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# Collective Scientific Knowledge

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Abstract

Philosophical debates about collective scientific knowledge concern two distinct theses: (1) groups are necessary to produce scientific knowledge, and (2) groups have scientific knowledge in their own right. Thesis (1) has strong support. Groups are required, in many cases of scientific inquiry, to satisfy methodological norms, to develop theoretical concepts, or to validate the results of inquiry as scientific knowledge. So scientific knowledge-production is collective in at least three respects. However, support for (2) is more equivocal. Though some examples suggest that groups have scientific knowledge independently of their individual members, these cases are also explained in terms of relational complexes of members' beliefs.

## *1. Introduction*

Is there collective scientific knowledge? The traditional answer is no. Philosophical accounts of science and knowledge tend to emphasize individuals, treating groups as epistemic epiphenomena. However, these individualistic assumptions are increasingly questioned.[1] The following sections survey these questions, focusing on two collectivist claims: (1) groups *produce* scientific knowledge, and (2) groups *have* scientific knowledge. Section 2 introduces key concepts and distinctions. Section 3 examines support for thesis (1), describing three ways groups may be required for scientific knowledge-production. Section 4 examines support for thesis (2), which rests on the premise that scientific groups have irreducibly collective beliefs. This premise does not follow from thesis (1), but requires further argument. The most significant argument for this premise rests on Margaret Gilbert's idea of a 'plural subject.' Section 5 sketches Gilbert's general theory and its application to scientific belief. But an alternative view, that group belief is a relational complex of individual beliefs, better accounts for social aspects of science. This alternative, though compatible with much of plural subjects theory, undercuts support for thesis (2). Section 6 summarizes the results of this survey, and indicates their broader significance.

## *2. Preliminaries*

Discussions of science and the social are rife with ambiguity and misunderstanding. Some basic distinctions will be helpful, in navigating this contested theoretical terrain. The traditional analysis of knowledge as justified true belief, though notoriously inadequate, indicates three conditions widely considered necessary for knowledge. Accordingly, a tripartite distinction of aspects of knowledge can be drawn at the outset:

i) knowledge-producing practices;
ii) knowledge had by a subject; and
iii) what is known (i.e., the content of knowledge).[2]

Nearly all contemporary philosophical discussions of knowledge assume that (iii) is propositional knowledge; that what is known is some proposition p. In this framework, which I assume throughout, there are three senses in which knowledge could be collective:

$i_c$) knowledge that p is collectively produced;
$ii_c$) subject S collectively knows that p; and
$iii_c$) p's content is collective.

'Collective' here means, roughly, 'irreducibly group-involving.' Reduction, and therefore irreducibility, can be understood in different ways; I discuss these concepts further below. The notion of a group assumed here is more intuitive: a collection of two or more persons acting together for some shared purpose.[3] There are evidently groups in this sense, in scientific and other contexts. The question at issue is how such groups relate to scientific knowledge.

Exactly *what* is collective differs for each of ($i_c$)-($iii_c$): the process of acquiring knowledge ($i_c$), epistemic attitude of knowing ($ii_c$), or content of a proposition ($iii_c$). The last, which hinges on the nature of reference, propositional content and social metaphysics, is beyond the scope of this essay.[4] This leaves two theses to consider:

(1) Groups are necessary for producing (some) scientific knowledge.
(2) Some scientific knowledge is irreducibly had by groups.

For brevity, I will refer to the process by which scientific knowledge is produced as 'inquiry.'[5] So thesis (1) could be restated as 'Groups are necessary for inquiry,' where inquiry is understood more narrowly than in common usage. Note that neither collectivist thesis is universal. So, if true, (1) and (2) do not rule out scientific knowledge for individuals. Though some (notably Nelson 1990) have defended the idea that groups rather than individuals are the primary scientific knowers, most collectivists take it for granted that individuals have and produce scientific knowledge. Many also treat theses (1) and (2) as closely connected (*e.g.*, Wray 2007). If the two are conflated, evidence for collective inquiry is taken as evidence that groups have knowledge in their own right. But it is important to distinguish theses (1) and (2), for reasons brought out in the following sections.

