Cause and Effect, Conditionals, Explanations

Essays on Logic as
The Art of Reasoning Well

Richard L. Epstein

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Advanced Reasoning Forum

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Essays on Logic as The Art of Reasoning Well

Contents of Other Volumes in the Series

REASONING in SCIENCE and MATHEMATICS

Models and Theories
Experiments
On Mathematics

PRESCRIPTIVE REASONING

Reasoning with Prescriptive Claims
Prescriptive Models
Vagueness, Supervaluations, and the Method of Reflective Equilibrium
Rationality

The FUNDAMENTALS of ARGUMENT ANALYSIS (2013)

Arguments
Base Claims
Fallacies
Generalizing
Analogies
Induction and Deduction
Rationality
Truth
Probabilities
On Metaphysics

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Valid Inferences
The Metaphysical Basis of Logic
A General Framework for Semantics for Propositional Logics
Why Are There So Many Logics?
Truth
Vagueness
On Translations
Three Questions about Logic
Language, Thought, and Meaning
Reflections on Some Technical Work in Formal Logic
- Gödel's Theorem
- Categoricity with Minimal Metaphysics
- On the Error in Frege's Proof that Names Denote

The Twenty-first or "Lost" Sophism on Self-Reference of John Buridan

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Preface

This series of books presents the fundamentals of reasoning well, in a style accessible to both students and scholars. The text of each essay presents a story, the main line of development of the ideas, while the footnotes and appendices place the research within a larger scholarly context. The essays overlap, forming a unified analysis of reasoning, yet each essay is designed so that it may be read independently of the others. The topic of this volume is the evaluation of reasoning about cause and effect, reasoning using conditionals, and reasoning that involves explanations.

The first essay summarizes material that can be useful as background from *The Fundamentals of Argument Analysis* in this series.

The essay "Reasoning about Cause and Effect" sets out a way to analyze whether there is cause and effect in terms of whether an inference from a claim describing the purported cause to a claim describing the purported effect satisfies specific conditions. Different notions of cause and effect correspond to placing different conditions on what counts as a good causal inference. An application of that method in "The Directedness of Emotions" leads to a clearer understanding of the issue whether every emotion need be directed at something.

In the essay "Conditionals" various ways of analyzing reasoning with claims of the form "if . . . then . . ." are surveyed. Some of those uses are meant to be judged as inferences that are not necessarily valid, and conditions are given for when we can consider such an inference to be good.

In "Explanations" verbal answers to a question why a claim is true are evaluated in terms of conditions placed on inferences from the explaining claims to the claim being explained. Recognizing that the direction of inference of such an explanation is the reverse of that for an argument with the very same claims is crucial in their evaluation. Explanations in terms of functions and goals are also investigated.

In a companion volume *Reasoning in Science and Mathematics* causal reasoning and explanations are connected to the use of models and theories in science. In particular the nature of causal laws is

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discussed in the context of theories. The study of laws and confirmation is also analyzed in the essay "Generalizing" in *The Fundamentals of Argument Analysis* in this series.

Reasoning well about cause and effect, understanding how to use conditionals, employing and evaluating explanations—these are skills that can benefit us not only in our daily lives, but in science and our search for fundamentals of our knowledge and experience. Come, let us reason together.

> For never yet has any one attained
> To such perfection, but that time, and place,
> And use, have brought addition to his knowledge;
> Or made correction, or admonished him,
> That he was ignorant of much which he
> Had thought he knew; or led him to reject
> What he had once esteemed of highest price.
>
> Attributed to the old man in the comedy by
> William Harvey, *De generatione animalum*

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Acknowledgments

Many people have helped me over the years I have been working on this material. William S. Robinson and Fred Kroon, in particular, have given much of their time and thought to suggestions that have improved the work. The late Benson Mates was a major inspiration for much of the effort to clarify my ideas.

Charlie Silver, Branden Fitelson, Peter Eggenberger, Carolyn Kernberger, and the members of the Advanced Reasoning Forum helped me a lot in the initial stages of the work, while Michael Rooney offered comments on the final draft. Throughout I have benefited much from the editorial advice of Peter Adams.

Much that is good in this book comes from the generous help of these people, to whom I am most grateful. The mistakes are mine, all mine.

Publishing history of the essays in this volume

The essay "The Directedness of Emotions" is new and grew out of an e-mail dialogue with Fred Kroon. The other essays are revisions, often quite substantial, of material in the corresponding sections of my *Five Ways of Saying "Therefore"*.

