

# What is Explanation?

## Interface

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Jaako Hintikka,  
“What is Abduction?  
The Fundamental Problem  
of Contemporary Epistemology,”  
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**E**xplanation is the bread-and-butter activity of any technical communicator. We work on other kinds of communication, of course. On any given day, we may find ourselves simply reporting on work accomplished rather than explaining it. We may find ourselves writing memos to audiences who don't want explanations but who require persuasion before they'll allocate resources to our projects. Even so, to be a technical communicator is to be a professional explainer. Apart from other kinds of communication, done as well or better by journalists or marketing types, we particularly strive to make plain the otherwise opaque workings of hardware or software, various kinds of appliances, or procedures.

We explain things for a living, but how well can any of us explain the nature of explanation itself? What makes technical explanation different from persuasion or narration, for instance? Fortunately for us, explaining things is much like riding a bicycle. We can do it without knowing what, exactly, it is that we do. Most seven-year-olds can stay upright on a bike without (consciously) knowing a thing about gear ratios and gyroscopic forces. It's a different story, however, if someone wants to design a radically new kind of cycle. That person has to understand the basic principles that underlie traditional forms.

Likewise, Web-based instructional systems have pushed us away from traditional kinds of paper-bound explanation. In these new realms, anything better than hit-and-miss

success will require a clear sense of basic principles. With that in mind, I will discuss the basic logic of explanation first proposed by the philosopher C. S. Peirce in the 1870s, and more recently extended by Hintikka [1].

### EXPLANATION LOGIC

The phrase, “logic of explanation” is to be taken literally. In deriving an analysis of the explanatory process, Peirce began with the simple, three-line syllogism:

PREMISE : (a) All  $M$  is  $P$ .  
PREMISE : (b) This  $S$  is an  $M$ .  
CONCLUSION : (c) This  $S$  is  $P$ .

This particular form of syllogism does not count as explanation but rather as logical **deduction**. The validity of this form of argument is a matter of **description** rather than explanation. If the premises are true, the conclusion has to be true because the premises already implicitly describe the conclusion. To use a concrete example, let  $M$  = beans in a sack, let  $P$  = white, and  $S$  = a particular bean. Suppose I have a sack of beans. Suppose I already know that all the beans in the bag are white. If I take any example bean from that already-proven bag, I can already see without looking (again) that it must be white. All logical and mathematical “proofs” are based on this kind of reasoning. The premises may or may not be true, but a logically valid deduction, in itself, is infallible in preserving the truth (or error) of premises in particular examples.

Following Aristotle, Peirce noted that a different kind of reasoning emerges if we change the order of

statements in a syllogism. Logical **induction** is a mirror-reversal of the ordered statements from a deductive syllogism:

PREMISE : (c) This *S* is *P*.  
 PREMISE : (b) This *S* is *M*.  
 CONCLUSION : (a) All *M* is *P*.

In concrete terms, suppose I find a white bean (*S*), and I know the bean is one taken from a particular sack (*M*). I might conclude that I have a sack full of white beans (*P*). Now, of course, an inductive argument based on a single case is a pretty weak argument, but all experimental conclusions are based on this kind of reasoning.

Although the validity of deduction is a matter of static **description**, the validity of an induction depends on adequate, long-term **reproduction**. Induction is quite fallible, but if there are any nonwhite beans in the sack, these will be discovered if the inductive observations are repeated often enough. Statistical likelihood of error in the induction decreases rapidly as more and more white beans are taken at random from the sack [2, p. 124].

Experimental results are rarely (if ever) self-explanatory, however. This is evident because induction is not the same thing as explanation either. Peirce pointed out that there is a third way to rearrange the lines of the syllogism. That third way is the basis of explanatory reasoning:

PREMISE:  
 (a) All *M* is *P*. (All the beans  
   in this bag are white)  
 PREMISE:  
 (c) This *S* is *P*. (This bean is white.)  
 CONCLUSION:  
 (b) This *S* is *M*.  
       (This bean is from this bag.)

In concrete terms, suppose you had a bean-bag chair in your den, and you knew it was full of white beans. If you found a white bean on the floor of the den, you'd automatically explain the presence

of that one bean by concluding that it came from your bean-bag chair.

