Empirical Philosophy of Science: Introducing Qualitative Methods into Philosophy of Science

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Abstract A growing number of philosophers of science make use of qualitative empirical data, a development that may reconfigure the relations between philosophy and sociology of science and that is reminiscent of efforts to integrate history and philosophy of science. Therefore, the first part of this introduction to the volume *Empirical Philosophy of Science* outlines the history of relations between philosophy and sociology of science on the one hand, and philosophy and history of science on the other. The second part of this introduction offers an overview of the papers in the volume, each of which is giving its own answer to questions such as: Why does the use of qualitative empirical methods benefit philosophical accounts of science? And how should these methods be used by the philosopher?

Keywords Empirical methods · Qualitative research · History and philosophy of science · Naturalized philosophy

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1 Introduction

When philosophers of science make use of qualitative methods, they draw upon a long and rich research tradition that is rooted in the social sciences and has gradually been adopted in other fields.[1] The use of qualitative methods in philosophy of science brings philosophers in close contact with philosophically inclined social scientists studying science, and at the same time it brings forth new perspectives on the classical problem of the integration of history and philosophy of science. This introduction will give an overview of the new relations to sociology of science and history of science brought about by the use of qualitative methods, and it will shortly present the papers in the volume—each of which gives its own answer to two questions: Why does the use of qualitative empirical methods benefit philosophical accounts of science? And how should these methods be used by the philosopher?

1.1 History and Philosophy of Science

The role that empirical insight can play in the philosophy of science is extensively debated in discussions on the relevance of historical to philosophical accounts of science (and vice versa). The relation between history and philosophy of science has been an issue of contention for half a century.[2] In the late 1950s and early 1960s, a new historiography of science developed that aimed at describing past science in its historical integrity rather than through the lens of the present, and by doing so it provided an image of science that seemed to differ from the image entailed by standard philosophical accounts at the time. Historically inclined philosophers of science therefore began suggesting that philosophy of science should be concerned with the historical structure of science rather than with an ahistorical, logical structure that they saw as having little relation to the actual scientific enterprise. In addition, they advocated that philosophers should conduct their own historical research directed towards specifically philosophical questions rather than rely on accounts developed by historians.

[1]While qualitative methods have gradually been adopted by many fields outside sociology, the methods themselves have also developed (for histories of how qualitative methods have developed and been received, see Denzin and Lincoln (2000), Vidich and Lyman (1994), Brinkmann et al. (2014)). The idea of qualitative methods as it is used today was established during the 1960s and 1970s when the first handbooks, textbooks and specialized journals focused on qualitative methods appeared (see e.g. Glaser and Strauss 1967; Filstead 1970; Bogdan and Taylor 1975). During the 1980s, they were increasingly adopted within psychology, educational research and areas such as nursing science, and a decade later in health care research more generally.

[2]We are here referring primarily to the Anglo-Saxon tradition of history and philosophy of science. In the continental tradition, the history of the relation has been different, see e.g. Gutting (1989, 2005). For overviews of the Anglo-Saxon history, see e.g. Mauskopf and Schmaltz (2012).

In attending to science through history, this emerging historical philosophy of science was faced with the question whether the accounts it provided were descriptive or prescriptive. In addressing this question Kuhn, for example, argued that his theses about the structure of scientific revolutions should be read in both ways at once: his account of the development of science was a prescriptive theory, and the reasons for taking it seriously were that scientists do in fact behave as the theory says they should. This might seem circular, but as with any other theory, the success of a theory of the development of science should be dependent on its ability to explain new data that had not been involved in its initial formulation.

Parallel to the growing institutionalization of history and philosophy of science (HPS) as a field, the discussion continued whether the relation between history and philosophy of science really was an intimate relationship, or if it was rather just a marriage of convenience (see e.g. Feigl 1970; McMullin 1970; Giere 1973; Burian 1977).[3] Whereas most philosophers of science agreed that philosophy of science had to be informed by a close attention to science, there was less agreement on whether the history of science was to play a privileged role. Arguments in favor of an integrated history and philosophy of science varied from the more pragmatic argument that early science is often more accessible than contemporary science to more principled arguments, asserting that topics of a particular type, such as how science develops over time, necessarily require a historical perspective.

