



How we load our data sets with theories and why we do so purposefully



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ARTICLE INFO

Article history:

Received 1 March 2016

Received in revised form

10 July 2016

Available online 4 September 2016

Keywords:

Theory-ladenness

Statistical imputation

Perception

Data

ABSTRACT

In this paper, I compare theory-laden perceptions with imputed data sets. The similarities between the two allow me to show how the phenomenon of theory-ladenness can manifest itself in statistical analyses. More importantly, elucidating the differences between them will allow me to broaden the focus of the existing literature on theory-ladenness and to introduce some much-needed nuances. The topic of statistical imputation has received no attention in philosophy of science. Yet, imputed data sets are very similar to theory-laden perceptions, and they are now an integral part of many scientific inferences. Unlike the existence of theory-laden perceptions, that of imputed data sets cannot be challenged or reduced to a manageable source of error. In fact, imputed data sets are created purposefully in order to improve the quality of our inferences. They do not undermine the possibility of scientific knowledge; on the contrary, they are epistemically desirable.

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1. Introduction

In this paper, I compare theory-laden perceptions with imputed data sets. The similarities between the two allow me to show how the phenomenon of theory-ladenness can manifest itself in statistical analyses. More importantly, elucidating the differences between them will allow me to broaden the focus of the existing literature on theory-ladenness and to introduce some much-needed nuances.

One of the main reasons why theory-laden perceptions have been extensively discussed in philosophy of science is that they pose an apparent threat to scientific knowledge. As a result, their very existence has been challenged, or dismissed as merely one of the many potential sources of error inherent in every experimental framework that we can learn how to control.

In sharp contrast, the topic of statistical imputation has received no attention in philosophy of science. Yet, imputed data sets are very similar to theory-laden perceptions, and they are now an integral part of many scientific inferences. Unlike with the case of theory-laden perceptions, the existence of imputed data sets cannot be challenged or reduced to a manageable source of error. In fact, imputed data sets are created purposefully in order to improve the quality of our inferences. They do not undermine the possibility

of scientific knowledge; on the contrary, they are epistemically desirable.

Accordingly, I propose to substantiate the following three theses:

1. Theory-laden observations need not be treated as an inevitable nuisance. They can be created purposefully for their epistemic benefits.
2. Some scientific inferences cannot be understood and assessed unless we understand how and why our observations are theory-laden.
3. The theories loaded onto our observations need not play a role in the justification of our scientific models.

This paper comprises three main sections. In the first section, I explain the thesis of the theory-ladenness of perception and highlight the fact that it has been cited as an obstacle to scientific knowledge. This will set the stage for a fruitful discussion of imputed data sets.

In the second section, I introduce imputed data sets and furnish an example based on a simulated data set. I also show why statistical imputation is important. The results presented in that section can be reproduced using the R code provided on the following websites: <http://grmaranda.weebly.com/> or <https://ulaval.academia.edu/GuillaumeRochefortMaranda/Papers>. In the third and last section, I compare imputed data sets with theory-laden perceptions. This provides the philosophical crux of this article.

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2. Theory-laden perceptions: The controversy

The expression “theory-laden observation” refers to more than one phenomenon (Bogen, 2014). For example, when we say that our observations are theory-laden, we can mean that our observation reports are couched in theoretical vocabulary (see Chalmers, 2013; Churchland, 1979, 1988; Kuhn, 1962 for examples). We can also mean that our theoretical conjectures have directed our attention towards a certain observable phenomenon (see Brewer & Lambert, 2001; Couvalis, 1997 for examples). Here, however, I wish to focus exclusively on the idea that our theoretical beliefs can determine, at least in part, the content of our perceptual experiences. This is the thesis of the theory-ladenness of perception.¹

To be more precise, the theory-ladenness of perception is a thesis in cognitive psychology. It holds that perception is the result of an unconscious inference which is determined by top-down theory information and bottom-up sensory information (Brewer & Lambert, 2001; Gregory, 1997). This theory can be traced back to Hermann von Helmholtz (1866):

Following von Helmholtz’s lead we may say that knowledge is necessary for vision because retinal images are inherently ambiguous (for example for size, shape and distance of objects), and because many properties that are vital for behaviour cannot be signalled by the eyes, such as hardness and weight, hot or cold, edible or poisonous. For von Helmholtz, ambiguities are usually resolved, and non-visual object properties inferred, from knowledge by unconscious inductive inference from what is signalled and from knowledge of the object world (Gregory, 1997, p. 1122).