Aristotle seems to have considered this kind of reasoning to be another kind of induction. Mystery writers from A. Conan Doyle onward mistakenly label this kind of reasoning as deduction. Peirce, on the contrary, argues that this reasoning is neither deduction nor induction. He introduces a third term, calling it **abduction**. Unlike deduction, this kind of reasoning is highly fallible—the bean may have come from the kitchen instead. Unlike induction, no amount of repetition is going to make the “abductive” explanation less fallible: the floor of your den could be covered with white beans, but without further investigation, you'd be no more sure that they came from the bean-bag chair than you would be if you just found one bean.

That explanation would only be validated if you reasoned, by deduction, that if an example bean did get out of its bag, the bag must have a bean-exit (i.e., a hole) in it. You would then have to go to the bag and give it a shake. If another bean fell out, you could conclude, by induction, that your original explanation is valid. The white bean(s) did indeed come from the bean-bag chair. As Peirce notes:

Abduction having suggested a theory, we employ deduction to deduce from that ideal theory a promiscuous variety of consequences to the effect that if we perform certain acts, we shall find ourselves confronted with certain experiences. We then proceed to try these experiments, and if the predictions of the theory are verified, we have a proportionate confidence [inductively] that the experiments that remain to be tried will confirm the theory. I say that these three are the only elementary modes of reasoning there are. [3, paragraph 209]

Thus Peirce was satisfied that there are three basic modes of reasoning, **deduction**, **induction**, and **abduction**, each respectively validated by **description**, **reproduction**, and **experimentation**.

## EXPLANATION PUZZLES

Hintikka has recently questioned whether Peirce's arguments are sufficient proof that explanations generated by abduction represent a genuine and independent form of reasoning, a legitimate and rational process of inference. This is a serious philosophical problem because abduction seems to be the only thought process that is “ampliative,” that is, thought which generates new theories, new knowledge, and new explanations [1, p. 506]. Deduction only manipulates the information already described in premises already known, and induction only generalizes from facts already known. Yet, deduction and induction have the advantage of having self-contained “rules of inference”:

The term “rule of inference” is usually restricted to cover only such inferences as can be justified in terms of the premise–conclusion relation either because the step from the premises to a conclusion is truth-preserving [deductively], or because the premises make the conclusion probable [inductively] [p. 512].

Unlike deduction and induction, abduction does not seem to be self-contained. It must go outside its own premises for validation, to deductive experiments in thought and inductive experiments in the actual world. Without these, an abductive explanation seems little more than a wild guess. (That bean might have come from anywhere!) Hintikka proposes a solution to this puzzle by identifying another logical process besides premise  $\rightarrow$  conclusion, which is inherent in the ampliative, explanatory reasoning of

abduction. This is the logical relation that exists between questions and their presuppositions.

Whether the answer to a question is true or false, the presuppositions for a question must be granted as true before the question can have any answer at all. *Where's my pen?* presupposes that I have a pen, regardless of where it is. This logical fact is exploited in "gotcha" questions such as *Have you stopped beating your spouse?* The person who answers is trapped, regardless of whether they answer yes or no. This is because the question already presupposes that *you have beaten your spouse*.

Hintikka suggests that a question  $\rightarrow$  answer  $\rightarrow$  presupposition logic is inherent in any abductive explanation. Presupposition drives the movement from abductive premises to abductive conclusions, similar but not identical to the compulsory, descriptive movement from deductive premises to deductive conclusions. His claim is nicely illustrated by "lateral thinking puzzles." These are particularly thorny brain teasers, which seem impossible to solve without the right leading hint, which typically takes the form of a question:

A man walked into a bar and asked the barman for a glass of water. They had never met before. The barman pulled a gun from under the counter and pointed it at the man. The man said "Thank you" and walked out. Why should that be so? [p. 529]

Here is the first hint: What need would be satisfied by a glass of water, but equally well satisfied by getting pointed at with a gun? This question presupposes that there is something in common between the gun pointing and the water. This presupposition forms the conclusion of an abductive syllogism:

(a) Water belonging to class X (=M) is whatever the man needed (=P).

(c) Being pointed at by a gun (=S) is whatever the man needed (=P).  
(b) Being pointed at by a gun (=S) belongs (like water) to class X (=M).

The premises of this syllogism are the bare facts of the story that raised the question in the first place. With the problem set up as a question that presupposes a certain kind of conclusion, many can solve the puzzle. If they can't, a second hint question may be given. This second question [see endnote] contains a presupposition that makes the abductive conclusion, the explanation of the lateral-thinking puzzle, even more obvious.

