on science-related issues? Relying on recent developments in social epistemology, this paper argues that scientific education should have the goal not of bringing laypersons' understanding of science closer to that of expert insiders, but rather of cultivating the kind of competence characteristic of "competent outsiders" (Feinstein 2011). Moreover, it argues that philosophers of science have an important role to play in attempts to promote this kind of understanding, but that to successfully fulfill this role, they will have to approach central questions in the field differently.

Keywords: Public Understanding of Science; Division of Cognitive Labor; Epistemic Authority; Trust; Scientific Norms

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1. Introduction

The division of cognitive labor brings about extreme inequalities in scientific knowledge and understanding, raising significant concerns about the public's ability to make sound decisions on science-related issues. Addressing these concerns involves combating public ignorance and misunderstandings about science. But what must the lay public understand about science to allow it to make sound decisions on science-related issues? And what is the role of philosophers of science in organized attempts to advance this understanding?

For brevity, I refer to what the public must know or understand to allow for sound science-related decisions as *the public's epistemic needs*. Note that focusing thus on the public's ability to make sound decisions may lead us to ignore important classes of significant truths. Left out will be all truths of pure epistemic significance (Kitcher 2001), knowledge of which is intrinsically valuable, but which are devoid of any practical significance. Moreover, we shall ignore concerns about public understanding of science other than the ability to make sound decisions, such as concerns about the effect of ignorance on laypersons' ability to make autonomous decisions (Faden and Beauchamp 1986). Nonetheless, this formulation allows us to address the most prominent concern about public ignorance regarding science: that it prevents both individual laypersons and democratic communities from making good decisions on science-related questions (Anderson 2011).

The paper defends two main claims. First, that scientific education should not ultimately aim to bring laypersons' understanding of science closer to that of experts' understanding *of their own field of expertise*. Instead, the goal should be to cultivate "competent outsiders" with respect to science (Feinstein 2011); what a competent outsider needs to understand about science is not a subset of what expert scientists know about their field. And second, that philosophers of science

have an important role in attempts to promote this kind of understanding, but that they have to approach central questions of the field differently to successfully fulfill this role.

In section 2, I distinguish between two approaches to the public's epistemic needs: the dominant Scientific Content (SC) approach and the Scientific Division of Labor (SDoL) approach. Sections 3 and 4 use recent developments in social epistemology to clarify the "competent outsider" notion central to the SDoL approach and to defend its characterization of the public's epistemic needs. Section 5 discusses possible objections to and misinterpretations of the SDoL approach. Section 6 discusses the role of philosophers of science in attempts to promote understanding characteristic of the competent outsider.

2. Approaches to the Public Understanding of Science

Attempts to improve public understanding of science have a long history, as do debates about how to conceptualize the goals of these attempts (Bromme and Goldman 2014). Various approaches have employed different definitions of public understanding or scientific literacy and suggested different answers to questions about measuring and improving public understanding of science. I distinguish here between two broad families of approaches, suggesting different answers to our question about the public's epistemic needs. The *Scientific Content* (SC) approach is the dominant approach to the public understanding of science. It focuses on measuring and improving public understanding of scientific texts and the "content of science"—the kind of things one can read about in typical scientific publications or scientific journalism—aiming to improve the public's understanding of scientific concepts, theories, facts, and methods. What is common to the approaches in this varied group is the idea that what the public needs to understand about science is a subset of what scientific experts understand about their own field

of expertise. This family of approaches includes those that employ the "deficit model," assuming that scientists not only have scientific information needed by laypersons but are also sensitive to the public's epistemic needs; such approaches therefore adopt a "one-way, top-down communication process" whereby scientists "with all the required information—[fill] the knowledge vacuum in the scientifically illiterate general public as they [see] fit" (Miller 2001, 116). SC approaches also include some dominant rivals of the deficit model, in as much as they reject that model's assumptions about the process that determines what scientific contents should be communicated to the public but not the idea that what the public ultimately needs to understand is a subset of what expert scientists should know about their own field (Miller 2001).