## *3. Collective scientific inquiry*

In order for a process of inquiry to produce scientific knowledge, at least three conditions must be satisfied:

(1a) inquiry is properly performed;
(1b) the result of inquiry (p) is true; and
(1c) p is accepted as scientific knowledge.[6]

If involvement of a group (or groups) is necessary to satisfy any of (1a)-(1c), then inquiry is collective and thesis (1) is true. Philosophical, historical and social studies of science suggest that, in many cases, groups are necessary to satisfy all three conditions. I consider each in turn.

Whether groups are necessary for condition (1a) to be satisfied is difficult to say, as we lack a general account of scientific method. Methodological standards in science vary

enormously across disciplines, locales and historical periods, and new standards and methods of obtaining evidence are continually invented. However, several very broadly-applied norms for inquiry do demand the involvement of groups. For example, hypotheses must be confirmed by evidence. In fields such as genomics, high-energy physics, nanotechnology, biomedicine, and many others, assembling evidence sufficient to test a hypothesis is beyond the ability of any single researcher. A collaborative team is therefore required to satisfy the norm (Staley 2007, Wray 2002). This holds *a fortiori* for the norm that multiple independent lines of evidence are needed to establish a hypothesis. Assembling diverse bodies of evidence and establishing convergence among them is, in many cases, a job requiring multiple researchers (Galison 1997). More generally, the robustness and reliability of results is enhanced by diverse perspectives on an object of inquiry, which interact to reveal implicit, hitherto unquestioned, background assumptions (Longino 2002). So in many (if not all) episodes of inquiry, groups are required to satisfy (1a).

I assume that a proposition's truth or falsity is independent of processes by which it is established as scientific knowledge.[7] But this does not rule out a necessary role for groups in satisfying (1b). This is because scientific results are articulated in terms of theoretical concepts. Where those results are true, there is a good fit or mapping between conceptual and worldly domains (Giere 1988). Developing a conceptual domain such that good fit can be achieved requires effort. As a matter of historical fact, this effort involves groups in many cases. In at least some of these, such as the concepts of induced radioactivity, nuclear fission, and Heisenberg's Uncertainty Principle, it is difficult to imagine how conceptual developments could have occurred without interactions among distinct groups of scientists (Andersen 2009, Bouvier 2004). Insofar as collaboration is necessary to develop theoretical concepts, which figure in true theories, groups are needed to satisfy (1b).

Validation of a result as scientific knowledge marks the end of a process of inquiry. [8] 'Acceptance' in condition (1c) is thus to be understood as an *action* which closes an episode of inquiry, not an attitude had by an epistemic subject (see §4). [9] It is tempting to suppose that such an act of acceptance can only be accomplished by a scientific community. The idea that scientific knowledge is essentially public, and that the end of inquiry involves community-level acceptance, is deeply-entrenched in our contemporary understanding of science, and embodied in practices of publication and peer review. If this is correct, then groups are necessary to satisfy (1c). However, given the diversity and flexibility of scientific practices, and their perennially fuzzy boundaries, it seems too strong an assumption that group acceptance is a universal requirement for producing scientific knowledge. There may be cases of genuine scientific knowledge in which individual acceptance suffices to validate a result as scientific knowledge. But at least in many contexts, it takes a scientific community to satisfy (1c).

So thesis (1) is supported by at least three conditions for inquiry. Though to claim that *all* inquiry is collective via (1a)-(1c) goes too far, there is good reason to think that *some* inquiry is collective, in one or more respects. For thesis (2), however, matters are otherwise. Some collectivists are likely to object at this point that thesis (2) follows automatically from community-level acceptance of scientific knowledge (1c). If a scientific community accepts a result as scientific knowledge, so the thought goes, then surely the community itself *has* that knowledge. However, knowledge that a scientific community has upon acceptance of a result as scientific knowledge can be interpreted in several ways, not all of which are collective in an interesting sense. A scientific consensus that p might simply be the aggregate of individual scientists' beliefs, or some more sophisticated combination of their attitudes (Tuomela 1992, Corlett 1996, Niiniluoto 2003). Thesis (2)

asserts something stronger: that scientific groups have *irreducibly collective* knowledge. The latter concept must now be considered more closely.

## *4. Collective scientific belief*

Irreducibly collective scientific knowledge had by a group is, in a sense to be specified, independent of knowledge had by its individual members. By analogy with the individual case, necessary conditions for a group S to collectively know that p include:

(2a) S believes that p;
(2b) p is true; and
(2c) S's belief that p is appropriately based on properly-performed inquiry.