The first presentation of the relation of arguments and explanations was at a talk at the Second Conference on Logic and Reasoning of the Advanced Reasoning Forum that was held in Bucharest, Romania, sponsored by New Europe College; it was published as "Arguments and Explanations" in the *Bulletin of Advanced Reasoning and Knowledge*, vol. 1, 2001, pp. 3–17.

The first exposition of the method of evaluating causal claims as inferences appeared in the first edition of my *Critical Thinking*.

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Background: Claims, Inferences, Arguments

Claims

Claims A *claim* is some written or uttered declarative sentence that we agree to view as true or false, but not both.

The word "uttered" is meant to include silent uttering to oneself. From now on I'll use "utterance" to include writing, too.

We do not need to make a judgment about whether a sentence is true or whether it is false in order to classify it as a claim. A claim need not be an *assertion*: an sentence put forward as true by someone.

Some say that claims only represent things that are true or false, namely, abstract propositions or thoughts. But it's utterances we use in reasoning together, and we can focus on those, as representatives, if you like, of abstract propositions or thoughts.

The word "agree" in the definition of "claim" suggests that it is a matter of convention whether we take a sentence to be a claim. But almost all our conventions, agreements, and assumptions are implicit. Our agreements may be due to many different reasons or causes, including perhaps that there are abstract propositions.

Often when we reason we identify one utterance with another, as when Dick says "Ralph is not a dog" and later, when Suzy thinks about it, she says "I agree. Ralph is not a dog." We do so when we believe the utterances are equivalent for all our purposes in reasoning.

Equivalent claims Two claims are equivalent for our purposes in reasoning if no matter how the world could be, the one is true if and only if the other is true.

I will often assume such equivalences without explicitly saying so.

Often what people say is *too vague* to take as a claim: there's no single obvious way to understand the words, as when someone says

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"This is a free country." Yet, since everything we say is somewhat vague, it isn't whether a sentence is vague, but whether it's too vague, given the context, for us to agree to view it as true or false. In an auditorium lit by a single candle some parts are clearly lit and some are clearly dark, even if we can't draw a precise line where it stops being light and starts being dark. The *drawing the line fallacy* is to argue that if you can't make the difference precise, there's no difference.

Inferences

We reason in order to discern whether certain claims are true. But we also reason to discern whether a particular claim follows from one or more other claims. We might not know whether those other claims are true. But were they true, would the truth of this other claim follow? At the basis of all reasoning is the notion of one claim following from one or more other claims.

Inferences An *inference* is a collection of claims, one of which is designated the ***conclusion*** and the others the ***premises***, which is intended by the person who sets it out either to show that the conclusion follows from the premises or to investigate whether that is the case.

Whether some claims constitute an inference depends on the intent of the person uttering them. Sometimes people indicate that intention by using certain words to indicate that a claim is meant as a premise, or as a conclusion, or to indicate whether he or she believes the claim.

Conclusion indicators
hence; therefore; so; thus; consequently;
we can then show that; it follows that

Premise indicators
since; because; for; in as much as; given that;
suppose that; it follows from; on account of; due to

Indicators of speaker's belief
probably; certainly; most likely; I think

These and many other indicator words are not part of a claim but show our intent in using the claim in a particular way.

In order to investigate the idea of a conclusion following from premises we make some definitions.

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Valid, strong, and weak inferences An inference is *valid* if it is impossible for the premises to be true and conclusion false at the same time and in the same way.

An inference is *strong* if it is possible but unlikely for the premises to be true and conclusion false at the same time and in the same way. An inference is *weak* if it is neither valid nor strong.

The classification of invalid inferences is on a scale from strongest to weakest as we deem more or less likely the possibilities we consider in which the premises are true and conclusion false.

For example, the following is a valid inference:

Maria is a widow.
So Maria was married.

We do not know if the premise is true, but if it is, then the conclusion is not false. In this case the conclusion surely follows from the premise.

The following is valid, too:

All dogs bark.
Spot is a dog.
So Spot barks.

Here we know that the first premise is indeed false: Basenjis can't bark, and some dogs have had their vocal cords cut. But it's not the truth or falsity of the premises and conclusion that determines whether an inference is valid, strong, or weak; rather, it is the ways in which the premises and conclusion could be true or false. In any way that the premises of this inference might be true, the conclusion would be also.

In contrast, the following inference is strong:

Almost all dogs bark.
Ralph is a dog.
So Ralph barks.

