HERBERT A. SIMON

15 June 1916 · 9 February 2001
HEN HERBERT A. SIMON died on 9 February 2001, the world of ideas lost a great twentieth-century "Renaissance man." Simon was a central figure in several developments of twentieth-century science: behavioral economics, political science and public administration, artificial intelligence, cognitive psychology, and computer science. He enjoyed living the life of ideas. He was teaching large classes and advising students until his death. Working until the end, from his hospital bed in the last days of his life, Simon commented on a paper written by his old friend William Cooper, about the history of operations research in America.


When Simon died, he was the Richard King Mellon Professor of Computer Science and Psychology at Carnegie Mellon University. He had come to Pittsburgh in 1949 and was a major force in establishing the Graduate School of Industrial Administration at the Carnegie Institute of Technology (now Carnegie Mellon University).

He received major awards from many different scientific communities. These include the A. M. Turing Award of the Association for Computing Machinery (1975), the Distinguished Scientific Contribution Award of the American Psychological Association (1969), the National Medal of Science (1986), and the Nobel Prize in Economics (1978).

Although he contributed to many different scientific disciplines, Simon often said that all his life he really had just one big research problem: understanding decision making in individuals and organizations. Simon described himself as a “monomaniac.” It was the interdisciplinary character of this problem that brought Simon’s work to so many scientific disciplines.

Simon spent his early years with his parents and his older brother on the West Side of Milwaukee in a middle-class neighborhood. As a boy, he was rather shy, preferring to spend most of his time reading by himself. He often walked to a park as early as 5 A.M. to climb into a tree and read before breakfast. At first, Simon intended to study biology. However, after he went on a strawberry hunting trip, and discovered that he was colorblind (unable to distinguish the strawberries from the plants), he changed his mind, thinking that colorblindness would be too big a handicap in biology. He then briefly considered studying physics, but then thought that perhaps there weren’t really any major advances left to be made in physics. “They have all these great laws,” Simon said. “Newton had done it, no use messing around
with it.” So, upon finishing high school in 1933, Simon enrolled instead at the University of Chicago, with an interest in making social science more mathematical, and an intent to major in economics. Simon preferred reading on his own to taking classes, and he particularly refused to take the class in accounting (which was required to graduate in economics). He majored instead in political science. Among the classes he did take were mathematical economics (with Henry Schulz), logic (with Rudolph Carnap), and mathematical biophysics (with Nicolas Rashevsky).

Considering these influences, it is no surprise that Simon’s dissertation, later published as *Administrative Behavior*, is as relevant to political science and to organization theory, as it is to economics.

It was *Administrative Behavior* that first brought Simon to prominence. The book was quickly recognized for its insights into human behavior in general, and for Simon’s idea of “limited rationality” in particular. *Administrative Behavior* provided Simon with a basis for his subsequent work in economics and the other fields to which he contributed. As Simon noted in the introduction to the fourth edition of the book, “*Administrative Behavior* has served me as a useful and reliable port of embarkation for voyages of discovery into human decision making; the relation of organization structure to decision making, the formalized decision making of operations research and management science, and in more recent years, the thinking and problem solving activities of individual human beings.” In particular, the views that Simon develops in *Administrative Behavior* on decision making and limited rationality stayed with him as he proceeded to translate his political science insights into economics, organization theory, psychology, and artificial intelligence.

The idea that human rationality is goal-directed but of limited information-processing capability stayed with him for the next fifty years, as Simon investigated decision making in individuals and organizations. Simon argued that organizations make it possible to make decisions because they constrain the set of alternatives to be considered and the considerations that are to be treated as relevant. Organizations can be improved by improving the ways in which the limits on rationality are defined and imposed.

After completing his Ph.D., Simon taught at the Illinois Institute of Technology. His main field was still political science, but he spent much of his spare time learning physics and mathematics, and had also begun publishing in economics journals. In particular, Simon’s participation in the seminars at the Cowles Commission proved useful for his intention to translate the central ideas in *Administrative Behavior* into economics. As he recalled, “My first important movement from the recesses of outer space toward the sun was my association with the Cowles Commission, which was at the very center of the new postwar
developments in mathematical economics and econometrics.” As a result, Simon early on learned about game theory, operations research, and statistical decision theory. Those influences are particularly clear in his collection *Models of Man*, published in 1957.

Simon was attracted to the exciting intellectual environment emerging at the Carnegie Institute of Technology in Pittsburgh. After moving to Carnegie in 1949, Simon stayed there for more than five decades. At Carnegie, Simon collaborated on work that established the field of organization theory. The founding work was a major study done with James G. March, published as *Organizations*. The book continued the argument that decision makers are not able to act in an objectively rational manner; rather, they are constrained by both cognitive and external limitations. So, instead of assuming that each decision maker scans all possible alternatives and chooses the one that maximizes expected utility, Simon argued that decision makers instead use “satisficing” as a criterion for making decisions; they choose the first alternative that looks “good enough.” March and Simon wrote in *Organizations*, “Most human decision making, whether individual or organizational, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives.” Simon also continued working on problems relating directly to economics, and was involved in applying operations research techniques to a study of production planning (a collaboration with Charles Holt, Franco Modigliani, and John F. Muth).

