1. Typical Causal Arguments

A typical causal argument will involve inferring to a cause for an event or a fact from observations about that event or fact. For example, if you see a big brown stain next to your overturned coffee cup just after hearing your roommates Great Dane run through the room, you will likely infer that the dog spilled your coffee.

Here the idea is that you take the observations and bring them under causal generalizations, which will guide you to identify the relevant and unobserved causal factor. In this case, the observations are hearing the dog and seeing the spilled coffee, and the generalization is something like if a big dog runs next to a coffee cup, it can knock over that cup. Your observations make something like this generalization relevant, and the generalization directs you to link the running of the dog and the spilling of the coffee.

You are inferring in the example from effect to cause, but you can also infer from cause to effect, which looks less like an explanation and more like a prediction. In both explanation and prediction, you are exploiting the causal structure of the universe for the purposes of understanding and perhaps controlling the world in which you live.

2. Necessary and Sufficient Conditions

Our example demonstrates that causal generalizations are important for the purpose of bringing your observations in contact with causal regularities—otherwise they are just a bunch of disconnected facts about your experience. It is the regularities that relate them as causes to effects (or as causal factors to characteristics of effects).

The causal generalization above is written as a conditional, i.e., an if ... then statement. It expresses the relationship between two conditions, the antecedent, or the if part, and the consequent, or the then part. The antecedent is a sufficient condition for the consequent—if the conditional is true, then whenever the antecedent condition obtains, so must the consequent condition; that is, the truth of the antecedent condition suffices for the truth of the consequent condition.

On the flip side, the consequent condition is necessary for the antecedent condition. Given the truth of the conditional, you will not have a situation in which the antecedent condition is true and the consequent condition is false, although you might have a situation in which the antecedent is false and the consequent true. Thus, for the antecedent to be true, the consequent must be true, which is to say that the consequent is a necessary condition for the antecedent.
Consider an example: let’s say that it is just true that if I am in my office, my lights are on. (Take it as a given that I am afraid of the dark.) If you notice me going into my office and you know that this conditional is true, then you will also know that my office lights will be on. This amounts to exploiting the fact that my being in my office is a sufficient condition for my lights being on. Alternatively, if you walk by my office and you notice that my lights are off, you will know that I am not in it. This amounts to exploiting the fact that my lights being on is a necessary condition for my being in my office—they must be on for me to be in there. (This is not to say that if they are on I am in my office—it could be that the janitor is in there, or I just forgot to turn them off. Necessary conditions are not the same things as sufficient conditions.)

3. Tests for Necessary and Sufficient Conditions

- The Sufficient Condition Test: this is designed to determine when something ISN’T a sufficient condition
  - If A is a sufficient condition (SC) for B, then whenever A obtains, B obtains. That is: (A is a SC for B) \( \Rightarrow (A \text{ obtains } \Rightarrow B \text{ obtains}) \)
  - If you don’t know whether A is a SC for B, then you would need to check every circumstance in which A obtains to see if B does as well; this is a tall order and not something you can typically do with a simple test
  - However, as you know, it is easy to falsify a conditional by finding a counterexample; thus, you can easily establish that A is not a SC for B by finding a situation in which A obtains but B does not. This is the Sufficient Condition Test
  - If you want to run this, follow the following steps:
    a. Identify the target condition, A, and look for those situations in which the target condition is not found (i.e., look for \( \sim A \))
    b. In those situations where we have \( \sim A \), look to see what other conditions are found
    c. Conclude that those conditions are not sufficient for A
    d. Example:

<table>
<thead>
<tr>
<th>B</th>
<th>( \sim C )</th>
<th>( \sim D )</th>
<th>( \sim E )</th>
<th>A</th>
</tr>
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<tbody>
<tr>
<td>( \sim B )</td>
<td>C</td>
<td>D</td>
<td>( \sim E )</td>
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<tr>
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<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>A</td>
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</tbody>
</table>

Here the rows that matter for us are 2 and 3. Row 2 tells us that conditions C and D are not sufficient for A, since C and D are both found there while
A is not. Row 3 tells us that C is not sufficient for A. These data leave open the possibilities that B and E are sufficient conditions for A, but they don’t prove this.

- *Then Necessary Condition Test:* this is designed to determine when something *ISN’T* a necessary condition

  o If D is a necessary condition (NC) for C, then whenever C obtains, D obtains. That is: (D is a NC for C) ⊃ (C obtains ⊃ D obtains)

  o Once again, if you don’t know whether D is a NC for C, then you would need to check every circumstance in which C obtains to see if D does as well; this is a tall order and not something you can typically do with a simple test

  o However, as above, it is easy to *falsify* a conditional by finding a counterexample; thus, you can easily establish that D is *not* a NC for C by finding a situation in which C obtains but D does not. This is the *Necessary Condition Test*

  o If you want to run this, follow the following steps:

    e. Identify the target condition, A, and look for those situations in which the target condition *is* found (i.e., look for A)

    f. In those situations where we have A, look to see what other conditions are *not* found

    g. Conclude that those conditions are *not* necessary for A, since in those situations you had A but you didn’t have them

    h. Our example again:

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<thead>
<tr>
<th>B</th>
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<td>~B</td>
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<tr>
<td>B</td>
<td>C</td>
<td>D</td>
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<td>A</td>
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</tbody>
</table>

Here the rows that matter for us are 1 and 4. Row 1 tells us that conditions C, D, and E are not necessary for A, since we have A but C, D, and E are lacking. Row 4 doesn’t tell us anything—all the conditions are present along with A, so we cannot rule any of them out as necessary conditions based on that situation. Together, these data leave open the possibility that B is a necessary condition for A, but they don’t prove this.

- *The Joint Test:* run these both at the same time
4. **Inferring to Causes**

While it is not necessarily obvious, some have proposed analyzing causality in terms of conditional relationships like this. For example, John Mackie argues that a cause is an *insufficient* but *necessary* part of an *unnecessary* but *sufficient* condition for the effect. This INUS analysis makes causality a complex combination of the antecedent and consequent conditions in a generalized conditional of the sort that we are using the model causal generalizations.

As the authors note, sometimes we look at the sufficient condition as the cause and sometimes the necessary condition. This depends on the nature of the observations we have in hand and how those fit into the causal regularities that obtain. In the Legionnaires case, you know the effect (viz., death) and you know a bunch of causal factors (e.g., being in Philadelphia at that hotel, being in the lobby), but you are unsure of the key causal factor. In that case, even after identifying the guilty bacterium, you can’t say that it was a *sufficient* condition, since people with healthy immune systems were able to take it on board and not die. However, it proved to be a *necessary* condition, and since it is the kind of necessary condition that one typically thinks of as a *cause* in cases like this, it is identified as such.

Contrast this with the destruction of a home in New Orleans during hurricane Katrina. Homes can be destroyed for all sorts of reasons—gas explosions, airplane crashes, fires, etc.—so Katrina would not be a necessary condition of the destruction of the home in question; however, its impact was sufficient for the destruction of the home. We say in this case that the home was destroyed by Katrina, treating the sufficient condition as the cause.

In these cases, the context in which we’re evaluating the causal relationships determines what we designate as the cause, and this will depend at least in part on our interests and purposes in looking for the cause.