If we know no more about Ralph than that he is a dog, then any way in which the premises could be true and conclusion false is unlikely, for we know how rare those are. In this case, too, we say that the conclusion follows from the premises, though there is no certainty, no "must" in that. It is only that relative to what we know, it seems to us very unlikely that the premises could be true and conclusion false.

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The following, however, is weak:

Louise is a student.
So Louise isn't married.

There lots of ways the premise could be true and conclusion false: for all we know, Louise might be forty years old with a husband and child.

Our evaluation of the strength of an inference is relative to what we believe. "Likely" means "likely to us." But typically the scale from strong to weak is not so completely relative to a particular person that there is no hope we can agree on the strength of inferences. Suppose we disagree. I find a particular inference strong, and you find it weak. If we wish to reason together, you should describe to me a way the premises could be true and the conclusion false that you think is not unlikely. That may depend on knowledge you have of how the premises could be true which I do not have, but once you've made that explicit we can agree or disagree that there is such a possibility. The only issue, then, would be whether we agree that the possibility is likely. Sometimes we can't come to a clear determination, but further examination will leave us with a clearer understanding of what our differences in evaluation are, based on more than just whim. When the beliefs involved in determining the strength of an inference are made explicit, determining the inference to be strong or weak is far more likely to be a shared judgment.

In sum, we say that the conclusion of an inference ***follows from*** the premises if the inference is valid or strong.

Arguments

The paradigmatic use of inferences is in attempts to convince someone that a claim is true.

Arguments An *argument* is an inference that is intended by the person who sets it out to convince someone, possibly himself or herself, that the conclusion is true.

Arguments are attempts to convince, whether someone tries to convince you, or you try to convince someone else, or you try to convince yourself. But that does not mean that the criterion for whether an argument is good is whether the argument actually does convince. If I'm drunk, you may give me an excellent argument that my driving home is dangerous; though I remain unconvinced, the argument is no

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worse. A politician may make a bad argument that you should vote for her, but though you may be convinced, that does not mean the argument is good. Perhaps other ways to convince, such as entreaties, exhortations, sermons, or advertisements, can be judged by how well they convince, but that is not a criterion for judging attempts to establish the truth of a claim. A *good argument* is one that gives us good reason to believe the conclusion. But what does "good reason" mean?

If an argument is to give us good reason to believe its conclusion, we should have good reason to believe its premises, for from a false claim we can reason as easily to a false conclusion as a true one.

> The Prime Minister of England is a dog. All dogs have fur.
> So the Prime Minister of England has fur. (false conclusion)

> The Prime Minister of England is a dog. All dogs have a liver.
> So the Prime Minister of England has a liver. (true conclusion)

It seems, then, that a good argument should have true premises. But consider:

> There are an even number of stars in the sky.
> So the number of stars in the sky can be divided by 2.

> There are an odd number of stars in the sky.
> So the number of stars in the sky cannot be divided by 2.

One of these has a true premise, but we cannot tell which. A standard that gives us no way to evaluate arguments is not part of the art of reasoning well. Rather, for an argument to be good we must have good reason to believe its premises. We might, though, have good reason to believe the premises and not be aware of that. For an argument to be good, we need to recognize that we have good reason to believe the premises and actually believe them, for otherwise what convincing is done has no basis in our beliefs.

Plausible claims A *claim is plausible* to a particular person at a particular time if:

- The person has good reason to believe it.
- The person recognizes that he or she has good reason to believe it.
- The person believes it.

A claim that is not plausible is *implausible* or *dubious*.

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The classification of claims as plausible or implausible is on a scale from the most plausible, ones we recognize as true, to the least plausible, those we recognize as false. Though we do not have precise measures of plausibility, we can often compare the plausibility of claims and by being explicit about our background we can usually agree on whether we will take any particular claim to be plausible. If we did not think that we can share our judgments of what is plausible, we would have no motive for trying to reason together. So if I say a claim is *plausible* without specifying a particular person, I mean it's plausible to most of us now, as I'm writing.

Good reason to believe a claim needn't always be established by reasoning, for then we would have no place to start, no plausible claims that would not require further justification, continuing forever. Some claims we take as plausible because of our personal experience, or our trust in authority, or our beliefs about the nature of the world.

But it's not just that the premises of a good argument have to be plausible. They have to be more plausible than the conclusion, for otherwise they would give us no more reason to believe the conclusion than we had without the argument.

