

Event Causation

1000: Introduction and Overview

Consider two disputes. In the first, two lawyers are arguing a lawsuit in which a guest's child was accidentally shot by the host's child at a party. Mr. Host was showing Mr. Guest his new gun, when he was called away to put out a fire in the kitchen. Mr. Guest put away the gun, but later their two sons got into the gun cabinet, played with the gun, and Mr. Host's son tripped, and accidentally shot Mr. Guest's son in the leg.

- + "The defendant, Mr. Host, was negligent, because he left the gun loaded."
- + "My client, Mr. Host, is not negligent. He left the study where the gun was kept to tend to an emergency in the kitchen, and he instructed Mr. Guest to put the gun away and pull the cabinet door shut to lock it. He had no reason to suspect that Mr. Guest's son knew where the key to the cabinet was hidden. If Mr. Guest hadn't irresponsibly told his son where Mr. Host hid his key, the boys would not have gotten into the gun cabinet, and this tragedy never would have happened!"
- + "Your honor, Mr. Host was doubly negligent. If he had not removed the child-lock protection that came with the gun, then we would most certainly not be here today. "
- + "I really must differ. Mr. Host's son was 13, and already knew how to disable a child-safety lock. The lock would have made no difference."

In the second argument, two political candidates are debating about the merits of public school vouchers. The Republican candidate supports school vouchers, while the Democratic candidate does not.

- + Republican: "Giving families vouchers will lead to more competition among schools, and more competition among schools will lead to better schools. Experiments in Milwaukee have already demonstrated that students who take advantage of vouchers learn more than those who wanted to use vouchers but could not. Our entire society is predicated upon the power of the free market. We don't allow monopolies in this country because they hurt the consumer. Why should we allow the public schools to have a monopoly on education?"
- + Democrat: "My opponent makes things sound so simple - would that it were so. First, there is no solid statistical evidence that vouchers have any positive effect on students who use them. Second, vouchers will never provide enough money to fully fund a private education. Third, vouchers take precious money away from the public schools, which are already underfunded. The children left behind who can't afford to supplement the voucher to go to a private school will be dramatically worse off than they are now. The effect of this policy will be to ruin the public educational system, a system that, while not perfect, is the primary means by which our society can remain egalitarian. Vouchers do not provide equal opportunity for all, and without that we are lost. I propose we improve the public schools - not gut them. "

Both conversations involve causation, but in very different ways. The legal dispute involves a single event: an accidental shooting at a particular party. It seeks to identify which of many possible actions or non-actions caused the accident, and which of these, if any, are the responsibility of the defendant. The policy dispute is not about a single event, but rather how society will generally respond to an intervention that effects thousands of people. Both candidates are well aware that some students will benefit and some suffer under either policy. The argument is not about single cases but about general trends.

The legal dispute involves what is called "event causation," and the policy dispute involves what is called "variable causation," or "causation among variables." What we say about "event causation" certainly relates to what we say about "variable causation," but it is important to keep the two separate. In this module, we cover "event causation." In the next we cover "variable causation."

In event causation, **events**, like "I fell on the icy sidewalk this morning," are said to cause other events, like "I sprained my wrist." In scientific and statistical contexts, **variables** (pH, mass, number of cigarettes smoked per day, etc.) are the focus, and statistical trends or general laws the target. Variables take on values (pH = 7.0, mass = 2 kilograms, number of cigarettes smoked per day = 20, etc.) for different individuals.

In the next module, we will explain how causal relations among events are related to causal relations among variables and their values. In this module, we will give the briefest introduction to the intricacies of event causation.

2000: Events and Conditions

What is a "cause" and a corresponding "effect"? Consider a few examples:

- 1 A cue ball hits the eight ball and causes the eight ball to fall into the corner pocket.
- 2 My daughter knocks over her glass of milk and it soaks my new pants.
- 3 Pumping the handle of a well causes water to rise up the well pipe and spill out the well mouth.
- 4 Pushing the gas pedal causes the car to accelerate.

These are all cases in which one **event** produces, or is responsible for, another **event**.

