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WHAT ARE WE TALKING ABOUT WHEN WE TALK ABOUT SCIENTIFIC OBJECTIVITY?

Abstract: Philosophers of science often suggest that the key feature of scientific research is striving for objectivity and that we should evaluate scientific practice by whether it is objective or not. In this paper, we will analyze several definitions of scientific objectivity to illustrate the complex meaning of this term and examine its role in evaluating scientific practice. First, we will introduce Lorraine Daston and Peter Galison's standpoint concerning the historical connection between the genesis and development of scientific objectivity and the practices of visual representation in the research practice of the 19th and 20th centuries. We will accomplish that by outlining the process of establishing scientific objectivity as an epistemic virtue and a vital feature of the "scientific self". Subsequently, using Heather Douglas and Marianne Janack's conceptual analysis of scientific objectivity, we will show that scientific objectivity is characterized by an "irreducibility of meaning" and an "endemic instability" caused by the overuse of metaphors in defining this concept. In the final section, in light of contemporary problems such as the crisis of reproducibility, we examine to what extent philosophical definitions help test the objectivity of scientific practice and point to an intriguing attempt to define "objectivity for the research worker" using the model proposed by Noah van Dongen and Michał Sikorski.

Keywords: scientific objectivity, scientific self, conceptual analysis, scientific research, reproducibility.

1. Introduction

Scientists are not isolated from society. In this sense, like all other citizens, they should respect the rights and property of other people, not

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harm them, but aid them and comply with the law. As experts from a particular field, in addition to civic duties, scientists have specific obligations because of their distinct roles in the broader community, which consequently rewards them with a certain authority and autonomy. The broader inventory includes a whole range of norms that should be fulfilled in different domains of professional, scientific practice: impartiality, honesty, objectivity, openness, recognition of colleagues, respect for intellectual property, respect for colleagues, competence, legitimacy, social responsibility, efficient and responsible use of resources, verifiability, coherence, empirical support, precision, economy, etc. (Resnik, 2006: 36).

As we can notice, some of the mentioned norms are moral in nature, others come from law, and others are epistemic. Most frequently, objectivity stands out as the most important of all norms and is also the primary feature of a scientific enterprise with a dual, moral, and epistemic character (Daston & Galison, 2007: 42; Resnik, 2006: 45).

Objectivity is a trait of scientific conclusions, methods, and results that excludes personal social, economic, and political biases from the procedures of experimental design, testing, analysis, review, and publication (Reiss & Sprenger, 2017; Resnik, 2006: 35). Moreover, other moral and epistemic norms, such as honesty, openness, empirical support, verifiability, and precision, can be founded on different approaches to objectivity (Resnik, 2006: 52). Furthermore, if we glance at things from a broader perspective, objectivity is a normative ideal, like justice, virtue, or piety (*Ibid*).

In this article, we will analyze from different angles the connection between the epistemic authority of science and the concept of objectivity. First, we will consider some noteworthy philosophical definitions and then examine whether philosophers have provided a satisfactory conceptualization of objectivity that might be of practical use to researchers today. Given that objectivity is not only an incredibly vast topic but also a somewhat controversial one, it should be stated that we have covered it only partially. We have tried to provide a balanced and concise display of some of the relevant viewpoints and discussions in the paper, but understandably we have yet to address many issues.

We begin our articulation with the central ideas introduced in the most significant study of objectivity in this century, the book *Objectivity* by Lorraine Daston and Peter Galison, in which the authors present the history of this epistemological concept.[1] Genre-wise, some authors

1 "This is a book for meditation and loaning to friends. It's a book prize for the best undergrad in the class. The bounty of information, the charm of anecdote, the care with which each sentence is composed, the elegance of illustration, the power of the

assign this book to the history of science, others to historical epistemology, and still others, such as Ian Hacking, believe that it is a work from the field of meta-epistemology (Hacking, 2015: 19).[2] In any case, this comprehensive study of the concept of objectivity, its use over the last two centuries, and the associated practices is an indispensable reference for any discussion of this topic. For that reason, in the following section, we will take a closer look at the most significant insights and arguments related to it.

