
Social Coordination in Scientific Communities

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Kubnian philosophy of science has established the existence of a social dimension within epistemology, but neo-Kubnian accounts remain limited by linguistically centered conceptions of rationality and normativity. As an alternative, I use an embodied epistemology to reframe two neo-Kubnian concepts: Fred D'Agostino's (2010) federal model of enquiry and William Rehg's (2009) immanent cogency. Both concepts are concerned, in part, with how scientific communities balance conservative and innovative impulses. By treating interaction as a fundamental frame of analysis, embodied epistemology offers a more nuanced perspective on this "essential tension," while also blunting realist re-interpretations of each concept.

1. Introduction

The social epistemology of science to date has not adequately accounted for the embodied nature of cognition. This lacuna is evidenced in part by what Fred D'Agostino (2014) refers to as an "undertow" in the philosophy of science, which has pulled some of Kuhn's revolutionary conceptual innovations (such as his conceptions of reason and argumentation) back towards the traditional notions they are meant to replace. My primary concern in the following is to show how framing neo-Kuhnian social epistemology within the embodiment movement in cognitive science blunts such reactionary re-interpretations. In §1, I argue that linguistically centered conceptions of rationality and normativity leave neo-Kuhnian accounts vulnerable to realist undertow and, as an alternative, sketch the rudiments of an embodied epistemology. Towards the latter end, I draw upon Mark Bickhard's interactive model of representation (1996, 2002) and Hanne De Jaegher and Ezequiel Di Paolo's concept of participatory sense-making (2007).

In order to give some context to the undertow issue, in §2 I chart the development of social epistemology using K. Brad Wray's explication of Kuhnian epistemology (2011). This sets up my analysis of two major works in neo-Kuhnian social epistemology: Fred D'Agostino's (2010) *Naturalizing Epistemology* (§3) and William Rehg's (2009) *Cogent Science in Context* (§5). Beginning with the former, the central theme of D'Agostino (2010) is how communities of enquiry balance conservative and innovative impulses, which Kuhn (1977) refers to as the "essential tension." D'Agostino's *federal model* of enquiry broadens Kuhn's account beyond science, modeling all epistemic divisions of labor in terms vertical and horizontal axes of enquiry. The federal model shares important affinities with participatory sense-making's notion of coordination mechanisms, but D'Agostino's account stands at a crossroads between embodied and disembodied epistemologies. To highlight this tension, I turn to Steve Fuller's conception of social epistemology, which has heavily influenced D'Agostino.

Fuller's account is one of two varieties of disembodied social epistemology that I examine in §4. Articulating the connection between Fuller (2002, 2011, 2012) and D'Agostino clarifies the obstacles to linking the federal model of enquiry to participatory sense-making and the larger embodied cognition framework. My critique of Fuller thus serves two purposes: first, to show that an embodied epistemology provides a more nuanced perspective on D'Agostino's mapping of epistemic communities and, second, to lay the groundwork for revising another disembodied social epistemology—namely, Martin Kusch's communitarian epistemology (2002a, 2002b, 2013). Among the many merits of Kusch's communitarian epistemology is linking the social epistemology of science—in particular, Barry Barnes (1983) and the associated strong program in the sociology of knowledge—to a broader notion of epistemic communities. Yet communitarian epistemology, as with Fuller, is limited by an overly narrow, linguistically centered understanding of normativity. To buttress my reframing of Kusch's communitarian epistemology and D'Agostino's federal model, I turn to Rehg's concept of cogency.

In §5, I consider Rehg's argumentation theory (2009), which details "microsocial" dynamics within communities of enquiry. This helps to clarify the relationship between the institutional mechanisms described by D'Agostino and participatory sense-making's more fine-grained focus on two-person interaction. The key concept of Rehg's theory is cogency, which entails that argumentation is a context-specific process that involves an indefinite range of potential factors. The immanent nature of argumentation facilitates the balancing of innovation and stability within scientific communities. To conclude, I review the advantages of an embodied account of the essential tension as compared to a linguistically centered one.

2. Battling the Undertow of Realism: The Need for “Embodied” Social Epistemology

Anti-realist positions that endorse a linguistic notion of rationality and normativity—that is, accounts in which the primitive nature of reason and norms are understood in propositional terms—are inherently vulnerable to realist re-interpretations. D’Agostino (2010, p. 2) endorses such a variety of anti-realism—citing Kusch (2002a) and Rorty (1989) as support—though he refrains from defending anti-realism in *Naturalizing Epistemology* in order to focus instead on its “collectivist” implications for social epistemology. D’Agostino positions his anti-realism as an extension of the so-called “linguistic turn” (Rorty 1992) in philosophy. In §3, I use James Ladyman’s critique of *Naturalizing Epistemology* (2012) to detail how D’Agostino’s account remains vulnerable to realist undertow. In the present section, I focus on identifying the basic features of D’Agostino’s anti-realism in connection with Kusch’s communitarian epistemology (2002a); Kusch’s account is especially relevant given its aforementioned link to the sociology of science.

The cornerstone of Kusch’s communitarian epistemology is his concept of social identity. Kusch understands social identities as a “social kind” (2002a, 2013); other social kinds include money and marriage. For Kusch, money, marriage, and social identities are all constructed via the medium of language. Drawing upon Edward Craig (1999), Kusch (2013) argues that the concept of knowledge originated due to the need to mark a specific type of social identity—namely, being a reliable informant. As a result, the concept of knowledge, like money and marriage, is itself a social kind. In contrast to natural or artificial kinds, social kinds depend on language speakers for their continued existence: if all language speakers disappeared, so too would all social kinds. On this view, the performative and constructive dimensions of language take on a greater significance than the ability to refer to mind-independent material objects. The anti-realist character of communitarian epistemology is clear: knowledge is anchored primarily to its role within social communities rather than to a mind-independent objective reality. Yet Kusch’s position, I argue, still entails an *attenuated* realism that leaves the door open to realist reconstructions.

Although the shift to a pragmatically oriented notion of language is salutary, Kusch retains a key aspect of the realist picture. On both views, the medium of language enables different cognitive subjects to possess *mutually shared* truths: on the classic realist picture, the shared truth is a physical aspect of the world; for Kusch, subjects recognize the same linguistically stipulated social roles. Accordingly, on Kusch’s account, there is a social normativity that is functionally analogous to the notion of mind-independent material objectivity. To illustrate the nature of social norms, consider the example of money: money’s existence requires people to

recognize it as essentially the same thing, as a means for exchanging goods. Likewise with regard to knowledge, members of a community must effectively recognize its meaning as designating a reliable informant. The proviso of *reliability* entails that Kusch's anti-realism is *not* radically voluntarist, since the reliability of informants is determined in no small part by their understanding of and ability to manipulate natural and artificial kinds. Kusch's communitarian epistemology thus displaces but does not eliminate the role of material determination, with the latter's role being mediated by socially constructed identities and other social kinds. Given this linguistic conception of normativity, I turn now to the rudiments of an embodied conception. My primary goal for the remaining portion of §1 is to use the following sketch to highlight some problematic features of the linguistic conception that would otherwise go unnoticed, contrasting them with an embodied interactivist model.

The decisive difference between embodied and disembodied epistemologies hinges upon a distinction between external *contact* and external semantic *content*. On an embodied epistemology, the former supplants the latter, a conceptual innovation that ultimately undermines the very notion of *mutually shared* semantic truths. This is the respect in which an embodied epistemology provides a stronger foundation for anti-realism, thwarting realist reconstructions. But with regard to human cognition, my critique of mutually shared truths will not be fully articulated until §4, when I reconstruct Kusch's conception of social identity; for the moment, I focus on how the concept of external contact entails a different picture of epistemic agency—a shift from epistemic agency as a passive content-receiver in favor of an anticipatory agent in continuous contact with his or her environment. To establish the basic difference between contact and content, I begin with Bickhard's account of minimal forms of epistemic agency.

