ROBERT DUNCAN LUCE

BORN: May 16, 1925
DIED: August 11, 2012

Duncan Luce experienced two perquisites of being a renowned mathematical psychologist. He was crowned with laurels, including the American Psychological Association's Award for Distinguished Scientific Contributions, the American Psychological Foundation's Gold Medal for Life Achievement, and the National Medal of Science, which was draped over his shoulders by President George W. Bush in 2005. He held distinguished chairs at the University of Pennsylvania, the University of California–Irvine, and Harvard, where he was Alfred North Whitehead Professor of Psychology (1976–81), Victor S. Thomas Professor of Psychology (1983–88), and chair of the Department of Psychology and Social Relations (1981–84).

At the same time, few of his nonmathematical colleagues could say just what he did. *Science* magazine explained that he "sought to provide axiomatic formulations for the social sciences." Duncan himself, responding to those who wondered what mathematics had to do with psychology, would ask whether "all factually correct things one might say about a person are independent of one another" and then explain that "the study of how one set of statements can be deduced from a set of other statements, taken as primitives, was in fact mathematics." But, he would despair, "at best this tends to draw a sympathetic, but pained, expression and at worst the . . . suggestion that I belong under the care of a good (presumably clinical) psychologist."

By temperament and training, Duncan was more mathematician than psychologist. When he left Scranton for MIT in 1942, he majored in aeronautical engineering because of a romantic fascination with flying, which led him to join the Navy's V-12 program and, later in life, earn a pilot's license. Math and physics engaged him more than engineering. After World War II he entered graduate school in applied mathematics at MIT because he thought physics was too involved with weaponry and too formally developed for him to make a contribution. Neither was he confident he could become a distinguished pure mathematician.

This modesty would always endear Duncan to his colleagues. He described himself as shy; confessed that reading, writing, and lecturing did not come easily; characterized his research as "plodding"; and periodically disavowed his own contributions. But his brilliance was conspicuous, from instantly spotting an errant negative sign in a blackboard filled with equations to conceiving new formalizations in many subfields of psychology.

Though mid-century MIT had no psychology department, its laboratories and centers boasted several pioneering social psychologists, including Kurt Lewin, Alex Bavelas, and Leon Festinger of cognitive dissonance fame. Luce, in search of an application of mathematics to social science, was recruited into Bavelas's group dynamics laboratory to model the combinatorics of small-scale social interactions. This led to an interest in the then-new theory of games and rational decisions. Together with the decision theorist Howard Raiffa (later a professor at Harvard Business School and Harvard Kennedy School), Luce wrote an accessible synthesis for social scientists, *Games and Decisions* (1957), which catapulted that field outside its mathematical origins and is still widely consulted.

Rational decision-making became Duncan's second major research theme. He developed a probabilistic complement to Von Neumann and Morgenstern's algebraic approach, conceiving of choices as probabilities conditional on a set of alternatives. Luce formulated his eponymous "choice axiom" (not to be confused with the "axiom of choice" in set theory), a probabilistic version of the Independence from Irrelevant Alternatives. That foundational axiom of rational choice holds that that the probability of selecting one item over another should not be affected by the presence or absence of other items in the pool of alternatives. When Luce moved to Columbia University in 1953, he got to know the philosopher Sidney Morgenbesser, who mischievously defied the axiom in a famous anecdote. A waitress offered him a choice of apple pie or blueberry pie. Shortly after he chose apple, she returned and said they also had cherry pie on the menu that day. Morgenbesser said, "In that case, I'll have blueberry."

The question of how internal psychological variables, such as the desirability of alternatives, relate to physical quantities inspired Duncan's third research area, the foundations of measurement. Every psychology student learns that numbers can be assigned to things in different ways that allow different mathematical operations: a 40-year-old is twice as old as a 20-year-old, but 40-degree weather is not twice as warm as 20-degree weather; the 40th-place finisher in the Boston Marathon does not lag the 20th-place finisher as much as the 20th-place finisher lags the winner; and the Celtic wearing 40 on his jersey has no mathematical relationship to the Celtic wearing 20 at all. This is just a sample of the measurement types that Luce formalized and synthesized, culminating in his monumental co-edited trilogy, *Foundations of Measurement* (1971–1990).

Measurement is intimately related to Duncan's fourth research area, psychophysics, the relations between objective quantities like amplitude and frequency and subjective quantities

like loudness and pitch. He plumbed these mathematical relationships and sought to explain them in terms of the neural pulse trains that convey signals from the sense organs to the brain. In his book *Response Times* (1986), he scrutinized the most popular behavioral metric of cognitive psychologists at the time, showing, for example, how quicker discriminations between more discrepant sounds could be explained by the brain counting or timing the incoming neural spikes and doing statistics on the tallies: holding degree of confidence constant, larger differences require smaller samples.

Together with his scholarly contributions, Duncan was revered for his sagacity. He was a precocious critic of the thoughtless use of statistics in social science, anticipating by decades the replicability crisis. His scientific noblesse oblige was humbling. He wrote or edited major handbooks, and chaired or led many committees and societies, including at the National Academy of Sciences, the National Research Council, and the Society for Mathematical Psychology. And belying his stolid demeanor, he was known for his flamboyant turquoise jewelry, his generosity toward colleagues, and his dedication to his aging father and to his daughter, Aurora, and third wife, Carolyn Scheer, who survive him.

Respectfully submitted,

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