2. A brief history of scientific objectivity

Briefly, the central thesis that Daston and Galison advocate in their book *Objectivity* is that the connotation of terms associated with "objectivity" has varied considerably over the past two centuries (Daston & Galison, 2007: 35). Since the 19th century, "objectivity has had its prophets, philosophers, and preachers," (Daston & Galison, 2007: 17) but its distinctiveness, as Daston and Galison point out, was most evident in the example of a regular scientific practice – the production of images. For this reason, the two renowned historians of science have chosen to portray the history of objectivity through images from scientific atlases, or rather, through selected assemblages of images that served to identify the major research subjects in particular disciplines. Their comprehensive analysis of naturalistic illustrations from the eighteenth century onward reveals, as they state, three distinctive forms of objectivity– "truth to nature", "mechanical objectivity" and "trained judgement" (*Ibid*).

Their analysis commences with the recognition that throughout most of the eighteenth and nineteenth centuries, the process of constructing scientific knowledge was in many ways analogous to the approach of creating a work of art (Daston & Galison, 2007: 35; Ambrosio, 2015: 354). Namely, as scientists of the time sought to "capture nature in its ideal form", they

analysis, and the formidable structure of the whole". With these words, Ian Hacking began his talk at the *Objectivity from a Historical Perspective* roundtable dedicated to this book. Hacking was followed by talks of Peter Dear, Matthew L. Jones, and authors Lorraine Daston and Peter Galison (Dear, Hacking, Jones, et al. 2012: 17).

2 *Historical epistemology* is a collective term for several diverse approaches to studying the history of epistemic concepts such as objectivity, observation, experimentation or probability, as well as the historical trajectories of research subjects such as the electron, DNA, or the phlogiston. This term also refers to the primary research direction of the Max Planck Institute for the History of Science in Berlin, founded in 1994 and led by Lorraine Daston, who has contributed significantly to the popularity of this approach among historians of science (Feest & Sturm, 2011: 286).

paid attention to how they could depict a particular individual plant or animal as a "representation" of that ideal when preparing illustrations for atlases (Daston & Galison, 2007: 66). Objectivity, in this case, is defined by its affinity to realism-what Daston and Galison anoint a "truth to nature" perspective.

Pictures served the ideal of truth-and oftentimes, the ideal of beauty, along with the truth. "Truth to nature" requires a thorough knowledge of diversity and deviations in nature in order to "perfect" the individual phenomena found around us (Daston & Galison, 2007: 104). The scientists of the 18th and the first half of the 19th century had the "duty to correct nature for the sake of truth" (Ambrosio, 2015: 354): Their illustrations show that for them, representation was inseparable from the act of discernment, which meant visualizing, not individual natural phenomena, but their ideal manifestations.

The advent of photography brought about a radical change. Since 1839, when the first daguerreotype was displayed at the French Academy of Sciences, the status of photography has been the subject of heated debate. Initially, scientists believed it was the ultimate tool for achieving accurate observation and measurement. Its mechanical and reproducible character was the rationale for believing that the camera functioned as a kind of "artificial retina", devoid of subjective perspective (Daston & Galison, 2007: 187; Ambrosio, 2015: 358). By the end of the 19th century, photography was also being utilized to observe phenomena that were otherwise considered imperceptible. It also found its use to measure and obtain experimental records. Daston and Galison associated the emergence of the contemporary concept of scientific objectivity with photography's advent.

Although the concept of "mechanical objectivity" extended to a broader range of scientific instruments, they singled out photography as the principal reason that led scientists to adopt a non-interventionist attitude toward the subject of their research. Mechanical reproducibility contrasted sharply with the ideal of "truth to nature", in which the willful intervention of the researcher lends credibility and scientific status to the pictures. In contrast, "mechanical objectivity" mandates the researcher to adopt an *ascetic attitude* toward the object of scientific inquiry. Human intervention is substituted by the procedural use of technologies that ensure that the scientist's judgment is truncated in the visualization process. This form of objectivity went hand in hand with the increasing reliance of scientists on recording and measuring instruments, which, like the camera, promised to be able to thoroughly eliminate the human factor (Daston & Galison, 2007: 122; Ambrosio, 2015: 358; Christin, 2016: 27).

