Journal of the American Philosophical Association (2016) 344–363 © American Philosophical Association
DOI: 10.1017/apa.2016.16

Cross-Disciplinary Research as a Platform for Philosophical Research

ABSTRACT: *It is argued that core areas of philosophy can benefit from reflection on cross-disciplinary research (CDR). We start by giving a brief account of CDR, describing its variability and some of the ways in which philosophers can interact with it. We then provide an argument in* principle *for the conclusion that CDR is philosophically fecund, arguing that since CDR highlights fundamental differences among disciplinary research worldviews, it can be used to motivate new philosophical problems and supply new insights into old problems. We close by providing an argument* by example *that uses the epistemology of peer disagreement to establish the potential of CDR for core philosophical areas. With this argument, we aim to demonstrate how the complex research contexts that CDR affords can point the way toward important avenues of epistemological research by highlighting potential limitations of key epistemological components, such as peerage and uniqueness.*

KEYWORDS: cross-disciplinary research, research worldviews, disagreement, idealization, epistemic peers, uniqueness

Introduction

Philosophy often makes progress by paying attention to other forms of human activity, mining those activities for puzzles and perspectives that provide raw material for our philosophical mills. Not all forms of human activity are equally promising sources of philosophical material—philosophy has gained more from psychology and mathematics, for example, than it has from accounting or mortuary science. Our purpose in this paper is to make the case that one rich and underappreciated source of philosophical ore is cross-disciplinary research (CDR), our understanding of which we explain in section 1. Many pressing, complex problems, such as climate change and world hunger, require CDR. As a result, CDR is an increasingly important part of the intellectual landscape, commanding the attention of research centers and funding agencies alike, such as research centers funded under, for example, the Science and Technology Center program

Authors are listed in alphabetic order and contributed equally to the preparation of this article. For helpful comments, pointers, and discussions, the authors thank Joshua Alexander, Graham Hubbs, Liela Rotschy, students in O'Rourke's Fall 2013 Interdisciplinary Epistemology seminar, and audience members of the 2014 meeting of the Central States Philosophical Association, especially our commentator, David Blanks. We were also significantly aided by comments from two anonymous referees.

of the US National Science Foundation and the Clinical and Translational Science Awards program of the US National Institutes of Health.[1] In its efforts to integrate conflicting disciplinary ontologies, methodologies, values, and vocabularies, CDR generates raw material of interest to those engaged in philosophical investigation, material that can motivate novel philosophical work.

Our suggestion that CDR is an underappreciated source of philosophical raw material may seem misguided or outdated. After all, much philosophy is itself cross-disciplinary, borrowing concepts and conundrums from other disciplines that become the objects of philosophical scrutiny. This is highlighted by the use of the schema *philosophy of X* to identify many areas of philosophical research, where substitution instances for *X* are often other research domains, such as mathematics, physics, or biology. Indeed, typically under the banner of 'interdisciplinarity', one of these substitution instances is *cross-disciplinarity* itself (e.g., Hoffmann, Schmidt, and Nersessian 2013; Frodeman 2014). These observations, though, are beside the point. As we detail in section 2, we are neither advocating that philosophy become more cross-disciplinary nor that philosophers do more philosophy of cross-disciplinarity; rather, we argue that core areas of philosophy stand to profit from attention to CDR—that it is a fertile source of new problems and new insights on old problems for areas such as epistemology, metaphysics, and philosophy of language.

In what follows, we supply a two-pronged argument for the conclusion that philosophical core areas can benefit from reflection on CDR. After giving a brief account of its nature and detailing several ways in which philosophers can engage with it, we provide an argument *in principle* for the conclusion that CDR is philosophically fecund. In particular, we argue that it highlights fundamental differences among research worldviews that can reveal new philosophical problems and supply new insights into old problems. Second, we provide an argument *by example* that uses a specific problem from epistemology—viz., peer disagreement—to establish the potential of CDR to inform core philosophical areas. Here, our aim is to demonstrate how the complex research contexts afforded by CDR can illuminate important dimensions of the epistemological problem space, thereby underscoring important avenues of epistemological research on disagreement and related matters.

1. The Nature of Cross-Disciplinary Research

In this section we provide an account of CDR for those unfamiliar with it, starting with the idea that CDR is a kind of research. We take research to be a systematic mode of inquiry that ultimately aims to produce new knowledge or understanding by buttressing old results or establishing new results (cf. Thagard 1997), which may involve one or both of discovery and invention. Thus, in one facet, research is the search for what is currently not known or understood. Other modes of inquiry

1 Most of these centers and agencies have focused on CDR in the sciences. In what follows, we follow suit. We suspect, however, that the general lesson of this essay applies more generally across the CDR spectrum.

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are not similarly oriented. With application, for instance, knowledge is put to work to produce a product. It may be a new type of product, when, say, knowledge in chemical ecology and entomology is used to identify a new sort of biocontrol, but it need not be, such as when knowledge of mechanics and structures guides civil engineers in building another bridge. The various modes of inquiry often bleed into one another, such as when the need for a suitable application of some discovery motivates researchers to search for ways of putting that knowledge to work. Thus, it can be difficult to determine whether an inquiry qualifies as research, although we take the examples supplied below to be illustrative.

CDR is also *cross-disciplinary*. Research typically takes as input *form* (e.g., methods, confirmation standards) and *content* (e.g., knowledge, information). When it does so from multiple disciplines in combination, at least to a suitable degree, the process is *cross*-disciplinary. The metaphor of *crossing* disciplines here is meant to evoke two images: the crossing of disciplinary boundaries, evoking travel from one country to another, and the crossing of disciplinary knowledge or information, calling to mind the crossing of species in the creation of hybrids. These images illuminate two important aspects of CDR: movement among different disciplinary traditions and the combination of different disciplinary products and perspectives. In this paper, we employ the term 'cross' as a generic term to cover different types of disciplinary combination, as we explain below.