Bickhard's interactivist model of representation shifts the question of representation away from the usual one of content to the act of representing itself (1996, 2002). This shift is made on the grounds that semantic content is derivative of an organism's embodied engagement with its environment. Representations, on this view, primarily serve to differentiate between different interactive *contacts*. Bickhard writes, "differing environments may leave that (sub)system [whatever initiates an interaction] in differing final internal states or conditions when the interaction is 'completed'. Such possible internal final states, then, will serve to differentiate possible environments" (1996, p. 60). The term "differentiation" expresses the semantic *opaqueness* between environment and interacting system. The final state reached does not bear informational content from environment to organism; instead, the only information that perceptual differentiators contain about the environment is that it caused the given final internal state within the

organism to be reached. The internal state thus only implicitly defines the environment (1996, p. 61). Differentiation and implicit definition are in this manner the two foundations of interactive representation.

Since Bickhard (1996) treats the *act* of representing as a precondition for representational *content*, all perception presupposes goal-directedness. Detailing a minimal form of epistemic agency is, in this regard, essential for illustrating how primitive goal-directedness is nonrepresentational. Rather than representations, at the most primitive level, goals are functional switches with a success result (e.g., further processing/anticipation of another interaction) and a failure result (e.g., a trial and error interactive process) (1996, p. 62).¹ This dovetails with treating viable self-maintenance as the most basic epistemic norm. In sum, perception consists of an opaque signal contemporaneous with an organism's engagement with its environment rather than an informational channel in which perception is the reception of external content. In the context of scientific argumentation, the opacity of perception has a number of implications; in §5, I consider the phenomenon of cross-talk between scientists as one consequence of this opacity and note some of the epistemic benefits of cross-talk within scientific communities in relation to Kuhn's essential tension. A more immediate implication of perceptual opacity is the intrinsic significance of interaction—interaction isn't merely an incidental or replaceable means for acquiring external content.

To illustrate the difference between interactive *contact* and external *content*, Bickhard (1996) reinterprets Fodor's (1990) frog example. For it to eat, according to the interactivist model, a frog does not represent, say, a fly or a worm. Instead, the fly and worm appear as two potential types of interaction: "tongue-flick-at-a-point" and "tongue-flick-between-two-points," respectively (1996, p. 64). The frog anticipates specific kinds of eating opportunities, the salient issue being how to flick its tongue rather than what the tongue flicks at. Frogs flick their tongues rather indiscriminately; fortunately, they live in a world where many of those flicking opportunities bear edible fruit. If philosophers took it upon themselves to shoot BBs across their fronts, this would change their world dramatically. Ingestion of metal spheres would constitute error and could trigger learning new behavioral patterns, but for the vast majority of frogs who have been spared the machinations of philosophers, BBs don't count as errors. The crucial point is that an organism anticipates its interactions and, in doing so, perceives its environment. Perceptual salience is a function of what surprises an organism, surprise only being possible given prior anticipations. Accordingly, learning is based on an error-guided relationship in which organisms cope with their mistaken

1. For two crucial discussions and defenses of intrinsic (nonrepresentational) intentionality, see Weber and Varela (2002) and Di Paolo (2005). I briefly consider the former in §4.

anticipations. One immediate upshot of this account of salience is that it addresses the “Frame Problem” in psychology and Artificial Intelligence.² This insight is made all the more compelling given the model of learning and higher-order abstraction that follows, which I turn now to explicating.

Bickhard (2002, p. 1) develops his model of learning by identifying two basic ways in which an organism can cope with error: (i) the regulation of the interactive processes between a rational system and its environment and (ii) the construction of new interactive “(sub)systems” that act as a “kind of metaregulation.” That is to say, upon encountering error, the two non-exclusive options for an organism are to (i) modify how it interacts with its environment or (ii)—to use mentalistic vocabulary weighted toward persons—refine its understanding of the interactive environment. The first and most basic type of error regulation, which most organisms are limited to, corresponds to the first level of Bickhard’s “levels of knowing” model (Bickhard 2002, p. 8). Rational systems such as humans can abstract from (i) and thereby represent aspects of the environment in terms of interactive possibilities. Importantly, this new level—which is the first instance of (ii)—is itself open to abstraction. Abstracting from (ii) would in turn create a new higher level of knowing that is also open to abstraction and so on, with no determinate upper bound on the levels of abstraction.

The parallel development of (i) and (ii) is reciprocally enabling. The abstractions of (ii) enable the creation of more specialized environmental niches that dramatically reshape (i). One notable example of an epistemic niche—thanks in large part to the efforts of Kuhnian epistemology—is the scientific research institution. Such communities facilitate novel forms of cognitive activity and levels of abstraction. This latter implication thus designates a way in which (i) reshapes (ii). That is, the construction of epistemic niches, such as research institutions, play an integral role in new levels of abstraction that fall under the direct purview of cognitive science. The development of (i) and (ii) thus run in parallel in the sense that there is no isomorphic correspondence between them—that is, (ii) doesn’t internalize (i)—even though the two mutually influence and enable developments within each other.³ De Jaegher and Di Paolo’s concept of participatory

2. Regarding the Frame Problem in AI, see Zenon Pylyshyn (1987). Interactivism’s ability to address this problem is indicative, I believe, of the general advantages of a non-exceptionalist approach to human cognition, in which embodiment and the details of engagement are not treated as incidental details. My main task in the present paper is to show the ramifications this has for the social epistemology of science.

3. The reciprocal relationship I have in mind corresponds to the notion of reflective equilibrium, as first conceived by Goodman (1983) and whose normative significance was highlighted by Rawls (1999).

sense-making (2007, 2008) occupies a special place with regard to this parallel development, since participatory sense-making relates directly to both (i) and (ii).

Participatory sense-making is Janus-faced. As developed from within cognitive science, it is concerned with the cognitive subject as such; while as a model of face-to-face interaction, participatory sense-making is concerned with an especially important type of epistemic niche. It should be noted, however, that one of the concept's most important insights—in concert with Bickhard's interactive model of representation—is that the cognitive subject cannot be modeled in a vacuum. Hence, participatory sense-making's concern with two-person interaction is not simply an add-on to a core subject but rather the articulation of a particular interactive mode. Separated from all modes of interaction, the cognitive subject is a meaningless abstraction. In the following, I show how participatory sense-making's insights with regard to two-person interaction shade into the larger-scale domain of scientific communities.

Participatory sense-making affords a valuable perspective on the mutually constraining relationship between cognitive science and social epistemology. The preceding sketch of an embodied epistemology provides some key considerations in articulating the relationship between the two fields: given an active anticipatory agent, the interactive context is of primitive significance rather than external content, and it is for this reason that the dynamics of interaction are not merely incidental details. Building upon these two points, in §4 I argue that the phenomenon of endogenous coordination dynamics explains how social interaction is epistemically productive without presupposing shared truths or a shared understanding between interactants. Indeed, the lack of understanding (e.g., cross-talk) is crucial to maintaining the essential tension within scientific communities. In §2, I sketch Thomas Kuhn's original account of the social dimension of scientific communities, which will help establish what is missing from neo-Kuhnian social epistemology that participatory sense-making addresses.

3. Kuhn's Narrow Conception of Social Epistemology

On the one hand, Thomas Kuhn (1962, 1977, 1992) sets the explanatory targets for much of the social epistemology of science while, on the other, suffering from some major lacunae that have been forcefully highlighted in the contemporary field. In *Kuhn's Evolutionary Social Epistemology*, Wray (2011) explicates Kuhn's philosophy of science with an eye towards the contemporary field of social epistemology. To understand Kuhn's uneven contribution, it is helpful to start with his formative interest in the psychology of discovery. In particular, Bruner and Postman (1949) influenced

Kuhn greatly.⁴ The key lesson that Kuhn drew from the study is that “perceptual organization is powerfully determined by expectations built upon past commerce with the environment” (Bruner and Postman 1949, p. 222; Wray 2011, p. 51). The study’s finding bears on the process of discovery in science. But despite Kuhn’s initial interest, Kuhnian epistemology is ultimately far more indebted to the philosophy of language than to psychological accounts of perception or any other *details* of embodiment.