I assume that any further conditions required for S to know that p are independent of collective aspects of knowledge, and that satisfaction of condition (2b) is similarly independent.[10] The two sets of conditions associated with theses (1) and (2) display a kind of complementarity, with linkages between (1a) and (2c), (2a) and (1c). But these paired conditions are distinct.

Conditions (1a) and (2c) are both about properly-performed inquiry. Suppose properly-performed inquiry is necessarily collective, in that only a group can accomplish it.[11] Then knowledge-production is collective, via condition (1a). It does not follow that knowledge thereby produced is irreducibly had by a group via (2c). Condition (2c) demands that a subject's belief that p be appropriately based on the inquiry that yielded p as an item of scientific knowledge. But, unless 'appropriate basing' requires direct experience or a complete representation of the entire process of inquiry, (2c) does not constrain the nature of the epistemic subject. And it is implausible that appropriate basing requires so much.[12] If it did, then scientific knowledge would be restricted to those with intimate experience of the evidential practices involved in its production. However, scientific knowledge is famously *un*restricted in this respect. For example, experiments in high-energy physics are performed by thousands of researchers, and involve evidential practices that no single individual comprehends in detail (Galison 1997, Knorr Cetina 1999, Staley 2007). This does not, however, prevent individuals from knowing that an experiment has a certain outcome (Giere 2007).

Appropriate basing does plausibly require that certain social epistemic relations (*e.g.*, trust and authority) hold between those involved in inquiry and those who know the result. And the former include groups, at least in some cases (§3). But this does not mean that groups are knowing subjects in these cases. For all that has been said so far, of course, they might be. The point is that, given thesis (1), further argument is needed to establish thesis (2) via condition (2c). The question of who *has* scientific knowledge must be considered in its own right. Condition (2a) is therefore the crux for thesis (2). If groups cannot have scientific beliefs in their own right, then thesis (2) must be false.

Conditions (2a) and (1c) are similarly connected, though their tie is complicated by the vexed issue of belief and acceptance. The belief/acceptance distinction is motivated by two uncontroversial premises: first, that groups lack the neurological structures and psychological mechanisms characteristic of individual epistemic agents; and second, that groups can endorse viewpoints distinct from the views of individual members, as in committee decisions, jointly-authored reports, election results, and many other familiar examples. Taken together, these two premises suggest that, while groups cannot have beliefs in exactly the same way that individuals do, they can be subjects of an epistemic attitude *like*

belief. 'Acceptance' is the usual term for this epistemic attitude, which is available to both individuals and groups (Cohen 1992, Pettit 1992, Wray 2001, Gilbert 2002). It is not self-evident, however, that groups cannot have beliefs, full-stop. This issue is extensively debated in philosophy of mind (Schmitt 2003; see Mathiesen 2006 for references). What is clear is that if 'belief' is understood as a psychologically rich concept, making individual psychology essential, then groups cannot have beliefs. Such a 'thick' construal of belief necessitates an attitude of acceptance that can be attributed to groups. But a psychologically 'thin' construal of belief does not.

The term 'belief' in condition (2a) refers to a psychologically thin conception, which does not by definition prohibit groups from having this attitude. A sufficiently-thin conception of belief subsumes thicker concepts of both belief and acceptance, thereby bracketing the question of their relation.[13] So my examination of thesis (2) does not take the belief/acceptance contrast as a point of departure. This is the approach used by Staley (2007) to examine collective scientific belief, and recommended by Mathieson (2006) for epistemology more generally. An alternative approach is to take collective scientific knowledge as hinging on the contrast between these two 'thick' epistemic attitudes, which differ in aims, mechanisms of formation, shaping influences, and guiding ideals (Mathiesen 2007, 210–213). But this has the disadvantage of complicating analysis by multiplying attitudes and encouraging conflation of theses (1) and (2).[14]