Among several alternatives to the SC approach, I focus on one that emphasizes the importance of the division of cognitive labor between expert scientists and laypersons. I call this the *Scientific Division of Labor* (SDoL) approach.[1] Without denying the importance of understanding scientific contents, the SDoL approach maintains that because of the division of cognitive labor, what laypersons must understand about science is not a subset of expert scientists' knowledge about their field of expertise. According to views within the SDoL approach, an important part of what laypersons need to understand about science is the scientific division of cognitive labor. Moreover, such views maintain that because of this division of labor, laypersons need to employ different forms of reasoning from those employed by experts (Bromme, Kienhues, and Porsch 2010).

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[1] Kitcher (1990) originally used the term "the division of cognitive labor" to discuss relations within the scientific community, but the term can also be applied, as here, to relations between laypersons and scientists.

I use recent epistemological accounts of authority-based belief to motivate and clarify the central claim of the SDoL approach: that because of this division of labor, what laypersons must understand departs significantly from what the SC approach suggests. I argue that in considering what scientific claims to believe, laypersons are subject to different cognitive norms than scientific insiders and thus, appropriately use different forms of reasoning and different cognitive resources than do scientific insiders. Therefore, what laypersons need to understand about science is not a subset of what expert scientists know about their field.

3. Competent Outsiders, Expert and Marginal Insiders

Feinstein (2011) nicely expresses the idea that scientific education should be more sensitive to this division of cognitive labor, complaining that scientific education currently produces "marginal insiders." "These are students who have sat through a long parade of concepts and theories. . . . Their understanding of science is fairly primitive. . . . A small number of them will go on to be real scientific insiders, but for most, this glimpse is all they get" (181). [2]

Feinstein suggests that we should rethink the goals of scientific literacy, seeing "science literate people" not as insiders but as "*competent outsiders* with respect to science." These are "people who learned to recognize the moments when science has some bearing on their needs and interests and to interact with sources of scientific expertise in ways that help them achieve their own goals" (2011, 180; original emphasis).

The idea that scientifically-literate people are "competent outsiders" can be variously interpreted, including in ways compatible with the SC approach: thus, what distinguishes

[2] Feinstein does not use the term "division of cognitive labor." However, his discussion of "scientific insiders" and "competent outsiders" implies this division.

competent outsiders from both expert insiders and "marginal insiders" is the kind of scientific facts, theories, concepts, and methodologies that each understands. Here, what competent outsiders understand is a subset of what expert insiders understand, but a different subset from what marginal insiders understand.

An alternative interpretation suggests that the difference between expert insiders and competent outsiders goes further: that outsiders and insiders might need to employ different *forms* of reasoning (Bromme and Goldman 2014) and that better competence as an outsider requires something quite different from becoming more like the expert. Recent developments in social epistemology will help to articulate, clarify, and motivate the claim that we should promote such outsider competence.

Central to the distinction between appropriate forms of reasoning for expert insiders and for lay outsiders is the concept of belief on authority (Keren 2007; Zagzebski 2012).[3] The general idea, developed below, is that while competent outsiders should often form beliefs on the authority of insiders, expert insiders, because they serve as authorities, should not form beliefs this way *on questions within their field of expertise*.[4] Accordingly, different forms of reasoning

[3] It is important to note that this distinction between insiders and outsiders is relative to fields of specialization. Most laypersons are outsiders with respect to all scientific fields, but no scientist is an insider in all fields.

[4] Even though expert insiders should not form beliefs on issues within their narrow field of expertise on the authority of other expert insiders, this does not mean they should not form beliefs this way on matters beyond their fields, on which, as footnote 3 suggests, they are outsiders. Accordingly, the above claim is compatible with Hardwig's (1991) claim that trust and deference to authority are essential to science.

are appropriate for insiders and outsiders. Insiders and outsiders are subject to different norms for reasoning, and appropriately respond to different kinds of reasons for belief. Outsiders appropriately use types of evidence on which it is inappropriate for insiders to rely; outsiders, but not insiders, should also sometimes refrain from basing their beliefs on certain other types of available evidence.