Kuhn’s shift towards the philosophy of language was partly a response to criticism of *The Structure of Scientific Revolutions*. Given the criticism, Kuhn modified his understanding of scientific revolutions, no longer characterizing them as paradigm changes, which—akin to the Bruner and Postman study—he had described as gestalt shifts in perception (Kuhn 1962, p. 85; Wray 2011, p. 15). In place of gestalt shifts, scientific revolutions came to be understood as lexical or taxonomic changes within a particular discipline. This shift dovetailed with Kuhn’s emphasis on theory choice and the overarching role of the philosophy of language. One of the motivations behind Rehg’s (2009, p. 44) concept of cogency, as discussed in §5, is a dissatisfaction with Kuhn’s dependence on the philosophy of language.

Kuhn also viewed his taxonomic conception of scientific revolutions as a way to avoid the excesses of both realism and relativism. In consonance with the latter, Kuhn (1992, p. 115) held that science is not converging on a unified account of a theory-independent reality, as evidenced by the “evolution” and proliferation of new scientific disciplines. Yet contrary to relativism, Kuhn is an internalist with regard to theory change (Wray 2011, p. 160). In this context, internalism entails the claim that scientific disputes are settled on the basis of evidence rather than factors putatively “external” to science, such as political concerns or other such interests. Political concerns and the like are of *no* epistemic significance, according to Kuhn. The internalist position is directed especially against the strong program in the sociology of knowledge, which Kuhn invested a great deal of effort in criticizing, such as in his 1992 essay.⁵

4. In Bruner and Postman’s study, subjects were asked to successively identify playing cards, some of which were painted in the opposite color (e.g., a black three of hearts); it took on average four times longer for test subjects to identify these “trick” cards (1949, pp. 209–10).

5. Kuhn took particular issue with the strong program’s “symmetry principle”—in which the same types of explanations should be employed for successful *and* unsuccessful knowledge claims. Kuhn believes that the principle obscures the distinctive role that nature plays in scientists’ formation of beliefs. See Bloor ([1976] 1991) for the first and most famous defense of the symmetry principle; for an overview of the strong program, see Barnes, Bloor, and Henry (1996).

As evidenced by his critique of the strong program, Kuhn construes the social dimension of epistemology narrowly. The essential feature of science's social dimension is, on Kuhn's view, how individuals weigh objective criteria differently (Wray 2011, p. 161). Given the domain-general values of accuracy, simplicity, consistency, scope, and fruitfulness, for example, individual scientists will prioritize each differently, differences that impact the evaluation of competing theories. This subjective dynamic causes risk spreading within scientific communities and also offers another explanation for why scientific disputes can be protracted. Yet, insofar as it is epistemically significant, the subjective weighting of criteria acts *only* to spread risk within a community by ensuring that scientists will work on competing theories (Kuhn 1977, p. 332). The subjective factors ultimately *do not* play a role in theory choice: after some period of time, the community's efforts either produce a clear winner (one that everyone endorses) or the community branches into different specialties.

Philip Kitcher challenges Kuhn's exclusion of political interests for very different reasons than those of the strong program. Taking up the theme of risk spreading, Kitcher (1990) argues that a broad range of interests are in play. In a scenario reminiscent of James Watson and Francis Crick's discovery of DNA's structure, Kitcher imagines a community of scientists pursuing the structure of a very important molecule ("VIM"). In a situation where the discovery would earn a coveted prize (e.g., a Nobel Prize), Kitcher argues that a community composed of ruthless egoists would achieve a better spread of effort and risk than if all of the scientists were pursuing high-minded ideals (e.g., acquiring truths) (1990, p. 16).⁶ Additional and less sordid interests—such as national or personal loyalties, personal investment, and so on—also ensure a diverse distribution of effort. It is important to note that Kitcher's incorporation of these diverse interests rests on the same justification as Kuhn's own understanding of the social dimension of science: for both, these social factors are instrumentally valuable for furthering research. Kitcher thus shows that one of Kuhn's most important themes—the distribution of risk within a community—involves a diverse range of interests that promote rather than detract from scientific enquiry and thereby should not be counted as external to science. Specifically, Kitcher makes the compelling (and, in retrospect, somewhat obvious) point that the credit mechanisms of science are not incidental to its progress and growth; indeed they are more than incidental to its very subject matter.

6. D'Agostino's discussion of communication inhibitors, such as first-mover bias and social comparison pressures, bolsters Kitcher's point by suggesting that there are common social factors that can overwhelm the differential weighting of objective criteria (2010, pp. 53–54).

Treating the social dimension of science as strictly an instrumental resource is one limitation of Kuhn's epistemology. Kitcher's immanent critique broadens the range of relevant factors but, importantly, still retains the basic presupposition that the social dimension is just an instrumental means. This type of instrumentalism in social epistemology is a crucial source of vulnerability to realist undertow: it appears as though the social dimension is just a means for acquiring objective truths. Further broadening Kuhnian epistemology by shifting away from Kuhn and Kitcher's focus on risk distribution in favor of examining epistemic divisions of labor, Fred D'Agostino mitigates this vulnerability to realist reconstructions.

4. D'Agostino's Federal Model of Enquiry and the Inexhaustibility of Descriptions

D'Agostino (2010) is interested in the actual process of breaking complex, multifaceted problems down into manageable parts that individuals can work on. One of the central difficulties is that properly dividing up a problem often presupposes the very knowledge that a community is pursuing. The federal model of enquiry is both a description of and a normative prescription for how scientific communities cope with this ineliminable difficulty. Accordingly, the inseparable relationship between description and prescription is one of the key insights of D'Agostino's account, which I will argue in §4 is best understood within an embodied epistemology. D'Agostino's account falls short of adopting an embodied framework, which I think explains its remaining vulnerability to realist re-interpretations as detailed later in the present section.

D'Agostino organizes his account of epistemic divisions of labor around the concept of an "assembly bonus," a concept adopted from social psychology and management science. The concept of an assembly bonus refers to a benefit wrought from pooling the cognitive efforts of different individuals without specifying any particular type of task or activity (Collins and Guetzkow 1964). One reason for drawing upon fields such as management science is a lack of substantive analyses of epistemic divisions of labor within social epistemology, despite being a familiar theme. Kitcher (1990), for instance, only addresses its "subjective" dimension—that is, how individual attitudes to a problem differ (D'Agostino 2010, p. 113). The subjective dimension, as D'Agostino understands it, consists of interpersonal communication issues, such as the previously noted issues of first-mover bias and social comparison pressures. And Kitcher's egoistic pursuit of prizes represents one means of overcoming such obstacles.⁷

7. D'Agostino notes other "disinhibitors" that help to overcome communication issues, such as "multiple accountabilities," "novelty premiums," and "asset ownership" (2010, p. 64).

The “objective” dimension of epistemic divisions of labor refers to the process of breaking down problems for collaboration. Given this task, D’Agostino considers how four types of enquiry fare: exhaustive, myopic, parallel, and modular enquiry (2010, pp. 119–27). To illustrate these four types of enquiry, I turn now to amplifying one of D’Agostino’s own examples involving the design of a computer, specifically its motherboard and hard drive systems (2010, pp. 122–25). Beginning with the first type: in an exhaustive enquiry, every conceivable technical design of the motherboard and hard drive systems would be attempted. Once every possibility has been evaluated, the optimal combination is selected (2010, p. 119). Exhaustive enquiry guarantees finding a global optimal solution—the best available design for the motherboard and hard drive—but is inefficient given its time and resource demands.

A myopic enquiry, the second type, randomly selects a single trait of either system and tinkers with it, searching for any added value. Tinkering with a trait stops when it results in neutral or negative value. With regard to the computer example, myopic enquiry fosters iterative improvements on the motherboard and hard drive systems in a timely manner (2010, p. 120). Myopic enquiry is thus efficient but ineffective for finding an optimal solution.

The other two types of enquiry—parallel and modular—are more sophisticated approaches. D’Agostino first introduces the computer design problem to highlight the potential yet ultimate weakness of parallel enquiry. Rather than treating the design space as one undifferentiated whole, parallel enquiry proceeds by breaking the space down into independent tasks, in this case the motherboard and hard drive problems. This enables separate teams to survey more designs for each component in a timely manner but presupposes that the problem space is decomposable. Any residual interdependencies between tasks renders a parallel enquiry inconclusive, potentially pitting teams at cross purposes; in this particular case, there were as many conflicting design possibilities as compatible ones between the motherboard and hard drive systems.

