MICHAEL LEWIS

built their theory, to treat a math model of human behavior as an accurate description of how people made choices. At a convention of economists in 1953, Allais offered what he imagined to be a killer argument against expected utility theory. He asked his audience to imagine their choices in the following two situations (the dollar amounts used by Allais are here multiplied by ten to account for inflation and capture the feel of his original problem):

**Situation 1. You must choose between having:**

1) $5 million for sure

or this gamble

2) An 89 percent chance of winning $5 million
   A 10 percent chance of winning $25 million
   A 1 percent chance to win zero

Most people who looked at that, apparently including many of the American economists in Allais's audience, said, "Obviously, I'll take door number 1, the $5 million for sure." They preferred the certainty of being rich to the slim possibility of being even richer. To which Allais replied, "Okay, now consider this second situation."

**Situation 2. You must choose between having:**

3) An 11 percent chance of winning $5 million, with an 89 percent chance to win zero

or

4) A 10 percent chance of winning $25 million, with a 90 percent chance to win zero

Most everyone, including American economists, looked at this choice and said, "I'll take number 4." They preferred the slightly lower chance of winning a lot more money. There was nothing wrong with this; on the face of it, both choices felt perfectly sensible. The trouble, as Amos's textbook explained, was that "this seemingly innocent pair of preferences is incompatible with utility theory." What was now called the **Allais paradox** had become the most famous contradiction of expected utility theory. Allais's problem caused even the most cold-blooded American economist to violate the rules of rationality.*

Amos's introduction to mathematical psychology sketched the controversy and argument that had ensued after Allais posed

* I apologize for this, but it must be done. Those whose minds freeze when confronted with algebra can skip what follows. A simpler proof of the paradox, devised by Danny and Amos, will come later. But here, more or less reproduced from *Mathematical Psychology: An Elementary Introduction*, is the proof of Allais's point that Amos asked Danny to ponder.

Let $u$ stand for utility.

In situation 1:

$u(gamble 1) > u(gamble 2)$

and hence

$1u(5) > .10u(25) + .89u(5) + .01u(0)$

so

$.11u(5) > .10u(25) + .01u(0)$

Now turn to situation 2, where most people chose 4 over 3. This implies

$u(gamble 4) > u(gamble 3)$

and hence

$.10u(25) + .90u(0) > .11u(5) + .89u(0)$

so

$.10u(25) + .01u(0) > .11u(5)$

Or the exact reverse of the choice made in the first gamble.

This is an EXCELLENT book. Click here to see it

THE UNDOING PROJECT

Maurice Allais wins Econ Nobel in 1988.

Amos Tversky was Daniel Kahneman's co-author. Kahneman wins Nobel in 2002. Tversky dead so cannot win.

1u(5) means a 100% chance (certainty) multiplied by the utility to you of 5 ($5 million)

This is simple algebra: $1u(5) - .89u(5) = .11u(5)$

this is the Allais paradox. Write it in your own words here:
that, you could explain not only why people bought insurance and lottery tickets. You could even explain the Allais paradox.*

At some point, Danny and Amos became aware that they

* Here is the simpler version of the paradox. Danny and Amos created it to show how the apparent contradiction might be resolved using their findings about people's attitudes toward probabilities. And so in a funny way they "solved" the Allais paradox twice—once by explaining it with regret, this time by explaining it with their new theory:

You are offered a choice between:

1. $30,000 for sure
2. A gamble that has a 50 percent chance of winning $70,000 and a 50 percent chance of winning nothing

Most people took the $30,000. That was interesting in itself. It showed what was meant by "risk aversion." People choosing between a bet and a certain amount would accept a certain amount that was less than the expected value of the bet (which here is $35,000). That did not violate utility theory. It just meant that the utility of a chance to win 70 grand is less than the utility of a twice as likely chance to win 30 grand—which in this case makes the 30 grand a certainty. But now consider a second choice between bets:

1. A gamble that gives you a 4 percent chance to win $30,000 and a 96 percent chance to win nothing
2. A gamble that gives you a 2 percent chance to win $70,000 and a 98 percent chance to win nothing

Most people here preferred 2, the lower chance to win more. But that implied that the "utility" of a chance to win $70,000 is greater than the utility of a twice as likely chance to win $30,000—or the opposite of the preferences in the first choice. In Danny and Amos's working theory, the paradox was now resolved differently. It wasn't that (or at least not only that) people anticipated regret when making a decision in the first situation that they did not anticipate in making the second. It was that they treated 50 percent as more than 50 percent and saw the difference between 4 percent and 2 percent as far less than it was.

Danny and Amos had a problem on their hands. Their theory explained all sorts of things that expected utility failed to explain. But it implied, as utility theory never had, that it was as easy to get people to take risks as it was to get them to avoid them. All you had to do was present them with a choice that involved a loss. In the more than two hundred years since Bernoulli started the discussion, intellectuals had regarded risk-seeking behavior as a curiosity. If risk seeking was woven into human nature, as Danny and Amos's theory implied that it was, why hadn't people noticed it before?

The answer, Amos and Danny now thought, was that intellectuals who studied human decision making had been looking in the wrong places. Mostly they had been economists, who directed their attention to the way people made decisions about money. "It is an ecological fact," wrote Amos and Danny in a draft, "that most decisions in that context (except insurance) involve mainly favorable prospects." The gambles that economists studied were, like most savings and investment decisions, choices between gains. In the domain of gains, people were indeed risk averse. They took the sure thing over the gamble. Danny and Amos thought that if the theorists had spent less time with money and more time with politics and war, or even marriage, they might have come to different conclusions about human nature. In politics and war, as in fraught human relationships, the choice faced by the decision maker was often between two unpleasant options. "A very different view of man as a decision maker might well have emerged if the outcomes of decisions in the private-personal, political or strategic domains had been as easily measurable as monetary gains and losses," they wrote.