Besides events, we also identify **conditions** as causes or effects. For example, the air temperature being below 32 degrees Fahrenheit is a condition that causes the water on the lake's surface to turn to ice. The street having a steep slope is a condition that causes a ball to roll down to the bottom of the hill. Conditions are enduring features of a situation, while events are changes in a situation. We group events and conditions, and call them "factors."

< [A link to exercises in the interactive version of this module.](#) >

Consider the simulation of a car (below). You can press the accelerator, apply the parking brake, and turn the lights on or off. Experiment with this simulation to see what events and conditions cause the car to move, and which keep it still.

< [A simulation in the interactive version of this module.](#) >

< [A link to exercises in the interactive version of this module.](#) >

The distinction between events and conditions is not nearly as clean as we have made it out to be. Which of the possible causal factors in the car simulation above is best described as an "event?" Which are best described as a "condition?" Perhaps **any** of the causal factors in the car may be described either as conditions or events. We can describe the event "pushing on the accelerator" as the condition "the accelerator is fully depressed." We can describe the condition "lights are on" as the event "the lights are turned on" We say that a causal factor is a condition if it is a relatively stable or enduring feature of the situation, e.g. the gas tank being full. A causal factor is called an event if it is an activity that changes a feature of the situation, e.g. setting the parking brake.

3000: Counterfactual Causation

Even if we assume that causes and effects are events or conditions, we still need to give an account of what sort of **relationship** connects cause to effect. Philosophers and legal scholars have debated the issue for over 2,000 years, and there is no account generally agreed upon. For event causation, the legal system uses what is essentially the **counterfactual theory of causation**, which is generally attributed to David Hume.

In particular cases where the causes and effects are events or conditions that have already occurred, causation can be viewed as a counterfactual relationship between the causal event (or condition) A and the effect event (or condition) B.

Definition: Counterfactual Cause

A was a **counterfactual cause** of B if i) A occurred before B, and ii) had A not occurred, B would not have occurred either.

For example, we say that the event of the Titanic hitting an iceberg was the cause of it sinking because we believe that if it had not hit an iceberg, then it would not have sunk. We say the account is counterfactual, because it depends on the phrase: "had A not occurred," which is counter to the facts, that is, what did happen.

In legal settings, where responsibility for an accident is at stake, the parties typically dispute whether the effect **would** have occurred if, contrary to what did happen, something else happened. For example, in the case of the accidental shooting, consider the arguments again.

- + "The defendant, Mr. Host, was negligent, because he left the gun loaded."
- + "My client, Mr. Host, is not negligent. He left the study where the gun was kept to tend to an emergency in the kitchen, and he instructed Mr. Guest to put the gun away and pull the cabinet door shut to lock it. He had no reason to suspect that Mr. Guest's son knew where the key was hidden. If Mr. Guest hadn't irresponsibly told his son where Mr. Host hid his key, the boys would not have gotten into the gun cabinet, and this tragedy never would have happened!"
- + "Your honor, Mr. Host was doubly negligent. If he had not removed the child-lock protection that came with the gun, then we would most certainly not be here today. "
- + "I really must differ. Mr. Host's son was 13, and already knew how to disable a child-safety lock. The lock would have made no difference."

The first argument blames the host because he left the gun loaded. Does this count as a cause according to the counterfactual theory? Perhaps, because presumably, had Mr. Host not left the gun loaded, the accident would not have happened. Consider the second argument, however. The lawyer for Mr. Host claims that leaving the gun loaded should not have resulted in the accident, had Mr. Guest not told his son where the key was hidden. In fact, the lawyer is arguing that it was reasonable for Mr. Host to **expect** that the gun cabinet would be locked and safe from the children as soon as Mr. Guest pulled it closed - an expectation that was incorrect because of Mr. Host's action. By the counterfactual theory, both leaving the gun loaded and revealing the whereabouts of the key are causes. In the legal dispute, all the lawyers might accept both as causes, but then argue about which was preventable by a "reasonable person."