The connection of (1c) and (2a) can now be seen. Suppose the subject that accepts p as scientific knowledge must be a group; e.g., a scientific community. Then inquiry is collective, via (1c). It does not thereby follow that knowledge produced by such inquiry is had by the accepting group, via (2a). Recall that a group's acceptance of p is an action that concludes an episode of inquiry (§3). Condition (2a) requires that the group have an epistemic attitude toward p, belief in the 'thin' sense, that is irreducibly collective – i.e., not reducible to analogous epistemic attitudes had by individual members of the group. This follows from (1c) only given the further premise that a group's act of acceptance is or entails an irreducibly collective epistemic attitude: belief that p. It is plausible that an act of acceptance entails *some* attitude attributable to the group (Staley 2007, Schmitt forthcoming).[15] But establishing that this attitude is irreducibly collective requires further argument; it does not follow directly from (1c). So although the two sets of conditions (a-c) are linked, support for (1) does not automatically accrue to (2). Studies of collective scientific belief that do not explicitly distinguish theses (1) and (2), but argue from collective features of scientific inquiry such as consensus statements and jointly-authored papers (Beatty 2006, Wray 2006, 2007, Staley 2007) offer direct support only for the former.[16]

Arguments for collective knowledge had by scientific groups do not cite features of inquiry. Instead, they focus on examples in which an epistemic attitude (belief in the psychologically thin sense) is attributed to a group but not its individual members (e.g., Gilbert 2000, Beatty 2006, Rolin 2008). This line of argument aims to establish thesis (2) via (2a), by demonstrating that some scientific groups have beliefs that cannot be reduced to members' beliefs. The most straightforward cases of reduction are *summative*; i.e., a group's belief is just the sum or aggregate of individual members' beliefs. For group G to summatively believe that p, it is necessary and sufficient that all or most of G's members believe that p. Summative group belief is *reducible* to the beliefs of individual members, in the sense that the latter provide necessary and sufficient conditions for the former. This is a classic sense of reduction, though not the only one that bears on questions of scientific knowledge (Fagan 2011, forthcoming). Scientific consensus is often interpreted as summative. It is common to suppose, for example, that there is consensus in the molecular

biology community that biological information flows only from DNA to RNA to protein (i.e., the Central Dogma), just in case most molecular biologists believe this.[17]

This example is instructive, because in fact there is no summative consensus on molecular biology's Central Dogma. Exceptions to the one-way flow of biological information from DNA to RNA to protein are well-documented, such as reverse transcription from RNA to DNA and protein-mediated epigenetic processes that impact development and evolution. Most molecular biologists today do not believe the Central Dogma, in a strict sense. Yet the idea that biological information follows a linear track from DNA to RNA to protein is still prevalent, though few molecular biologists would endorse it if pressed. This and many indicate examples indicate that science involves *non-summative* group beliefs that p, for which it is neither necessary nor sufficient that all or most of members believe that p (Gilbert 2000). Collective belief is often identified with non-summative belief (*e.g.*, Gilbert 1989, 288–292). This identification presupposes that the summative/non-summative distinction coincides with the reducible/irreducible distinction. If the two distinctions coincide, then non-summative beliefs (for which it is neither necessary nor sufficient that all or most individual members believe that p) are just those group beliefs that are irreducible to members' beliefs. Identification of these as collective beliefs naturally follows, and therefore thesis (2) via (2a). However, the summative/non-summative and reducible/irreducible distinctions do not necessarily coincide in this way.

The concept of reduction is notoriously resistant to unequivocal characterization. Even assuming the classic notion, reduction by necessary and sufficient conditions, there are other relations than simple summation by which individual and group beliefs can be connected, such that the former provide necessary and sufficient conditions for the latter (Corlett 1996). For example, a group's belief may be the belief had by the greatest number of members, the intersection of all members' beliefs, the belief had by the most authoritative members, the average or median belief of members (for beliefs with quantitative content), the belief had by representatives of all G's members after deliberation in accordance with norms most members of G endorse, *etc.* Therefore, not all non-summative group beliefs are irreducible in the classic sense. Furthermore, on a collective interpretation, the Central Dogma example is confusing: the molecular biology community believes the Central Dogma, though most molecular biologists do not. Unlike stock collectivist examples of juries and hiring committees, in which a group's viewpoint is clearly identified, it is not obvious that the molecular biology community really has a viewpoint here. Yet the Central Dogma does play some role on the scientific stage. The concept of collective belief irreducibly had by a scientific group does not illuminate it, however.

