Advancing the Empirical Turn in Philosophy of Science: The Affordances of Mixed Methods Approaches

Kathryn S. Plaisance[1,2,3] & Sara Doody[1]

[1]Knowledge Integration, [2]Department of Philosophy, [3]Department of Psychology, University of Waterloo

1. Background and Goals

Background: The Empirical Turn in Philosophy of Science (PoS)

- Philosophy of science has been turning to empirical data in recent years to examine scientists' views, understand scientific inquiry, and study philosophy of science (PoS) itself
- Empirical approaches can improve the descriptive adequacy of philosophical accounts and shed light on philosophical topics such as scientific reasoning and collaborative knowledge production (Wagenknecht et al. 2015; Steel et al. 2017, Plaisance 2020; Hangel & ChoGlueck 2023, Osbeck et al. 2024)
- Philosophers of science tend to focus on one methodology, either quantitative or qualitative:

Quantitative Approaches in PoS

- **Surveys** about scientists' philosophical views (e.g., Steel et al. 2018; Beebe & Dellsén 2020)
- **Bibliometrics**, including citation analyses (e.g., McLevey et al., 2018; Pradeu et al., 2024)

Qualitative Approaches in PoS

- **Interview-based approaches** generating specific, contextual data (e.g., Leonelli, 2016)
- **Ethnographic approaches** with philosophers embedded in science labs (e.g., Nersessian, 2022; Osbeck & Nersessian, 2017)

Goals: Introducing Mixed Methods

- Despite the increasing use of empirical methods, few philosophers have attended to mixed methods
- Our goals in this poster are to:
  (1) Provide an overview of mixed methods approaches
  (2) Offer examples of ongoing mixed methods studies within philosophy of science
  (3) Describe the benefits of mixed methods for philosophers of science
  (4) Share resources for those interested in learning more about these approaches

2. Mixed Methods Approaches

What are Mixed Methods?

- Mixed methods involve the combination of qualitative (QUAL) and quantitative (QUAN) approaches
- Creswell and Plano Clark (2017) offer a useful taxonomy of mixed methods designs:
  - **Convergent** (QUAN + QUAL): qualitative and quantitative analyses are combined/compared
  - **Explanatory sequential** (QUAN → QUAL): quantitative results are explained by qualitative data
  - **Exploratory sequential** (QUAL → QUAN): qualitative results inform quantitative instruments

Affordances of Mixed Methods

- Offer more comprehensive understanding of research questions by drawing on QUAN (i.e., breadth) and QUAL (i.e., depth) approaches
- Well-suited to complex and multifaceted research questions
- Sequential designs enable further investigation of emergent findings
- Approaching research from multiple methodological paradigms enhances the validity and trustworthiness of findings

Limitations of Mixed Methods

- Time consuming due to integration of QUAL and QUAN approaches
- Requires more expertise: typically, QUAN researchers need to seek out QUAL expertise/collaborators and vice-versa
- Can be costly in terms of human resources (RAs), participant remuneration, and relevant services (e.g., transcription, survey panel firms)
- Researchers may emphasize one approach (e.g., QUAN/qual or QUAL/quan), limiting their ability to adequately answer certain research questions

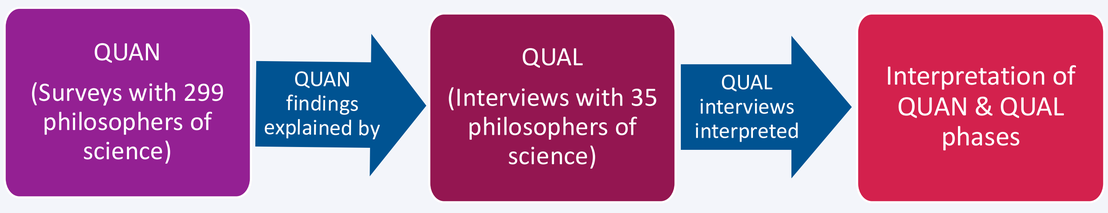
3. Case 1: Explanatory Sequential Design

Case 1 is an example of an **explanatory sequential design** (QUAN → QUAL), where the qualitative phase is used to explain findings from a preceding quantitative phase (Plaisance et al. 2021a; 2021b)

- Useful for exploring quantitative trends to understand what might be driving or underlying them
- Best when the researcher already knows the important variables to be studied