In the case of the child-safety lock, the lawyers do not agree on the causal claim. The guest's lawyer claimed that, had the host not removed the child safety lock, the accident would not have happened. The host's lawyer argues that, since the host's son knew how to remove a safety lock himself, that the accident would have happened anyway.

[< A link to exercises in the interactive version of this module. >](#)

Consider a more complicated example. Suppose you were driving on a rainy day, came to a sudden stop in your car to avoid hitting an animal, and you were hit from behind by a car with malfunctioning anti-lock brakes in which the driver had just downed two beers. The case in court might examine whether the brakes, the driver's inebriation, or the rain was to blame. The essential question in each case is counterfactual: would the accident have occurred if the driver had been sober? Would the accident have occurred if the anti-lock brakes had been working properly? Would the accident have occurred if it had not been raining?

In real life we can't go back and replay the accident scene with no rain, or with sober drivers. Lawyers and juries are forced to use common sense and in some cases known scientific laws to contemplate what would have been. Here, however, we have a computer, and computers allow us to simulate and replay the world as many times as we like. In the following simulation, you get to investigate the counterfactual situations under debate. You get to choose whether the trailing driver drank alcohol, whether he had normal brakes vs. antilock brakes, and whether the road was wet or dry. Your choices may or may not produce a collision. Try all eight combinations to see which settings produce a rear-end collision and which do not.

[< A simulation in the interactive version of this module. >](#)

[< A link to exercises in the interactive version of this module. >](#)

4000: The Multiplicity of Causes

The car accident simulation reveals a complicated causal situation: no single event or condition, like "the trailing driver had consumed three beers," is the cause of the accident, according to the counterfactual theory. Instead, a combination of several events and conditions caused the accident. Even if the trailing driver had been sober, the accident would still have happened, because the road was wet and the anti-lock brakes were not functioning properly. For the accident not to have happened, at least two factors would have had to be different. Either:

- + The trailing driver had to have been sober **and** the road dry, or
- + The trailing driver had to have been sober **and** the anti-lock brakes functioning properly.

We can legitimately say that either of several complex events caused the accident. We can say that the accident was caused by a drunk driver and a wet road, or it was caused by a drunk driver and malfunctioning anti-lock brakes. In the first case, had both the driver not been drunk and the road not been wet, then the effect would not have happened. In the second case, had both the driver not been drunk and the anti-lock brakes not been malfunctioning, then the effect would not have happened either.

Even though virtually all effects are the result of a complex array of causal factors, in everyday conversation and in legal contexts we often designate one factor as being "the cause" of an effect. For example, consider the sinking of the Titanic. In 1912, the Titanic sank on its maiden voyage from England to America a few hours after hitting an iceberg off the coast of Nova Scotia. When asked, "What caused the Titanic to sink?" most anyone would say: "hitting an iceberg."

Was hitting the iceberg the only cause of the Titanic going down? Certainly it is one cause. Had the boat not hit an iceberg, it would not, in all likelihood, have sunk. But is it the only cause, according to the counterfactual account? That is, are there any other factors that would have prevented the boat from sinking had they been different even if it did hit an iceberg? Of course. If the ship had been constructed differently, for example if it had a triple hull made out of stronger, less brittle steel, then hitting the iceberg might have damaged the ship but not sunk it. Thus it is correct to say the boat's hull construction was a cause of its sinking.

Consider a house that burned down after a fire started when a frayed electrical wire shorted out and sent out a spray of sparks that set fire to a stack of newspapers sitting nearby. Was the presence of oxygen in the room a cause of the fire? Yes. Was the presence of newspapers in the room a cause? Yes. If there had been no oxygen in the room the newspapers would not have ignited, and the house would not have burned down. Yet we do not usually cite the presence of oxygen as the cause of the fire. The reason is that oxygen is present both in houses that do burn down and houses that do not burn down -- it is a constant cause, and does not explain why some houses burn down, while other houses do not.

