

## Philosophy of Science and Transdisciplinary Epistemology

How are the demands of research affected by the involvement of more than a single field? What novel research outcomes become possible? As the 2020–2021 Integrated Arts Research Initiative (IARI) Graduate Fellow and a philosopher of science, I am interested in using the CERN–IARI Collaboration—a project that aims to make substantive contributions to visual art, mathematics, and physics—as a case study to develop an epistemology of transdisciplinary research.

Science is value-laden. It has to be, because our finite cognitive capacities and resources force us to decide what is worth knowing.<sup>1234</sup> The division of scientific labor therefore entails a division of priorities: researchers exclude all but a limited set of values, and the consumers of research—readers, policymakers, institutions—are responsible for bringing the priorities back together in order to make decisions. “Following the science” has become shorthand for making decisions that are informed by research, which is perhaps more important now than it has ever been. Yet the motto is misleading, as we actually expect and need our institutional leaders to consider a diverse set of values that mostly get suspended by any given field of study.<sup>5</sup>

For example, as the philosophers of science Eric Winsberg and Johannes Lenhard explain, researchers in climate science standardly make “projections” rather than “predictions” with different emissions scenarios as boundary conditions; the emissions scenarios depend on non-climate factors (e.g., economic, technological) that climate scientists are not positioned to comment on directly.<sup>6</sup> Nor do they make specific policy prescriptions, as policy depends on a richer set of values than a single field can provide. Leaders can use the research to inform action effectively or not, but if they really did only “follow the science” without integrating it into the broader context, their decisions would be myopic with respect to the variety of values that we all hold. Because there is no protocol for exposing this decision-making process, the negotiation of disparate values remains implicit and so opaque to critical analysis.<sup>7</sup>

Transdisciplinary research has the potential to explore alternatives to this division of labor by explicitly making this negotiation a part of the process, thereby presenting novel possibilities for knowledge production. Aiming to produce a single piece of research that makes citable contributions to visual art, linear algebra, and quantum physics, the CERN–IARI Collaboration is an experiment in research methods and forms. As Mary Beth Leigh, arts-science researcher and professor of microbiology at the University of Alaska Fairbanks, remarked during the group’s first public presentation, transdisciplinarity is often a utopian aim;<sup>8</sup> excluding the research on pedagogical purposes, the literature of arts/science integration is littered with diagnoses of projects that failed to effectively cross disciplines. Two contributors to the project, Spencer Museum Curator Joey Orr and artist-in-residence Janet Biggs, have similarly lamented that science-related art projects are rarely symbiotic: that is, they are rarely deeply generative of

the scientific work they instrumentalize.<sup>9</sup> Corrollarily, work in science routinely instrumentalizes the arts as a means to visualize, but rarely engages with it deeply as a method of research in its own right. As Biggs explained, the participants aim for this collaboration to be *substantive* to their own fields and *generative* of their collaborators. “Substantivity” here means making decisions that meet the different demands of their fields; “generativity” expresses the hope that the novel constraints (e.g. the demands of visual art applied to mathematics) will lead to novel insights that the fields would not reach on their own. This is interdisciplinarity. If the group successfully achieves transdisciplinarity, it will be by developing a vocabulary and set of standards adapted to their project, not simply inherited from their fields.

The fields involved in the CERN-IARI Collaboration all have their own specific values: not only valuations of what is worth investigating, but also epistemic standards,<sup>10</sup> reasoning heuristics,<sup>11</sup> publishing and professional expectations, and writing and citing conventions. Normative judgments become buried under practices and heuristics that depend on them; the philosopher of science William Wimsatt calls this condition “generative entrenchment,” and it means that the normative judgments become opaque.<sup>12</sup> For example, Winsberg and Lenhard argue that complex climate simulation models become holistic, meaning that their components cannot be evaluated in isolation from the whole.<sup>13</sup> Models are designed for specific purposes and incorporate locally motivated evaluations. An idealization or approximation adequate for one purpose may not be adequate for another, but when parts of models are incorporated into new projects, Winsberg and Lenhard argue, it is infeasible to obtain information about the values motivating the hundreds or thousands of such choices. Those value judgments therefore become opaque, or invisible. In the same way, disciplines are constituted by heuristics and practices justified not by their objective superiority over alternatives, but at least in part by their satisfying a set of normative concerns.

Some fields are more conscious of their value-laden foundations than others. Throughout the process, Orr has reminded the group of the growing awareness in the art world that “museums are not neutral,” which is even the name of a movement.<sup>14</sup> Contemporary artists are trained through studio critique to be aware of their forms and, in some cases, even expected to answer for the ethical and political connotations that their works inherit.<sup>15</sup> Other academic institutions and disciplines are no more neutral, but their workers are not trained to reflect explicitly on their forms.