The increasingly frequent reliance on technologies in scientific practice has brought with it new moral and epistemic acuities.[3] As Daston and Galison noted, the virtues attributed to machines were stressed as models for humans to emulate, the most important being associated with diligence and a dedicated and focused work ethic. In addition, machines had the unique advantage of not comprehending theories and being unable to think about them, which held them from the inevitable bias characteristic of humans. Daston and Galison distinguish this widespread belief in machines' superior objectivity and quality as a paradigm of "mechanical objectivity" (Daston & Galison, 2007: 123).[4]

Over time, however, researchers realized that adherence to "mechanical objectivity" had its price: the machines registered only a small part of the natural phenomena the scientists wanted to record or left their imprints on objects that were not there. It turned out that the machine's photograph, imprint, or X-ray often required clarification and misled researchers, mainly because it contained too much information which was largely irrelevant or implausible.[5] In the late nineteenth and early twentieth centuries, a new paradigm emerged, "trained reasoning", in which scientists again started to rely on their expertise and experience to add their interpretation to the data provided by the machine, for example, by adding complex color schemes or combining different images to obtain composite vistas. For example, solar magnetogram require a trained expert to "extract" the correct signal from the data registered by the instruments. Daston and Galison cite this example as an illustration of "trained judgement" (Daston & Galison, 2007: 21).

3 For more on the ethical and epistemic challenges and complexities of relying on automation and mechanization in scientific practice, see Kušić & Nurkić (2019).

4 Stanford sociologist Angèle Christin sees a contemporary version of the ideal of mechanical objectivity in viewpoints that describe algorithms as value-neutral tools of rationalization and objectivity, as opposed to human individuals whose thoughts are shaped by various biases rendered by class, race, gender, or political attitudes (Christin, 2016: 28). Christin points out that *Big Data* analysis, which has fundamentally transformed practice in numerous scientific fields, is increasingly described "as the cure for 'broken' systems shaped by long histories of bias, inefficiency, and discrimination" (*Ibid*). Christin aside, Galison himself has criticized the assertions that algorithms managing artificial intelligence are more objective than human experts in procedural, methodological, and value terms (Galison, 2019).

5 In her study, in which she converses about how the views of artistic photographers influenced practices of visual representation in science, Chiara Ambrosio points out how pictorialists looked with scorn at the widespread attitude among scientists about the objective nature of photographs (Ambrosio, 2015: 359). A very frank polemic often had sarcastic undertones, as in a 1903 brief article entitled "Ye-Fakers," in which the pictorialist photographer Edward Jean Steichen explicitly ridiculed the asceticism preached by advocates of mechanical objectivity (Steichen, 1903: 48).

We conclude this brief review of the history of visual representation in scientific atlases by noting that objectivity has permanently moved along two tracks – one involving the development of the epistemology of scientific practices and the other leading to the adoption of the distinctive moral virtues that Daston and Galison refer to as the "scientific self" (Daston & Galison, 2007: 229).[6]

Having sketched the unusual historical development of scientific objectivity, we discuss below several influential viewpoints that reveal the tribulations we may encounter in attempting to define this concept. After depicting the views of Heather Douglas, Marianne Janack, and Ian Hacking, in the final part we will explore whether researchers can rely on and apply an appropriate conceptualization of objectivity in practice.

3. Endemic instability

It is unnecessary to emphasize that some of the most important questions within the philosophy of science have to do with objectivity in one way or another. We will only enumerate a few here: the problem of induction; the criteria for preferring a theory; the realism/anti-realism debate; scientific explanation; experimentation; quantification; application of statistics; the role of values in science; feminism. For instance, when articulating "epistemic risks", objectivity is viewed through the prism of the problem of induction, the notion of "procedural objectivity" is associated with experimentation, and "statistical objectivity" with the application of statistics, and so on (Harding, 2015; Biddle & Kukla, 2017; Douglas, 2004; Freese & Peterson, 2018). For a broader understanding of discussions of objectivity in the philosophy of science, an overview of a range of additional issues is necessary beyond our article's scope.