In everyday language, we tend to identify one factor as "the cause" if the **presence of the factor is unusual**. For example, it is quite unusual (fortunately) for a trans-Atlantic passenger ship to hit an iceberg. An electrical short that sprays sparks is also unusual in the course of everyday life. Thus we identify them as "the cause." Events or conditions like the presence of oxygen or the Titanic's hull construction are causes, but because they are normal events or typical background conditions, they are not cited as such in everyday conversation. In legal settings, normal background conditions, or expectations about what is normal, are crucial in identifying causes that are **legally relevant**. For example, suppose someone walks into a shop, and then while leaving plows into the door and breaks their nose. They sue, claiming that if the shopkeeper had opened the door at the appropriate moment, they would not have injured themselves. While their claim is causally true, it is clear that the normal expectations for shops do not include having the shopkeeper open the door for us at the moment we wish to leave.

In some cases more than one factor in a situation seems unusual, and in these cases we have trouble identifying one factor as "the cause." For example, consider the 1966 fire that killed astronauts Gus Grissom, Ed White and Roger Chaffe during ground tests of the Apollo I spacecraft. The fire was started by an electrical short, but the air in the cabin was 100% oxygen, instead of normal air that consists of less than 20% oxygen. The fire would not have started without the electrical short, but it would not have killed the astronauts if the oxygen level had been less than 20%. Identifying "the cause" of the Apollo tragedy is therefore difficult even in everyday language.

[< A link to exercises in the interactive version of this module. >](#)

Consider the causes of water boiling. At least three things affect whether water boils or not: a) temperature, b) air pressure, c) salinity. Here is an applet that allows you to adjust those three factors to see when the water boils.

[< A link to a Java applet in the interactive version of this module. >](#)

[< A link to exercises in the interactive version of this module. >](#)

When a set of causal factors (like certain values of temperature, pressure, and salinity) are collectively responsible for an effect (boiling of water), there is no real difference between the "cause" and the "background conditions" other than what features remain stable across different cases. For example, the air pressure in the Los Angeles basin is fairly stable, as is the salinity of the water than comes out of the taps in L.A. In this context, the background conditions are relatively stable, but the temperature of a sample of water varies a lot. Most water is not heated, a lot of water is heated but not to 212 degrees, and some water is heated to that temperature and more. So when asking about what we need to do to make our water boil in L.A., it makes sense to talk about heating water to over 212 degrees as being the cause of that water boiling. In Denver, the background pressure condition is different than in L.A., and thus the boiling temperature is lower. Though different, the pressure in Denver is a stable background condition there. In general, context provides the cues for what is a stable background condition and what factors are under consideration and can thus be considered variable.

5000: INUS Causation

5100: Sufficient Conditions

In typical circumstances lots of factors combine to cause an effect, and in many contexts there are a variety of combinations of factors that could have produced the same effect. For example, the shooting accident might also have happened if Mr. Host had not left the gun loaded, but left the gun cabinet unlocked and left a box of bullets out in plain view. So assessing causation can become extremely complex, even for simple events like a shooting accident.

John Mackie, a philosopher writing about causation in the middle of the twentieth century, developed language for talking about event causation that makes the complexity more manageable. Mackie used the logical ideas of **sufficient** and **necessary conditions**, and it is to these ideas we now turn. In this subsection we cover sufficient conditions, and in the next necessary conditions. In the one after that we present Mackie's synthesis: the INUS account of causation.

In the boiling point applet, many different arrangements of temperature, salinity, and atmospheric pressure are sufficient to make water boil. When many factors combine to produce a given effect, we say they are "jointly sufficient" to bring about the effect. It might be that none of the factors is sufficient by itself, but together the factors will produce the effect. A temperature of 200 F is not sufficient to boil water by itself, for example, for it requires certain assignments of salinity and pressure. When the salinity is 0 and the atmospheric pressure is less than 23 inches, however, then water will boil at 200 F.

Definition: Jointly Sufficient

A set of factors is **jointly sufficient** for an effect if the effect would surely occur if the factors were to all occur.

Consider the car accident simulation again.