Another topic of discussion was how historical cases could and should be selected and what and how philosophers could generalize from them. On the one hand, philosophers critical of the historical turn argued that if cases were selected to illustrate a philosophical position already developed, then it could be questioned as to how far these cases would work as support. Conversely, if starting from the historical cases, it was questionable how much could be generalized from just a few or sometimes even a single case (see e.g. Pitt 2001; Burian 2001). On the other hand, historically inclined philosophers of science argued that history of science neither generated facts from which philosophical generalization could be induced, nor did it generate evidence by which philosophical theories could be directly tested. Instead, historical cases and philosophical analyzes need to be integrated in a mutual, iterative process (Chang 2012).

1.2 Beyond History: A Broader Approach to Naturalized Philosophy

In the following decades, the historically inclined philosophy of science came to be seen as just one approach of a *naturalized* philosophy of science. Following on Quine's (1969) argument for "naturalizing" epistemology by using findings from

[3]See also Nickles (1995), Schickore (2011) and the collection of papers in Mauskopf and Schmaltz (2012) for later surveys of the debate.

scientific investigations from biology, psychology, and sociology to advance the project of justification of knowledge claims, a number of philosophers of science advocated naturalistic approaches as well (see, e.g. Giere 1988; Goldman 1986; Kitcher 1993; Laudan 1977; Nersessian 1984; Thagard 1988).

Quine had argued that justification and the status of knowledge claims depend on the characteristics of processes that generate and maintain belief. One approach was to inform analyses of science with findings and theories from the rapidly growing cognitive sciences on how humans in general perceive and generate knowledge about the world (Barker et al. 2001; Chen et al. 1998; Andersen et al. 1996; Darden 1991; Giere 1988; Gooding 1990; Nersessian 1984, 1987, 1992, 1995). Nersessian (1987) coined the term 'cognitive-historical' analysis for the philosophical method that took into account the cognitive processes of scientists in their construction of knowledge. In defense against the charge of 'circularity' in using the findings of science to study science, she argued: "The assumptions, methods, and results from both sides are subjected to critical evaluation, with corrective insights moving in both directions. The goal is to bring historical and cognitive interpretations into a state of reflective equilibrium, so as to make the circularity inherent in the approach virtuous rather than vicious." (Nersessian 1995, p. 196).

1.3 Sociology and Philosophy of Science

Whereas the relation between history and philosophy of science has been seen as a marriage, although it was up for dispute whether this marriage was established by love or convenience, the relation between sociology and philosophy of science has varied from periods of polite indifference to periods of mutual hostile competition.

At the time when HPS emerged and institutionalized, sociology of science was dominated by scholars such as Merton (1973), Hagstrom (1965), Zuckerman (1978), Chubin (1976), Cole and Cole (1973) who all took a macrosociological approach focused on describing the social structure and culture of science, including norms and deviant behavior, stratification and reward, and the growth and decline of scientific specialties. The work on scientific specialties, in particular, had obvious relations to Kuhn's work on paradigms and normal science, and Kuhn himself explicitly referred to the work of Hagstrom and others as the key to identifying scientific communities. This early macrosociology of science included both quantitative and qualitative studies, but with the emergence of the Science Citation Index in the 1960s quantitative studies of citations and co-citations gained prominence and eventually developed into its own specialty of scientometrics (see Wouters 1999, especially Chap. 4).

During the 1970s and 1980s sociologists of science increasingly turned away from the macrosociological focus on scientific communities and their stratification, and turned instead towards a microsociological focus on scientists' practices as they unfold locally in the laboratory. Key contributions to this new microsociology, such as Latour and Woolgar's (1979) *Laboratory Life* or Knorr-Cetina's (1981)

The Manufacture of Knowledge, showed how ethnographic and other qualitative methods could be used to study scientific practice. At the same time, in arguing for a social constructivism on which it should be explained in purely sociological terms why scientists believe what they do and how scientific ideas, methods and practices change over time, the more radical versions of this new microsociology of science crossed philosophers' favored boundary between internal and external aspects of science. The reactions were seen in the Science Wars of the 1990s, when both philosophers and scientists attacked what they saw as a dangerous attack on rationality. Hence, although the new microsociology of science devised an empirical method for how detailed case studies could be made of the practices of contemporary science in contrast to historical science, philosophers (at least in the Anglo-Saxon tradition), did not initially see it as opening up new venues for philosophical investigations that could supplement historical case studies.