It is a thesis that is usually presented as a conjecture meant to provide an explanation for various optical illusions: “Some phenomena of illusion provide evidence for the uses of knowledge for vision; this is revealed when it is not appropriate to the situation and so causes a systematic error, even though the physiology is working normally” (Gregory, 1997, p. 1122).

One such illusion that is often mentioned in the literature is the Ames room illusion (see Gillies, 1993; Papineau, 1979). It involves a non-rectangular room such that a properly situated observer can perceive two people of similar size as if they were of different heights. A possible explanation for this illusion is that our experience is determined not only by the visual inputs (bottom-up information) but also by our background beliefs (top-down information) about the usual shape of a room. In other words, the explanation for the illusion is that our perceptions are theory-laden.

Donald Gillies, for instance, clearly adopts this kind of explanation:

It is easy to understand what is happening here. The brain has the choice of interpreting the visual input according to either of the following theories: T1: The two people are approximately the same size, but one is much further away because the room is an odd shape. T2: The room is the usual rectangular shape, and the people are different sizes. Here, T1 is correct, and T2 incorrect. Yet anyone, on seeing the Ames room for the first time, will unconsciously opt for T2. This is perhaps not surprising. Experience has made us all very familiar with the fact that rooms are nearly always rectangular in shape, while people often vary in

size. Thus, on the basis of experience, T2 is better confirmed than T1, although T1 is in fact correct. [...] The Ames room shows very clearly that ordinary everyday observation is theory-laden (Gillies, 1993, pp. 143–44).

Some have even claimed that the credibility of such an explanation is enhanced by the existence of neural pathways between the higher cognitive centers of the brain and the visual modules in which the early stages of perceptions occur.

The thesis of the theory-ladenness of perception has been presented as a feature of scientific practice which can produce scientific knowledge (see Feyerabend, 1993; Hanson, 1958; Kuhn, 1962 for examples). But it has also been more recently discussed by philosophers of science because of the apparent threat that it poses to the possibility of scientific knowledge:²

If all observation is theory-laden, the objectivity of scientific research might be undermined, for it seems that we may well be unable to tell whether our perceptions accurately capture aspects of the world. (Couvalis, 1997, p. 11).

The issue of the role of top-down, or reentrant, neural pathways that transmit signals from the higher cognitive centers to the perceptual modules is important to the philosophy of science, since it is the existence of these pathways that is used as one of the arguments for the cognitive penetrability, and thus for the theory-ladenness, of perception [...], thus clearing the way for relativistic theories of meaning and scientific theories (Raftopoulos, 2001; pp. S187).

On the views of perception that Fodor is out to resist, (theoretical) conception is capable of penetrating perception thoroughly. Theoretical commitments infiltrate observation. Consequently, theory-neutral observation is impossible, and scientists must decide between competing theories on grounds that are pragmatic and holistic at best – grounds that Fodor finds insufficient for a satisfactory defense of scientific rationality. (McCauley & Henrich, 2006, p. 81).

The problem is that if we always justify theories with theories, then we appear to enter an infinite regress of justification or a vicious circle of justification. It is thus not surprising that many philosophers have challenged the existence of theory-laden perceptions (see Fodor, 1984) or downplayed their importance as a credible obstacle to obtaining scientific knowledge.

Jerry Fodor, most notably, has pointed out that we can be victims of optical illusions, such as the Ames room illusion, even if we know how the illusions work (see Fodor, 1984). Therefore, even if our beliefs were capable of influencing the content of our experiences, that influence is clearly very limited and it is thus unable to adequately sustain the argument against the possibility of scientific knowledge.

Moreover, it has been argued that our perceptual experiences play a very minor role in many experimental frameworks. Scientists often merely observe digits or needles on a scale (see Fodor, 1991). The visual stimuli in such environments are not ambiguous, vague, or anomalous. Yet the most convincing cases of theory-laden perceptions involve just such stimuli. Indeed, they are necessary to produce optical illusions such as the Ames room illusion. Hence, even if we acknowledge the existence of theory-laden perceptions

¹ I elect to single out this thesis is because I intend to compare imputed data sets with theory-laden perceptions only. Other versions of the phenomenon of theory-ladenness, although intrinsically interesting, are not relevant for my purposes.

² Other version of the thesis of the theory-ladenness of observation have been advanced in support of scientific realism (Maxwell, 2009). In this paper, however, I only address the literature on the theory-ladenness of perception that focuses on the potential threat that it poses to scientific knowledge.

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