4. Believing on Authority, Following the Consensus

Consider first a form of reliable evidence on which outsiders, but not insiders, may appropriately base belief. In forming beliefs, the best epistemic policy for laypersons often involves asking themselves not directly what proposition to believe but rather whether and whom to trust. This follows from the obvious fact that attempts to further the public's understanding of science, however successful, do not—and are not *intended* to—change the basic fact that cognitive labor is divided in our societies and that scientists and laypersons have different roles within this division. As long as this division persists, experts will often be placed in a superior position for judging matters within their field of expertise, and the best epistemic policy for laypersons will often be to form their beliefs by trusting experts, rather than weighing the evidence themselves (Hardwig 1991; Zagzebski 2012; Keren 2014a).

Some early treatments of epistemic trust assumed that trust is blind, and not evidence-based (Hardwig 1991; Faulkner 2007). However, recent literature in social epistemology shows that such trust need not be blind, both in the sense that laypersons often have available evidence for assessing experts' trustworthiness (Goldman 2001) and in the sense that relying on this evidence is not incompatible with trust (Keren 2014a).

What sources of evidence should laypersons rely upon when considering whether to trust experts? Information about patterns of agreement and disagreement among purported experts and authorities comprises a primary source of reliable evidence for laypersons (Goldman 2001; Miller 2013). Certain patterns of consensus among experts provide strong reasons to trust those experts, while if scholars in a field fail to reach any substantial agreement on almost anything, as some suggest is the case in philosophy (Chalmers 2015), that might be a reason not to trust them on such contested questions.

Agreement and consensus patterns can also provide reliable evidence to expert insiders about matters within their expertise. However, insiders are subject to scientific norms disallowing reliance on such evidence in many contexts. Thus, it would seem strange and inappropriate for an expert scientist to respond to a challenge to her claim on matters within her specialization—at a scientific conference, say, or in referee reports—by saying that it is justified because it is a majority view among experts (while it is appropriate for laypersons to justify their scientific views by appealing to such scientific consensus). In such contexts, and on such matters, expert insiders should not judge a claim based on the consensus within the field, even though consensus among other experts can be a reliable mark of trustworthiness even for an insider (so reliable that, of all evidence available to her, this may be the most reliable indication of truth).

Beyond the seeming inappropriateness of certain appeals to consensus, further indication of the existence and scope of norms disallowing such appeals comes from consideration of the function such norms might play.[5] If collegial consensus within their field may be such a reliable indicator of truth, why should experts not form beliefs on matters within their field based on this

[5] For further discussion, see Keren (2017).

consensus? Scientific norms disallowing this are not general epistemic norms against forming beliefs in unreliable ways: even for experts, this way of forming beliefs is sometimes the most reliable. Rather, such norms serve a different function: their point, I submit, is to allow consensus among experts to be a reliable sign of trustworthiness,[6] which requires that experts themselves not form their beliefs, on questions within their expertise, by following the consensus among their colleagues.

To illustrate this, consider an ideal community of experts trying to determine the truth value of some proposition. Assume (unrealistically) that this community satisfies the conditions of *Condorcet's Jury Theorem* (CJT): if each scientist forms her judgment independently, she has a greater-than-fifty-percent chance of being right; moreover, each scientist's chances of being right are statistically independent of the chances of her colleagues being right. Because this community satisfies the conditions of CJT, the chances of the majority's opinion being right increases rapidly with the size of the community (Cohen 1986). Accordingly, an individual scientist who formed her belief by following the majority would have a higher chance of being right than one who made her judgment independently. However, the reliability of the community's majority view would rapidly decrease the more scientists based their belief on that majority, for then there would be fewer independent expert judgments underpinning the reliability of the majority opinion. Thus, communal norms against member's beliefs, reliably-formed based on the majority view, play an important role in preserving the reliability of that

[6] This claim has some affinity with Zollman (2010). However, while Zollman focuses on the positive communal effects of limiting scientists' access to information, my claim concerns the function of scientific norms disallowing reliance on certain kinds of information even when accessible.

view and allow nonmembers to form reliable beliefs on the basis of the expert community's majority view.