6 To illustrate, here is the opening paragraph of the first chapter of the book *Objectivity*, entitled "The Epistemologies of the Eye". "Scientific objectivity has a history. Objectivity has not always defined science. Nor is objectivity the same as truth or certainty, and it is younger than both. Objectivity preserves the artifact or variation that would have been erased in the name of truth; it scruples to filter out the noise that undermines certainty. To be objective is to aspire to knowledge that bears no trace of the knower — knowledge unmarked by prejudice or skill, fantasy or judgment, wishing or striving. Objectivity is blind sight, seeing without inference, interpretation, or intelligence. Only in the mid-nineteenth century did scientists begin to yearn for this blind sight, the "objective view" that embraces accidents and asymmetries, Arthur Worthington's shattered splash-coronet. This book is about how and why objectivity emerged as a new way of studying nature, and of being a scientist." (Daston & Galison, 2007: 17).

Before turning to some contemporary philosophical critiques of the concept of objectivity, let us briefly consider the interpretations of some of the most prominent philosophers of science of the 20th century. Underlying the viewpoint advocated by the leading proponents of logical empiricism is the conviction that facts are "out there somewhere" in the external world and that it is the scientist's mission to uncover, analyze and systematize them. Objectivity is the measure of whether they have been triumphant in this endeavor. In this sense, science is objective to the extent that it succeeds in discovering and generalizing facts and abstracting them from the subjective perspective of the individual scientist (Reiss & Sprenger, 2017).[7]

Robert Nozick equates objectivity with *invariance* and utilizes "objectivity" as a modifier for "truth" and "fact." Invariance, according to Nozick, is what remains when one abstracts from other properties of objectivity – accessibility from different perspectives, possibilities of intersubjective agreement, and the independence of a given truth or fact *p* from human "beliefs, desires, hopes, and observations or measurements that *p* is" (Nozick, 1998: 21). In contrast to Nozick, who focuses on the interactions between man and the world in his account of objectivity as invariance, Thomas Nagel refers to individual thought processes in his account of objectivity as *aperspectivism*, i.e., a "view from nowhere", while Bernard Williams refers to objectivity as an *absolute concept* (Nagel, 1986; Williams, 1985).

Recently, one of the critical topics of debate on scientific objectivity is the proliferation of meanings of this term (John, 2021: 4). Namely, its semantic richness is reflected in the multitude of possible categorizations and subdivisions, as Heather Douglas and Marianne Janack point out.

Although objectivity is one of the most prevalent concepts in the philosophy of science and epistemology, Heather Douglas believes that we are dealing with one of the most ill-defined terms. Douglas points out that every time we reach for objectivity, we appeal to its rhetorical power and say, "I endorse this and you should too" (Douglas, 2004: 453). In other words, and a milder form, we should trust the outcome of the process that objectivity produces. In exploring whether objectivity hauls with it something else besides this persuasive power and call to trust, Douglas was able to articulate eight distinct, operationally accessible meanings. Unlike many of her predecessors whose views we have mentioned, she concluded

7 In his book *The Advancement of Science: Science Without Legend, Objectivity Without Illusions* (Oxford University Press, 1993), Philip Kitcher criticizes this view and ironically calls it the "Legend" of how successive generations of scientists have written the entire true history of the world (Kitcher, 1993: 3).

that none of these eight meanings could be strictly reduced to one another, making objectivity an *irreducibly complex concept* (Douglas, 2004: 465).

Marianne Janack went a step further than Douglas. She noted the striking tendency in philosophic attempts to define objectivity – relying on the ideal of perspective in explaining something that is the opposite of perspective (Janack, 2002: 274). Janack's critique is directed at the overuse of metaphors in the conceptual analysis of the notion of objectivity. Without denying the importance of metaphors as a heuristic tool for our understanding of the world, she contends that in the case of defining objectivity, the problem is that perspectival metaphor is both a "cognitive frame for the concept" and an "explanation of the concept" (*Ibid*). "The 'frame'", as she states, "undermines the 'target' of the metaphor" because "we use the idea of perspective to explicate the ideal of perspectivelessness" (Janack, 2002: 275) – and so we get paradoxical definitions such as "a view from nowhere" that is a perspective that is not a perspective at all and the like, which is consistent with Lorraine Daston's supposition that the historical rise of scientific objectivity began precisely with the "escape from a perspective" (Daston, 1992: 598).