Lateral-thinking puzzles illustrate how the right question can sharply focus an explanatory problem. From this, Hintikka concludes that Peirce was essentially correct in his distinction between deductive, inductive, and abductive reasoning. Abductive explanations are externally validated by deductive exemplification and inductive experiments, but abduction also follows an internal logic, the logic of question, answer, and presupposition [p. 527].

### APPLIED EXPLANATION PRINCIPLES

An understanding of explanation and its basic logic should be helpful in the design of technical communication. One point made by the Peirce/Hintikka model is that theoretical explanation does require external validation (apart from abduction's internal question-presupposition logic). Abstract explanations are created by abduction, but they must be made valid by examination. This examination must include a specific description of examples (by deduction). There have to be enough of these examples that the audience can draw confident general conclusions (by induction).

In practical terms, this means that technical communicators must

be prepared to illustrate every abstract operation or procedure they are trying to explain with concrete, working examples.

No procedures can realistically cover every button click, while any chosen sequence of actions is purely arbitrary. Particular queries or form designs are effectively infinite, and relate both to the structure and purpose of the database that users have designed. Thus it seems a better technique is to provide users with several fully developed examples that use as many of the variables and options as possible, so that users can infer how best to use the facilities for their own purposes. Indeed, recent research by IBM . . . found that expert and experienced users actively craved this kind of documentation [4, p. 271].

In addition to this general insight, the Peirce/Hintikka model may be especially valuable for new kinds of communication that break with traditional forms. Problems arise, for instance, when information is placed on the World Wide Web:

The design challenges posed by the Web are unparalleled in either print or television. Designers in this medium have the luxury of neither linear narrative structure nor temporal cohesiveness. Although they might conceptualize the site as a whole, construction must allow for multiple points of entry and maintain coherence in spite of the facts that users frequently do not visit every page and they may attend to the site over several visits [5, p. 20].

The problems of nonlinear information design are not entirely new. Reporters habitually write headlines and lead-paragraph summaries that allow each newspaper reader to idiosyncratically navigate a nonlinear narrative path through the daily paper. As a result, news

sources like *USA Today* have made a fairly easy and nearly direct transition to the Web. The real problem is that technical explanation differs in critical ways, as a genre, from narrative news reporting. The Peirce/Hintikka model of explanation points to ways in which technical information can be adapted to the Web, however.

For example, this model emphasizes the central importance of questions. The right question can serve to quickly focus an audience on presuppositions that form the basis of an explanation. News reporters already seem to be following this principle as they answer a who-what-when-where template to create their lead-paragraph summaries. The critical point is that technical communication differs from reporting, as a genre, in terms of the kind of question that serves as appropriate focus, not who-what-when-where, but rather, **how** and **why**.

Because of the success of news-headline formats on the

Web, there is a tendency for all Web designers, including technical communicators, to follow newspaper-like formats too slavishly, creating headline-like directory <links> from their homepage such as these [6, p. 237].

For example, a headline *Engineering Division Re-evaluates Stability Testing*, answering *who* and *what*, is followed by links <Data from last year's west-cost test reconstructed> to answer *what*, *when*, and *where* and validity of the original test criticised> to answer *what*.

These link labels indicate answers to who-what-when-where kinds of questions. They do not address how and why. The nature of the technical points is hidden. These can be brought out, however, if the links are revised or added to indicate answers to how and why kinds of questions.

If we use the same headline from the above example, *Engineering Division Re-evaluates Stability*

*Testing*, we can use this link <Minute differences in vehicle paths shown to create large differences in lateral acceleration> to answer *how* and this link <Original test fails due to lack of control in critical variable> to answer *why*.

When users click on these links, they are better prepared to anticipate information on the pages that follow. The nature and focus of the technical explanations is more apparent. The above example illustrates the utility of using the right kind of question and answer to focus technical information, an insight gained from a close examination of the basic logic of explanation.

## ENDNOTE

How many different ways are there to cure hiccups? Hintikka borrows this lateral-thinking puzzle from Paul Sloane and Des Mac Hale's *The Lateral Logician*, Quality Paperback Book Club, 1996. Similar puzzles can be found at <http://www.lateralpuzzles.com>

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