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Communicating with scientific graphics: A descriptive inquiry into non-ideal normativity

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ABSTRACT

Scientists' graphical practices have recently become a target of inquiry in the philosophy of science, and in the cognitive sciences. Here I supplement our understanding of graphical practices *via* a case study of how researchers crafted the graphics for scientific publication in the field of circadian biology. The case highlights social aspects of graphical production which have gone understudied – especially concerning the negotiation of publication. I argue that it also supports a challenge to the claim that empirically-informed "cognitive design principles" offer an apt understanding of the norms of success which govern good scientific graphic design to communicate data and hypotheses to other experts. In this respect, the case-study also illustrates how "descriptive" studies of scientific practice can connect with normative issues in philosophy of science, thereby addressing a central concern in recent discussions of practice-oriented philosophy of science.

1. Introduction

In recent decades, philosophy of science, and studies of science more broadly, have taken a "practice turn." A traditional focus on abstract products of science (e.g., theories as organizations of knowledge) has been swapped for a focus on the everyday activities of scientific knowledge production. This can be seen as part of a broader trend toward naturalism in 20th century philosophy (Scerri, 2006, pp. 119–128). Naturalism in general, and a practice-oriented approach in particular, seems to recommend descriptive methods of inquiry. This leads to a puzzle: philosophers have worried whether descriptive methods can speak to "the proper sorts of normativity" – most centrally, epistemic norms of evidence and confirmation – that were traditionally regarded as the purview of philosophy of science (Woody, 2014, p. 12; compare; Kim's 1998 worries about; Quine, 1969).

One option is to revise our understanding of some traditional forms of normativity – to adapt but retain a relatively traditional focus. For example, Collins and Evans' (2002) "Third Wave STS" seeks to reconceive epistemic normativity in terms of expertise, bringing epistemology back into a practice-oriented picture (but see Lynch 2014 and subsequent commentary). As another option, the hardcore descriptives might convince us to abandon normative concerns. I do not pursue either option here. Against the second option, I demonstrate how descriptive studies of scientific practice can speak to a class of normative issues. However, against the first option, the varieties of normativity I will discuss have not been a topic of traditional discussion. In particular, they are not epistemic: I am not concerned here to discuss standards of "evidence" or "confirmation" or how expertise grants any "epistemic authority." Rather, I think one of the most central ways that descriptive methods can speak to normative issues is by enlightening us about varieties of normativity in scientific practice that traditional inquiry has obscured. This introduction frames my approach conceptually. The paper implements it.

Consider recent discussions in political philosophy. A number of political philosophers are concerned that traditional methods of inquiry have provided little practical action-guidance in the political sphere, and a set of debates, all cast under the rubric of "ideal vs. non-ideal theory," have reconsidered the aims of political philosophy in light of this result. Valentini (2012) offers a helpful overview of the debate. To my knowledge, an analogous ideal/non-ideal distinction has not previously been drawn in philosophy of science, though it seems apt. Despite a traditional philosophical impulse to think we might offer prescriptions to improve scientific practice, it is questionable whether we have succeeded, and somewhat presumptive to think we non-practitioners could (cf. Weinberg, 1992; ch. 7). Our presumption is strongest if we regard our prescriptions as having an *a priori* justification that requires no attention to actual scientific practice.

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I suggest that to resolve the basic puzzle of how practice-oriented philosophy of science can speak to normative issues, we may view it as a contribution toward a "non-ideal" normative theory which aims for a high degree of "realism" (Valentini, 2012; §2). The (plausible) idea is that what counts as good practice, in practice, involves contingent factors which are not apprehensible by *a priori* reflection on a utopian ideal of science. Rather, we need descriptive methods to tell us, *a posteriori*, what the contexts of practice are actually like, and what shape good (though perhaps not *ideally* good) practice can take here in non-utopian reality. The (modest) aim of *prescriptive* non-ideal theory is to offer realistic action-guidance that is sensitive to contingent constraints that inform real-world scientific practice (compare Valentini's §3 on "transitional" theories).

One possible difficulty for highly realistic, non-ideal, normative approaches is that "the more factual constraints are introduced in the elaboration of normative … principles, the more these will appear to offer an uncritical defence of the *status quo*" (Valentini, 2012, p. 659). In political philosophy, this is a serious worry, since (e.g.) real-world injustices are unfortunately rampant. The sad fact is that a suitable analysis must maintain, as Valentini puts it, some "distance between the 'ought' and the 'is' " (Valentini, 2012, p. 660). A non-ideal theory that assumes "realism" about injustices could lose the critical standpoint from which to evaluate them as unjust. Valentini's suggestion, following Joseph Carens, is that the degree to which one's normative theory should be realistic or factual – the size of the "distance" to maintain between "ought" and "is" – depends upon one's aims. If you aim to analyze an ideal, to assess how far we are from it, then reality is relevant to the assessment, but not to the analysis, and the distance between "ought" and "is" may be vast. If you aim to provide prescriptions to guide action here and now, your prescriptions should incorporate data regarding the here and now, and the distance between "ought" and "is" will be lesser.