1.4 The Latest Turns in Philosophy of Science

In recent decades, philosophers of science of various inclinations have become more interested in sociology of science and in including qualitative methods in their philosophical repertoire. Cognitively inclined philosophers of science have tried to overcome the boundary between the cognitive and the social through ethnographic investigations of distributed cognition in order, for example, to understand the reasoning practices in the evolving cognitive-cultural systems that comprise a modern research laboratory staffed with scientists with different competences and equipped with a multitude of artifacts (Nersessian 2006). Other philosophers of science have started pointing out that epistemologists' traditional focus on the warranted/justified beliefs of the individual cognitive agent leaves out important social aspects in scientific knowledge creation and have used qualitative research methodologies to investigate such topics as epistemic dependence and the dynamics of epistemic trust (Wagenknecht 2014, 2015). The use of qualitative methods to investigate philosophical topics has also spread beyond topics related to the social aspects of knowledge production, for example to investigate scientists' views on models and modelling (Bailer-Jones 2002; Chandrasekharan and Nersessain 2015; Mattila 2005; MacLeod and Nersessian 2013; Nersessian and Patton 2009), simplicity (Riesch 2010), or conceptions of risk (Mansnerus 2012).

Much of this work mirrors the empirical turn that has been seen in ethics from the 1990s onwards, especially in medical and bioethics where there is a growing literature reporting empirical investigations of people's actual moral intuitions, beliefs, reasoning and behavior by means of qualitative methods such as interviews or participant observation. Like in philosophy of science, a recurrent theme in this literature has been the relation between the descriptive and the normative, and the means by which philosophical inquiry and empirical research can be fruitfully integrated and contribute to the development of normative ethics (see e.g. Kon 2009; Leget et al. 2009; de Vries and van Leeuwen 2010).

2 Overview of This Volume

The papers in this volume explore benefits and challenges of an empirical philosophy of science and address questions such as: What do philosophers gain from empirical work? How can empirical research help to develop philosophical concepts? How do we integrate philosophical frameworks and empirical research? What constraints do we accept when choosing an empirical approach? What constraints does a pronounced theoretical focus impose on empirical work?

2.1 Part I: "Foundations"

The first part of this volume lays out the foundations of what an empirical philosophy of science could be. In two papers, philosophers of science reflect upon their use of qualitative empirical methods such as participant observation and open-ended interviewing. These reflections address basic issues of the relationship that empirical philosophy of science creates between first-hand, empirical insight and philosophical theorizing.

In addressing the delineation of the empirical from the non-empirical, *Osbeck and Nersessian* confront a fundamental issue in the use of empirical methods in philosophy of science. In the first part of their paper, the authors point out that non-empirical questions are key to any empirically-based analysis. Based on their experience with the formulation of empirically-based, philosophical accounts of science, the authors elaborate on two such non-empirical questions: What counts as an empirical approach to the study of science? And, given an empirical approach has been chosen, what is the appropriate unit of analysis for such a study? Osbeck and Nersessian show that each of the two questions opens a range of possibilities and requires a series of well-argued for choices. When non-empirical questions are settled, empirical questions can be tackled. Drawing on their own research, the authors show which philosophically relevant issues can be fruitfully approached as empirical questions, and they describe in instructive detail the qualitative empirical methods that they have previously employed and the insights that they were able to gain.

Mansnerus and Wagenknecht tackle the link between empirical and non-empirical (or, as they refer to it, between concrete and abstract) from a different angle. Reflecting upon the experiences that they as philosophers have had with the use of qualitative methods, they describe the relationship between philosophical conceptualization and empirical data as an iterative dialogue between abstract and concrete, theory and data. In their view, this dialogue benefits from a 'feeling with' the empirical phenomenon under study that the philosopher-investigator is able to develop in the course of her fieldwork. The authors describe how the dialogical interplay between conceptual discourse and concrete empirical insight manifests itself in their work, i.e., when analyzing the practices of infectious disease modelling or, respectively, studying a team of planetary scientists.

2.2 Part II: "Case Studies"

The second part of this volume compiles four papers that argue for the use of empirical knowledge, gained through qualitative empirical methods, in the philosophical analysis of scientific practice. These papers span problems as varied as the epistemic character of modeling practices in finance, the representation of reductionism in popular science, the study of explanations in science textbooks, and the investigation of commercialized biomedical research. Except for the last paper in this part, all authors provide hands-on insights gained from personal experience with the use of diverse qualitative methods ranging from ethnographic methods to text analysis.