[< A simulation in the interactive version of this module. >](#)

[< A link to exercises in the interactive version of this module. >](#)

There are several jointly sufficient sets of factors that could have caused the accident:

- + The trailing driver was drunk
- + The road was wet and the anti-lock brakes were mal-functioning.
- + The trailing driver was drunk, the road was wet, and the anti-lock brakes were mal-functioning.

The third set is sufficient, but redundant. It includes the first two, and it includes more factors than it needs to produce the effect. The first two sets are "minimal": if you take any of the conditions out of them, they are no longer sufficient. In general, when listing sets of jointly sufficient conditions, include only **minimal sets**.

[< A link to exercises in the interactive version of this module. >](#)

5200: Necessary Conditions

Sometimes there are individual conditions or events which **must** be present for the effect to occur. In these cases we say the factor is **necessary** for the effect. For example, for paper to catch fire and burn, oxygen must be present. Thus the oxygen is necessary for the fire.

The counterfactual theory identifies necessary conditions as causes. It says that a factor is a cause if, had it not happened, the effect would not have happened either. Since the effect did happen, the factor is necessary for the effect. In the sinking of the Titanic, hitting the iceberg was necessary for the effect. Had it not happened, the ship would not have sunk.

In the last section we explained sets of jointly sufficient conditions. Any one of the conditions in a set of jointly sufficient conditions might also be a necessary condition. For example, for a golfer to be legitimately declared the winner of tournament he or she must:

- + have a lower score than all the other players,
- + fill out the scorecard properly each of the four days of the tournament, and
- + not be caught violating any of the rules of play.

All three things are **jointly sufficient** for a win, but each is also necessary. None of the conditions is sufficient by itself. If you had the lowest score, that alone would not guarantee a win. Why? Because you might have failed to sign your scorecard one day.

Definition: Necessary Condition

An event or condition is a **necessary condition** for an effect if the effect could not occur without the factor.

< [A link to exercises in the interactive version of this module.](#) >

To illustrate further, consider the auto accident again.

< [A simulation in the interactive version of this module.](#) >

Many combinations of factors could have caused the same sort of collision between the same two cars. The front driver might have stopped suddenly (as before), the pavement might have been dry this time and he might have been sober and his reflexes OK, but the trailing driver's anti-lock brakes might have malfunctioned and caused a massive skid. Alternatively, the pavement might have been wet, the trailing driver sober, but the anti-lock brakes might have malfunctioned. We might represent these two situations as follows:

TABLE 5200-1: TWO ACCIDENT SCENARIOS

Situation 1	Situation 2
The front driver stopped suddenly	The front driver stopped suddenly
The road was dry	The road was wet
The trailing driver was drunk	The trailing driver was sober
Anti-lock brakes functioned normally	Anti-lock brakes malfunctioned
Result	Result
Rear-end collision	Rear-end collision

< [A link to exercises in the interactive version of this module.](#) >

5300: INUS Conditions

The counterfactual theory says that a factor, like hitting the iceberg, was a cause of the Titanic sinking, if, had the factor **not** been present, the effect would not have happened. Intuitively, the counterfactual theory insists that a factor is identified as a cause if its occurrence was "necessary" for the effect. This makes good sense when things are simple and one event jumps out at us as necessary for the effect. For example, if I slip on the ice and sprain my wrist, it's obvious that slipping on the ice was a cause. Had it not happened, I would not have sprained my wrist. Slipping was necessary for spraining my wrist. In more complicated situations, however, the counterfactual theory doesn't work so well.

Consider the car accident again. As we originally described it, you came to a sudden stop on a wet road to avoid hitting an animal, and you were hit from behind by a car with malfunctioning anti-lock brakes in which the driver had just downed several beers. Which of the following, if any, are causes according to the counterfactual theory?

- + the driver's beer buzz, or
- + the wet road, or
- + the malfunctioning anti-lock brakes

From the simulation, it should be apparent that **none** of these factors are causes according to the counterfactual theory! If the driver had been sober, the accident would still have happened. If the road had been dry, then the accident still would have happened. If the anti-lock brakes had been functioning correctly, then the accident still would have happened. At least two of these factors had to have been different for the accident to have been prevented.