This study examined **the views, attitudes, and experiences of philosophers of science regarding broadly engaged work, including collaborations with scientists and engineers**

- QUAN (survey of 299 philosophers of science) → QUAL (interviews with 35 philosophers of science)
- This design was chosen because researchers held insider status within philosophy of science and had experience collaborating with scientists, allowing them to develop well-informed survey questions



- The survey enabled us to **make broad, statistically-supported claims**, which turned out to challenge commonly held beliefs and assumptions about engaged work (Plaisance et al. 2021a) – for example:
  - interest in engaged work was high, countering assumptions that few people value this work
  - actual barriers to engaged work were significantly lower than perceived barriers
- QUAN findings informed the interview guide and identification of participants for the QUAL phase
- Interviews allowed us to **explore complex phenomena in more detail** (Plaisance et al. 2021b):
  - the motivations philosophers of science have for engaging with others
  - the important role of upstream and downstream impacts
  - how face-to-face engagement serves as an effective pathway to influence

4. Case 2: Exploratory Sequential Design

Case 2 uses an **exploratory sequential design** (QUAL → QUAN), where data from the qualitative phase inform decisions for a subsequent quantitative phase (e.g., survey instrument design)

- Useful for developing a measurement tool grounded in participants' views and experiences
- Best when there is little existing knowledge to inform the development of quantitative instruments

This study examined **scientists' and engineers' attitudes towards philosophy of science and their experiences collaborating with philosophers of science**

- QUAL (interviews with 20 scientists & engineers) → QUAN (survey of 2,083 scientists and engineers)
- This design was chosen because, unlike Case 1, there was little-to-no existing knowledge about how scientists and engineers perceived or experienced collaborations with philosophers of science

- Interview data generated insights into the *actual* experiences of scientists and engineers, such as:
  - beliefs that these collaborations enabled participants to become *better scientists*
  - frustrations that their disciplinary colleagues do not seem to value philosophy-STEM collaborations as much as traditional STEM research—if at all
- QUAL findings were used to develop hypotheses and survey questions for the QUAN phase
- The survey data challenged assumptions about scientists' & engineers' perspectives, showing that:
  - most scientists and engineers are interested in collaborating with philosophers of science
  - low-stakes engagement is quite common, with over 50% if participants reporting such activities
  - the #1 barrier to formal collaboration was not knowing any philosophers of science

5. What Mixed Methods Offer Philosophy of Science

Empirical methods can serve as helpful additives to established philosophical argumentation

- Many empirical approaches are designed to elicit tacit knowledge and practices, which can generate unexpected insights, test philosophical accounts, and add richness to philosophical claims

Qualitative approaches are well-suited to questions concerned with contextual understandings

- QUAL methods such as interviews can prompt individuals to articulate attitudes, feelings, and experiences affecting scientific practice that otherwise may go unstudied or even unnoticed

Quantitative approaches offer methods that go beyond case studies and allow for generalizability of results, enabling broad, statistically-supported claims about science and scientific practice

- Some QUAN methods, like surveys, also allow philosophers to tap into aspects of scientific reasoning that do not appear in scientific publications (e.g., scientists' philosophical assumptions)

Mixed methods are useful when both contextual *and* generalizable findings are needed to address research questions (e.g., common barriers to collaboration *and* how those barriers are experienced)

- M.M. enables philosophers to make empirical claims about science that are both rooted in particular contexts/groups and tested with statistical analysis to enable broad claims

6. Advocating for a Pluralistic Approach

Philosophical & mixed methods approaches can be mutually beneficial

- Many existing knowledge-generation practices in philosophy of science echo empirical approaches
  - Analyzing texts, observing lab meetings, and talking with scientists may count as QUAL methods
- When deployed as part of a well-designed study, these approaches can generate robust empirical data to support, test, or refine philosophical analyses
- However, philosophers should use caution before conducting rigorous empirical studies as they may not be necessary, and the added demands may distract from the research questions being pursued
- Overall, knowledge generated from philosophical methods and mixed methods can inform one another

Advice for pursuing empirical & mixed methods research

1. Consider whether your research questions really require empirical or mixed methods
2. Be prepared to invest a significant amount of time and effort, especially for mixed methods research
3. Read mixed methods texts or take a research methods course that covers mixed methods
4. Look at other studies that use the methods you're interested in
5. Find collaborators with relevant expertise

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References & Resources →