SCIENTIFIC COLLABORATION AND COLLECTIVE KNOWLEDGE

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Scientific Collaboration and Collective Knowledge
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Oxford: Oxford University Press, 2017, £55.00
ISBN 9780190680534

Scientific collaboration is taking place with increasing frequency, at least since the Manhattan project. Globalization and rapid advancement in communication technologies have made easier national and international inquiry across different scientific disciplines. Boyer-Kassem, Mayo-Wilson, and Weisberg have collected eleven chapters that address conceptual and normative issues about collaborative research and ensuing collective knowledge in the sciences. These issues are clustered around four core topics, each forming one part of the book: (i) information sharing among scientists, (ii) the reasons and strategies for (fruitful) collaboration, (iii) challenges, in terms of accountability, to the ordinary notions of authorship and refereeing, and (iv) the relationship between individual and group opinions in social decision-making problems. Most of the authors employ formal tools (mathematical models, computer

simulations) to discuss and analyse different aspects of the dynamics of scientific communities and collaborative research. Here, I focus on the notable contributions of each chapter.

Part I of the book consists of two chapters. Both address the question of what information scientists should communicate to one another. 'Information' is a catch-all term for any kind of shareable content.

Strevens's 'Scientific Sharing, Communism, and the Social Contract' proposes a strategy to justify and explain the stability of science's communist norm for an unrestricted sharing of information. The norm, introduced by Merton ([1942]), demands that scientists share all their data with their colleagues. The strategy is modelled and assessed by assigning probability distributions to scientific discoveries. Drawing on a number of empirical studies, Strevens argues for the existence of such a norm; he then proposes a two-step 'Hobbesian vindication' of it. The first step consists in transforming the norm into a social contract that enforces the behaviour prescribed for scientists. The second step describes a beneficial rationale for a contractual exchange of all information among the scientists. His vindication of the communist norm is a bedrock for the defenders of the unrestricted sharing of scientific information.

However, Strevens's idealized proposal raises two concerns. First, he assigns no cost to the exchange of information. This places the idealization far from current scientific practice: scientific collaboration often comes with significant costs to the collaborators. Second, external factors may constrain scientists' behaviour. For instance, various industrial research institutes or corporations that fund scientific research restrict information exchange. So, even if the scientists adopt the communist norm, an important question remains unanswered: how should scientists respond to the external factors influencing their research? Strevens's proposal calls for additional work to address these concerns while preserving the benefits of the communist norm.

Angere and Olsson's 'Publish Late, Publish Rarely! Network Density and Group Performance in Scientific Communication' suggests a completely different approach to the exchange of information. They question the common-sense supposition that there is a positive correlation between the number of members of a research network and the performance of the network. They build a Bayesian model for group inquiry and implement it in Laputa, a simulation environment for analysing the epistemic properties of communication in networks. Their numerical analyses suggest that information quality plays an important role in decision-making about information-sharing among collaborators. From this study, Angere and Olsson draw some morals that may have practical significance, the most notable of which is that scientists should publish rarely 'in the interest of science as an institution'. This chapter is quite intriguing as their proposal clashes with a commonly emphasized success norm for young researchers in academia: 'publish early, publish frequently'. This clash invites us to seriously reconsider the social structures of scientific practice and, in particular, the role funding agencies play in incentivizing frequent publishing. This chapter, together with Strevens's, are high points of the book. They suggest promising ways to formally engage with the social epistemology of science.

Part II is composed of two chapters that address the questions of why scientists collaborate and how we can encourage more fruitful collaboration. Zollman's 'Learning to Collaborate' proposes an epistemic network model to analyse the optimal structure of scientific collaboration. He models the formation of collaborative groups as social networks in which the conceptual schemes of collaborators can only be exchanged unidirectionally. Zollman considers three metrics for evaluating patterns of collaboration:

social optimality, stability, and learnability. By carrying out simulation experiments in various settings, he challenges the ordinary preconceptions that the number and diversity of collaborators increase productivity and that decreasing the cost of exchange between collaborators increases productivity. Zollman's simple model invites two improvements. First, the model assumes that the choice of collaborators is voluntary. In reality, however, various socio-political and other pragmatic factors influence this choice, and these constraints ought to feature in the model too. Second, the assumption that scientific collaboration is unidirectional should be relaxed, allowing for the possibility of a multi-directional flow of information.

Muldoon addresses the division of cognitive labour in scientific collaboration. Models of cognitive labour division are important because they enable us to understand the social structure of science and to ask normative questions about achieving optimality with regard to different epistemic aspects of scientific practice. Muldoon observes that previous models for understanding the division of cognitive labour, such as Weisberg and Muldoon's ([2009]), assume scientists pay no cost for acquiring new skills. His new model introduces three costs—two fixed costs associated with skill acquisition and equipment, and a variable cost associated with collaboration—enabling us to discuss fruitfully various aspects of the social structure of collaborative science, as well as some epistemic concerns about the production of scientific knowledge through collaboration. This chapter presents a novel epistemic landscape for an in-depth analysis of various normative questions concerning interdisciplinary research.