Begging the question An argument *begs the question* if it has a premise that is not more plausible than its conclusion.

Further, for an argument to be good, the conclusion must follow from the premises. For example, consider:

> Richard L. Epstein is the author of this essay.
> So Richard L. Epstein is bald.

This argument is weak: there are lots of likely ways the premise could be true and conclusion false. Though you know that the premise is true, it gives no reason to believe the conclusion.

Arguments, being inferences, are classified as valid, strong, or weak, and as with inferences it is valid or strong ones we take as establishing that the conclusion follows from the premises. But do strong arguments give good reason to believe the conclusion?

As an example, consider that last week Dick heard there are parakeets for sale at the mall. He knows that his neighbor has a birdcage in her garage, and he wonders whether the cage will be big enough for one of those parakeets. He reasons:

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(‡) Every parakeet I or anyone I know has seen, or read, or heard about is less than 50 cm tall. So the parakeets on sale at the mall are less than 50 cm tall.

This argument is not valid. A new kind of parakeet that is 1 meter tall might have been discovered in the Amazon; or a new supergrow bird food might have been developed that makes parakeets grow very tall; or aliens might have captured some parakeets and shot them with rays to make them very large; or . . . . But any possibility Dick or we can think of for the premise to be true and conclusion false is unlikely—so unlikely that Dick and we have good reason to believe the conclusion. The argument is strong.

Strong arguments, as in this example, give us good reason to believe the conclusion, or at least good enough reason for our daily lives and, as we'll see in the following essays, for science. Moreover, a strong argument is often better than a valid one with the same conclusion. Replacing the premise of (‡) with "All parakeets are less than 50 cm tall" would yield a valid but worse argument, for that claim is less plausible than the premise of (‡). There is often a trade-off between how plausible the premises of an argument are and how strong the argument is: the less plausible the premises, the stronger the argument.

Arguments that lie in the broad center of the scale and the clearly weak ones are certainly not good. We needn't bother to classify them as bad versus very bad, since any bad argument tells us nothing about the conclusion we didn't already know.

We now have three tests an argument must pass for it to be good.

Necessary conditions for an argument to be good

- The premises are plausible.
- The argument does not beg the question.
- The argument is valid or strong.

These conditions are relative to a particular person, though we can have confidence that they establish an intersubjective standard for the evaluation of arguments.

Whether these conditions are also sufficient is a large topic which is examined in the companion volume in this series *The Fundamentals of Argument Analysis*. In what follows, though, I will generallly treat them as both necessary and sufficient.

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Repairing arguments

In our daily lives we often treat many arguments as good that do not seem to satisfy these conditions. For example, consider:

Lee: Tom wants to get a dog.
Maria: What kind?
Lee: A dachshund. And that's really stupid, since he wants one that will chase a frisbee.

Lee has made an argument, if we interpret rightly what he said: Tom wants a dog that will chase a frisbee, so Tom shouldn't get a dachshund. On the face of it that argument is not strong or valid. Still, Maria knows very well, as do we, that a dachshund would be a bad choice for someone who wants a dog to play with a frisbee: Dachshunds are too low to the ground, they can't run fast, they can't jump, and the frisbee is bigger than they are, so they couldn't bring it back. Any dog like that is a bad choice for a frisbee partner. Lee just left out these obvious claims. But why should he bother to say them?

We normally leave out so much that if we look only at what is said, we will be missing too much. We can and should revise many arguments by adding an unstated premise or even an unstated conclusion.

When are we justified in doing so? How do we know whether we've revised an argument well or just added our own assumptions? To repair arguments that are apparently defective, we must have some standards, for otherwise we will end up putting words in other folks' mouths. Such standards depend on what we can assume about the person with whom we are reasoning or whose work we are reading.

The Principle of Rational Discussion We assume that the other person with whom we are deliberating or whose reasoning we are evaluating:

- Knows about the subject under discussion.
- Is able and willing to reason well.
- Is not lying.

Often someone with whom we wish to reason does not satisfy these conditions. But when we discover that, then it makes no sense to continue to reason with him or her. We should be educating, or consoling, or pointing out errors.

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The Principle of Rational Discussion justifies adopting the following guide.

The Guide to Repairing Arguments Given an (implicit) argument that is apparently defective, we are justified in *adding* one or more premises or a conclusion if and only if all the following hold:

- The argument becomes valid or strong.
- The premise is plausible and would seem plausible to the other person.
- The premise is more plausible than the conclusion.

