

On Determinacy, Uncertainty, and Reciprocity

by David LUDDEN*

Why did the house burn down?

A house burns down, and after a thorough investigation, the fire marshall determines the cause of the fire to be arson. The police step in and investigate, and in short order have their suspect:

Tom is a 25-year-old local man who is unemployed and still lives with his divorced mother. He had never done well in school; he was withdrawn, had few friends, and was often delinquent. He dropped out of school at 16, had several menial jobs over the next nine years but never kept one for more than a few months. He lost his last job as a gas station attendant over three years ago for drinking on the job. Since that time and before he had spent several nights in the county jail, each time either for drunken driving or for intoxication in public. Once when he was arrested he was found to have a marijuana cigarette on his possession. His driver's license was revoked a year and a half ago for repeated drunken driving. Up until now, though, he had never been convicted for a felony.

When Tom was brought into the police station, he readily admitted he'd set fire to the house. The police investigator now also suspects him of several other incidents of arson in the area over the last three years. Tom denied these, but confessed that he'd torched several other buildings that had burned down recently, even though in these cases arson was not suspected as the cause.

A psychiatrist who examined Tom after his arrest testified to Tom's mental instability and recommended confinement to a psychiatric hospital over imprisonment, asserting that imprisonment would only cause greater psychological damage. The judge, being of the old school, however, decided Tom was nothing but a troublemaker and gave him the maximum sentence for arson. He was quoted by the local newspaper after the trial as saying: "That'll teach the punk a lesson."

Tom was sent to the state penitentiary, but was paroled early for good behavior.

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Three weeks after he got home, he torched the house of the judge who had convicted him.

This time the case went before a judge who was known for his liberal and innovative ideas. He called in a team of six renowned psychologists and psychiatrists to examine Tom. When the judge asked for their reports, he got six different analyses. One psychologist stressed Tom's unstable environment in childhood: his father was a drunk and usually unemployed; his mother was domineering, and before as well as after her divorce from Tom's father she had had numerous affairs. Arson was an attempt at attracting the attention of the parents who otherwise ignored him, the psychologist said. A psychiatrist, citing the same childhood situation, described Tom as a latent homosexual, who, unable to express his homosexuality openly, instead sought expression through fire. Still another psychologist said something about attempted rebirth through fire, rising anew from the ashes, and so on. The other three reports only confounded the judge more.

Having no idea which report was right, but knowing nonetheless that something had to be done, the judge ordered Tom confined to the state hospital for the criminally insane. During the two years Tom has been confined, he has behaved well and has responded to treatment. There have been no incidents of arson, but then again, Tom has had no access to the means of making fire, either. He is soon due to be released...

Where do the questions end?

The fire marshal determined that the *cause* of the fire was arson. The police investigator found that Tom *started* the fire. The psychologists and psychiatrists agreed that Tom's unstable childhood environment *caused* him to become an arsonist, even though they disagreed on the exact nature of the relationship between his childhood and his arsonism as an adult.

The whole situation has been examined in terms of the conceptual framework of cause-and-effect. Then, while we are following the chain of cause-and-effect, let's go further and ask these questions: Why was Tom's childhood environment so unstable? Why did Tom's father become an alcoholic? Why was Tom's mother domineering and promiscuous? What factors were involved in their childhoods that caused these tendencies as adults? And what about their parents?

The questions never end. So long as you work on the assumption that all events are related by cause-and-effect relationships, there is always an earlier cause that you can look for, and that found, a still more primary one, and so on, back and back and

back, until you get to the beginning of time—back to the Big Bang, or back to the moment God spake, “Let there be light!” or whatever primal cause you care to believe in.

You might just as well say the house burned down because thirty billion years ago the universe exploded. And that sounds ludicrous—it is ludicrous.

The principle of determinacy

Cause-and-effect is a useful tool in analysing the structure of phenomena and the relationship between their parts. But cause-and-effect is only a tool, a kind of thinking tool that helps us contemplate and understand the nature of the universe. It is not, however, the true nature of the world, any more than the plastic model of an F-16 you bought your son for his birthday is a real F-16.

Unfortunately, most people confuse the model with what they vaguely refer to as “reality.” Laymen and uneducated people can be excused, perhaps, for this confusion. However, scientists, philosophers, and academics, in other words, those who think for a living, must have a clear understanding of what cause-and-effect is, and even more importantly, what it is not.