The final type of enquiry is a response to the fact that problem spaces often cannot be decomposed without residual interdependencies, especially not without the very knowledge of the domain that is sought after. Modularity is a design that creates a “high degree of independence or ‘loose coupling’ between component designs by standardizing component interface specifications” (D’Agostino 2010, p. 128). Modularity thus reflects the fact that standards must be constructed for how decomposed components should relate to each other. The construction of standards, which ensures consistency between individual tasks, comes at a cost. The modularized interface between tasks minimizes the possibility of conflict but, in doing

so, constrains the ability of individuals to explore possible solutions. This is the basic sense in which fixing parameters imposes a *path dependency* on the eventual solution. In terms of the computer design example, parameters were placed on which potential motherboard and hard drive designs could be explored by each separate team. Only an exhaustive enquiry can guarantee that there's not a more effective global solution outside of any such standardized parameters, but using an exhaustive enquiry to validate a modular one would undercut the latter's efficiency. Modularity thus mitigates though does not eliminate the trade-offs between efficiency, effectiveness, and conclusiveness found in exhaustive, myopic, and parallel enquiry, respectively. Modularization is not by itself a methodological blueprint for enquiry but depends on broader dynamics within epistemic communities.

Given the limitations of modularity, D'Agostino notes the need for "*both division and diversity to pursue enquiry in complex situations*" [emphasis in original] (2010, p. 134). That is, it is necessary to have different teams create different design rules and then compete, producing knowledge that is less myopic than a single modularization but still much more efficient than an exhaustive enquiry. Having competing teams thereby mitigates but does not eliminate the myopia that results from modularity's path dependency. D'Agostino writes, "we are stuck with history ... 'the explanation of why something [such as a problem-solution] exists rests on how it became what it is'" (2010, p. 135). Solutions to complex problems must be understood in terms of historical paths. The arbitrariness that results from path dependency is independent of the arbitrariness produced by the sordid motives of individual researchers (p. 136). That enquiry should be understood in terms of where it has come from rather than as approaching a determinate endpoint is not merely an artifact of the rhetorical demands of winning arguments—or the sordid motives of enquirers—but is intrinsic to the very posing of problems and tasks. In this regard, D'Agostino highlights a more profound social dimension of science than recognized by Kuhn or Kitcher.

Building upon the generic notion of an epistemic division of labor, D'Agostino proposes a "federalist model" of enquiry. The basic purpose of the model is to conceptualize how intra-research team dynamics relate to the community-level competition of different teams. The federal model demarcates a community of enquiry along a horizontal and a vertical axis consisting of "jurisdictions" and "levels," respectively (2010, p. 147). A jurisdiction consists of a deliberative body that partitions a research domain. Some jurisdictions run in parallel to each other, some overlap, while some subsume others. Levels correspond to hierarchies between various jurisdictions, the highest level possessing only one deliberative body.

At lower levels, the deliberative bodies are research teams that work roughly in parallel and compete with each other. Higher levels act as “adjudicators” for lower ones, with the highest level being the final adjudicator. An adjudicator has a privileged perspective on the competition between two teams, possessing more information than either team had when each began and being less attached to either solution than the respective teams (2010, p. 149). The federal model, with its horizontal and vertical axes of enquiry, to some extent idealizes the structure of actual epistemic communities.⁸ In a particular community of enquiry, the roles of team member and adjudicator are often mixed up, with individuals serving multiple functions and working on multiple teams.⁹

The two-axis model of epistemic communities identifies in abstract terms cognitive processes that are endogenous to particular communities. Within a research team, individual cognitive tasks are structured by modular interfaces in order to coordinate with other individual efforts. That is to say, individual efforts are *not* isolated activities that are aggregated to form a group product. The significance of modularization is evident from the need for competition between different groups, a result of the myopia induced by modularization’s path dependency. Furthermore, the crucial role of adjudication can only occur within such a community. In sum, the efforts of individuals can be properly understood only in relation to how they complement and compete with each other’s efforts. Furthermore, the risk spreading emphasized by Kuhn and Kitcher suggests that, in such communities, individuals themselves understand their efforts in relation to others.

The emergent patterns identified by the federal model of enquiry are, I argue, general types of *coordination*. On my reading, the federal model identifies patterns of joint sense-making—which De Jaegher and Di Paolo (2008, p. 42) define as a cognitive activity whose meaning cannot be explicated in terms of discrete individuals. In this way, the federal model extends the insights of participatory sense-making to larger social contexts. Yet even though his account complements participatory sense-making, D’Agostino himself falls short of endorsing an enactivist or any other embodied framework. This is in part because, as noted above with regard to his anti-realist position, D’Agostino brackets the issue of the fundamental

8. Kitcher and Wray both allude to the federal model’s two axes. Of most direct relevance, Kitcher notes that a purely self-interested community of individuals only excels if it is divided up into “fiefdoms” (1990, p. 17). Yet Wray nor Kitcher explore the general dynamics between these two axes.

9. As I detail in §5, Rehg’s (2009) Fermilab case study substantiates and also complicates D’Agostino’s model of parallel and vertical axes of enquiry.

nature of knowledge in order to focus on describing epistemic communities. The upshot of this argumentative strategy is that D'Agostino's account stands on its descriptive merits, which makes the account relevant for a wide range of theorists. The downside, however, is that the account remains open to realist undertow.

Ladyman (2012, p. 605), for example, faults D'Agostino (2010) for not addressing the question of *what* knowledge and justification are. Such questions must be addressed, Ladyman thinks, in order to *naturalize* epistemology, which the title of D'Agostino's book promises to do. Ladyman thus proposes that a more appropriate title would have been "socializing knowledge" (2012, p. 605). Accordingly, Ladyman suggests an individualistic reconstruction, with Kuhn's essential tension existing at the individual level. D'Agostino's description of community dynamics would thus explain how a larger social group balances out the more fundamental blend of conservative and innovative impulses that co-exist in each individual (Ladyman 2012, p. 606). While Ladyman doesn't himself pursue the following line of reasoning in his brief review, his proposal can cite D'Agostino's own distinction between the objective and subjective dimensions of the division of labor and claim that the former is more fundamental.

It is clear from D'Agostino's own account how the objective dimension shapes and supports the subjective one. D'Agostino writes, "the very existence of the objective impediments may serve to 'tune' our communities of enquiry to work effectively in overcoming the subjective impediments" (2010, p. 143). It is important that the environment is a complex problem space because this complexity is what elicits and fosters a division of labor and a diversity of approaches. Yet the reciprocity of the relationship—how the subjective dimension shapes and supports the objective one—is not as apparent. D'Agostino (2010, p. 89) details the significance of having an appropriate culture of enquiry, such as a culture that includes shallow consensus.¹⁰ But such considerations are easily re-situated within Ladyman's individualistic epistemology as mere exigencies and, as such, they would be incidental to the nature of objective knowledge.

Ladyman's reconstruction could even grant that human understanding of objective reality is always tied to and constrained by the historical trajectories of our epistemic communities. On this Ladyman-inspired reading, enquirers compete with each other to better approximate aspects of the objective world, despite being stuck with inherent arbitrariness. This

10. The term 'shallow consensus' refers to communicative patterns within epistemic communities in which agreements provisionally conceal underlying disagreements. In §5, I relate this communicative pattern to the opaqueness of perception using Rehg's account of scientific argumentation as an intermediate link.

interpretation is consistent with Kuhn's evolutionary epistemology so long as it is not claimed that all of science's disciplines approximate the objective world in a unified manner. Hence, this interpretation reads Kuhn's evolutionary epistemology as essentially a contemporary version of the Tower of Babel story. In sum, while D'Agostino shows how the social epistemology of science informs cognitive science—counteracting the latter's tendency to treat interactive environments as merely input for cognitive processing—it is also important to recognize how cognitive science informs social epistemology. To identify the sense in which the subjective dimension shapes objectivity—and to show how cognitive science informs social epistemology—I return to Bickhard's account of nonrepresentational embodied directedness.