Inputs from multiple *disciplines* get combined in CDR. There are many characterizations of *discipline* available in the literature. Some emphasize intellectual dimensions, characterizing disciplines as epistemic communities or cultures (cf. Nelson 1993; Knorr-Cetina 1999). Others emphasize institutional dimensions and treat disciplines as markets (Turner 2000) or social organizations (Wildman 2010). In this essay, we adopt an ecumenical account of *discipline* that acknowledges both types of dimensions: a discipline is a research community organized around a research worldview, determined, in part, by commitments to certain modes of inquiry and ways of conceiving the world, and institutional dimensions that structure professional practice within the discipline (cf. Bammer 2013).

The intellectual dimensions are captured by the idea that disciplines are organized around different research worldviews, constituted in part by different foundational commitments (e.g., assumptions, attitudes, presuppositions) that can be understood as *philosophical* in the sense that they can be classified using philosophical categories such as *epistemic* and *ontological*. These commitments are acquired through or shaped by disciplinary training (Eigenbrode et al. 2007). Epistemic commitments are reflected in the methods and techniques used during disciplinary research as well as in the confirmation standards applied to indicate knowledge or other epistemic goods; ontological commitments concern such matters as the types of objects and events over which disciplinary claims quantify. These philosophical commitments shape the nature of the questions asked within the discipline and the types of answers offered. (We elaborate further on this aspect of disciplines in section 3.)

Disciplines also have a significant institutional dimension. They are often organized into societies, with regular meetings and journals, and into departments

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or schools in postsecondary institutions (Weingart 2010). Further, they have an interest in maintaining themselves as intellectual enterprises, which they do through graduate programs and job markets designed to produce future generations of disciplinarians (Turner 2000).

In accommodating many aspects of disciplinary identity, our ecumenical approach fails to provide a single, clear, and decisive definition of 'discipline'. That's how it should be—disciplinary boundaries are vague and often shifting. Nevertheless, taken together, the intellectual and institutional dimensions highlight the fact that disciplines are distinguishable communities whose members have different research worldviews. We take CDR to involve the *confrontation*—and, ideally, the *combination*—of those worldviews, or at least the combination of disciplinary inputs (i.e., the forms and contents) that are constitutive of those worldviews.

By way of illustration, we provide the following three examples of CDR:

A. In 1999, the National Institutes of Health and the Robert Wood Johnson Foundation created several Transdisciplinary Tobacco Use Research Centers that focus on bringing together researchers from psychology, epidemiology, economics, genetics, statistics, public health, and other disciplines to investigate the scientific, political, and health-related aspects of tobacco use (Stokols et al. 2003).
B. In response to requests by local citizens, a group of university researchers collaborate with the United States Geological Survey to generate an area water quality survey. This survey includes sections written by hydrologists, limnologists, soil scientists, and biologists, collected together into a single report.
C. Preparing an article on the binding problem in philosophy of mind, a philosopher devotes many hours to studying neuroscientific reports of parietal lobe activity.

These efforts are instances of cross-disciplinary research because in each case they involve efforts to generate new results (viz., about tobacco use, local water quality, and the nature of perceptual experience) that combine contents and forms drawn from different disciplines.

These examples highlight the remarkable diversity of CDR. By identifying dimensions along which the examples vary and then using them to specify the overall 'space' of CDR, we can begin to appreciate the full range of that diversity:

1. Number of participants—from a single individual (C) to a large-scale collaboration (A)
2. Disciplinary 'width' (i.e., the degree to which participating disciplines differ from one another philosophically)—from more narrow (C) to very broad (A)
3. Epistemic integration (i.e., the extent to which distinct disciplinary inputs are recombined as part of the research process)—from

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> multidisciplinary mixtures involving little recombination, where each disciplinary input is incorporated without alteration into a single 'umbrella' framework (B) to interdisciplinary compounds involving significant recombination (A, C)

A full characterization of CDR would require *systematic* description of its multidimensional variability, which is not our quarry in this essay (see Klein 2008; Frodeman 2010). Even so, our list of dimensions, while not comprehensive, does allow us to characterize key concepts and major taxonomic categories of CDR. Key concepts such as collaboration and integration are tracked by dimension 1 and dimension 3, respectively. Major taxonomic categories, such as multi-, inter-, and transdisciplinarity, are cashed out in terms of combinations of dimensions 2 and 3.

Finally, although our conception of CDR does not require significant integration or collaboration, or discriminate between multidisciplinary, interdisciplinary, or transdisciplinary research, those instances of CDR that are both integrative and collaborative (typically, interdisciplinary or transdisciplinary) are most likely to give rise to interactions that illuminate core philosophical issues for reasons detailed in section 3. Accordingly, such instances of CDR will be the focus in what follows.

2. Philosophy in Relation to CDR

Philosophy as a practice stands in a number of complex relations with other human practices, such as psychology or mathematics. This is reflected in the fact that philosophical engagement with one of these practices often doesn't just count as *doing philosophy*—it often also qualifies as doing philosophy of psychology or philosophy of mathematics. The broad sweep of these philosophical engagements suggests that there is a philosophical side to many human practices. CDR is one of these human practices, and philosophers engaged with CDR operate in different ways depending on how they are related to it. We can use this nexus of relationships between philosophy and CDR to articulate our goal in this article, distinguishing it from other aims with which it could be confused.