A more general and fruitful way to think about group belief is *relational*. The basic idea is that a group belief is not just a heap of individual beliefs, but includes relations among them as well: trust, authority, and the like. So relational group beliefs are not simple things, but systems of members' beliefs and social epistemic relations among them (Niiniluoto 2003, 271–273). Tuomela's 'positional group belief' (1995), Corlett's 'sophisticated summative belief' (1996), Ernst & Chant's 'equilibrium view' (2007) and Fagan's 'interactive belief' (2011) are all refinements of this basic relational view. Despite being framed in terms of groups having irreducibly collective knowledge, Wray's (2007) account of epistemic interdependence among members of scientific groups also falls into this category.[18] The relational view provides a plausible account of the Central Dogma: its persistence in molecular biology today is fully determined by molecular biologists' beliefs, together with relations of epistemic authority that structure the molecular biology community. In this case, teaching practices are important. All or most students of molecular biology are taught, by experts whose authority they accept, that the Central Dogma

is (basically) correct. So the idea persists, though students who go on to become practicing molecular biologists later learn that it is, strictly speaking, false. So we are not faced with the stark discontinuity of the collectivist interpretation: the molecular biology community believes the Central Dogma, though most molecular biologists do not. Instead, the relational view of group belief reveals connections among individual beliefs, and the role of these connections in the group at issue.

Summative group belief may be treated as a special, limiting case of relational group belief. For a group to summatively believe that p, it is necessary and sufficient that all or most members of a group believe that p. For a group to relationally believe that p, it is necessary and sufficient that belief that p derives from members' beliefs concerning p and social epistemic relations among those beliefs. Summative cases are just those involving minimal social epistemic relations. More typically, relational group belief involves aspects of social life, which knit the members together into a group. So there is a sense in which relational beliefs are group-involving. But this does not entail that relational belief is had by a group as such, as thesis (2) requires. Nothing more than beliefs of individual members, singly or arranged in relations, is posited. The sense in which relational belief is collective is that of thesis (1).[19] So the relational account does not support thesis (2) via (2a). An argument for the latter must support the idea of a group believer, over and above the individual members.

### *5. Plural subjects*

Examples of both summative and non-summative group belief, as we have seen, are readily interpreted in relational terms. And the relational view has many other attractions: it avoids introducing a new mode of epistemic agency, dovetails with socio-historical accounts of scientific inquiry, and encourages investigation of social epistemic systems that can impact scientific consensus. The collective interpretation, on the other hand, introduces a new epistemic agent, characterizing the group itself as a ''locus of power and knowledge'' (Tollefsen 2004). But, so far, this idea has been specified only negatively: non-summative, irreducible, not determined by members' beliefs. There is no positive account of or motivation for a group's having collective scientific knowledge. Margaret Gilbert's theory of ''plural subjects'' transforms this situation. This theory not only defines collective scientific belief had by a group, but also provides the 'missing link' between conditions (1c) and (2a). Understandably, then, many studies of collective scientific knowledge presuppose that there are plural subjects with collective beliefs, in Gilbert's sense (*e.g.,* Bouvier 2004, Wray 2006, 2007, Staley 2007, Rolin 2008). Plural subjects theory is the primary support for thesis (2). So it merits careful consideration.

Gilbert's central concept is *joint commitment*.[20] Joint commitments, on her view, are created by two or more individuals mutually expressing willingness to enter into a commitment to believe, intend, or act, in some way, together. So joint commitments depend on individuals' attitudes, with respect to their formation. But, once created, a joint commitment constitutes a group as a plural subject: its unity fuses members into a ''corporate body,'' whose members have interlocking obligations and entitlements. A group's joint commitment is a simple whole – not a complex combination of members' personal commitments or attitudes. This distinguishes Gilbert's version of collectivism from relational group belief (§4). However, Gilbert's account includes the latter as well, conceived as a web of obligations and entitlements among members of a plural subject. A consequence of the simple irreducibility of joint commitment is that individual members of a plural subject cannot 'opt out.' Failure to conform to the obligations imposed by a joint

commitment incurs a cost: expulsion from the group, or loss of status, etc. If individuals tend to prefer to avoid costs, minimize risk, and avoid direct conflicts between personal and group viewpoints (all plausible assumptions), it follows that joint commitments stabilize human belief and action.