Janack also assumes that metaphorical determinations of objectivity are characterized by an endemic conceptual instability that she thinks is inevitable.[8] To reinforce this, she itemizes no fewer than 13 diverse meanings she has encountered in her inquiry of the relevant literature (Janack, 2002: 275):[9]

1. Objectivity as value neutrality;
2. Objectivity as lack of bias, with bias understood as including:
   a) personal attachment;
   b) political aims;
   c) ideological commitments;
   d) preferences;
   e) desires;
   f) interests;
   g) emotion.
3. Objectivity as scientific method;
4. Objectivity as rationality;
5. Objectivity as an attitude of "psychological distance";

8 For more information on other contexts of conceptual instability, see Nurkić (2022).

9 Janack verbatim states at one point, "philosophers and scientists writing on objectivity seem to abandon themselves to this 'drive to metaphorize' with nary a blink" (Janack, 2002: 274).

6. Objectivity as “world-directedness”;
7. Objectivity as impersonality;
7. Objectivity as impartiality;
8. Objectivity as having to do with facts;
9. Objectivity, as having to do with things as they are in themselves; objectivity as universality;;
10. Objectivity as disinterestedness;
11. Objectivity as commensurability;
12. Objectivity as intersubjective agreement.

When we try to apprehend what is actually denoted by objectivity, we undergo, as Janack suggests, “a dizzying array of different kinds of virtues, ideals, metaphysical positions and psychological states” (Janack, 2002: 276), emphasizing that science is no exception in this regard. Not only is the internal use of this term no more uniform in the domain of science than in other fields, but her research has revealed that scientific back-and-forths draw on all of the above meanings of objectivity. To make matters more ominous, among the subcategories clustered around the second connotation (“objectivity as lack of bias”) from Marianne Janak’s inventory are terms from the domains of law and politics, which are often cited as epistemic ideals in scientific discussions. In the following section, we will return to this issue, considering the usefulness of the philosophical conceptualization of objectivity for researchers. Before proceeding to the analysis from the outlook of scientific practice, we will also mention another engaging critique that starts from the meaning of the concept of objectivity, put forward by Ian Hacking.

In one of his seminal books, *Social construction of what?,* Hacking notes that words such as “fact”, “truth”, “reality”, or “knowledge” often operate at a different level than words used to denote ideas or objects, as he refers to them as “elevator words” (Hacking, 1999: 22). Support for this is found in Willard van Orman Quine’s analysis of the terms mentioned above, according to which they serve “semantic ascent”. Hacking argues that “facts, truths, reality, and even knowledge are not objects in the world, like periods of time or little children, fidgety behavior, or loving-kindness.” (*Ibid*). “These terms are on a higher plane,” Hacking acknowledges. He considers “objectivity” as one of them, which he asserts is not a virtue but instead accentuates the absence of vice. Such notions, he points out, lead to grandiose controversies that sound important but are empty (Hacking, 2015: 24).[10]

10 Hacking illustrates this with the following question, “Whose research in climate science meets the standards of scientific objectivity?” (Hacking, 2015: 20).

4. Objectivity in scientific reasoning

One of the strongest arguments in favor of scientific realism is that the only satisfactory explanation for the success of scientific theories is that they are true (or approximately accurate or proper in those respects that account for their success). This point of view is sometimes called the "ultimate argument for scientific realism" (Musgrave, 1988: 229). Without going further into the quarrels between realists and relativists in the philosophy of science, we would like to state at the beginning of the final chapter that the success of science is indisputable and that this is undoubtedly one of the main reasons why science is ascribed objective character and epistemic authority. We will also explore the extent to which current philosophical conceptualizations can be helpful to researchers and their practice, and draw attention to an interesting step in this direction. In particular, we will present a recent attempt to make the concept of objectivity advantageous for solving annoyances related to the crisis of reproducibility of the results of scientific theories (van Dongen & Sikorski, 2021: 2).