Based on her experience with the study of modeling practice in finance as a participant observer, *Svetlova* assesses the challenges and gains that an empirically-based philosophy of science faces. To do so, she begins by revisiting the debate about issues associated with "experimental philosophy", a mode of philosophical inquiry that makes use of quantitative methods such as surveying. She then discusses whether and to what extent philosophical approaches, including her own, face similar issues when they employ qualitative methods such as participant observation, in-depth interviews and text-analysis. For the study of modeling practice, the author argues, empirical approaches have proven fruitful, and she provides three concrete ways in which empirical insights have furthered her philosophical theorizing on the nature of scientific models: by giving a new inspirational impulse to philosophical theorizing, by challenging an existing theoretical point of view, and by providing background information that supports and specifies an existing theoretical position.

Riesch's work exemplifies how an empirical case study, combined with sociological theory, can benefit the philosophical study of scientific practice. By means of qualitative discourse analysis, Riesch studies the question of how reductionism is represented in a sample of popular science literature on sociobiology, evolutionary psychology or Nature/Nuture debates. He shows that reductionism has become an "identity marker" by which popular science authors signal their adherence to a wider social identity. The meaning of 'reductionism' is, thus, to be interpreted according to the stance which the author takes in the debate. Given this fact, Riesch argues that any deeper exploration of philosophical concepts in the thinking of practicing scientists has to take into account sociological factors that shape their interpretation. For a philosophical analysis to state that scientists use concepts in a 'confused', incoherent or inconsequent way is not enough. Instead, it is necessary to understand where and why possible conceptual confusion arises. To do so, Riesch points out, philosophical analyses profit from considering sociological theory.

Addressing a recently growing interest in case studies of scientific explanations in philosophy of science and science education, *Goddiksen* provides an empirical method for collecting and comparing exemplar explanations provided to science students. The aim of his method is to explicate possible qualitative differences between explanations in different disciplinary contexts. The problem that his

method addresses is the challenge that an empirical study of explanations needs to identify explanations without presuming the very features the presence, absence or variation of which it seeks to study. To the philosophical eye, it is often not apparent what a scientific explanation is. Drawing on his study of explanations of thermodynamics in physics and chemistry textbooks, Goddiksen discusses various strategies for identifying explanations in science textbooks, such as key word based sampling, and shows what results they can yield.

Jukola examines two cases of commercialized biomedical research in order to discuss the applicability of Helen Longino's view on the objectivity of science to current scientific practice and sketch ways in which Longino's account might need to be extended or specified. The author argues that it is of particular importance for philosophical analyses of scientific objectivity to attend to the extra-scientific influences on research practices. When, e.g., the distribution of private funding threatens the scientific objectivity of research, strictly scientific problems have roots outside science, and in such cases philosophy of science benefits from empirical knowledge about the mechanisms by which extra-scientific influences shape scientific practice.

2.3 Part III: "Empirical Philosophy of Science and HPS"

The volume's last two papers approach the relationship of philosophical theorizing and qualitative empirical insight by revisiting the debates that accompanied philosophy of science's long-standing involvement with the use of historical data, i.e., another kind of qualitative empirical data.

The paper by *Thorén* returns to the claim that history of science cannot provide solutions to the problems that philosophy of science studies. However, even if the claim was true, it would not imply that there cannot be a fruitful relationship between history and philosophy of science. The author argues that the relationship between the two disciplines is best understood as a transfer of problems, and he shows that such problem transfer has established genuine interdisciplinarity between history and philosophy of science. Moreover, he points out how philosophy's appropriation of problems raised in the historical, i.e., empirical, study of science has opened parts of philosophy of science towards empirical knowledge and, thereby, initiated deep changes in its disciplinary understanding.

Allchin addresses the question of how history's descriptive accounts can contribute to an empirically-informed, yet ultimately normative philosophy of science. Allchin explores an approach to this question that is popular among many philosophers of science, an approach adopting abstract philosophical norms about scientific knowledge but remaining uncommitted to the details of scientific practice by which these norms may be achieved. The study of these methods is left to historians of science. As Allchin points out, however, philosophical accounts that articulate the ways in which scientists achieve the normative goals of their inquiry are more complete and applicable to actual scientific practice. The author develops this point

by elaborating on the challenge that anomalies pose for philosophical accounts of science, and he illustrates his argument with a case study from cellular biochemistry. A purely abstract philosophy of science, Allchin argues, fails to recognize those strategies by which scientists can solve disagreement upon analogies.

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