In the physical sciences, especially in nuclear physics and astrophysics, it became increasingly clear in the early decades of this century that cause-and-effect was not always a very effective model for conceptualizing and describing events. It was found that the rules of probability were far more effective in explaining and even in predicting events than the cause-and-effect framework.

The cause-and-effect framework is based on the assumption that you can know everything about an event. If only you can find all the factors that entered into the event, you can explain why and how the event occurred, and even predict the future course of the event. This is the principle of determinacy.

However, in nuclear and particle physics, scientists understand that there are limits to how much you can know. You cannot see an electron or a pi-meson. The only way you can find a particle is to bounce another particle off it (that is, shoot randomly until you hit something), and see what issues forth from the collision. To observe an event is to influence the event.

This is true even on a more commonplace scale. For example, if you want to study the life functions of a frog, you can dissect it, but then it is no longer alive. By observing how the frog lives you have killed it.

On the vastest scale of all, astrophysics, the uncertainty principle dominates as well. In the universe, the fastest speed is the speed of light. No information of an event

can travel faster than light. If in the year 1988, a star 20 light-years from the earth were to explode, nobody on the earth would know about the explosion until 2008. Even if there happened to be an astronaut in the vicinity of the exploding star, and he dispatched a report of the explosion right away, that message would not arrive until after astronomers on the earth had already observed the explosion (the time delay being due to the time it took for light from the explosion first to reach the astronaut and then for him to send off his report). "Gee thanks," would probably be the sarcastic reply of the astronomers on earth.

There are limits to what and when we can know. We cannot see a beam of light before it reaches our eyes. And we cannot be aware of an event before it manifests itself.

The principle of uncertainty

At the two extreme ends of the study of the universe, sub-atomic physics at the minutest and astrophysics at the vastest, the probability framework is regularly used instead of the cause-and-effect framework. Even in sciences like chemistry and biology, experiments are routinely repeated several times and the average taken. There are always limits to what we can know.

The principle of uncertainty manifests itself in all aspects of daily life. Bookies, insurance companies, and stock-market speculators all use the probability framework in their businesses. (If, in fact, a bookie knows for certain which horse will win, or a speculator which stock will go up, we arrest him and put him in jail for using "inside knowledge".) Experienced teachers know that in a sufficiently large class, grades will usually fall into a bell curve, no matter what criteria are used as tests. Some teachers, so bound by the belief that grades must fall into a bell curve to be fair, will manipulate grades that do not fall into the curve until they do. But bell curves are not an expression of fairness, they are an expression of probability. It is a statement of the self-evident: "It is more likely to be normal than unnormal."

Unfortunately, in the "human sciences," such as psychology, political science, economics, history, and linguistics, the principle of determinacy still reigns in many quarters. And to the detriment of those sciences.

A linguist will spend his life studying the nature of language, and at the end of his career sit back and sigh at the realization that he still has no answers, only more questions.

For science is not, as many suppose, a quest for Truth. Rather, it is an exercise

in the manipulation of symbols within given conceptual frameworks. It is hoped that by this exercise we can come to a *better* understanding of the world. We manipulate symbols, compare our symbol configurations with our observations of the real world, contemplate the differences, then manipulate our symbols in other ways in the hope of narrowing the gap between symbol configuration and observation. To ask "What is the true nature of a thing?" is begging the question. The true nature of a thing is that it is. There is nothing we can say about that thing that is more true than it itself is.

The principle of reciprocity

Rather than thinking in terms of rules and laws and determination—that is, in terms of the cause-and-effect conceptual framework—it behooves the linguist or any other scientist to think of likelihoods, tendencies and averages—that is, in terms of the probability conceptual framework. The linguist should not despair that his "definitive" analysis still has some unanswered questions. It is better to have a theory that is right ninety percent of the time than it is to have a theory which is wrong ten percent of the time. (They are not the same.¹⁾)

And there is one more thinking tool that comes in handy in the "human" sciences, where the relationships between phenomena are generally speaking far more complex than they are in the physical sciences. It is the principle of reciprocity. This is what is meant, for example, in the term "spiraling," such as in the expressions "spiraling inflation" and "spiraling unemployment." A business slump in the automobile industry causes layoffs among autoworkers and a decline in the demand for steel. This leads to layoffs among steelworkers, which then leads to declines in demand and layoffs in other industries. As more people lose their jobs, less goods are bought, including automobiles, which means more layoffs among autoworkers, steelworkers, and so on down the line. It is arbitrary to draw a line somewhere and say that this is the cause. To say that a slump in the auto industry caused a widespread economic recession is ignoring (1) the question "What caused the slump in the auto industry?" and (2) the fact that the overall economic recession had an effect on the slump in the automobile industry as well.