Collective belief is one form of joint commitment. If ''some persons are jointly committed to believe as a body that p,'' then there is a collective belief that p, had by the group composed of those persons (Gilbert 2000, 39–41). A joint commitment to believe that p constitutes a group as a plural subject with the belief that p. Gilbert's theory extends to collective action as well: activities performed by a group rather than individuals, such as walking together or jointly writing a paper (1989, 2003, 2006). Indeed, on this theory, collective belief entails joint acceptance, and vice versa: a group is jointly committed to believe that p if and only if that group jointly accepts that p (1989, 194–195). So a group's act of joint acceptance entails an irreducibly collective belief that p. Because of these conceptual ties, rooted in the concept of joint commitment, condition (2a) follows from (1c) on Gilbert's theory (see §4). In this way, plural subjects theory runs theses (1) and (2) together: both stem from joint commitment.

Joint commitments also impose constraints on individual members: to *support* the group's belief that p, either explicitly (asserting ''*we* believe that p'') or tacitly (not calling p into question or expressing doubt that p). Costs of failing to provide such support discourages dissent or questioning of collective belief, and imposes epistemic conformity on individual members of a group. Given these definitions, conceptual ties and empirical assumptions about individual behavior, Gilbert's theory makes the following predictions about scientific change (Gilbert 2000, Fagan 2011):

(P1) Consensus tends to persist, while doubts or heterodox ideas tend to be suppressed.
(P2) Ideas that challenge scientific consensus tend to come from outsiders or new group members, for whom costs are less.
(P3) Shift to a new consensus is marked by expressions of support by prestigious scientists.

Gilbert's theory can therefore be evaluated in the same way as scientific theories that posit theoretical entities. Collective scientific belief, like classic theoretical entities such as the electron, is an unobservable theoretical construct, which (realists claim) has important concrete effects. Perhaps the realist strategies that succeeded with the electron could be deployed on behalf of a putative social entity. [21]

Inference to the best explanation (IBE) is widely used throughout the natural and social sciences to argue for the existence of unobservable entities and processes. [22] For an IBE argument to succeed, a theory must not just explain phenomena of interest (here, features of scientific change), but explain them *better* than available alternatives. The relevant alternative in this case is relational group belief. If P1-P3 are borne out by actual patterns of scientific change, which the relational account of group belief cannot explain as well, then IBE supports thesis (2), via (2a) and (1c), which are linked on Gilbert's theory. Suppose, for the sake of argument, that P1-3 are genuine patterns of scientific change. [23] Which account of group belief better explains them? Though it is difficult to say in general what makes one explanation better than another, here there is a clear answer. The very features that render joint commitment irreducible – its simplicity, unity, and independence from a complex of individuals' epistemic attitudes – make its connection to those attitudes mysterious. This is not to say that plural subjects theory provides *no explanation whatsoever* of social phenomena. But it cannot provide a *better*

explanation than an alternative that omits the concept of joint commitment. Any social phenomenon that can be explained in terms of plural subjects of joint commitment can be explained more simply without irreducible joint commitment, in terms of the network of obligations and entitlements that structures relations of members' beliefs to one another - that is, in terms of relational belief. Irreducibly collective scientific belief is not supported by IBE.

Indeed, much of Gilbert's account, including the formation of joint commitment and aspects of joint action, conforms to the relational account (Beatty 2006, Staley 2007, Wray 2007). This suggests that irreducible joint commitment is something of an idle wheel in Gilbert's own theory. Plural subject explanations of social phenomena invoke obligations and entitlements of members *to one another*. It is through these networks of mutual constraint that costs of defaulting on joint commitment are imposed. Irreducible joint commitment could be jettisoned, and the plural subjects theory would do the same explanatory work, with fewer stipulations and assumptions. [24] But this trades the idea of irreducibly collective belief had by groups, for that of a relational system of individuals' beliefs. Again, the overall result is support for thesis (1), but not thesis (2).

## *6. Conclusion*

While there is good reason to think that production of scientific knowledge is a collective process (thesis 1), the idea that scientific groups have knowledge of their own (thesis 2) remains dubious. There are at least three ways groups can be necessary for scientific knowledge-production: satisfaction of methodological norms, development of theoretical concepts, and validation of results as scientific knowledge. Historical, sociological and philosophical studies of science suggest that groups do play these roles in many (if not all) cases. So there is strong support for thesis (1). But it does not follow, from the involvement of groups in inquiry, that groups are knowers in their own right. Support for thesis (2) is equivocal at best. Arguments for this thesis presuppose that groups have beliefs. At least three senses of group belief can be distinguished: summative, relational, and collective. But only the last of these allows for scientific knowledge that is collective in a philosophically interesting sense distinct from thesis (1). The relational alternative undercuts arguments for (2) based on non-summative examples and Gilbert's sophisticated plural subjects theory. These considerations do not definitively prove that groups cannot have scientific knowledge, and that thesis (2) is false. They show, however, that there is little reason to accept it.