While this example is obviously unrealistic, a well-functioning scientific community need not satisfy the conditions of CJT for scientific norms disallowing deference to the majority view to contribute to the reliability of that view. Well-functioning scientific communities normally share two important characteristics with our idealized community: first, the chance of a typical member of such a community being right on a proposition is normally lower than that of the community-consensus being right; second, by basing their belief on the evidence rather than the consensus among their colleagues, typical members of such communities contribute to the reliability of the majority view.

It might be objected that this only shows that it would be bad if all insiders relied upon the consensus within their field, but not that insiders should not rely upon it. Why should it not be as good, or even better, if some relied on the consensus and some disputed it? Claims that diversity is what matters for increased community reliability, and that several different normative recommendations might achieve epistemically beneficial diversification (Solomon 2006), might seem to support this objection. However, even if Solomon is correct about most norms of diversification, norms against following the consensus have a unique function in promoting reliability. For scientists who simply follow the majority view no longer contribute to its reliability. Consider a community of which half is "independents," forming beliefs on their own weighing of the evidence, and half is equally divided between "followers," following the consensus among the first half, and "dissenters." In such a community, some diversity is preserved by the equal distribution between followers and dissenters; moreover, if the majority view among independents is reliable, then so is the majority view among the community as a

whole. Nonetheless, the second half of the community does not contribute anything to the reliability of the community view; ceteris paribus, it would be better if all were independents.

Thus, scientific norms ruling out reliance by experts on the community consensus allow a community of experts to serve as reliable authorities for others. But while expert insiders should not base their beliefs on such information, it can be most helpful to outsiders in determining whether to trust scientists, and which scientists to trust. That is, such information would be useful to outsiders, if only they understood how to use it: If they understood what type of information about expert consensus is available, how to obtain it, and what its significance might be. Moreover, they would need to understand that they may legitimately rely on such information, even if insiders may not. This understanding is a central component of being a competent outsider with respect to science.

So far I have emphasized evidence that can and should be used by outsiders, but that insiders should not use. Recent discussions of the concept of epistemic authority suggest that the reverse is also true. I will not elaborate on this, as the account of belief on authority has been discussed elsewhere (Raz 1986; Keren 2007, 2014b; Zagzebski 2012) and as the rationale for thinking that this establishes a difference between scientific insiders and lay outsiders is similar to the consensus case explored above. The basic idea is this: when I, a layperson, have reason to believe that an expert is in a better position to judge than I am, and that she appropriately responds to the evidence available to her, I ought to form my belief on her authority. That involves treating her judgment as providing me with a preemptive reason for belief (Zagzebski 2012; Keren 2014a): a reason for believing as she does, which is also a reason for not forming my belief on the basis of my own weighing of certain evidence available to me. Thus, if I have first-order evidence relevant to *p*, I should not form my belief regarding *p* on the basis of this

evidence but rather should simply believe as the expert does. The point is not merely that I might not be able to understand the significance of the evidence. Even if I do, because the expert has more evidence and is a better judge of it, I should believe as she does and allow her judgment to preempt mine. Doing so allows my belief to properly respond to the better evidence possessed by her and to better fulfill the twin epistemic goals of believing truth and avoiding error (Zagzebski 2012).

In contrast, expert insiders are expected not to take others' testimony as preemptive reasons for belief on matters within their expertise. They should not do so even though, within scientific communities, some might enjoy the kind of epistemic superiority over others that would mean that the latter's beliefs would be better-founded if based on the former's authority. As with forming beliefs by following the consensus, scientific norms rule-out such deference to authority not because it cannot be a good way for experts to obtain knowledge but because forming beliefs this way undermines the ability of the scientific community to function as an authority for laypersons. Both preemptively believing on authority and believing on the consensus in the field can be reliable ways of obtaining knowledge; but if experts in a specialty formed their beliefs interdependently in these ways, the diversity and independence on which increased community reliability depends (Cohen 1986; Goldman 2001; Longino 2002; Miller 2013) would be undermined.

