

Title: Analogical Reasoning in Medicine: Bayes meets Jeffrey

Abstract: Sometimes evidence for a hypothesis cannot be directly observed. This might be the case if the evidence is inaccessible for theoretical reasons. But even if observing the evidence for a certain hypothesis is theoretically possible, we still might not possess the know-how or the right tools to measure it. Alternatively, the costs to produce the evidence or to build the tools required to measure it might be too high. In such cases, evidence cannot be accessed for different practical reasons. The existence of widely recognized moral reservations might also make it impossible to observe evidence. This seems to be often the case in medical studies. Producing evidence to directly confirm a certain hypothesis might, for example, require surgical interventions on the brains of subjects.

Cases in which a hypothesis H cannot be directly confirmed by observing evidence E obviously cause trouble for scientists and physicians. Though such a hypothesis cannot be directly confirmed, it might make perfectly reasonable true or false claims. So is there really no way to confirm (or disconfirm) such a hypothesis? In medicine, one possible option consists in trying to find model organisms s^* that are similar (or analogous) enough to subjects s about which H claims this and that. One could then formulate a corresponding hypothesis H^* for these similar enough model organisms s^* . Contrary to s , these model organisms s^* might be used to produce evidence E^* that can be observed directly. (Think, for example, on studies investigating the efficacy of a certain medical compound by means of performing experiments on animals.) Now the hope is that our original hypothesis H can somehow be confirmed on the basis of observing E^* . After all, H^* makes a claim about s^* that is analogous to what H claims about s . If E^* can somehow be used to confirm H , then it seems that there is a possibility to empirically assess hypotheses whose corresponding evidence cannot be observed (for whatever reasons).

Some kind of confirmation on the basis of analogical reasoning is clearly applied in sciences such as biology, medicine and pharmacology. However, whether evidence E^* that directly confirms a hypothesis H^* can be used to confirm an analogous hypothesis H , is, in some sense highly controversial (see., e.g., the critique of Duhem, 1991, pp. 97ff or Bartha, 2010, sec. 1.9). A recent approach put forward by Dardashti, Hartmann, et al. (2015) seems to support the view that confirmation based on analogical inference is quite reasonable. They propose a Bayesian analysis. In particular, they argue that if the systems described by H and H^* (at least partially) share the same structural features, there might be a connection between H and H^* that establishes probability flow between evidence E^* and hypothesis H . This seems to be everything required for E^* to (indirectly) confirm H Bayesian style. So confirmation based on analogical inference would simply be a certain kind of Bayesian confirmation according to Dardashti, Hartmann, et al.'s approach.

In this paper we take up Dardashti, Hartmann, et al.'s (2015) idea to make sense of confirmation based on analogical inference in a Bayesian framework. After introducing and illustrating their approach by means of a simple toy example from medicine, we highlight several problems of the view that evidence E^* for a hypothesis H^* can confirm another hypothesis H making a claim about a totally different system. We then develop an alternative approach to confirmation on the basis of analogical inference that supplements Bayesian update by Jeffrey conditionalization and demonstrate that it can overcome these problems and gets the intuitions scientists and physicians have right.