Mackie gets the counterfactual theory out of this and messes like it by considering a cause to be a **necessary part of some minimal set of jointly sufficient conditions** for the effect.

Each jointly sufficient set of conditions is one of many ways to produce the effect. The set is minimal when none of its members are superfluous: that is, you need every member of the set to guarantee the effect. A cause is one member of such a set.

For example, there are several routes to getting a good job after college:

- + Be the candidate with good enough qualifications on paper to get an interview, and have a great interview
- + Be the candidate with by far the best qualifications on paper, and have a mediocre interview
- + Have unremarkable qualifications, but have a close relative who gets you an interview, and have a great interview
- + Have unremarkable qualifications, have a poor interview, but you are the only applicant for the job, and the company is desperate

No single factor is necessary in general. It isn't necessary to have remarkable qualifications if you have a relative inside the company. It isn't necessary to have a good interview if you are either really well qualified or the company is desperate enough.

To apply Mackie's theory to a particular case, first write out the minimal sets of jointly sufficient conditions for the effect, and then identify which set(s) actually happened. All the factors in each set is a cause, by Mackie's theory.

For example, if you got a job with no contact inside the company to get you an interview, and the company had the choice of several qualified candidates, then your good qualifications and good interview must have been causes.

Mackie's theory is known widely by an acronym: INUS. According to Mackie, a cause is an **INUS condition** for the effect: an Insufficient but Necessary part of an Unnecessary but jointly Sufficient set of conditions.

< [A link to exercises in the interactive version of this module.](#) >

Consider the shooting accident again. There are several ways the child of Mr. Guest might have been shot accidentally with Mr. Host's gun.

Cabinet is locked, but sons know where the key is, and the gun is left loaded. Cabinet is left unlocked, and the gun is left loaded
Cabinet is left unlocked, and bullets are left in the cabinet with the gun
No single factor is necessary overall. It isn't necessary for the cabinet to be left unlocked, and it isn't necessary for the gun to be left loaded.

If more than one set of sufficient conditions apply, then all the factors in all the sets that happened are to be considered causes by Mackie.

Consider the car accident again. There are at least two sets of minimal jointly sufficient sets of conditions that might have produced the accident and that **did** occur:

- 1 The trailing driver was drunk
- 2 The road was wet and the anti-lock brakes were mal-functioning.

Relative to the first minimal set of jointly sufficient conditions, the driver being drunk was necessary, and thus counts as a cause for Mackie. In the second set, the malfunctioning brakes and the road being wet are necessary. The reason identifying causes of the accident was tricky by the counterfactual account is that what actually happened according to our story included **both sets 1 and 2**. Thus the accident was doubly caused, or **overdetermined**.

In order to have prevented the accident, we would have had to make at least one condition that actually happened false. How might we do that? By either:

- 1 Making the trailing sober and making the road dry, or
- 2 Making the trailing sober and fixing the anti-lock brakes

Anytime at least two factors had to have been different for the effect to have been avoided, the effect is said to be "overdetermined." When an effect was overdetermined, then no single factor is a cause by the counterfactual theory. The factor is a cause according to Mackie's theory, however.

6000: Varieties of Causation

6100: Interactions

An event can be caused in many ways. It can be the result of interacting causes, of a chain of causes, it can be overdetermined by many causes, etc. In this and the next few subsections we give you some terminology for describing different ways an event might have been caused. In this subsection we cover interacting causes.

As we discussed above, in most cases there are many causes that act in concert to produce an effect. When the **influence** of one causal factor depends upon another causal factor, then we say the factors **interact**.

For example, the factors that cause a flashlight to go on are charged batteries and the flashlight switch. Flipping the switch to "on" will produce the effect (the light coming on) if the batteries are charged, and won't do anything if the batteries are dead. Similarly, the arrival of a train at a certain location is caused both by the engine running and the switches on the tracks leading to that point. The engine and the switch settings interact to cause the train to take a particular path. In a social context, taking an aggressive stance on an issue may make a good impression or a bad one, depending on one's gender. If you are male, then showing aggressiveness is often received well, but just the opposite is true if you are female. Thus taking an aggressive stance and one's gender interact as causes of a good or bad impression.