Thus, insiders and outsiders should employ different forms of reasoning to obtain knowledge and understanding about scientific matters. An important part of the information that laypersons need to have and understand to make sound decisions on science-related issues—to be able to determine which scientific claims to accept and, primarily, whether and which scientists to trust—is information that scientific experts should not rely on. What the former must

understand is therefore not a subset of the information the latter need to know about their field of expertise.

5. Objections

Before considering a number of objections to the SDoL approach defended here, it is important to clarify what follows from it: while rejecting the SC approach, it does not imply that understanding scientific content is unimportant for promoting outsider competence. Arguably, it is important. But the discussion does suggest that attempts to advance scientific literacy focusing *only* on improving the understanding of scientific contents are unlikely to contribute much to this kind of competence. For outsider competence requires efficient use of different forms of reasoning and cognitive resources than those used by experts.

Moreover, without a proper understanding of the division of cognitive labor, improved understanding of scientific content may sometimes hinder laypersons' ability to make sound decisions on scientific matters. A better understanding of scientific contents will neither turn laypersons into experts nor change the fact that the best way for laypersons to determine which scientific claims to believe is often to rely on the authority of experts. Worse, a better understanding of scientific contents, unaccompanied by a proper understanding of the division of cognitive labor might tempt some laypersons to base beliefs about scientific issues on their own weighing of scientific evidence rather than on the authority of experts. This is reinforced by the norms underlying many educational systems, equating cognitive sophistication with overcoming

the division of cognitive labor and thinking more like the experts (Bromme, Kienhues, and Porsch 2010).[7]

It might be objected that while laypersons may obtain *knowledge* of scientific facts by believing on the authority of scientists, this will not contribute to their *understanding* of science (Jäger 2016). A possible response to this involves questioning the assumption that the epistemic relation that laypersons need to have to scientific contents is one of understanding, rather than of knowledge (Slater, Huxster, and Bresticker 2017). However, effective reliance on science is likely to require both knowledge and understanding. So a more promising response is to note that knowledge obtained by deferring to expert authority does not guarantee, but can and often does contribute to, understanding, even if it involves preemptively believing the expert (Croce, 2017). Indeed, it is difficult to see how to promote lay understanding of science without laypeople believing at least some things on the authority of others.

Finally, it might be objected that laypersons already have sufficient understanding of the scientific division of cognitive labor. Anderson writes: "While citizens have the capacity to reliably judge trustworthiness, many Americans appear ill-disposed to do so" (2011, 145). According to this kind of view, it is motivational factors, rather than lack of understanding, that prevents laypersons from making sound decisions on scientific issues (Kahan et al. 2012).

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[7] This temptation for laypersons to form judgments based on their own weighing of scientific evidence may explain recent findings that increased education sometimes increases the gap between laypersons' opinions and the scientific consensus: it may for instance explain why political polarization on climate change increases with education (Kahan et al. 2012) and why among Republicans, concerns about anthropogenic climate change decrease with education (Hamilton 2011).

However, while I do not deny the importance of motivation, I doubt whether we should be so optimistic about the public's understanding of important aspects of the division of cognitive labor or the extent to which scientific education promotes this understanding. Unfortunately, we do not know enough about this aspect of the public understanding of science; not enough research has been done (Bromme, Kienhues, and Porsch 2010). Studies trying to determine whether lack of understanding of science contributes to lack of concern about anthropogenic climate change typically test the kind of understanding advocated by the SC approach, but not by the SDoL approach (Slater, Huxster, and Bresticker 2017). Much more empirical research is needed to determine the extent of lay understanding of the scientific division of cognitive labor and the extent to which better understanding could contribute to lay decision-making on scientific issues. However, anecdotal evidence and initial empirical studies are suggestive. Consider lay understanding of how information about the extent of consensus within a scientific community can be used to determine whether and whom to trust. What do college students know about the availability of reliable information on consensus patterns within scientific communities? Do they know how to find and use such information when it is available? To what extent does college education promote their ability to use such information? Anecdotal evidence from my classes—where I ask students to determine the extent of consensus among scientists on politically contested scientific questions and to report their findings in class—suggests that students' levels of understanding of these questions is extremely low; it suggests, moreover, that higher education hardly prepares students for this kind of task. An empirical study systematically examining student performance on and reactions to similar tasks seems to confirm my anecdotal evidence, indicating, for instance, that in spite of the usefulness of such information, students