These aims are distinct, but not incompatible. Analogously, a practice-oriented approach need not challenge ideal normative approaches in philosophy of science: we simply have different aims. We can put descriptive projects to work in support of (non-ideal, realistic) normative projects that permit less distance between "ought" and "is."

My own view is that the relation between descriptive and normative projects can be even closer: the question is whether *all* normative inquiry must aim for corrective prescription. Scientists can be criticized for failing to meet a variety of extra-scientific normative standards: the current distribution of funds, goods, and qualified individuals to do science likely involves injustice, and the existing institutions and policies whereby one is initiated into the practice of science are likely exclusionary, in problematic ways. Other arrangements should be prescribed. But in some ways, the scientific *status quo* looks to need no defense. I (and also many naturalists) do not see fit to call into question that those who are privileged to do science are, in the main, largely succeeding in their professional practices. The happy fact is that we need not always maintain distance between an "ought" and the "is" – sometimes, humans practices are already good, by the relevant standards. In such a case, it is presumptive, and I think misguided, for a non-practitioner to undertake normative inquiry for the purposes of offering prescriptions to make practice "better." The task is rather to articulate what the normative standards for success are, as these are actually being fulfilled here and now. (To put a pseudo-Kantian spin on it: granted that some success in scientific practice is actual, *how* is it actual?)

Now, success in scientific practice is by no means automatic, universal, or constant. Gaps do indeed arise between even non-ideal "oughts" and the "is." Scientists themselves recognize this when they carry out a meta-practice of *reforming* some of their own practices. In such cases, scientists exhibit what I call *normative self-regulation*: they alter what they do so as to be doing what they believe they ought to do, and by pursuing reform, they intend to meet (and occasionally, alter) standards of scientific success. When practicing reform, scientists do their own implicit, non-ideal, normative inquiry, and immediately put its prescriptions into action to close the gap between "ought" and "is." I (and many naturalists) maintain that scientists do this quite well on their own: by and large, their practices of reform tend to close large gaps between "ought" and "is," restoring real-world success.

Descriptions of normative self-regulation would provide a unique window into the non-ideal norms which govern everyday science, and how scientists enact their success. Moreover, it is quite possible that success in science, as it happens, might involve meeting a variety of non-ideal norms that have previously been overlooked (e.g., they may form no part of a utopian ideal of practice). In what follows, I use a descriptive method to uncover just such forms of under-discussed normativity, using a case study of scientists' meta-practices of reforming their own graphical practices. I make no suggestion that we should abandon ideal normative theory in philosophy of science: I do not use the term "utopian" as a pejorative. Nor do I claim that we should abandon prescriptive projects. I simply pursue different aims.

The paper proceeds as follows. First (§2), I review recent research regarding scientists' graphical practices. Cognitive scientists have advanced a set of empirically-informed "cognitive design principles" as non-ideal prescriptions for scientific graphic design, and I review some of them. Next (§3), I introduce my case study, highlighting two aspects of it that I then examine more closely (§§4&5). Throughout, I argue that graphical practices have a (non-ideal) normative life of their own: they are (in part) governed by standards of success which should not immediately be assimilated to traditional categories of normativity that philosophers of science have previously invoked to understand good science (e.g., standards of evidence; standards of good explanation) or that philosophers have studied elsewhere (e.g., aesthetic standards). Moreover, I argue that scientists' practices of reform reveal that the "cognitive design principles" are not plausibly non-ideal norms of expert practice: they do not offer basic prescriptions which can aid scientists in making good graphics to communicate with other experts, since they overlook important contingent features that constrain and inform success in this practice. As I conclude in §6, the case-study is of philosophical interest insofar as it contributes to a (non-ideal) normative project in the philosophy of science. It is of additional interest insofar as it uncovers previously understudied forms of (non-ideal) normativity.

2. Recent work on scientists' graphical practices

2.1. Aspects of graphical practice

For my purposes, I employ a coarse-grained distinction between five aspects of scientific graphical practices ("GPs"). As I remark in footnotes, Pauwels' (2006) more fine-grained division supports these distinctions, plus others.

1. *Design Demands*. [1] We can think of this as the "why" of graphical production: what is a graphic meant to show, and who is it for? Some are meant to be mere eye-candy (e.g., a submission for

[1] Creators must settle the intended "referent" and the "intent or purpose" of the graphic, and plan for their intended "style of execution" – all of this will constrain "production practices" (Pauwels, 2006). Similar themes are discussed by Pauwels (2011) in relation to how one should go about *analyzing* and *presenting* "secondary research graphics" to an audience, as I do here.