After meeting Allen Newell at the RAND Corporation in the early 1950s, Simon began applying his ideas to cognitive psychology and computer science (as the field was later named). An important event occurred in 1955 with the work on the landmark artificial intelligence (AI) computer program, the Logic Theorist.

One of the graduate students, Edward Feigenbaum, asked Simon how he could make important contributions to so many different fields. It was in this context that Simon’s view of himself working on one theme was first articulated: “I’m a monomaniac. I am a monomaniac about the study of decision making.”

The field of artificial intelligence (AI) recognizes Simon as one of its four cofounders (together with Allen Newell, Marvin Minsky, and John McCarthy). Collaborating closely for several decades with Allen Newell, Simon worked on building information-processing models of human problem solving.

It is clear that Simon’s ideas on AI were born in the context of his earlier work on economics, political science, and organization theory. Consistent with the idea of limited rationality, Simon suggested that decision makers use heuristics—rules of thumb, good guesses—to make decisions (rather than using optimizing decision procedures). Similarly,
in Simon’s work on modeling human chess-playing behavior, he pointed to the impossibility of a player’s enumerating and evaluating all move sequences. Instead, players use heuristics based on prior experience and chess lore and chess literature. Heuristics don’t lead to optimal solutions. They are “knowledge tools” for “satisficing.”

Simon’s work on the Logic Theory program and on a chess-playing program became the basis for later developments in cognitive science and artificial intelligence, building on ideas, concepts, and mechanisms such as problem space, heuristics, search, and strategies.

One of Simon’s insights was that the observed complexity of human behavior arose from simple and general underlying mechanisms that were applied to a complex task environment. Simon illustrated this with his famous metaphor of “the ant on the beach.” The ant’s goal is to reach some distant food. While the ant’s path to the food seems very complex, twisting and turning, most of the apparent complexity is due to the grains of sand to be traversed. The complexity of the environment, rather than the complexity of mechanism within the decision maker, gives rise to the observed behavior. “In solving problems,” March and Simon wrote, “human thinking is governed by programs that organize myriads of simple information processes—or symbolic manipulating processes if you like—into orderly, complex, sequences that are responsive to and adaptive to the task environment and the clues that are extracted from that environment as the sequences unfold.”

Using the information-processing language of computer programming, Simon and Newell also built their general model of problem solving (GPS). GPS, Simon and Newell thought, could be applied in any task environment. The model used “means-ends analysis” for achieving goals; GPS analyzed differences between the current state and the goal state. It chose operators to reduce the differences between these states until there were no differences remaining. The task environment was represented as a table of associations between operators and the differences they affected. GPS was reported in a book that is a twentieth-century landmark in the study of thinking: Human Problem Solving.

Simon continued contributing to research on psychology and artificial intelligence for decades. He contributed significantly to theories of learning, recognition, and memory. For example, Simon joined with his former doctoral student Feigenbaum in developing an information-processing model that offered simple mechanistic explanations of major phenomena of verbal learning, predicted behavior in new experiments, and accounted for the behavioral plasticity observed. The resulting model, EPAM (Elementary Perceiver and Memorizer) has been under continuous development and extension by Simon and his collaborators ever since.

Simon also developed an interest in scientific discovery. He wanted
to understand how scientists develop new theories. As was typical for Simon, ideas that had emerged in other disciplinary contexts were also used for understanding discovery. His earlier work in economics, political science, artificial intelligence, and the philosophy of science is echoed in the work on scientific discovery. Working with several coauthors, Simon sought to understand discovery in psychological and information-processing terms. They studied scientific discovery as a form of heuristic search through problem spaces. These theories were tested using computer simulation models.

Simon used various tools, languages, and models to understand the same overall problem: human decision making. For example, in much of his work from the early 1950s, collected in the papers in *Models of Man*, Simon had used different mathematical approaches such as matrix theory and partial differential equations. In the course of using these mathematical tools, Simon found that they were unsatisfactory. They were not flexible enough to express the richness and the complexity that Simon saw as inherent in decision-making processes. But it was precisely this richness that he wanted to model. He turned to computer language because it proved useful for expressing the information-processing activity that Simon saw as underlying decision making.

None of these facts about his work, however, conveys the fullness and enthusiasm with which Simon lived his life. He was a proud husband and father, a skillful chess player, a piano player, and many things besides. These were not separate compartments of his life. Each seemed to flow into the others, and he was always alert to the possible scientific significance of everything he saw around him. For example, his research on chess was typical of the way in which he worked as he played, and vice versa. His enthusiasm was infectious and it was impossible to be around him without feeling part of his joy. He was deeply respected and loved by colleagues and students both for his wisdom and for his human warmth. He was survived by his wife, Dorothea Pye Simon, who died on 15 August 2002, and three children, Katherine, Peter, and Barbara.

Elected 1959

**Mie Augier**
Postdoctoral Fellow
Stanford University

**Edward Feigenbaum**
Kumagai Professor of Computer Science Emeritus
Co-Scientific Director Emeritus
Knowledge Systems Laboratory
Stanford University