have very little experience trying to determine the extent of consensus among scientists (Keren, Liviatan and Barzilai 2018).

6. Implications for the Philosophy of Science

To conclude, let us consider the role that philosophers of science should play in promoting the kind of understanding of science required for the outsider competence advocated by the SDoL approach. If what has been said so far is correct, philosophers of science should arguably play an important role in such attempts. One of the central tasks of the field is traditionally to explain when, and in virtue of what, scientists and the scientific community have authority on scientific questions. Therefore, insights from the philosophy of science can make an important contribution to the understanding characteristic of competent outsiders. However, for philosophers of science to fulfill this role, how they address some central questions of the discipline must change.

Consider, for instance, the demarcation of science. This question—how to draw the line separating science from pseudoscience—is clearly of great concern to competent outsiders. As Laudan and others have seen, this question interests us primarily because of the authority that scientists enjoy: because, when scientists make scientific claims, "we generally believe *them*" (Laudan 1983, 111; my emphasis). But in asking whether and how science can be demarcated, philosophers of science have often not been sensitive to the concerns and perspective of the outsider nor to how these differ from those of the insider. Take Laudan as an example: In claiming that the very question of how to demarcate science is spurious, the line of demarcation, which Laudan is after, and declares nonexistent, is not the kind that could be helpful to an

outsider trying to determine *whom to believe*. It would be useful only to someone trying to determine directly what claims to believe.

Laudan's discussion does not merely ignore the epistemic needs of the outsider; it is also blind to the existence of epistemically significant questions facing the outsider that are distinct from those facing the insider. While Laudan is after a criterion that would shed light on the credibility of science, his discussion is insensitive to the distinction between credible persons and credible statements. It is this insensitivity that allows him to claim that once we answer epistemic questions such as "when is a claim well confirmed?" the problem of demarcation becomes spurious and there is no further question of epistemic significance to be asked (1983, 124). But if my claims here are correct, this is a very significant mistake. There remains a distinct and highly significant epistemic question about when a person, a scientist, rather than a scientific claim, should be trusted and believed. This is the epistemic question that the competent outsider needs to grapple with. Laudan's discussion, failing to recognize it as a distinct question, therefore ignores it.

If the SDoL approach is correct, then the question of when scientists should be trusted should be of primary concern in attempts to improve public understanding of science. It is also a question on which philosophers of science can and should shed some light. But In order to do so, they need to avoid the kind of mistake Laudan makes and that also underlies the failure of the SC approach. Because of the division of cognitive labor, scientific insiders and lay outsiders have different epistemic concerns, are governed by different epistemic norms, and properly rely on different kinds of evidence. This difference is ignored both by the SC approach and by Laudan.[8]

[8] Many of Laudan's recent critics also exhibit a lack of sensitivity to the difference between the concerns and perspectives of outsiders and those of insiders. Thus, Pigliucci (2013) rejects

If my claims here are valid, this difference should not be ignored within attempts to promote public understanding of science nor within the philosophical discussion of the demarcation of science.

Laudan's insistence that a successful line of demarcation should be formulated in terms of a set of necessary and jointly-sufficient conditions, claiming that a fuzzy line, drawn based on degrees of empirical testing and theoretical soundness, would nonetheless be useful. However, Pigliucci does not ask whether such a line can be useful to insiders, outsiders, or to both. Moreover, because drawing the line requires an evaluation of the comparative empirical support for theories, it is unclear whether such a line could be useful to lay outsiders.

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