Bickhard's frog example (§1) explains how the subjective dimension shapes and constrains objectivity, thereby blunting realist reconstructions of D'Agostino. The lesson of the example is that a frog perceives tongue-flicking opportunities (e.g., a flick-at-one-point, a flick-between-two-points, and so on)—as opposed to first identifying an object (e.g., a fly or worm), then determining whether it is edible and, if so, what tongue flick the object demands, and, finally, acting on a desire to eat by actually flicking its tongue. Rather than referring to a mind-independent material entity, objectivity is a function of how an organism partitions its world into interactive possibilities: that is, how an organism anticipates, acts, and then differentially responds to the feedback from its actions. Only if there were a dramatic change in a frog's environment—such as people flicking BBs in the frog's visual field—would a frog need to refine its discrimination of tongue-flicking opportunities. But even given such a refinement, perception would still consist of differential contact rather than the reception and subsequent processing of external content.

An embodied epistemology, as articulated by Bickhard's model of error-guided learning, is thus one way of responding to Ladyman. If knowledge is in its most primitive form skillful interaction with the world—not a contentful mental state—then providing a “how” as opposed to a “what” account does, in fact, help to *naturalize* epistemology. Yet it is not entirely clear how sympathetic D'Agostino is to an embodied epistemology. As noted above, D'Agostino's anti-realism is aligned with the linguistic turn of Rorty and Kusch. The closest that D'Agostino (2010, p. 20) comes to endorsing an embodied epistemology is in his discussion of “bounded rationality.” Bounded rationality is a formal description of some cognitive limits inherent to finite beings. With the concept, D'Agostino shows that the collectivization of inquiry is a response to “in principle” considerations as opposed to merely practical exigencies. That is, epistemic communities are more than the aggregate effort of what would happen if a single individual had more time.

Of the seven factors that D'Agostino notes in connection with bounded rationality, the first and most important one is inexhaustibility. Echoing the familiar Kuhnian theme of nominalism, inexhaustibility refers to the endless ways in which any material state of affairs can be described (2010, p. 21). In this respect, D'Agostino's anti-realism, like Kusch's own (§1, §4), is closely tied to the philosophy of language. This focus is borne out by the rest of the factors that D'Agostino discusses. Reflexivity, for example, is even more closely related to Kusch: when a claim is made regarding agents and those agents subsequently become aware of it, the claim may be either reflexively undermined or confirmed. Reflexivity thus highlights the performative dimensions of language use, which is central to Kusch's account. Rather than linking these factors to the embodied nature of cognition, D'Agostino moves towards more abstract matters. The other factors of bounded rationality explicate the nominalist implications for human deliberation.

In an earlier article, D'Agostino (2006) gives a more extensive analysis of bounded rationality. In the article, D'Agostino contrasts a planning conception of reason with the emergence in a number of fields (e.g., economics, political theory, and management science) of an improvisational conception of reason. D'Agostino argues that not only is the planning conception a woefully inadequate description of human problem solving, it can also "stupefy" those who promulgate it. Acting in accord with the planning conception can hinder an agent's attentiveness to her environment—exemplified, for instance, in scrutinizing a pre-established plan in the face of an unexpected eventuality rather than improvising based on the particular situation (2006, p. 11). D'Agostino thus emphatically treats reasoning as a context-specific process. But even given the priority of interactive contexts, without an embodied epistemology, it's still possible to posit an underlying and more fundamental cognitive core. That is to say, precisely delineating the improvisational conception of reason from the traditional one requires showing how embodied cognition entails that rationality is in its most primitive form a refinement of an organism's interactions.

Thus far, I have only illustrated embodied rationality in terms of frog tongue-flicking, a case of minimal epistemic agency far removed from the concerns of social epistemology. In §4, I present a second illustration, one that falls squarely within the domain of social epistemology, when I reconstruct Kusch's conception of social identity. One of the chief obstacles to making this connection, however, comes from neo-Kuhnian social epistemology itself; in the next section, I link the previously discussed notion of inexhaustible descriptions to broader movements within social epistemology. I will use Steve Fuller, one of the field's most influential theorists,

as an exemplar in this regard since he explicitly endorses a disembodied rationality. This critical discussion provides the resources for then reconstructing Kusch's communitarian epistemology.

5. Disembodied Social Epistemologies

In the present section, I contrast my proposed synthesis of social epistemology and cognitive science with disembodied varieties of social epistemology. The hallmark of the latter is the belief that social interaction rests upon mutually recognized (i.e., socially *objective*) truths. The two figures that I focus on in the present section—Steve Fuller (2002, 2011, 2012) and Martin Kusch (2002a, 2002b)—each endorses such a view, with differing emphases and aims. Concerning the former, despite my discussion of Fuller's social epistemology being necessarily abbreviated, I address it for three reasons: first, Fuller has directly influenced D'Agostino's federalist model; second, his influence on social epistemology as a whole offers a more general perspective on the anti-realism prevalent within the field; and finally, Fuller explicitly endorses a disembodied conception of rationality. Fuller's explicit avowal further highlights what is at stake between embodied and disembodied conceptions of social epistemology. In the present section, I focus on the differing accounts of normativity that each entails; I argue that the embodied conception provides a more nuanced and heterogeneous account of normativity, one that strengthens the Kuhnian notion of an essential tension. My discussion of Fuller is, in this context, not intended to be the final word on his social epistemology but rather only clarifies the tensions between embodied and disembodied accounts.

Fuller's influence on D'Agostino is direct and, in a number of ways, salutary. D'Agostino's *federalist* model of enquiry builds in part on Fuller's claim that epistemology is nothing other than political philosophy applied to the community of enquiry (Fuller 2002, p. 6; D'Agostino 2010, p. 151). The political nature of epistemology stems from the same basic issue raised by Kitcher (2001, 2011)—namely, scarcity of resources. Fuller (2012) writes:

Much of the ongoing discussion, especially among analytic epistemologists, about whether science “aims for the truth” has been misdirected because, in my view, the interesting disagreements arise less over that question than which truths are worth pursuing and the means by which they are pursued (p. 269).

The problem of how resources should be allocated in scientific research, which analytic epistemology has neglected, stems in part from the inexhaustibility of descriptions. Any given material state of affairs can be described in an indefinite number of ways, each description expressing a different truth. A truth thereby fails to indicate whether it is more salient

than other truths. Fuller adds another dimension to inexhaustibility, describing himself as a “realizationist”: “my position would be more accurately described as ‘realizationist’ (rather than, say, ‘relativist’). I believe that we increasingly come to turn into reality whatever we conceive” (2012, p. 272). Material states of affairs are themselves pliable—not just descriptions of them. In this way, Fuller underlines the inherently political character of scientific research: researchers’ use of limited resources shapes the physical reality of humanity’s future in accord with particular priorities and values. D’Agostino’s federalist model conceptualizes some of the social structures that enable scientific communities to negotiate these issues. But unlike the federalist model—which is compatible with (even if lacking) an embodied epistemology—Fuller embraces a disembodied conception of rationality, as evidenced in his model of how the public via social epistemology can inform scientific research.

Optimism permeates Fuller’s discussion of how the public can inform scientific research, an optimism concerning science’s potential for shaping reality to suit our desires. Fuller’s vision of humanity’s future—while driven by the rhetorical aim of highlighting the politics of science—betrays a disembodied conception of rationality and normativity. Given the wide range of research possibilities to pursue, Fuller beckons to *trans*- and *post*-humanist possibilities. Trans-humanism is founded on the idea that humans are “intellects that happen for now to possess animal bodies” (Fuller 2011, p. 63). That Fuller even considers trans-humanism a possibility implies that the body does not play any intrinsic role in cognition. The body, instead, appears as an aggregate of material needs that the mind takes care of as if they were menial chores. The body’s physical needs are thus considered incidental to the mind’s powers—as if the body were just another aspect of the material world that biologically dependent minds wisely choose to maintain. According to this picture, a human mind could just as easily perceive potential food as the color of tree bark—if, that is, the mind were freed from the chore of feeding a body. It is with regard to this point—detaching cognitive abilities from the body—that Fuller endorses a disembodied epistemology.