First, we are not arguing for 'philosophy *as*' CDR (Frodeman 2010; Hoffmann et al. 2013) or 'field philosophy' (Frodeman 2008), which involves philosophers working side-by-side with collaborators from science, policy, and practice on complex problems such as climate change and sustainability. An instance of what Hansson (2008) calls 'philosophy *with*', philosophy *as* CDR builds on the power of philosophy to make a difference as a contributing partner to efforts of common concern (see also Dohn 2011). While we recognize the importance of philosophy *with* and *philosophy as*, they are not the focus of this article.

Second, we are not advocating for 'philosophy *of*' CDR (Hansson 2008); we are not recommending investigations of CDR 'in a *disciplinary* manner, as a discrete domain of reflection' (Frodeman 2010). Our focus is on core areas of philosophy such as epistemology and metaphysics. By way of analogy, consider the relationship

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between metaphysics and the Special Theory of Relativity (STR). One can, for example, use insight and concepts from STR in discussing the metaphysics of time without thereby doing philosophy of physics (Godfrey-Smith 1979). In the same way, we argue that there are important insights, as well as new problems, to be gleaned by metaphysicians and epistemologists from CDR without recommending that these researchers become philosophers of CDR.

This analogy spotlights the preposition we need: 'from'—what we are interested in could be called 'philosophy from', i.e., philosophical work drawing material (e.g., facts, examples, ideas) from cross-disciplinary activity to inform first-order philosophical investigations. For example, one form of philosophy *from* CDR would be what Prinz (2008) calls 'empirical philosophy'—that is, philosophy that turns on the empirical results of nonphilosophers—if it involves mining cross-disciplinary work for empirical results relevant to one's first-order philosophical investigations. Philosophy *from* CDR can arise out of collaborative work with cross-disciplinary groups, but it is not philosophy *as* CDR or philosophy *with* CDR in the senses articulated above. It is not aimed at articulating a philosophical theory of CDR. It emphasizes research in core philosophical areas. A philosopher of language, for example, could draw an issue from a CDR context without doing philosophy of CDR, as our analogy above suggests. In sum, we focus on CDR as a *source* of philosophical content, and not on CDR's foundations and methods as the philosophy *of* CDR might.

CDR can be a source of philosophical content in two ways. First, it can be the source of new issues and conundrums that are brought into the open by this mode of research practice. Second, it can be a source of new lessons and ways of thinking about old philosophical problems. The first argument we offer below, the argument in principle, applies to both ways of being a source. Our second argument, the argument by example, just focuses on the second way.

3. An Argument in Principle for the Philosophical Fecundity of CDR

CDR, especially when it is integrative and collaborative, is similar to a particle collider: much as the collision of subatomic particles yields surprising new entities, so the 'collision' of different disciplinary commitments, assumptions, and armamentaria in CDR contexts creates surprising new combinations and confrontations, potentially rich in philosophical content (O'Rourke and Crowley 2013). We take this particle collider image to represent a deeper truth, viz., CDR is *in principle* a rich source of content that ranges across many areas of philosophical concern. In this section we turn this image into an argument for the philosophical fecundity of CDR.

We begin by reiterating that CDR as an activity involves the combination of different disciplinary contents and forms. Disciplines are associated with research worldviews, acquired through or inflected by the training involved in becoming a

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member of the discipline. Held by researchers, these worldviews comprise various key commitments concerning matters such as the following:

- the *ontology* of phenomena identified by or associated with research questions: the types of objects, properties, and events taken to constitute the phenomena under investigation
- the *methods* appropriate for investigating research questions
- the *confirmation standards* appropriate for determining when one has generated an answer to a research question that is reasonably well supported
- the *values* appropriate to answering, exploring, and choosing a research question, including epistemic values (e.g., predictive power, explanatory scope, simplicity) and social values (e.g., access to health care, justice, ending world hunger)

These commitments can be considered parameters of research activity. They help structure what you take to be problematic, how you respond as an investigator, and when you decide the investigation has reached its end. In other words, they help shape the way one thinks, acts, and communicates as a researcher, manifested in one's own research and in how one responds to the research of others. In crossing disciplines, then, CDR involves the combination of commitments drawn from these worldviews, a process that can be understood as a kind of disciplinary hybridization.

As parameters of research activity, these commitments can be understood as *philosophical* in nature. We can make this point in two ways. First, these parameters correspond to central areas of philosophical concern, e.g., the nature of the world under investigation, our knowledge, and our values. When philosophers study specific modes of research—in mathematics, say, or biology—they often evaluate the influence of these kinds of commitments. Second, these parameters frame how one experiences, interprets, acts, and talks as a researcher; more specifically, they help differentiate the relevant from the irrelevant when it comes to the research effort. Although a researcher may not think of these commitments as philosophical, their foundational role in framing scholarly investigation installs them as key normative dimensions of the researcher's philosophy of research. Therefore, in crossing disciplines, CDR entails the combination of different *philosophical* commitments.

While this combination need not be problematic, there will often be enough disciplinary breadth in a CDR project to make managing differences among worldviews stand out as a key challenge (Eigenbrode et al. 2007). This is more likely if the research is collaborative and integrative. Such CDR brings investigators together who have different backgrounds and who think, act, and communicate as researchers in different ways. Tendencies in thought, action, and communication are often tacit, making differences among them difficult to identify. If an investigator is used to certain ways of thinking, carrying out research, and communicating results, then challenges to these tendencies (e.g., from

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confrontations with incompatible worldviews) can generate resistance. Of course, such challenges can arise in monodisciplinary collaborations, but monodisciplinary collaborations will typically comprise researchers with similar commitments due to similarities in training and professional activities that help render differences in research tendencies more tractable.