If the argument is valid or strong, yet one of the original premises is implausible, we may *delete* that premise if the argument becomes no worse. In that case we say the premise is ***irrelevant***.

Given only this Guide, we might try to repair every argument into a good one. That would be wrong, for there are standards for when an argument is unrepairable.

Unrepairable Arguments We cannot repair a (purported) argument if any of the following hold:

- There is no argument there.
- The argument is so lacking in coherence that there's nothing obvious to add.
- A premise is implausible or several premises together are contradictory and cannot be deleted.
- The obvious premise to add would make the argument weak.
- Any obvious premise to make the argument strong or valid is implausible.
- The conclusion is clearly false.

It's not that when we encounter one of these conditions we can be sure the speaker had no good argument in mind. Rather, we are not justified in making that argument for him or her, for it would be putting words in his or her mouth.

In addition to these conditions for an argument to be unrepairable, a list of other kinds of arguments, called fallacies, have been deemed to

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be typically so bad that they, too, are rejected as unrepairable when we encounter them.

Consideration of two particular kinds of arguments is important for the essays that follow: generalizations and analogies.

Generalizations

Generalizations A *generalization* is an argument in which we conclude a claim about a group, called the ***population***, from a claim about some part of it, the ***sample***. Sometimes we call the the conclusion the *generalization*. Plausible premises about the sample are called the ***inductive evidence*** for the generalization.

The following are generalizations:

(‡) Every dog I've seen barks.
So all dogs bark.
sample: The dogs the speaker has seen.
population: All dogs.

Every dog I ever met except one can bark.
So almost all dogs bark.
sample: The dogs the speaker has met.
population: All dogs.

Of dog owners who were surveyed, 98.2% said their dogs bark.
So about 98% of all dogs bark.
sample: The dogs of the pet owners surveyed.
population: All dogs.

The last is called a *statistical generalization* because its conclusion is a statistical claim about the population.

If we have no reason to think that the sample is similar to the population, then the generalization is worthless, a bad argument. What we want for a good generalization is for the sample to be representative.

Representative sample A sample is *representative* if no one subgroup of the whole population is represented more than its proportion in the population. A sample is ***biased*** if it is not representative.

The first and second examples at (‡) are bad because we have no reason to think that the dogs the speaker has seen are representative of

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all dogs. We don't know enough about the sample in the third generalization to make a judgment about whether it's representative.

Random sampling is an important method for getting a representative sample.

Random sampling A sample is *chosen randomly* if at every choice there is an equal chance that any of the remaining members of the population will be picked.

Random sampling does not guarantee that the sample will be representative. Choosing two students randomly from the 716 at McEpstein High School to interview about their views on gay marriage is not going to give a representative sample. The sample has to be large enough for us to have good reason to think it is representative.

But even if we have confidence that the sample is representative, if it's not studied well then it's no use for concluding anything about the population. Maria asked all but three of the thirty-six people in her class whether they've ever used cocaine, and only two said yes. So she concluded that almost no one in the class has used cocaine. But there's no reason to think that people will answer truthfully to such a question, so her generalization is not good.

Necessary conditions for a generalization to be good

- The sample is representative.
- The sample is big enough.
- The sample is studied well.

These conditions do not establish a different standard from the necessary conditions for an argument to be good. They only spell out in more detail what is required for the argument to be strong.

Analogies

Analogies A comparison becomes *reasoning by analogy* when it is part of an argument: On one side of the comparison we draw a conclusion, so on the other side we say we should conclude the same.

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of our reasoning. Whether there is something "out there" beyond our reasoning which is the "real" cause and effect in the world is a debate that can continue. In the meantime, we can get on with reasoning about cause and effect in our lives.[9]

I wish we could resolve here what we should take as normal conditions and establish sufficient conditions for a causal inference to be

[9] This is not the same as Hume's view that the notion of causal necessity lies entirely in the mind's habit of observing constant conjunction, as will be clearer in the examples below. The necessity (or strength) of the causal relation is as "real" as that of any inference. Hume's rejoinder to his critics in *A Treatise of Human Nature*, pp. 167–168, seems more apt:

> What! the efficacy of causes lie in the determination of the mind! As if causes did not operate entirely independent of the mind, and wou'd not continue their operation, even tho' there was no mind existent to contemplate them, or reason concerning them. Thought may well depend on causes for its operation, but not causes on thought. This is to reverse the order of nature and make that secondary, which is really primary. . . .
>
> I can only reply to all these arguments, that the case is here much the same, as if a blind man shou'd pretend to find a great many absurdities in the supposition, that the colour of scarlet is not the same with the sound of a trumpet, nor light the same with solidity. If we have really no idea of a power or efficacy in any object, or of any real connexion betwixt causes and effects, 'twill be to little purpose to prove, that an efficacy is necessary in all operations.