This conclusion does not, however, vitiate the importance of collective conceptions of science. A 'deflated,' relational modification of plural subjects theory is useful in explicating social aspects of key scientific episodes: engagements with the public (Beatty 2006), collaborative research (Staley 2007), and conceptual innovation (Andersen 2009). The moral is not to abandon the idea of collective scientific knowledge, but to focus on aspects of inquiry that include epistemically significant interactions among individuals. Crucial roles of groups in scientific knowledge-production can be illuminated without supposing that groups themselves have scientific knowledge.

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*Short Biography*

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*Notes*

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[1] For discussions of general social epistemology and group belief, see: *Synthese* 73 (1987); *Episteme* 1 (2004); *Social Epistemology* 21 (2007), and Schmitt (1994, 2003).
[2] These conditions follow Longino (2002, 77).
[3] The notion of 'acting together' can be analyzed in various ways (e.g., Bratman 1999, Gilbert 2003). Note that groups so defined are small, face-to-face assemblages; it is possible that enduring social institutions do not qualify as groups in this sense.
[4] The associated collectivist thesis is that the content of (some) scientific knowledge makes ineliminable reference to groups. Whether this is so depends on the nature of reference and propositional content, as well as social metaphysics. These issues are beyond the scope of this essay.
[5] The referent here might be more accurately described as 'successful inquiry.'
[6] These conditions are, again, modeled on the traditional analysis of knowledge as justified true belief.
[7] Excepting propositions *about* those processes or their novel material products.
[8] In principle, investigation can always be re-opened, but in practice every episode of inquiry terminates at some point.
[9] Thanks to an anonymous reviewer for raising this point.
[10] With the possible exception of cases where p's content refers to collective aspects of knowledge. These cases, though important in some areas of social science, can be put aside for the purposes of this essay.
[11] As a universal claim, this is too strong (see §3). I assume it here only to exhibit the independence of theses (1) and (2).
[12] Knorr Cetina (1999) seems to endorse this view; critiqued in Giere (2007).
[13] See Schmitt (forthcoming) for more discussion of this issue.
[14] Conflation is encouraged because accounts of belief and acceptance use features of inquiry to characterize attitudes had by epistemic agents, effectively running theses (1) and (2) together.
[15] Staley's (2007) concept of ''group belief'' is just such an attitude: a basis for actions such as issuing a group statement (333, note 1). Thanks to an anonymous reviewer for bringing this point to my attention.
[16] The situation is actually more complicated, as most collectivists endorse Gilbert's plural subjects theory, which links conditions (1c) and (2a) in a different way. Section 5 addresses Gilbert's account, and argues against this line of support of thesis (2).
[17] This is Crick's version of the Central Dogma (a term he coined, perhaps ironically).
[18] Wray argues that only groups that are functionally organized to achieve the goal of scientific knowledge such that members are mutually interdependent can have scientific knowledge, and that research teams, but not sub-fields or the scientific community as a whole, meet this condition (2007, 340–343). His arguments are therefore, like other defenses of the relational view, concerned with knowledge-production (thesis 1).
[19] Relational group belief therefore meshes with the considerations in §3. For example, groups of interacting scientists (research teams, sub-fields, or whole disciplines) often issue statements derived from member individuals' beliefs and social epistemic interactions among them (Wray 2006, Staley 2007).
[20] For details, see Gilbert (1989) Chapter 4; also Gilbert (2000, 39–41; 2006, 7).
[21] The IBE argument is not explicit in Gilbert (2000). Instead Gilbert, understandably, proceeds on the assumption that her theory is correct. The IBE argument is, however, easily reconstructed if this assumption is relaxed (details in Fagan 2011, forthcoming).
[22] See Psillos (1999) for a systematic defense of scientific realism based on IBE.
[23] In fact, none of P1-P3 have been independently confirmed by empirical studies of science (Wray 2006, Fagan 2011, Fagan forthcoming). So it is premature, at least, to think they need explaining.

[24] More detailed versions of this explanatory argument appear in Fagan (2011, forthcoming).

## *Works Cited*


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