Two common ways in which factors can interact are:

- + By the factors "working together" to cause the effect;
- + By one factor blocking the influence of the other factor.

The first kind of interaction is exemplified by the flashlight example given above. Moving the switch to "on" completes the circuit, and the batteries provide the electricity for the bulb to light. In the language of the previous section, each cause is necessary to the light coming on, and the two causes together are sufficient for the effect. For example, if the switch is already flipped to "on", then the batteries being charged is necessary for the bulb to light. Similarly, if the batteries are charged, then the switch being "on" is necessary for the bulb to light. And when the batteries are charged, and the switch is "on", then the bulb will light - they are jointly sufficient.

The social situation described above also provides an example of this kind of interaction. One's gender and one's aggressiveness interact in a causal process that produces a good or bad impression.

Consider the light bulb below. Click on the red battery to toggle between charged (solid red battery) and uncharged (broken line through the battery), and click on the switch to open or complete the circuit.

[< A simulation in the interactive version of this module. >](#)

[< A link to exercises in the interactive version of this module. >](#)

Definition: Interacting Causes

When the influence of one causal factor depends upon the presence of another causal factor, then we say the factors are **interacting causes**.

In the car accident simulation, an example of two causes that do **not** interact are the driver being drunk and the anti-lock brakes mal-functioning. The effect of the driver being drunk does not depend upon the brakes. Two causes that **do** interact are the mal-functioning brakes and the wet road. If the road is dry, then the brakes will work just as well to stop the car whether the anti-lock feature works or not. If the road is wet, however, then the brakes will work if the anti-lock feature is working, but not otherwise.

6200: Pre-emptive Causes

Another way in which causal factors can interact is when one factor "blocks" or "pre-empts" the influence of the other factor. If I told you that I lay in the sun on the beach this Saturday for eight hours, you might respond "I'll bet you got quite a sunburn, if you didn't wear sunscreen!" This remark illustrates our knowledge that being out in the sun for eight hours causes a sunburn, but that wearing sunscreen can block the causal influence of the sun. Wearing sunscreen prevents the sunlight from giving me sunburn. More generally, one causal factor can block or interrupt the causal influence of another factor, and thereby prevent the production of the effect.

As another example, consider a normal car in which a full tank of gas causes the engine to run. By clamping the hose that feeds gasoline into the carburetor, we can prevent a full gas tank from causing the engine to run. We have a case in which a condition (the hose being clamped) interrupts a necessary causal event (the gas flowing from the tank to the engine).

6300: Causal Chains

Perhaps you have seen a picture of a Rube Goldberg device that produces some effect through a sequence of odd cause and effect relationships--a man slips on a banana peel, which causes him to fall onto a catapult which throws a weight up to a bucket, which causes the bucket to descend, which raises a chain, which tips a teapot, which pours tea, etc. One of the striking things about such imaginary devices is that if anything goes wrong, if any piece of the process is interfered with, the effect won't come about, e.g., the tea won't be poured. Another important fact about these devices is that we can start them anywhere along the sequence; if we just raise the chain, the teapot will still tip, and the tea will pour.

Many causal processes are like this. Turning the ignition key turns the car on or off through a process that changes the state of the circuitry in the steering column, which then turns the starter motor, etc. If one of the circuits is removed, or the starter motor is disabled, then turning the ignition switch will have no effect on whether or not the car turns on. At the same time, if we could somehow start the process without using the key, for example "hot-wiring" the car, then the car would still turn on. In general, when we have these kinds of **causal chains**, one factor causes another, etc., which then causes the effect.

In the simulation below, click on the refrigerator door to open and close it. Also, see what happens to the light when you click the yellow switch.