Given a disembodied epistemology, values like political equality and liberty appear as objective normative standards. Fuller believes that trans-humanism, for instance, fosters equality by freeing people’s minds from bodies that exist within inherently unequal material circumstances. Accordingly, liberty consists of a mutually shared freedom from material inequality; it is an objective goal for science to pursue, providing a blueprint for scientists to engineer humanity’s future. On this view, Fuller (2002, p. xvi) sees social epistemology as a shared foundation for our epistemic undertakings: on the one hand, it informs the public of the competing values at stake in different lines of enquiry and, on the other,

informs scientific communities of the public's preferences. Fuller thus offers a compelling vision of social epistemology's role in science and society, one that is a major advance over Kuhn's narrow social epistemology (§2). But treating norms as mutually shared objective standards obscures social normativities that endogenously emerge in actual social encounters within epistemic communities. To provide an alternative to the notion of objective norms, as well as a revised picture of social epistemology's role, I now revisit Bickhard's concept of intrinsic intentionality and error-guided learning (§1, §3).

Intrinsic intentionality is the basis for but does not itself consist of conscious intentions or representational aboutness. This distinction corresponds to Weber and Varela's (2002, p. 100) distinction between two senses of teleology: the most common sense of "external seemingly purposeful design" corresponds to representational aboutness while the second sense—"internal purposes immanent to the living"—denotes the biological nature of intrinsic intentionality. While Fuller thinks that the normative dimension of social epistemology is exhausted by conscious design (i.e., engineering the future to suit our desires), on the embodied view, values emerge from and remain intimately linked to the immanent purposiveness of living beings. Cognition, on this latter view, consists of an inherently value-laden perspective on the world; as opposed to being an incidental chore, metabolic constraints are the originary source of meaning and serve as the most basic normative standards for learning. Given this concept of intrinsic intentionality and immanent normativity, I turn now to their implications for the domain of science, a context thoroughly awash in representations, in contrast to the cases of minimal cognition favored by Weber and Varela in which the role of metabolic constraints are apparent. Bickhard's interactivist model has already provided an important first step to achieving this by grounding representations in nonrepresentational goal-directedness. To strengthen the link between, on the one hand, Bickhard's model of representation and error-guided learning and, on the other, the social epistemology of science, it is helpful to first revisit the normative implications of D'Agostino's federal model.

In his brief remarks on the normative implications of his federal model, D'Agostino hints at more nuanced forms of normativity than envisioned by Fuller. Near the end of *Naturalizing Epistemology*, for instance, D'Agostino styles his account as possessing "a definite whiff of the normative" (2010, p. 178). While D'Agostino pitches his account on the basis of its descriptive merits, he notes that a map of a terrain—such as his mapping of epistemic communities—has normative implications for any user, even if the mapmaker doesn't tell the user where to go. D'Agostino's point, as noted in §3, rests on the inexhaustibility of descriptions: no single description can

be treated as *the* objective account and so, as a result, the editorial decisions of the mapmaker reflects certain priorities and thereby values. This is an important insight that is consistent with—indeed highlights the role of—Fuller’s realizationist vision of social epistemology. But the inexhaustibility of descriptions—if it is taken to be the fundamental level of normativity—remains vulnerable to realist undertow: the social dimension appears as just a practically necessary means for getting a handle on and reshaping objective material states-of-affairs. But the inexhaustibility of descriptions fails to capture the most basic level of normativity—embodied directedness.

On the embodied view that I have developed, descriptions are higher level refinements of nonrepresentational goal-directedness. In terms of Bickhard’s levels of knowing model, descriptions repartition an agent’s interactive possibilities. To describe something is to abstract from a particular interactive context, with the greater abstractness affording new interactive possibilities and potential errors, creating a new level of knowing.¹¹ Likewise, given that rationality is primarily geared towards refining interactions, there is an in-principle motivation for understanding reason as improvisational, as proposed by D’Agostino (2006). The primacy of embodied interaction indicates a fundamentally different conception of objectivity, one that thwarts realist reconstructions, such as envisioned by Ladyman above. On the embodied view, objectivity is constituted by an agent’s interactive potentialities rather than being a material state of affairs that an agent has chosen to attend to amongst an infinite number of other possibilities. Whereas on the latter account, the impossibility of value-neutral descriptions is only the result of the need to exercise editorial control over one’s conscious attention, the embodied view points to a more fundamental kind of normativity. The normativity of nonrepresentational embodied directedness is integral to the very constitution of objects and, as noted in §1, is responsible for what appears as perceptually salient.

The context-specificity of rationality and normativity suggests a decidedly more modest role for the social epistemology of science than Fuller envisions. Fuller’s picture is more aligned with what D’Agostino refers to as the “planning conception” of reason than the improvisational one: social

11. Beliefs are, on this view, an especially important form of abstraction but neither an epistemically nor normatively primitive one. In exploring the nature of perception, Maurice Merleau-Ponty ([1945] 2012, p. 32) makes a related though more fundamental point. Criticizing both empiricist and intellectualist accounts of perception, he argues that conscious attention to one’s experiences does not clarify “preexisting givens” but rather actively constitutes new, determinate objects. Merleau-Ponty thus considers all conscious thought as derivative upon agents’ embodied interaction with their environments. Hence, the significance of beliefs stems from their determinacy *but not* primitiveness.

epistemology is meant to identify the goals of humanity's future (e.g., post-humanism), which scientists can then engineer. Contrary to Fuller's vision and in keeping with the improvisational conception of reason, I argue that social epistemology's role is more retrospective than prospective, useful for identifying interactive patterns within epistemic communities. This type of project is exemplified by D'Agostino's federal model. The interactive patterns indicate, in part, inchoate forms of normativity; in particular, social epistemology's population-level perspective can point to patterns that do not correlate with and may even be contrary to the conscious intentions and epistemic goals within a community, such as the communication inhibitors that D'Agostino discusses. To flesh out more of the immanent normativity at work in such scenarios, I will reconstruct Kusch's communitarian epistemology within an embodiment framework.

But before reconstructing Kusch's account, I want to consolidate some of the terminology discussed thus far. Over the course of the paper, I have offered a series of dichotomies; in §1, I began with two sets—an embodied epistemology aligned with anti-realism in contrast to a disembodied realist epistemology. Building upon this division, in §3 I argued that the former dovetails with an improvisational conception of reason in opposition to the planning conception. As suggested by my critique of Fuller's social epistemology, the division between these three sets of dichotomies ultimately concerns whether cognitive content is immanent (i.e., generated by particular agents acting within specific contexts) or context-independent (i.e., a mind-independent material state of affairs). Discussions of the inexhaustibility of descriptions can easily obscure this division, since inexhaustibility offers a more circumscribed perspective on the impossibility of value-neutral science, one that is compatible with realism. The issue with *attenuated* realist accounts is that they posit a determinacy at the most fundamental level of normativity, which obscures inchoate forms of normativity inherent to social interaction. In §5, I use Rehg's concept of cogent argumentation to highlight the immanent and inchoate normativity within scientific communities. But first I want to revisit Kusch's communitarian epistemology in order to better clarify what is problematic about the determinacy of attenuated realism and also to show how an immanent embodied framework can recapture the worthwhile insights from such accounts.

As discussed in §1, Kusch's communitarian epistemology stresses the performative dimension of language. The ability to use language to refer to mind-independent aspects of reality (i.e., natural and artificial kinds) is of secondary importance to the creation of "social kinds," which includes the concept of knowledge. To recap, knowledge is primarily a means for marking the social role of being a reliable informant. On this picture, social kinds act as a shared foundation for social interaction. With regard

to being knowledgeable, an interaction involving a person who holds the status will be structured such that he or she will be expected and trusted to provide information. Language provides a stability that imbues social kinds with a meaning that supersedes the particulars of any given social interaction. Social identities thus function as a mutually recognized or shared foundation for interaction.¹²

The determinate identities posited by communitarian epistemology create the following dilemma. Either the shared social identity is so vague as to be vacuous, or it is so rich that it is wildly implausible that it is actually shared by individuals. To address this dilemma, my alternative account of social identity jettisons the notion of a *shared* identity in favor of a more ephemeral and inchoate notion that is geared towards and derivative upon actual engagement between individuals. Using my characterization of the normativity of descriptions as a guidepost, I treat social identities as opaque coordinating factors that structure interaction.