What would it look like for researchers themselves to perform the negotiation that is typically performed by institutions, bringing the priorities of different fields into contact with one another? It is generally to sustain their own productivity and the tractability of their research questions that they are not required to perform it, but doing so may make different research outcomes possible. The CERN–IARI collaborators, working as an interdisciplinary collective, explore the extent to which the values of different fields can be considered while still rising to

the standards of those fields individually. Consensus has been central to the group's approach. One of my roles in this fellowship has been to review the group's meetings to create a "methods map": a record of topics and decisions, highlighted to show the different types of work that each piece of the conversation contributed to the whole project. I identified seven methods: "building consensus," "determining context," "determining action," "setting long-term goals," "speaking from one's field," "speaking across fields," and "determining method." This codification allowed me to identify patterns that characterize the group's workflow and observe changes in the group's approach over months of collaboration.

At the time of this writing, the most important shift took place in the group's fifth and sixth recorded meetings; in these two meetings, the group members gave presentations explaining how they understood the collaboration and what they wanted to accomplish, and then presented "states of the art" wherein they repeated back what the others had said in their presentations. Beginning in the sixth meeting, "building consensus" and "determining action" appeared to be strongly connected. I interpreted this as indicating the group was beginning to make decisions collectively. This was an important step toward creating an appropriate research paradigm, which is essential for transdisciplinary, practice-led research.<sup>16</sup> As Biggs and Miedlar have noted during the meetings, substantivity has a moral dimension, one linked to "integrity" and even "honesty." The collaborators are only familiar with (and ultimately, only bound to) the standards of their own fields, so they are individually responsible for ensuring that collective decisions can be justified by their own disciplinary priorities. Lack of consensus potentially represents a failure to cross disciplines. Building consensus therefore appears to be a precondition to making decisions, both at the global level—insofar as "building consensus" was a dominant method in the early meetings—and at the local level—where the two methods continue to appear together within conversations. The narrow expectations and priorities of their fields may have initially incentivized what Biggs has called "vampirism"—gleaning (often shallow) information from collaborators without reciprocally informing their research. The collaborators eventually found points of contact between their different disciplinary obligations that they could use to make decisions based on values that are relevant to their fields, but that their fields have traditionally lacked space to explore internally. They built their consensus on touchstone ideas—like "initial state," "interaction," and "experiment"—that became more "robust"<sup>17</sup> as they unified their understandings.

At the time of writing, this work is ongoing, and it remains to be seen whether the group will achieve transdisciplinarity, and even whether that outcome will ultimately be interesting to the collaborators. Orr and I continue to research the implications of transdisciplinary research for the philosophy of science. Our work will investigate why researchers use the methods that they do and what can be gained from transplanting methods across fields, using as case studies the CERN–IARI Collaboration, IARI's *Terra Anima* Inquiry from 2017–2018, and an inquiry planned for the future based on blockchain.

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<sup>1</sup> Helen Longino, “In search of feminist epistemology,” *The Monist* 77, no. 4 (1994): 472–485.

<sup>2</sup> Wendy S. Parker and Eric Winsberg, “Values and evidence: how models make a difference,” *European Journal for Philosophy of Science* 8, (2018): 125–142.

<sup>3</sup> Richard Rudner, “The scientist qua scientist makes value judgments,” *Philosophy of science* 20, no. 1 (1953): 1–6.

<sup>4</sup> William Wimsatt, *Re-Engineering Philosophy for Limited Beings* (Cambridge: Harvard University Press, 2007).

<sup>5</sup> Eric Winsberg, personal communication, October 12, 2020.

<sup>6</sup> Johannes Lenhard and Eric Winsberg, “Holism, entrenchment, and the future of climate model pluralism,” *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 41, no. 3 (2010): 253–262.

<sup>7</sup> For example, in the context of climate policy, the decision between conflicting, purpose-specific models is a value-laden decision that is worth interrogating, since, as Winsberg and Lenhard explain, there is reason to believe that the models will not converge but forever remain plural. There often is no straightforwardly superior model, so it may be important that the choice between models remains open to debate.

<sup>8</sup> Janet Biggs, Clint Hurshman, Agnieszka Międlar, Joey Orr, and Daniel Tapia Takaki, “Dear Arts Integration Community: A Letter of Inquiry from the CERN—IARI Collaboration” (presentation, Alliance for the Arts in Research Universities 2020 National Conference, Madison, WI, (online) October 28, 2020).

<sup>9</sup> Andrew Yang, “That drunken conversation between two cultures: Art, science, and the possibility of meaningful uncertainty,” *Leonardo* 48, no. 3 (2015): 318–321.

<sup>10</sup> Cited in n. 2 above.

<sup>11</sup> Cited in n. 3 above.

<sup>12</sup> Cited in n. 3 above.

<sup>13</sup> Cited in n. 4 above.

<sup>14</sup> <https://www.museumsarenotneutral.com>

<sup>15</sup> For example, the historical connection between photography and surveillance technologies, as discussed in Allan Sekula, “The body and the archive,” *October* 39 (1986): 3–64.

<sup>16</sup> Brad Haseman, “A manifesto for performative research,” *Media International Australia incorporating Culture and Policy*, 118 (1), 98–106.

<sup>17</sup> Cited in n. 3 above.

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