GST 83 — Necessary, Sufficient, Enabling and Inhibiting Causes

Formal Description

Causal effects commonly depend upon several causal contributions rather than upon a single cause. To analyse such causation, it is useful to distinguish between necessary, sufficient, enabling and inhibiting causes.

A **necessary cause** is a causal contribution without which a specified process or effect cannot occur. A **sufficient cause** is a causal contribution, or combination of contributions, that provides everything required for the specified process or effect to occur in the absence of sufficient inhibition. An **enabling cause** allows a process to operate or an effect to occur, while an **inhibiting cause** prevents, restricts or disrupts a process that would otherwise be capable of operating.

Necessity and sufficiency should be considered in relation to a specified recipient process and the transfers it requires. A process may require several different inputs. Each required transfer is necessary, while their complete combination may be sufficient for the process to occur provided that no sufficient inhibitor prevents it.

This transfer-level analysis is important because the source of a necessary transfer need not itself be necessary. If several source processes can provide an equivalent required transfer, any particular source may be replaceable even though the transfer remains necessary.

Enabling and inhibiting causes complement this analysis. An enabling causal contribution can make a process possible without itself being sufficient to produce the process, while an inhibitor may prevent or limit operation even when all necessary enabling inputs are available. A sufficiently strong inhibitor can therefore take causal precedence over otherwise sufficient enablement.

Apparent probabilistic causation may sometimes result from incomplete knowledge of these causal contributions. Where one known cause is present but other necessary enabling or inhibiting contributions vary between instances, the observed effect may occur only some of the time. This does not necessarily demonstrate that the underlying causation is itself intrinsically probabilistic.

Plain English Explanation

Suppose a process requires three inputs:

A + B + C → Process → Effect

If the process cannot operate without A, then A is necessary. The same may also be true of B and C. None of them need be sufficient individually. But if A, B and C together provide everything the process requires, their combination may be sufficient.

This gives us an important distinction:

Necessary means *it cannot happen without this.*

Sufficient means *this provides everything required for it to happen*, assuming nothing sufficiently inhibits it.

The distinction becomes more interesting when we ask what exactly is necessary.

Imagine that a building requires an electricity supply for a particular process to operate. Electricity might normally arrive from the national electricity network. If a local generator can provide an equivalent electrical supply during a power cut, however, the national network was not itself necessary. What was necessary was the required electrical transfer. More than one source could provide it.

We should therefore be cautious about saying: **"X is necessary because X normally causes Y."**

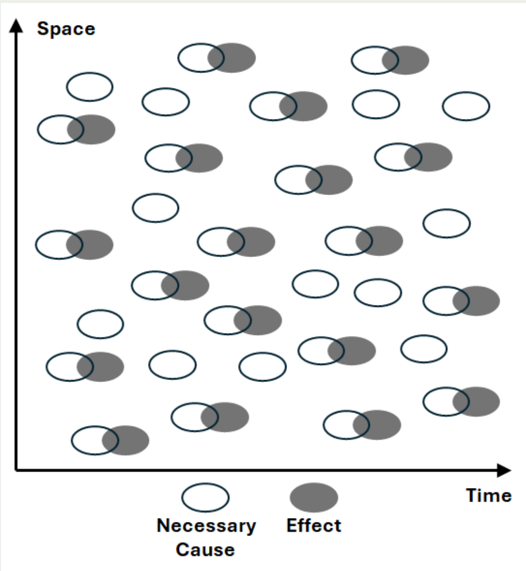
A better question is: **"What does the recipient process actually require in order to operate?"**

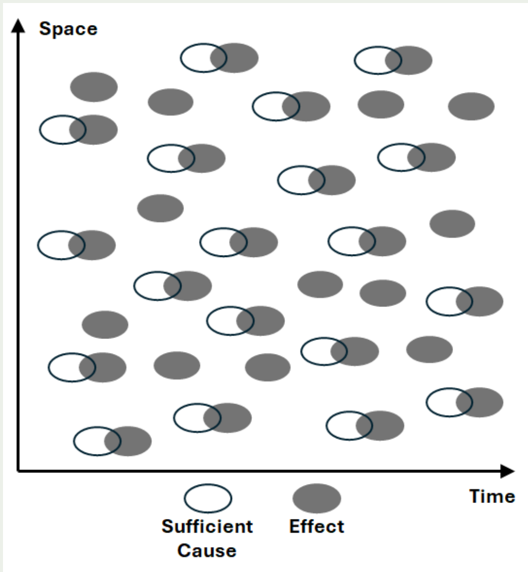
We can then ask where each required transfer might come from.

