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Information becomes evidence when an explanation can incorporate it into a causal framework

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ABSTRACT

Recognizing information as evidence is central to the development of scientific reasoning. When does information about an event come to be treated as evidence relevant to explaining the event? We asked whether this was increasingly likely to happen when an explanation becomes available that can incorporate both the event and the information into a single causal framework. In three studies, we presented participants with events for which there were two possible and plausible explanations (a baseline and one of two alternative explanations), as well as with two pieces of background information. While all explanations could account for the event, only one alternative explanation (the "target" explanation) could incorporate both the event and the background information into a single causal framework. The results indicated that information is more likely to be seen as evidentially relevant to an event when there is an explanation available that can accommodate both the event and the information into a single casual framework than when such an explanation is lacking. Furthermore, the presence of this information renders the target alternative increasingly plausible. That is, it is the interdependence of explanation or theory and evidence that allows us to realize that some information is likely to be evidential. However, for this to happen, the relation between explanation and information must be made salient, either by explicitly asking about it (as we did in Study 1) or by fleshing out the target explanation (as we did in Study 3).

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1. Introduction

There are two streams in the study of scientific or causal reasoning: one examines strategies that can be framed independent of content (Klahr, 2000; Koslowski, 1996; Kuhn, Amsel, & O'Loughlin, 1988); the other examines the content or information (including information about theory or mechanism) that people acquire (Carey, 1985). However, though often studied as independent aspects, the two are interdependent (Koslowski, 1996; Koslowski & Thompson, 2002), because the likelihood that a strategy or rule will be deployed depends on the background information available. For example, one strategy for identifying the cause of an effect is to identify an event that covaries with it. However, depending on the relevant background information (including information about mechanism or explanation), people do and should treat some covariations as causal but others as artifactual. In the present paper, we investigate the interdependence of theory and evidence with respect to the particular problem of deciding whether or not information is likely to be evidence.

Much of scientific reasoning involves evaluating explanations; it certainly occurs, for example, in formal academic settings. Furthermore, it also continues, outside of formal settings, as people encounter and evaluate, however tacitly, explanations for current events, historical events, and scientific research, including research reported in the popular press. In many situations in which one is trying to explain an event, there is an abundance of information. Thus, a first step often consists of deciding whether information is relevant to the explanation, that is, whether it is evidence. How do we make this decision?

Of course, in some situations, there is broad agreement about whether certain information is evidential. Most of us, for example, would treat information about bad weather and alcohol consumption as relevant to explaining an auto accident. However, in many cases, recognizing that information is evidential is not obvious, because it involves thinking about the information in a different way. Coming to think about information in a different way is, arguably, the kind of development that can continue to take place even after formal education has ended. Furthermore, coming to think about information in a different way occurs both in formal, academic settings and in informal, everyday settings.

The description of scientific reasoning termed "inference to the best explanation", or IBE (sometimes referred to as "abduction") argues that, in actual scientific practice, one explanation is chosen over its competitors because the chosen explanation provides a better causal account of the data (Lipton, 1991; Magnani, 2001; Thagard, 1989; Thagard & Verbeurgt, 1998). IBE or abduction draws attention to several important points. One is that an explanation is not evaluated in isolation; it is evaluated with respect to other, competing explanations. Thus, any single explanation is judged, not in an absolute sense, but in terms of how well (or badly) it stacks up with respect to plausible competing explanations; an explanation is favored over its competitor if it can account for information that the competitor cannot account for. IBE also draws attention to another sense in which an explanation is not evaluated in isolation: it is embedded in, and judged with respect to, the network of well-established background beliefs, or what else we know about the world—what Quine and Ullian (1970) referred to as a "web of belief" (that is, the background information not all of which is represented in the premises of the traditional H-D or hypothetico-deductive account). On the IBE view, an explanation is counted as plausible to the extent that it is causally consistent with well-founded background information. This feature of consistency with well-established background beliefs is termed "unification" or "consilience". Both aspects of IBE have an important consequence, namely, that evidence is not static; rather, information becomes evidence when a theory can accommodate it into an explanatory framework. Finally, in doing so, the theory itself becomes increasingly compelling precisely because it is able to situate the information into a broader causal framework—and can do so in a way that competing theories cannot do. That is, according to IBE, several things happen in tandem: the theory renders certain information evidential because it provides a better account of it than competing theories do in part by achieving consistency with well-established background information and, in doing so, the theory itself gains in credibility over its competitors precisely because it can account for information that other explanations cannot.

The classic example of IBE is evolutionary theory as an explanation for speciation. Evolutionary theory is widely accepted for several reasons. One is that it provides a better explanation of speciation than does the suggestion that different species arose spontaneously; it can account for the presence of intermediate fossil forms, the fact that particular adaptations depend on the type of environmental