In CDR collaborations, though, worldviews often clash, and it can be disorienting when they do—the differences strike at the very heart of what one takes to be *natural*; integrative CDR can be even more challenging, as it often requires collaborators to produce research outputs that transcend the disciplinary identity of the research inputs. Managing differences among research worldviews runs deeper than managing linguistic differences among disciplines. While it is difficult enough to relate one disciplinary language to another without a decoder ring, it is an altogether different kind of problem when collaborators cannot even be sure that they are seeing the research landscape in the same way. Although the ability to relate disciplinary languages is not sufficient for CDR success, it is important, and it depends on isolating something nonlinguistic to serve as an anchorage for linguistic mapping; however, to the extent that the research worldviews are incommensurable, even the search for a common anchorage could be undermined (for an example of the challenges in identifying and managing such objects, see Griffiths and Stotz 2014). Surmounting these challenges typically requires experts in one discipline to become students of another, at least to the point where they approach an interactional expertise that enables them to communicate with their fellow collaborators in ways indistinguishable from those of the collaborators' disciplinary colleagues (Gorman 2010).

Communication among collaborators, then, is critical in integrative CDR (NAS 2004), especially dialogue and negotiation about research commitments when they differ. The challenge of creating integrated hybrids out of disciplinary elements brings these differences into high relief, creating conflict out of what might remain mere difference in less integrated multidisciplinary research. Conversations that ease tensions between research worldviews, sometimes rendering them commensurable, will often be conversations about the parameters of research activity, so they will be conversations that highlight ontology, methods, and values, among other things (Eigenbrode et al. 2007; Cooke and Hilton 2015). That is, they will be *philosophical* conversations—not conversations about the -isms of theoretical philosophy, but rather conversations about the normative dimensions of disciplinary research worldviews.

Thus, CDR, especially when collaborative and integrative, brings into high relief differences of interest to metaphysics, epistemology, and value theory. These differences are often close to the surface and readily available for discussion and negotiation in a CDR context. We might make this point with the help of our initial *mining* metaphor: miners must sort the ore from less interesting rock, but this is easier when the vein is close to the surface. Because of the fact that integrative, collaborative CDR involves the confrontation of different research regimes, conflicts that can be explored philosophically in epistemic, ontological, and value-theoretic terms are common and close to the surface. Not all of these conflicts or their resolutions (where they occur) will be novel or particularly interesting, but

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the philosophical differences are salient and thus useful for unearthing materials to ground a philosophical investigation or to illustrate a philosophical point. We submit the following questions as examples of the philosophical ore made available by CDR:

- Under what conditions can different and ostensibly incommensurable disciplinary ontologies be synthesized into an integrated set of metaphysical commitments?
- Under what conditions can different technical languages be negotiated to yield a common understanding of a research landscape?
- Does CDR reveal a context within which peers can reasonably disagree?

We can now express the argument of this section in brief as follows: first, disciplinary worldviews comprise different philosophical commitments that often clash in CDR collaborations; second, these clashes qualify as challenges to the research effort; third, collaborators communicate about their different philosophical commitments in order to mitigate these challenges; fourth, these conversations are a rich source of philosophical ore to be mined by core philosophers; therefore, CDR is a fecund source of philosophically interesting material, including new puzzles for core areas of philosophy and new insights into existing philosophical debates.

4. An Argument by Example for the Philosophical Fecundity of CDR

This section supplies an example of the impact CDR can have on philosophical research. While there is no shortage of philosophical topics to which we could turn for an example (e.g., scientific ontology, linguistic interpretation, cross-disciplinary normative differences), in this article we concentrate on the epistemology of disagreement. In addition to being clearly relevant to conflicts that can arise when disciplinary worldviews are brought together, this topic has the virtue of being relatively new, making it easier to contribute to existing philosophical debates. The claim we advance is that examination of disagreements in CDR contexts reveals that maintaining a disagreement can be epistemically right, even in conditions of 'full disclosure' (see below)—a result that enriches the extant epistemology of disagreement in interesting ways.

In this section, we begin by arguing for a conditional: if two agents are epistemic *peers* with respect to proposition p and the *uniqueness thesis* is true, then in those cases where the agents take different doxastic attitudes toward p (and each is aware of the position of the other), at least one of them ought to revise his or her attitude. We then relocate a case used to motivate epistemological reflection on disagreement, putting it in a collaborative CDR context. We argue that in this context, it is not always the case that at least one of the disagreeing collaborators

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ought to revise his or her attitude. Sometimes the epistemically right thing to do is for both to 'stick to their guns'. We conclude by examining which component of the antecedent we should deny in completing the modus tollens. Our main claim is that whichever option the reader prefers, there are interesting implications for one of the prominent strands of discussion in the epistemology of disagreement.

It is worth emphasizing that our main point here is not that those who approach the epistemology of disagreement through peerage and uniqueness are mistaken in their recommendations. Indeed, we remain agnostic about whether or not at least one of the parties to a case of *peer* disagreement ought to revise his or her attitude. Instead, we argue that by thinking about disagreement in the context of collaborative CDR, it becomes clear that this way of approaching disagreement is conditioned on either a problematically false thesis in need of a suitable replacement (viz., uniqueness) or a potentially helpful simplification whose enrichment promises to enhance our understanding of disagreement (viz., peerage). Either way, reflection on CDR reveals avenues of interesting epistemological work.