Ernest Nagel in "In defense of logic without metaphysics," pp. 95–96, agrees that taking causality as "an objective ontological category" serves no purpose in establishing any particular generalization. On the other hand, Jaegwon Kim in "Explanatory realism, causal realism, and explanatory exclusion" gives a defense of "causal realism," the idea that the relation of cause to effect is an objective relation between events in the world. Michael Tooley in *Causation: A Realist Approach* is also a realist about causes:

> First, laws are to be identified with certain contingent, irreducible, theoretically specified relations among universals, and second, that causal relations between states of affairs are also theoretically specified relations. p. 5

He defines "P→Q" as "properties P and Q stand in the relation of direct causal necessitation." It doesn't seem that we can add further metaphysical constraints to the minimal notion proposed here to get his analysis. We might identify a property in his sense pertaining to an individual with an atomic proposition being true; but a negation of an atomic claim could not correspond to a cause, for he says that blue and red are properties, but not-green isn't (p. 6).

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good. But at best we can look at many examples and try to refine these conditions. Understanding the causal relation as a special kind of inference does not resolve all problems in our understanding of cause and effect. But it does give us a framework in which to discuss more clearly various points of view about the nature of cause and effect.

Let's now turn to examples that will illustrate and extend our analysis of how to reason about cause and effect.

Cartoon examples

An important step in analyzing whether there is cause and effect is to describe the purported cause and purported effect. By using cartoons to illustrate what we might see, we can examine that process, too. In what follows, I'll often say "the cause" or "the effect" when it should be clear that what I mean is "the purported cause" or "the purported effect" as described by claims.

The first issue we must resolve is how we can, even in theory, establish cause and effect. What can we do except check that each of the necessary conditions for the usual notion hold? In practice those conditions serve as sufficient, and I'll proceed as if they do. In the following sections I'll expand on many of the issues raised here.

Example 13 The cat made Spot run away.

Purported cause What is the cause? It's not just the existence of the cat. How can we describe it with a claim? Let's take it to be "A cat meowed close to Spot."

Purported effect Spot ran away.

Cause and effect each happened The effect is clearly true. The cause is highly plausible, for almost all things that meow are cats, at least where Dick would be walking Spot.

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It's (nearly) impossible for the cause to be true and effect false This is not clear. We have to establish the normal conditions. Some appeal to Spot's usual behavior must be made: In the past he's always chased a cat that meowed or made its presence known to him if it was close to him. That is, Spot normally chases cats, given the opportunity.

Even granting that, how shall we make these normal conditions precise? What is "given the opportunity"? We have no reason to believe he'll chase just any cat anywhere at any time at any distance from him. We do not know those normal conditions. And being unable to specify them, we can at best say that it is highly unlikely in this situation that the cat could meow and Spot not chase it.

The cause makes a difference Would Spot have run away even if the cat had not meowed near him? It would seem that under the normal conditions of a walk with Dick he would not, since Dick is holding the leash loosely, not prepared for Spot to run away at any moment, and he seems surprised. But would Spot have chased the cat even if it had not meowed? Perhaps yes, if he had been aware of it.

So let's revise the cause to: "Spot wasn't aware a cat was near him, and the cat meowed close to Spot." Now we can reasonably believe that the cause made a difference.

Cause precedes effect Yes.

There is no common cause Perhaps the cat was hit by a meat truck and lots of meat fell out, and Spot ran away for that? No, Spot wouldn't have barked. Nor would he have growled.

Perhaps the cat is a hapless bystander in a fight between dogs, one of whom is Spot's friend. We do not know if this is the case. So it is possible that there is a common cause, but it seems unlikely.

Evaluation The relation between purported cause and purported effect cannot be established to be valid, in part because we cannot specify the normal conditions with good precision. Further, there may be a common cause. Nonetheless, we have good reason to believe the original claim on the revised interpretation that the cause is "Spot wasn't aware a cat was near him, and the cat meowed close to Spot."

These are the steps we should go through to establish a causal claim. If we can show that one of them fails, though, there's no need to check all the others.

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Index

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