[< A simulation in the interactive version of this module. >](#)

[< A link to exercises in the interactive version of this module. >](#)

When talking about a particular causal chain, it is useful to be able to distinguish between the two kinds of factors: those that directly influence the effect, and those that directly influence other factors. A factor that influences the effect regardless of the value of the other factors in the system is a **direct cause**, and a factor that influences the result only by causing other factors, that in turn influence the effect, is an **indirect cause**.

Water falling over a dam, for example, turns a turbine that generates electricity. The falling water causes the turbine to turn, and the turning of the turbine causes electricity to be generated. Therefore, the turbine is a direct cause of the electricity, and the falling water is an indirect cause of the electricity.

[< A simulation in the interactive version of this module. >](#)

Whether a causal factor is direct or indirect depends on what other causal factors we consider. For example, suppose we did not consider the turbine (even though it really is there!) and considered only the height of the dam outlet gates and the quantity of falling water as causes of the amount of electricity generated. For that system of factors, the height of the outlet gates is an indirect cause of the amount of electricity generated, since it influences electricity production only by influencing the amount of falling water. And, for the same set of factors, the amount of water falling over the dam would be a direct cause of the amount of electricity generated.

[< A link to exercises in the interactive version of this module. >](#)

6400: Multiple Causal Processes

The different kinds of causal processes that we've been discussing can sometimes occur at the same time, in the same situation. You can have two different causal paths from one causal factor to the effect, in which one path is direct, and the other is part of a chain. For example, consider a case where the government raises taxes, people work fewer hours per week, make less income, and the government's revenue goes down.

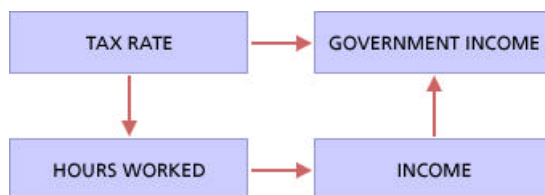


FIGURE 6400-1

An increased rate of taxation tends to increase the proportion of each worker's income the government takes (tax rate is a direct cause of government income), but the increased rate of taxation tends to decrease the number of hours people are willing to work, which decreases their income which decreases the government's income (tax rate is an indirect cause of government income through a causal chain with hours worked).

7000: Summary

A particular instance of causation, like the sinking of the Titanic, is a relation between one event and set of conditions, described as the "causal factors," and another event, the effect. According to the **counterfactual theory of causation**, one set of factors was the cause of the effect if the effect would not have occurred, had the causal factors not occurred.

Although we often identify a single event or condition as the only cause of an effect in everyday conversation, in reality effects are produced by an ensemble of causal factors. For example, a fire might have been caused by a short-circuit, the presence of something flammable near the short circuit, oxygen in the air, and any number of other causal factors. Causation is always complex, even though we often don't treat it that way. Background conditions, like the presence of oxygen in the air, are important in producing the effect, but if they occur regularly fail to elicit comment.

A set of causal factors is said to be "jointly sufficient" for an effect if their occurrence guarantees that the effect will occur. A causal factor is "necessary" if the effect cannot be produced without that factor. A causal factor can be necessary relative to a jointly sufficient set of factors. A jointly set of sufficient factors is minimal if removing any of the factors prevents the set from being sufficient for the effect.

If circumstances were such that more than one minimal set of sufficient factors occurred, then we say the effect was "overdetermined." For example, if you are shot in the heart while falling off a 40 story building, then your death is overdetermined. The shot or the fall would have killed you.

According to J.L. Mackie, a cause is an INUS condition: an Insufficient but Necessary factor in a Unnecessary but jointly Sufficient set of factors for an effect.

Causal relationships come in many varieties. In some circumstances, the influence of one variable depends on the value of another - in these cases we say the causes interact. For example, flipping a flashlight switch from off to on is a cause of the flashlight being on, but it is only influential when the batteries are charged. The batteries and switch thus interact to produce light from the flashlight.

Some causal relationships are direct and some indirect. For example, when we close the refrigerator door we cause the light inside the fridge to go off. We only do so indirectly, however. The door closing directly causes a little switch to close, which in turn causes the light to out.