As ambiguous descriptors, the meaning of social identities depends on the particulars of actual interactions, including each individual's unique experiential history. A social identity is an abstraction, which—like other kinds of descriptions—partitions an interactive space, thereby modifying the perceived range of relevant interactive opportunities. The range of interactive opportunities is partly a function of an agent's prior interactions, on the basis of which she has refined her expectations when confronted with negative feedback. It is in this sense that social identities serve as coordinating factors or behavioral attractors, as understood in terms of De Jaegher and Di Paolo's (2007, 2008) concept of participatory sense-making.¹³

Thinking of social identities as coordinating factors helps to explain a social status's relatively stable meaning without annihilating the idiosyncratic dimensions and intrinsic significance of social interaction. Salient differences in individuals' respective perceptions of a social identity can be smoothed out (or further entrenched) via the continuous feedback and refinement of encounters. There may even be crucial differences in

12. In accordance with this picture, Kusch states that the goal of communitarian epistemology "is to understand, rather than change, epistemic communities" (2002a, p. 2). Kusch thus sees his communitarian epistemology as *purely* descriptive. But communitarian epistemology's goal wrongly presupposes that description and understanding can be value-neutral.

13. While social identities and linguistic descriptions appear discordant with De Jaegher and Di Paolo's (2007, 2008) own examples of coordinating factors, this is a result of their rhetorical context. Their main objective is to counter cognitivism within the philosophy of mind. Furthermore, I am treating social identities in terms of how they influence social interaction, thus maintaining the priority that De Jaegher and Di Paolo give to the dynamics of engagement.

individuals' understanding of a social identity that go unnoticed because circumstances have not yet brought them to the fore. This is the sense in which social identities are shallow or opaque, analogous to D'Agostino's (2010) notion of shallow consensus (§3). Agreement conceals pervasive underlying disagreements, but without undermining the role that social identities play in interaction.

To illustrate how a social identity can structure interaction, I offer the following hypothetical scenario, inspired by D'Agostino's federal model. Consider the effect that learning of social comparison pressures within scientific communities could have on an individual researcher. The researcher might, for instance, be less likely to remain reticent when another team member voices a point at variance with her own findings. When offering a dissenting viewpoint, she can think of herself as searching for a "hidden profile" as opposed to making trouble or attacking her team member. This difference can be expressed in terms of the contrasting roles of a team helper as compared to a trouble-maker. The difference can have a decisive influence not only on whether the dissenter will share her divergent findings but also influence whether the contribution is a constructive one. The perspective of helping one's team is a stronger rhetorical position than challenging a team member.¹⁴

The relevant social identities in my example—"team helper" and "trouble-maker"—are more ephemeral than an idealized status like "being knowledgeable." The hypothetical scenario thus diverges from Kusch's discussion, yet I think such improvised social roles draw attention to the formation of identities and thus the dynamics that underpin more stable ones. Accordingly, I propose that more stable and widely recognizable social identities are a product of the same general dynamics—an opaque abstraction that is continuously refined and reinforced via social encounters. A linguistically centered account, by contrast, implies that a social role has a determinate function or set of functions, such as knowledge reducing to being a reliable informant. In this regard, Kusch's account dovetails with the problematic instrumentalism of Kuhn and Kitcher discussed in §2.

Rehg's (2009) concept of cogency dovetails with the embodied interactionist account of social identity. Cogency, for Rehg, represents the many context-specific factors that determine whether an argument is found to be persuasive within a scientific community. Possible factors include values such as openness, a person's argumentative temperament, and who receives credit. The indefinite range of possible factors is offset by the need for

14. Conversely, Rehg (2009) offers a case of a researcher who lacks sensitivity to the rhetorical dimension of enquiry and, as a result, is excluded from a scientific community. I detail this case and the rhetorical dimension of enquiry in the next section.

individuals to demonstrate a factor's relevance to a particular situation. Rehg thus suggests that the normativity of scientific argumentation involves "microdynamics" specific to particular interactive contexts (p. 2009, p. 67). In the next section, I bolster my critique of Fuller and Kusch's disembodied social epistemologies by detailing the contextual normativity of scientific argumentation.

6. Cogency and the Immanent Normativity of Scientific Communities

Rehg's guiding theme (2009) is "Kuhn's Gap," which refers to occasions when an argument is persuasive but not logically compelling. Rehg's concept of cogency relates to the "microdynamics" of persuasion in comparison to Kuhn's focus on macro-social institutional forces. Kuhn's merely superficial treatment of persuasion is evident from Wray's depiction of the evolutionary aspect of Kuhnian epistemology: when a scientific community confronts a theoretical dispute, either there will ultimately be a clear winner or the community splits into separate disciplines (§2). D'Agostino improves upon Kuhn by drawing on psychology and organizational studies, as detailed in §3, but still only considers these factors in terms of institutional dynamics that hinder or promote communication. D'Agostino's focus on macro-social institutional forces is exemplified by the federal model's two-axis depiction of epistemic communities.

With its treatment of microsocial dynamics, Rehg's theory of argumentation helps substantiate the link between Bickhard's model of the embodied cognitive subject and the institutional forces discussed by Kuhn, Wray, and D'Agostino. Rehg begins with the common idea of cogency, namely cogency as the "convincing quality" of an argument (2009, p. 6). This open-ended definition enables the term to cover a range of meanings, with the disparate meanings a reflection of cogency's context-dependence.

As one illustration of cogency's context-specificity, Rehg examines the process of collaboration and publication at Fermilab. The case study specifically deals with the research and discovery of the top quark, which spanned the years 1993–1995. Fermilab is an institution within which many different research teams collaborate. In connection with the top quark research, there were four separate teams: two teams counted lepton decays, one counted dilepton decays, and a fourth team reconstructed the kinematics of the decay events (Rehg 2009, p. 169). To pool and publish the four teams' results, the writing process involved four social roles: convener, godparent, writer, and audience (2009, p. 171). Two people acted as *conveners*, whose task was to convene meetings and record their minutes. The conveners asked each team to appoint a *godparent*, whose task was to provide an independent critique of the paper drafted by the *writers* (the third role). After the draft passed the godparents, it was then to be presented

to the *audience*, which consisted of all the Fermilab scientists who were not part of the four teams. The presentation to Fermilab as a whole acted as a final check before journal publication.

The case study exhibits the basic features of D'Agostino's federal model while also presenting some complications. The four teams worked in parallel, corresponding to the horizontal axis of the federal model, yet only two used the same technique. The difference in methodology led to some controversy regarding the kinematics group's claims, which I return to below. There was also a complication with respect to the vertical axis: while the godparents were meant to provide an independent critique of the paper draft, they ended up participating directly in its writing. The break with agreed-upon procedure, while criticized, was justified on the grounds that it improved the quality of the paper (Rehg 2009, p. 172). Hence, procedures and institutional structures were improvised upon when it was considered beneficial to the research.

The writing procedure—that is, the four social roles and three writing phases of draft, revision, and presentation to Fermilab as a whole—was adopted in the wake of having rejected a “four short papers” proposal. The rejection of this proposal—referred to within Fermilab as the “October massacre”—was due to the view that the papers were being rushed without sufficient vetting and motivated adopting the more rigorous writing procedure. The perceived rush in the prior proposal was due to the kinematics team, who wanted to publish their evidence for the existence of the top quark before the other teams. Complicating matters, two of the team members (Garry Goldstein and Richard Dalitz) were outsiders brought in because of their expertise in kinematics analysis.

The tense situation brought to the fore the difficulties involved in the collaboration of different types of specialists. The kinematics team claimed to have conclusive evidence for the top quark but none of the Fermilab scientists outside of the kinematics team were fully qualified to judge the claim's technical details. The difficult circumstance highlights the wide range of factors involved in argumentation, including the already discussed dialectics of the writing procedure. The kinematics team's rush to publish conflicted with the values of openness and thoroughness, which in turn prompted Fermilab scientists to adopt the four social roles and three phases of paper writing.