So long as you think in terms of cause-and-effect, you force yourself to make arbitrary and useless distinctions. Events do not begin and end in any clear-cut fashion, but rather proceed out of, towards, and amidst, other events. The singling out of individual events, even, is arbitrary.

The principle of reciprocity manifests itself in physics as well. At the level of sub-atomic physics, and at higher levels as well, the observation of an event invariably

alters the event. For example, we want to test the existence and identity of a particle suspected of being in a given locality. (Let's call it the "event-particle.") We shoot off a spray of particles whose identity is known in the general direction of the suspected particle until one of these particles (let's call it the "observation-particle") collides with the event-particle, and we observe what happens next. A number of things can happen when the observation-particle collides with the event-particle; for example: (1) the two particles bounce off each other and fly away in different directions; (2) the two particles combine to form a new particle; (3) the two particles annihilate each other in a flash of light. At any rate, the event-particle is not the same after the observation as it was before. The event-particle is now either in a new locality or its identity has been changed.

The result of observation depends on, among other things, the nature of the event. An event-particle that bounces off an observation-particle is different from one that combines with it. In this way the event affects the observation. Which is why an observation tells us anything at all. The observation affects the event, and the event affects the observation, because what we have really is two interacting events. For the observation is itself an event.

The experienced linguist knows this phenomenon all too well. The informant is self-conscious at being observed and tries to give the linguist what he thinks he wants ("correct speech") rather than what the linguist really wants ("natural speech"). "Just be natural!" is the impossible command. The experienced linguist knows that you get much better data from informants if they don't know they are being observed (such as through hidden microphones), but this practice is considered unethical and can sometimes get you sued for invasion of privacy.

The chicken or the egg?

Now if we turn back to the story we began this essay with, we find that the principle of reciprocity is a useful tool in coming to an understanding of the events. We ask "Why did Tom burn down the house?" and we find it is due to psychological problems brought on by his unstable childhood environment. Why was his childhood environment unstable? Because his father was an alcoholic and his mother was domineering. Why was his father an alcoholic? Why was mother domineering? She nagged him for drinking, he drank because she nagged him. Who started it all? We cannot say. Probably she had a tendency for domineering before the marriage, and he for drink. There is also much more involved than these two factors. There was also Tom's father's unemployment, which no doubt brought on more nagging from his wife and even greater temptation to

drink. Tom's mother's promiscuity was perhaps encouraged by her low opinion of her husband. All these factors, and many many more that we can never know for sure, came together and exacerbated each other until father's, mother's and son's lives were all ashambles.

Asking where it all began is like asking the question, "Which came first, the chicken or the egg?" To ask the question is a waste of breath, to ponder it seriously is a waste of time. But to go beyond the question, to see the reciprocal action and the happenstance collision of a multitude of random events is a big step towards understanding the situation as a whole. For it tells what we know for sure, what we cannot know at all, and what is reasonable to assume. In that such a conceptual framework tells us the limits of our knowledge, it provides us with a fuller and more powerful understanding of the situation than one that says we'd know exactly why things happened the way they did if only we know more about the factors involved.

At any rate, we can never know what a thing "is." A thing is what it is, it simply is. And we can only understand the thing in terms of the symbols we invent for it. The symbol is not the thing, and it is important for the scientist (and any symbol manipulator²⁾) to know the difference. There is always a gap between symbol and thing. And there are always more things than we can make symbols for.

In any instant there is an infinity of events. We cannot know them all. And what we do know we change in knowing them.

Notes

- 1) What I have in mind here is a theory which has predictive power in 90% of the cases, and can also predict when or how often it will be wrong, as opposed to a theory which claims general validity, and yet on testing against observation is found to be wrong 10% of the time.
- 2) This is Hayakawa's term.

Bibliography

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