4.1 Two Idealizations and Consequences

The philosophical study of disagreement is inspired by real-world examples, as when 'Two expert weather forecasters disagree about the weekend forecast' and 'Two equally well-informed economists disagree about the most likely movements in interest rates' (Feldman and Warfield 2010: 1). Such disagreements prompt many philosophical questions, such as when, if at all, is it epistemically reasonable, rational, or justifiable for the disagreeing parties to hold incompatible beliefs? Answering these questions in terms of real-world cases is not always an easy task. Such cases are often quite complex. Moreover, they aren't always epistemologically interesting, such as when one of the parties to the disagreement is in possession of a vital piece of evidence that the other lacks. To make progress on real-world cases of disagreement in a way that is philosophically interesting seems to require some degree of idealization.

Feldman and Warfield (2010) identify two commitments often made in the epistemology of disagreement that are idealizations, by our lights. (The sense in which the second commitment is an idealization is the technical sense found in philosophy of science, as in Frigg and Hartmann 2012; more details below.) We construe these commitments as follows:

1. The disagreeing parties are (epistemic) *peers*, where 'peers literally share all evidence and are equal with respect to their abilities and dispositions relevant to interpreting that evidence' (Feldman and Warfield 2010: 2).
2. The *uniqueness thesis* is true, according to which 'a given body of evidence justifies exactly one attitude toward any particular proposition' (2010: 6), or more fully, according to which, for any body of evidence e and proposition p, if each of S_1's and S_2's total evidence is e, then there is exactly one doxastic attitude (belief,

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> disbelief, or suspension of judgment) that is rational, justified, or warranted for each of S_1 and S_2 to have toward p.[2]

From these idealizations some implications seem to emerge. The following story, a version of which can be found in Feldman (2003: 184–88), helps make them clear.

Consider two doctors, J and K, each seeking the cure for some disease. J runs a study, yielding the result that treatment *X* is the cure. K runs another study, yielding the result that treatment *Y* is the cure. Assume there is a single cure for the disease, so if *X* is the cure, then *Y* is not, and vice versa. Assume further that neither doctor is aware of the other study. Neither is negligent in being unaware of the other study, and both have reason to think that they conducted their studies appropriately. So far so good—it certainly seems possible for two agents to approach the same question in isolation and for two incompatible yet well-justified beliefs to emerge.

Now suppose that J and K exchange all their information about the two studies: they share with each other all their evidence bearing on the question of which of the two treatments is the cure. As Feldman (e.g., 2006) would put it, they are now in a state of *full disclosure*. Assuming they are equally competent researchers—they are equally competent at weighing the evidence relevant to the question of whether *X* or *Y* is the cure—they are now peers, relative to this issue (Kelly 2005).

But what if, after exchanging their information, they continue to hold to their original beliefs? Would they be justified? It appears not. Since J and K are peers on the curative properties of *X* and *Y*, they share all evidence pertaining to those properties. This evidence, according to the uniqueness thesis, supports exactly one attitude—belief, disbelief, or suspension of judgment—toward each of the propositions *X is the cure* and *Y is the cure*. So at least one of the bundles of belief and disbelief had by J and K fails to be justified. Indeed, in general, if the uniqueness thesis is true and S_1 and S_2 are peers on proposition p while disagreeing over p, then at least one of them holds an attitude that is unjustified.

Further, it seems that at least one of them ought to revise his or her original belief. Feldman's *conciliatory* view is that both ought to suspend judgment. And that seems plausible, but there are other options. Perhaps other conciliatory views, those that propose merely modifying credences in the proposition (e.g., Christensen 2007; Cohen 2013; Elga 2010), provide a better account of what J and K ought to do. Or maybe a nonconciliatory view, a *steadfast view* (e.g., Bergmann 2009; Kelly 2005), according to which one can maintain one's belief in full despite there being a peer who disagrees, provides a better account. Or, to take just one more possibility, perhaps a middle-ground view is best. Examples here include Lackey's (2010) *justificationist view*, according to which the proper response in cases of peer disagreement depends on the justificatory status of the beliefs at issue, and

2 In the terms of Kopec and Titelbaum (2016), the version of uniqueness on which we focus is *interpersonal* uniqueness, with the claim that there is *exactly one* rational attitude to take on the body of evidence. While this version is logically stronger than claiming that there is *at most one* such attitude (e.g., Feldman 2007), since it rules out 'the possibility of rational dilemmas (i.e., cases where there isn't any attitude to hold toward some proposition)' (Kopec and Titelbaum, 2016: 191), this difference won't matter for the purposes of this article—none of the cases of disagreement we discuss below are cases of rational dilemmas, as best we can tell.

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Kelly's (2010) *total evidence view*, according to which the proper response depends on the total evidence the parties to the disagreement had.

We suggest that the epistemology of disagreement, insofar as it focuses on figuring out the proper epistemic response in cases of disagreement idealized along such lines, can be informed by relocating the discussion in the context of CDR. Our view is that important lessons emerge once we examine cases of disagreement in a CDR context, especially one where the disputants are cross-disciplinary researchers collaborating on a single project in the hope of developing a highly integrated product.

4.2 Disagreement in a CDR Context

Feldman's story about J and K is silent on many details. One point of omission is the research backgrounds of J and K. As described above, some of the biggest challenges to CDR arise from different commitments about research, including its philosophical dimensions. Managing these differences is crucial for successful CDR. We hope to make this salient by relocating Feldman's example in a collaborative CDR context.