The three chapters of Part III tackle some profound challenges concerning collaborative authorship, the refereeing process, and the role of power in collaboration and bargaining over collaboration. The first two chapters emphasize the lack of good strategies for the attribution of accountability and responsibility for authorship, while the third chapter examines the issue of fairness in a collaborative setting.

Huebner, Kukla, and Winsberg's 'Making an Author in Radically Collaborative Research' discusses fundamental difficulties in establishing accountability in highly collaborative research. The upshot of their argument is that our received notion of authorship fails for some kinds of collaborative research. The authors entertain various solutions to this problem, for instance, recognizing an irreducible notion of group authorship. However, this solution is not immune to the fundamental challenges that arise from the relationship between group authors and individual group members.

Wray's 'The Impact of Collaboration on the Epistemic Cultures of Science' pairs well with Huebner *et al.*'s chapter. Wray offers two main claims in his diagnoses of the descriptive and normative issues in collaborative research. His first is that in order to understand and explain the behaviour of scientists in collaborative work, we need to recognize and attribute the irreducible cognitive attitude of collective acceptance to a research team. Wray's second claim is that scientific epistemic cultures are rooted in individualistic norms of authorship and refereeing. These norms, he suggests, are inadequate for handling the large-scale nature of collaborative scientific research. He analyses a few attempts by some leading science journals to modify the standards for assessing the responsibility and accountability of authorship and refereeing but concludes that these attempts seem to be unsuccessful.

Neither Huebner *et al.*'s nor Wray's chapter offer remedies for the current crisis of accountable authorship and refereeing in academia, namely, how to employ the irreducible notions of collective

authorship in practice. Both chapters can be considered as serious invitations to engage in a profound conceptual re-engineering of the roles of 'authorship' and 'refereeing' in the production of scientific knowledge.

Bruner and O'Connor's 'Power, Bargaining, and Collaboration' focuses on the issue of fairness in collaborative research. They develop two evolutionary game-theoretic models to examine how the hierarchical structure of academia in general, as well as the uneven distribution of power among groups of collaborators, may disadvantage some in scientific collaborations and bargaining over collaboration. The authors conclude that in collaboration, as well as in bargaining over collaboration, social dynamical forces may result in disadvantages for the less powerful and minority groups. These formal models are thus explanatorily relevant in exploring the disadvantages in various settings. In other words, Bruner and O'Connor's models provide sharp tools for thinking about the challenges facing underrepresented and less powerful groups in academia.

Part IV is composed of two chapters that address how group opinions are, and ought to be, related to those of the individual in various social decision-making contexts. The relation can take the form of aggregation or clustering: aggregation attributes collective attitudes to the group level, whereas clustering makes this attribution at the level of subgroups.

Bonnay's 'A Clustering-Based Approach to Collective Beliefs' focuses on the problem of collective beliefs for communities where the opinions of individual members differ significantly from one another. He suggests an axiomatic approach for clustering like-minded subgroups. Bonnay draws a distinction between two types of groups: organized groups in which the members share a sense of group membership, and unorganized groups in which members have no such sense. He then proposes a conceptual defence of doxastic clustering in unorganized groups and presents a judgement-aggregation-like formal framework for the analysis of this defence. He suggests attributing collective beliefs to subgroups. The group members belong to a subgroup if their like-mindedness is above a similarity threshold. Bonnay's proposal is suggestive in cases in which the recognition of well-structured groups is difficult, but defining a criterion for an appropriate assessment of like-mindedness in groups remains an important challenge for this account.

In the last chapter, 'Opinion Aggregation and Individual Expertise', Martini and Sprenger survey various formal approaches for aggregating the epistemic attitudes of individuals. The survey covers aggregation of both binary judgements and probabilistic opinions in the presence of different expertise levels and/or disagreement among the members of a group. Further nuance is added by taking into account the decision-making context upon which group goals and the evaluative criteria for aggregation depend. Roughly speaking, opinion aggregation may be governed by two different principles: disagreement is resolved (i) without revision of individual opinions, or (ii) by using a belief revision procedure that enforces consensus among group members. The authors present various arguments to highlight different conceptions of group rationality and argue that each conception is appropriate for some decision-making context. Martini and Sprenger's chapter is a must-read for anyone who wants to learn about the core topics of opinion aggregation and group rationality from a formal standpoint.

Scientific Collaboration and Collective Knowledge suggests a promising bridge between formal analysis and the social epistemology of science. It is often assumed that the use of idealized and abstract models

comes at the cost of any engagement with real problems. However, most of the chapters in this collection benefit from the use of idealized formal models to highlight genuine issues in scientific practice. The authors provide provocative means for the assessment and discussion of collaborative practice in which there are both advantages and disadvantages for the sciences. My only concern about the collection is the lack of dialogue among the four parts. It would have been interesting to see a discussion of how the various individual challenges relate to one another. All the same, I highly recommend this collection to anyone interested in interdisciplinary research connecting social epistemology, formal epistemology, and the philosophy of collaborative sciences.

Acknowledgements

Many thanks to Franz Huber and Jonathan Weisberg for helpful feedback on an earlier draft of this review.

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Notes

[1] This first part treats purely quantum processes, whereas the second part includes classical data and its interaction with quantum data, and the third part treats the concepts of observables and complementarity by means of 'internal' Frobenius and Hopf algebras.