Rhetorical considerations also played a part in assessing the kinematics team's proposal. Krys Sliwa—the Fermilab scientist in charge of the kinematics team—described Gary Goldstein as “overexcited” (Rehg 2009, p. 177). Goldstein's temperament—his *ethos*—suggested to Sliwa and some of his other colleagues that he lacked the capacity for responsible judgment, and he subsequently lost access to Fermilab's data. There was at least one

additional major factor that influenced the assessment of the kinematics team, and it corresponds to the concern for credit attribution stressed by Kitcher (1990). If the kinematics team had published their paper first, then credit for the top quark discovery would have fallen primarily on scientists who were not part of Fermilab. At issue are not merely the selfish interests of Fermilab scientists but the credibility of Fermilab as a whole. Maintaining the credibility of the institution itself is crucial to its continued existence, a concern that also played a part in withholding data from an August 1993 conference presentation (Rehg 2009, p. 171).

Rehg interprets the Fermilab case study as displaying an immanent contextualism. All three of the major factors—the dialectical, rhetorical, and credit issues—took on their particular significance because of the kinematics controversy. The dialectical values of openness and thoroughness, for instance, only became relevant argumentative considerations when the kinematics team sought to publish their findings before the three other teams. To further conceptualize this immanent dynamic, Rehg draws upon Habermas's notion of transcendental standards of conversation, which Habermas understands as universal pragmatic presuppositions.¹⁵ Rehg, however, dispenses with the notion of *transcendental* standards and takes them instead as critical heuristics, thereby inverting Habermas as follows: rather than being regulative ideals for all conversations, values such as openness must be fought for by a particular agent in order for them to be meaningful in a particular context (e.g., the value of openness prompting the adoption of a more rigorous writing procedure) (Rehg 2009, p. 160).

Rehg's immanent contextualism complements embodied epistemology. The above controversy, for instance, can be usefully modeled using Bickhard's terminology. The kinematics team, from this perspective, created a situation in which the abstract values of openness and thoroughness were recognized by Fermilab scientists as relevant tools for restructuring the interactive space (i.e., the adoption of the four social roles and three writing phases). In this sense, the values were not objective blueprints—*pace* Fuller—but rather a means for differentially responding to a particular situation. In this regard, the values, like the temperament of the scientists, acted as coordinating factors.

15. See Habermas (1979) for his initial formulation of a "universal pragmatics" for communication. Habermas's (1984) *Theory of Communicative Action* builds upon this picture by arguing against narrow conceptions of rationality in the social sciences; one of Habermas's most important claims is that rationality is responsive to moral and evaluative claims, not just empirical facts. Although Rehg's immanent contextualism departs from Habermas's notion of transcendental ideals and the counterfactual mode of analysis, it still dovetails with the pragmatic orientation of Habermas.

Rehg's major contribution to embodied epistemology lies in his reconstruction of a tremendously complex form of normativity. Scientific argumentation is about as far from minimal cases of cognition as one can get, yet the contextual nature of scientific argumentation suggests that normativity retains an immanent character. Rehg's theory of argumentation unpacks a kind of rationality long held dear by philosophers of mind and science and, in doing so, supplants the notion of objective rationality in favor of the context-specific notion of cogency. In this respect, cogency buttresses Bickhard's account of rationality, suggesting that its insights hold beyond cases of minimal epistemic agency.

With regard to D'Agostino, Rehg's concept of cogency strengthens his discussion of cultures of enquiry, including the aforementioned notion of shallow consensus. The danger, as represented by Ladyman's (2012) review, is to read shallow consensus as merely a practical exigency; that is, as a practical necessity that only incidentally has a beneficial side-effect for enquiry. Cogency, by contrast, suggests that the rationality of scientific argumentation cannot be understood apart from the various practical considerations at work in any given context. One of the most important practical constraints on any argument, as discussed above, is what is considered relevant. The point of departing from Habermas's transcendental ideals is to claim that relevance is earned and *created* by particular agents for specific contexts, *not something that was previously there* and just needed to be revealed. In this manner, Rehg strengthens the notion of shallow consensus by showing that practical considerations thoroughly permeate scientific argumentation as opposed to just being a thin veneer, whose significance might be limited, for instance, to the rhetorical dimension of scientific argumentation. The ineliminable significance of context-specific practical factors is precisely why Rehg thinks Habermas's counterfactual mode of analysis is a toothless abstraction. But showing that scientific argumentation is permeated by practical considerations only mitigates, as opposed to undermining, the realist undertow.

By challenging the basic tenets of cognitive realism, the embodied epistemology that I have presented above substantiates Rehg's immanent contextualism and clarifies the connection between cogency and shallow consensus. Regarding shallow consensus, embodied epistemology entails that there is an important sense in which disagreements—especially when understood in terms of conflicting beliefs—do not exist so long as the agents involved have not attended to and articulated them. Or, to use terminology closer to Rehg's concept of cogency, the disagreements *are irrelevant* to the given context until an agent articulates why they should be taken into consideration. As previously noted in connection to Merleau-Ponty, beliefs and conscious thought in general are not epistemic primitives

but are rather abstractions from an agent's interactions. It is precisely for this reason that the context-dependence of cogency is not merely a contingent matter but relates to the semantic opaqueness of perception, as described by Bickhard's interactive model of representation.

Buttressing the concepts of shallow consensus and cogency with an embodied epistemology also adds another dimension to Kuhn's essential tension. Specifically, the embodied framework helps link while preserving the distinctiveness of Kuhn's (1962) notions of normal and revolutionary periods of science. The possible range of intermediate positions between the two periods increases dramatically when the semantic opaqueness of perception is recognized. Cross-talk, in which the meaning of a term importantly though perhaps imperceptibly differs between individuals, reflects, in part, the primitive significance of each individual's interactive histories and pragmatic orientations. In this manner, cross-talk can, on the one hand, inhibit innovation by enabling individuals to interpret a term conservatively but, on the other, nurture innovation by enabling the radical implications of a novel term come to light belatedly and perhaps more gradually, after it has undergone more extensive development than would have otherwise been the case. One example of the former is, of course, the realist undertow diagnosed by D'Agostino (2014). The semantic opaqueness of perception, and the nonrepresentational intentionality upon which it is based, entails that cross-talk and the balancing of conflicting epistemic impulses relates to the fundamental nature of cognition rather than being a case of intellectual finitude, laziness, or worse.

7. Conclusion

The social dimension of epistemology has broadened considerably since Kuhn's narrow internalist construal, yet the linguistically centered account of rationality and normativity has remained largely unquestioned. One consequence, as evidenced by both Fuller and Kusch's social epistemologies, is that the primitive level of both the epistemic and normative dimensions of enquiry are understood in terms of determinate conscious intentions; this in turn has left their social epistemologies vulnerable to realist undertow. As an alternative, I have sketched an embodied epistemology and applied it to two neo-Kuhnian concepts. With regard to D'Agostino's federal model of enquiry, embodied epistemology blunts Ladyman's realist critique by clarifying in what sense the subjective dimension of enquiry shapes and supports the objective dimension. This aspect of cognition requires recognizing the role of nonrepresentational goal-directedness, which is precisely what linguistically centered accounts obscure. Nonrepresentational goal-directedness relates to the opaqueness of perception and the resultant epistemic primacy of interaction, both of

which buttress the second neo-Kuhnian concept—Rehg’s context-specific notion of cogency.

The intrinsic importance of interaction is precisely why social contexts, such as scientific communities, are not merely incidental to individuals’ cognitive abilities. Scientists’ skills can only be properly employed in relation to the larger community within which they have developed—in relation to and partly constitutive of dynamics such as those identified by D’Agostino’s federal model of enquiry. Conversely, community-level dynamics—I have focused on Kuhn’s essential tension—are distorted if they are understood only from the perspective of institutional structures and mechanisms. Rehg presents his concept of cogency to help address this lacuna within the social epistemology of science, a move that I have substantiated with an embodied epistemology. The more general implication of my efforts is that social epistemology and cognitive science both need each other and should be employed together in order to give a more comprehensive and balanced perspective of individual cognitive subjects and the communities they shape and are shaped by. The concept of social coordination exemplifies the fruits borne by linking the two fields: coordination dynamics capture how interactive contexts can become autonomous processes but without annihilating the distinctiveness of the particular agents involved.

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