Suppose that J and K are working together on a malaria outbreak in Rwanda. J is a pathologist. His work emphasizes the role that eukaryotic protists of the genus *Plasmodium* play in causing malaria through mosquito bites. He believes that the best way to manage the outbreak is by making the drug quinine widely available in Rwanda. K is an entomologist. Her work is on the fitness of anopheline mosquitoes genetically modified so as not to support *Plasmodium* development (cf. Marrelli et al. 2007). She believes that the best way to control the outbreak is by releasing transgenic mosquitoes throughout Rwanda. The success of their joint project depends on their negotiating their difference of opinion. If they are to do it well, they should begin by trying to understand each other's positions. At this point, prior to exchanging their reasons for believing as they do, it is plausible to think that J and K may be in a state of reasonable disagreement. The right thing to do, at this moment, is for each to try to understand the other's position, without rejecting it outright.

There is no guarantee that the exchange will be successful in getting J and K to settle their disagreement. This is true even if they were to disclose fully their evidence for their respective positions. In some ways, their situation resembles those standoffs involving peers and uniqueness exemplified in Feldman's original story. (One might be tempted to reject the peer assumption here, or even the uniqueness thesis; we address these temptations below.) So the question arises: Now that we are considering a disagreement in a collaborative, cross-disciplinary context, is it true that that at least one of them ought to revise his or her belief in some way? The answer we propose is: No, not always.

Although underemphasized in the epistemology of disagreement, the benefits of cognitive diversity more generally have been widely noted in philosophy of science (e.g., Kitcher 1993), feminist epistemology (e.g., Harding 1993), and experimental psychology (e.g., Minson, Liberman, and Ross 2011). One benefit

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of cognitive diversity worth emphasizing here is a type of epistemic creativity, involving the production of original, innovative, or novel proposals for solutions to theoretical or practical problems that span multiple disciplines. The empirical research indicates that, under the right conditions (De Dreu 2006), continued and open disagreement on teams of collaborators concerning the task before them is associated with increased potential for generating theoretical and practical products that are novel and useful (see Nemeth and Nemeth-Brown 2003; Schulze and Seuffert 2013). Importantly, the evidence suggests that this association carries over to CDR contexts (Yong, Sauer, and Mannix 2014). Thus, on a CDR team it is reasonable to think that continued, open disagreement can be an opportunity. It can highlight differences and motivate the search for resolution. The resolution need not consist in one party to the disagreement convincing the other to modify his or her original attitude. Sometimes resolution happens by adopting a new approach to the problem that the team is addressing. Just as two vehicles apparently on a collision course in two dimensions may be seen to be comfortably distant in three dimensions, so too one can seek to address disagreement on a CDR team by reframing the challenge being addressed.

It is our contention that interdisciplinary epistemic creativity is an important epistemic good whose chances of being secured are significantly decreased when a revealed disagreement resolves too quickly, as when the disagreeing disciplinary parties immediately modify their beliefs after evidential disclosure. For creatures like us, it seems that a downgrade in our beliefs—a shift from belief to its absence or from full credence to lowered credence—tends to mark the positions as not fully worth fighting for, and that tends to undermine the motivation necessary for finding a creative third option (cf. Nemeth, Brown, and Rogers 2001 on authentic dissent). Moreover, without the conviction associated with greater credences, the other party to the disagreement is less likely to take the opposing view seriously. To be sure, the likelihood of achieving this epistemic good does not drop to zero when disagreement is attenuated or eliminated by adjustment in credences or adoption of a quasi-belief state like supposing, hypothesizing, or accepting. Still, it seems that, in general, the greater a person's credence, the more apt she is to rely on the belief in guiding her actions, and thus the more apt she will be to go through the difficult task of trying to find a 'third way'. The same seems true when we compare beliefs with mere belief-like states. Thus, there is reason to think that in many situations the chances of securing some epistemic goods are significantly decreased when a disagreement goes unexplored.

That result has an important implication for the epistemology of disagreements in the collaborative CDR context: sometimes the epistemically right thing is for the two disagreeing parties to retain their beliefs in full. Different epistemological frameworks will have different ways of reaching this conclusion. A lot will depend on what the frameworks take the primary epistemic goal(s) to be. But if the frameworks emphasize the standard ones—those of maximizing true belief and minimizing false belief—then one argument proceeds as follows. A main reason for collaborating across the disciplines (if not the whole point) is that some problems are too complex for a single discipline. Often what is needed to solve these problems is an insight that no single disciplinary researcher can supply—an insight that can

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only come from forms of epistemic creativity that we call 'cross-disciplinary'. Thus, when it comes to CDR teams addressing such problems, anything that will significantly diminish the chances of generating a moment of genuine cross-disciplinary creativity, such as when revealed disagreement gives way too quickly, is something that increases the chances that the team won't solve the problem that brought the team members together.

Assuming the standard epistemological picture of primary epistemic goods, failure to solve the problem that brought the team together is a major epistemic failure, since it involves a team of agents persisting in a state of not obtaining a true belief regarding the answer to their research question. Presumably, then, resolving disagreement too quickly is a violation of epistemic obligations, duties, or requirements; it is reasonable to think that we are epistemically obligated to avoid regulating our doxastic lives—from forming, retaining, or modifying our states of belief, disbelief, and suspension of belief—in ways that we have good reason to believe will significantly increase the chances of major epistemic failure. In view of these considerations, it is not automatic that in our recontextualized case at least one of J or K ought to revise his or her belief. It just may be that both ought to retain their original beliefs in full, at least until the opportunity to leverage team differences has been seized. And that has implications for a prominent strand of the epistemological literature on disagreement.