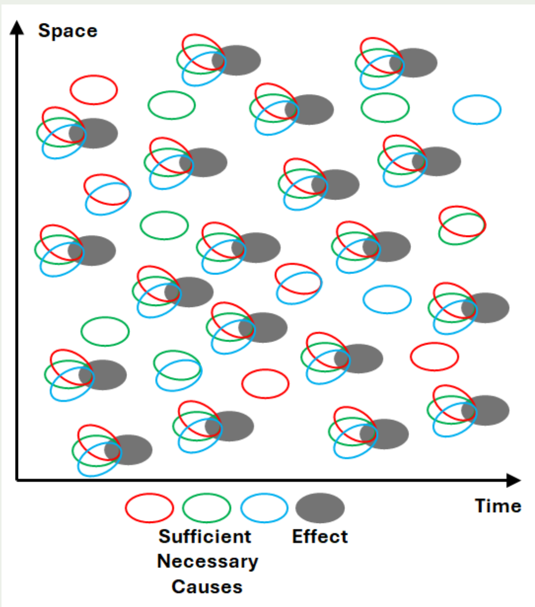
Enabling causes allow processes to occur. Oxygen, for example, enables ordinary combustion. But the presence of oxygen alone does not normally cause combustion: other necessary causal contributions are required.

Inhibitors work in the opposite direction. A process may have all of its required enabling inputs and nevertheless fail because something prevents it from operating. This is why sufficiency must always be considered in relation to inhibition.

These distinctions help us move beyond searching for “the cause” of an event. Complex effects often arise because several causal contributions converge upon processes, while other causal contributions enable, inhibit or modify their operation.







Examples

Combustion provides a simple example. A combustible material may require fuel, sufficient oxygen and an appropriate ignition input. Removing one necessary contribution can prevent combustion even though the others remain available. Conversely, the presence of oxygen alone is clearly not sufficient to cause combustion.

Biological processes provide many richer examples because they commonly require several simultaneous inputs and may also be inhibited. A cell may require particular nutrients and environmental conditions for a process to occur. Supplying one required nutrient can therefore increase the probability of the process occurring across observed cases without that nutrient being sufficient by itself.

Alternative sources are common in engineered systems. A process requiring electrical power may normally obtain it from the electricity network but obtain the same necessary input from a standby generator when the normal source fails. This illustrates why necessity may attach to the transfer required by the receiving process rather than to its usual source.

Inhibition can be illustrated by a machine containing a safety interlock. All of the inputs normally sufficient for operation may be present, but activation of the interlock prevents the process from occurring. Understanding the absence of operation therefore requires us to investigate inhibiting as well as enabling causal contributions.

Provenance and Links

The distinction between necessary and sufficient causes has a long history in philosophy and logic. Modern causal analysis has increasingly recognised that complex effects commonly result from combinations of causal conditions rather than single independently sufficient causes.

An important antecedent is John Mackie's analysis of causal complexity and his concept of INUS conditions, which showed how something ordinarily described as “a cause” may be an insufficient but necessary part of a larger causal combination. Kenneth Rothman's sufficient-component cause model similarly represents effects as arising from combinations of component causes and has been particularly influential in epidemiology.

The approach adopted in these course modules develops this reasoning by locating necessity and sufficiency more explicitly at the level of causal transfers required by recipient processes. Where alternative sources can provide equivalent transfers, the source need not itself be necessary even though the required transfer remains so. This provides a physical interpretation of why apparent causes may be substitutable.

The treatment of probabilistic causation also links to the broader distinction between ontological causality and epistemic uncertainty. An observed cause may alter the probability of an effect because other necessary enabling or inhibiting contributions remain unknown or variable. The possibility of intrinsically probabilistic causation is not thereby excluded, but observed probability alone does not establish it.

Practical Exercise

Continue your investigation of the town experiencing local flooding after heavy rainfall.

In the previous module, you began to decompress the sequence:

Heavy rainfall → surface runoff → increased river flow → rising water level → flooding → property damage

You will now investigate why heavy rainfall does not always cause property flooding.

Begin by selecting water entering a particular property as the effect you wish to explain. Consider what causal contributions would have to be present for this effect to occur. These might concern the amount of water arriving, the pathway available to it, the level reached by the floodwater and characteristics of the property itself. Do not try to produce an exhaustive list; identify several contributions that appear important.

For each contribution, ask whether it is **necessary**. If you remove that contribution while leaving everything else unchanged, can the specified flooding still occur? If it can, consider whether an alternative causal pathway or source can provide an equivalent required transfer.

Now ask what combination of causal contributions would be **sufficient** for water to enter the property. Remember that sufficiency refers to the complete causal combination required for the specified effect, not simply to a particularly important individual cause.

Next, identify at least one **enabling cause**. For example, consider circumstances that allow water to reach the property but which would not independently cause flooding. Explain what causal pathway the enabler makes possible.

Then identify a possible **inhibiting cause**. Imagine, for example, that a temporary flood barrier has been installed. Explain how this could prevent water entering the property even though the causal contributions that would otherwise produce flooding remain present.

Now consider two nearby properties. Both experience the same rainfall and a similar river level, but only one floods. Rather than concluding that rainfall caused flooding only "probabilistically", identify some of the unknown or differing enabling and inhibiting contributions that might explain the different outcomes.

Finally, return to the statement:

"Heavy rainfall caused the property to flood."

Rewrite this as a more causally decompressed explanation showing how rainfall might be one causal contribution within a combination of necessary, enabling and inhibiting causal relationships.

Keep your causal representation from this exercise. In the next module, Causal Chains and Networks, you will expand it beyond individual causal contributions and begin representing their branching, convergence and interaction as a causal network.