In recent years, as we know, numerous concerns in the scientific community have increasingly come to light, often labeled as unethical behavior, albeit for various reasons. Some involve overt fraud (such as fabrication and plagiarism), while others are somewhat more subtle but generally much more present and detrimental to the broader scientific community (Ioannidis, 2005; Open Science Collaboration, 2015). The collective term for this overall group of problems is the "crisis of reproducibility", which can be interpreted as being caused by a lack of scientific objectivity (van Dongen & Sikorski, 2021: 2). Existing philosophical theories of objectivity do not equip scientists with an appropriate conceptual framework to apply and improve their practice and eradicate (or at least reduce the likelihood of) the occurrence of this nuisance. One of the first and more substantial steps in this direction was recently undertaken by Noah van Dongen and Michal Sikorski to supply researchers with an empirically and methodologically sound inventory of facets that undermine scientific practice in their various domains (van Dongen & Sikorski, 2021: 8). They emphasize the conceptual framework that highlights the methodological quality of the research and the results obtained.

Van Dongen and Sikorski stress that their approach focuses on scientific problems that result from concrete decisions and practical actions by researchers. What exactly does this imply? Primarily the exclusion of several factors that are not under the immediate control of scientists and that have often been mentioned in eclectic definitions of objectivity. For example, Dongen and Sikorski ruled out issues of an ethical, financial, and political nature, but also some specific external factors, such as limited access to samples, instruments, or the policy to which most scientific journals are committed, namely to publish articles conveying experiments with positive results (van Dongen & Sikorski, 2021: 9).[11] The problems mentioned are beyond the control of individual scientists. They concern the position of science and the scientific community in the broader societal context rather than the verifiable practical procedures and decisions of scientific workers.

Van Dongen and Sikorski focused on the specific decisions and actions of the researcher before, during, and after the research. Namely, before the research, the scientist can make *a priori* decisions about the design of the experiment and the method of data collection, which can reduce/increase the likelihood of an outcome and thus open the door to bias (van Dongen & Sikorski, 2021: 8). After the research, a similar approach can be taken to process and analyze the data by straining all combinations until the desired (positive) result is achieved (van Dongen & Sikorski, 2021: 9). Their presumption of *objectivity for the research worker*, which we briefly conveyed, implies a verifiable conceptualization that would prevent the emergence of intricate practices during research. Dongen and Sikorski have furnished a model of this conceptualization that they hope will soon grow into tangible protocols for verifying the objectivity of research in various scientific fields (van Dongen & Sikorski, 2021: 19–22).

5. Conclusion

Objectivity is an epistemic virtue or norm that invokes moral values on the one hand and pragmatic efficiency in ensuring the acquisition and verification of knowledge on the other. As Daston and Galison put it, "epistemic virtues earn their right to be called virtues by molding the self, and the ways they do so parallel and overlap with the ways epistemology is translated into science." (Daston & Galison, 2007: 41). In the previous part of our paper, we attempted to provide three possible answers to how epistemology is translated into science. First, we approached the question of what we are talking about when we speak of scientific objectivity from a historical perspective, then from the angle of conceptual analysis, and finally from the position of scientific practice. From there, we have drawn several valuable conclusions.

11 This last type of bias can shut the door on authors describing experiments with negative results, influencing the skyrocketing publication rate of articles with false positives.

Regarding the historical side of objectivity, we can conclude that everyone engaged in science evaluated their work to the extent that it fit the distinctive kind of "scientific self" they cultivated. Conceptual analysis has revealed that one of the key features of objectivity is conceptual instability due to the fact that philosophers often resort to metaphors when trying to define it. Finally, as far as scientific practice is concerned, it has been ascertained that objectivity is not so manageable to verify and evaluate but that there are exciting attempts in this direction that could contribute to the solution of some accumulated tribulations that have burdened scientists and the scientific community in recent years (van Dongen & Sikorski, 2021: 19–22). Finally, we would like to reiterate that objectivity is quite an extensive and controversial topic. Although we have done our best to make our analysis and the selection of topics we confer relevant and congruous, it is understandable that we still need to address some issues.

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