4.3 Current Epistemology

Our central claims up to this point are two. First, it seems that if the uniqueness thesis is true and J and K are epistemic peers on proposition p while disagreeing over p, then at least one of them ought to revise his or her attitude toward p. Second, in cases of disagreement on CDR teams, revision should often be avoided until after the team has reaped the benefits of the disagreement. The conjunction of these two claims implies that in the context of a CDR team either the uniqueness thesis is false or epistemic peerage is unattainable. Whichever option the reader prefers, there are valuable opportunities for the epistemology of disagreement.

Suppose we embrace the first option and accept that in the context of a CDR team the uniqueness thesis is false. Given that it is a universal claim, if the thesis is false here, then it's just false. However, the significance of embracing this option—in effect, that the uniqueness thesis is false—depends on what kind of idealization uniqueness is supposed to be.

Philosophers of science often distinguish two types of idealizations. Frigg and Hartmann (2012) call these two 'Aristotelian' and 'Galilean'. In an Aristotelian idealization, the researcher focuses on aspects of the phenomenon under study deemed to be relevant while ignoring those thought to be irrelevant. Frigg and Hartmann give as an example the physicist in classical mechanics who depicts planetary systems as composed of objects with only shape and mass. In a Galilean idealization, the researcher introduces aspects believed not to be relevant or she 'warps' or omits aspects deemed to be relevant so as to make the phenomenon

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more tractable. For instance, the ideal gas law assumes that molecules are perfectly elastic and spherical when really they are not (McMullin 1985).

Epistemologists who advance the uniqueness thesis seem to treat it as a general epistemic truth. It appears to reflect efforts at isolating elements that are supposed to be relevant to the justification of beliefs and other doxastic attitudes, without introducing irrelevant aspects or omitting or modifying other relevant aspects. That is, uniqueness looks like an Aristotelian idealization, and so failure to capture the truly relevant aspects of the phenomena in question results in a straightforwardly false thesis. An opportunity thus opens up: the task of replacing the uniqueness thesis with a suitable successor. Likely, this opportunity is one that many epistemologists will happily take up in light of existing worries surrounding uniqueness (see Kopec and Titelbaum 2016 for review).

The other option for handling the implications of our two central claims is to target the idea of cross-disciplinary peers. Maybe there is something about cross-disciplinarity that prevents representatives of different disciplines from being peers. The thought is worth pursuing. As standardly construed in the epistemology of disagreement, peers on a proposition are equally competent at interpreting, weighing, or assessing the evidence bearing on the proposition. If the evidence comes from distinct disciplinary efforts, it is not obvious that one CDR collaborator will be as competent at interpreting the evidence that comes from another discipline as the collaborator from that discipline, and vice versa. It may be that an entomologist will invariably be better at interpreting entomological evidence than a pathologist. Perhaps, then, there is something to the thought that peerage stops at disciplinary lines.[3]

However, the reader who embraces the thought that peerage stops at disciplinary lines confronts a worry. If that thought is true, then much of the contemporary epistemology of disagreement will have little to say about disagreements found on CDR teams. De Cruz and De Smedt (2013: 170) press a more general version of the worry:

> If equal evidence were required for peer disagreement, virtually no scientific case would fall under this label, with perhaps the exception of members of the same lab, studying under the same supervisor, working on a specific and narrowly defined problem. However, restricting epistemic peers to clean cases makes the social epistemological toolbox of marginal relevance for scientific practice (and indeed, for any real-world situation) where messy and complex cases predominate.

There is something correct about this line of thought. To the extent that epistemological reasoning is predicated on a highly restricted assumption, as it is when it comes to disagreements between peers in the sense set out in section 4.1, such reasoning is unlikely, *on its own*, to shed much light on situations where the assumption fails to hold. A similar conclusion seems to hold when it comes to epistemological reasoning about cases that Lackey (2010) calls 'ordinary

3 The other alternative—that peerage extends across disciplinary lines—strikes us fascinating and seems to be assumed by the idea of interactional expertise (Gorman 2010).

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disagreements', where epistemologists merely assume that the disputants *take themselves* to be peers. It is probably not too often that the parties to a disagreement sincerely believe that they are equally familiar with the evidence and that they are equally adept at interpreting the evidence.

Still, we would caution against using the limited ability of much epistemological work on disagreement to throw light on real-world disagreements as a reason to reject this work wholesale. The limitation emerges from an idealization made, at least in part, in order to make progress on important parts of the epistemology of real-world disagreements. True, the idealization does involve a deliberate distortion. The real-world cases of disagreement that the epistemological literature ultimately aims to inform rarely, if ever, involve agents who share all the evidence relevant to the propositions at issue while being equals in their capacities to interpret evidence for and against the propositions. Thus, the assumption that the disputants are epistemic peers is a Galilean idealization. However, to reject epistemological work operating with this Galilean idealization on the grounds that it cannot, by itself, throw much light on real-world disagreements is to run the risk of rejecting the entire practice of making Galilean idealizations. In that case, one must have a problem with large parts of science where these idealizations are ubiquitous (see Ladyman 2008), and that strikes us as foolish.

To be clear, nothing we say here is meant to imply that epistemologists should refrain from thinking about *peer* disagreements in a narrow, technical sense. Much value may come from it, such as general principles governing correct responses to disagreements in these highly idealized cases, which are interesting in their own right. Our point is simply that the current practice of idealization in the epistemology of disagreement is impoverished and is missing some real opportunities. For many epistemologists, the point of considering these highly idealized cases of disagreement between epistemic peers is to shed light on how we ought to respond in actual cases of disagreement (e.g., Feldman and Warfield 2010). But epistemological practice has focused almost entirely on these highly idealized cases. It hasn't been sufficiently extended to include reflection on less idealized cases of disagreement. But it could and should.

The move from more idealized to less idealized models is a standard step in the method of Galilean idealization (McMullin 1985). It is what will make the insights of this literature more applicable to an epistemology of real-world disagreements. Moreover, it opens up an interesting way of arguing for standard epistemological theories of disagreement. For it may be that one theory is far better at supporting this 'de-idealization' process than its competitors. For instance, if it is true that neither J nor K ought to revise their beliefs in the CDR case, then it ought to count in favor of a standard epistemological theory of disagreement if it can explain this verdict in the CDR case in light of what it says about disagreements in highly idealized cases. The key is to know how the failure of J and K to be peers impacts their epistemic obligations—how they ought to respond to their disagreement—in the more realistic case. Thus, for example, a justificationist like Lackey (2010) might argue as follows. Because J is competent at interpreting pathologic evidence and is relatively incompetent at interpreting entomological evidence, he ought to assign a much greater weight to the pathologic evidence than to the entomological

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evidence. In fact, J should assign so much weight that even after full disclosure the justificatory status of the original belief remains so high for him that he ought to remain steadfast. The same is true for K and her original belief, *mutatis mutandis*. Other epistemologists will tell a different story, but however the story goes, the need for it is made salient by examining disagreement in CDR contexts.

4.4 An Objection and Reply

One might object that when we argued in section 4.2 that both J and K ought to remain steadfast in our story of cross-disciplinary disagreement, the sense in which they *ought* is not the sense in which peers are exhorted to remain steadfast in the current literature on peer disagreement. There are multiple ways of casting the worry. We focus on the version according to which our case involves an *ought* drawn from the epistemology of inquiry rather than the epistemology of belief, which, the objector argues, is the source of the *ought* that figures in current epistemological work on disagreement.

Certainly, our argument that J and K ought to remain steadfast even after full disclosure is one that involves reflecting on inquiry-relevant matters. It turns on the claim that being conciliatory too quickly can undermine pursuit of the goals of CDR research. Among epistemologists who want to draw a sharp distinction between the epistemologies of belief and inquiry (e.g., Christensen 2007), such claims are simply irrelevant to our epistemic obligations qua rational believers, bearing instead on our epistemic duties qua rational inquirers. Accordingly, the worry continues, to the extent that epistemological work on peer disagreement is part of the epistemology of belief, our conclusion that J and K ought to remain steadfast simply has no bearing on this work including its appeals to uniqueness and peerage.

This critique is an important one, deserving more space than we can give it here. What we can say is that there are arguments to which we are sympathetic against drawing a sharp distinction between the epistemologies of belief and inquiry. To the extent that they are sound and leave room for inquiry-based considerations of the sort employed in our argument, it seems that the lessons that we draw for the extant epistemology of disagreement are legitimate.

Let us suppose, though, that there should be a sharp distinction between the epistemologies. In this case, what value would reflection on our case of disagreement in CDR have for the epistemology of disagreement? One answer is that the epistemology of disagreement is more complicated than many philosophers seem to appreciate. Not only are there questions about how we should react to cases of disagreement *qua* rational believers, but there are also questions about how we should respond *qua* rational inquirers—that is, how should we respond to cases of disagreement insofar as the goals of rational inquiry are concerned? There is also the problem of how to integrate answers to these questions when they conflict. In those cases where the response coming out of the epistemology of belief differs from the response coming out of the epistemology of inquiry, what should we do epistemically, all things considered? What is our ultima facie obligation? Thus, even

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if a sharp line should be drawn between the epistemologies of belief and inquiry, there is still value in considering the epistemology of disagreement in the context of CDR.

Clearly, nothing we have said here is the last word on the epistemology of disagreement, but we hope we have been sufficiently provocative to motivate serious reconsideration of the existing options in the debate. If we have, then we have achieved our major goal in this part of the paper: to demonstrate that consideration of CDR enriches work in a core area of philosophy.

5. Conclusion

We have argued that philosophers can and should benefit from turning their attention toward CDR. Restricting our focus to philosophical work that draws its inspiration and focus *from* CDR without being philosophy *of* CDR, we have argued that core areas of philosophy stand to benefit from reflection on CDR, especially when they reposition their problems in the context of cross-disciplinary activity. This argument has taken two forms. First, we have argued *in principle* that the nature of CDR foregrounds philosophical commitments, creating an environment that is especially sensitive to the epistemic, metaphysical, and value-theoretic aspects of research life; when disciplinary combination puts these aspects into conflict, the conflicts can emerge as philosophical problems. Second, we have illustrated this argument with the epistemological problem of peer disagreement, arguing *by example* that evaluating traditional perspectives on this problem in a CDR context paves the way for new philosophical lessons and opportunities. Note that these arguments interact synergistically. The argument by example provides a level of detail that illustrates the value of CDR to core areas of philosophy, but no reason is given to think that our example generalizes. The argument in principle shows only that CDR should be interesting, but in doing this it supplies good reason to think that the value of CDR generalizes beyond our example. In combining these arguments, we have reason to think that CDR is interesting and generalizable, making a stronger case for the interest of CDR for core areas of philosophy than either of our arguments in isolation. In sum, CDR offers a wide-ranging platform for philosophical work that promises to shed new light on old philosophical problems while at the same time revealing new issues for philosophical concern.

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https://doi.org/10.1017/apa.2016.16 Published online by Cambridge University Press

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