

# Awards for Distinguished Scientific Contributions: 1979

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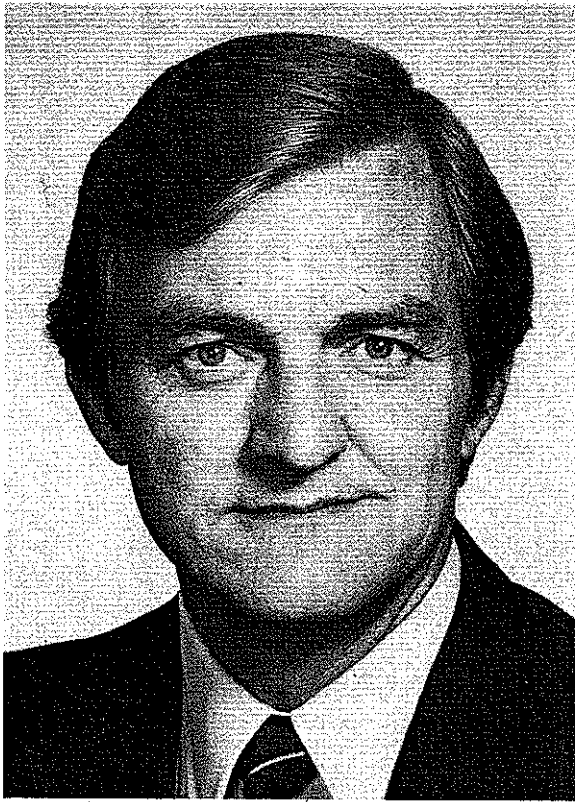
Thematic apperceptive measurement of motivation in 1950 and 1980.

With J. Kuhl. Motivational determinants of decision time: An application of the dynamics of action.

*Gordon H. Bower*

CITATION

"For his powerful analytic and conceptual insights into the acquisition, representation and use of knowledge. Ranging from studies on classical in-frahuman learning and conditioning to human imagery, memory, organization and language comprehension, he has repeatedly advanced our understanding by ingenious combinations of the methods of mathematics, computer science and artificial intelligence, linguistics and experimental psychology. His sound judgment and ability to foresee



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important issues and problems, and his exceptional talents as an editor and as a writer, but most importantly as a teacher, have significantly challenged and enriched the lives of his graduate students and colleagues.”

#### BIOGRAPHY

Gordon H. Bower was born December 30, 1932, and was raised in Scio, Ohio, a small village in the poverty belt of Eastern Ohio. Its population of 600 existed in sleepy isolation from the bustling world; Scio is a factory town, centered around a large pottery that employs successive generations of Scio families. Bower's parents were college educated and had been school teachers before his father was recalled to run the family's grocery and general store in Scio.

Despite the Depression, Gordon had a happy childhood, playing the role of Tom Sawyer. His older brother, Robert, was a constant companion and fellow plotter. Gordon spent long hours working in his family's grocery store or on neighboring farms, experiences that persuaded him to avoid a career in business, farming, or physical labor.

Upon seeing *The Lou Gehrig Story* at age 8, he decided to become a professional baseball player. He devoted countless hours of his next 13 years to playing baseball and also basketball. He was an accomplished athlete, was eventually selected to all-state teams in both sports, and was offered athletic scholarships to colleges. A side interest in music was sparked by his sister, who is a classical pianist. In high school he took up jazz trumpet with a passion, idolized Louis Armstrong, and played Dixieland in roadhouses.

After nearly flunking first grade, Gordon worked barely enough in elementary school to maintain adequate marks. His intellectual interests were eventually fanned by his family and several inspiring teachers. The greatest impact came from two high school teachers, Virginia and Jim Wiggins, who took an interest in his mind rather than his pitching arm. According to Bower, “Jim was vastly educated, thoughtful, concerned with the larger issues of national life. Virginia was vivacious, dazzlingly brilliant, dramatic, and cosmopolitan. I was greatly impressed by them, and in many fireside chats we planned my future, eventually deciding that I should become a psychiatrist. That's when I began studying Freud, Jung, and Fenichel in earnest. Bower graduated as the valedictorian in his high school class of 24 pupils.

He turned down offers to play professional baseball in order to accept a baseball scholarship from Western Reserve University (now Case Western Reserve) in Cleveland, starting in 1950. Although he did well pitching for four years in college and in semipro leagues, he eventually decided to pursue a professional career in psychology rather than in baseball.

According to Bower, “The transition to Cleveland and college was a mind-blowing experience for a culture-starved small-town boy. I had a voracious appetite for life and culture—for lectures, jazz bars, vaudeville, museums, socialist debates, the teeming masses, theater, the Indians, ballet, and the Browns. I drank in learning like a dried-out dromedary at whatever cultural trough Cleveland was offering.” At Western Reserve, Calvin Hall, a renowned Freudian, tutored Bower on the fine points of psychoanalytic theory. But Bower's intention of becoming a psychiatrist was abandoned after two years of disenchanting work with severe psychotics at the Cleveland State Mental Hospital.

Appropriately, another Western Reserve psychology professor, Charles Porter, appeared at that moment to captivate and inspire Bower's interest in experimental psychology and particularly in learning theory. Bower says of that time, "Chuck was a new PhD fresh out of Yale, was enthusiastic about Hullian behavior theory as 'hard science,' and he proselytized several of us into helping him formalize Hull's theory, using symbolic logic and mathematics. In retrospect, the project was ludicrous, but it served as an appropriate medium for the conversion experiences that budding scientists require from their teachers." Bower acquired interests in the philosophy of science, methodology, and mathematics, believing that theoretical psychology would soon become formalistic and quantitative. In support of those beliefs, upon graduation in 1954 he obtained a Woodrow Wilson Fellowship for a year of study in the philosophy of science and mathematics at the University of Minnesota. There, he studied with Paul Meehl, Herbert Feigl, and Michael Scriven, learned much higher mathematics, and conducted informal seminars on mathematical psychology.

In 1955 Bower entered graduate school at Yale University and studied the psychology of learning as a research assistant to Neal E. Miller. He did collaborative research with Miller for four years. Bower says, "Miller was my master teacher, my guru; he was the perfect model and father figure. He was dedicated, projected almost religious values about science, had a profusely inventive mind, was deeply involved in his own research, and encouraged me with his interest in my ideas." Bower's initial research with Miller was on the newly discovered reward effect from brain stimulation; in his first research paper, Bower reported discovery of dual reward-punishment locations in the rat's brain. Bower recalls, "I gave my first-ever paper at APA on that topic. As a graduate student, I was scared witless, because James Olds, the founder of that field, was speaking just after me on the program. I nearly fainted with relief when, after my talk, Olds popped up to report that 'he could confirm these important observations in detail.' From such rewards, professional dedication is made."

Midway through graduate school, in 1957, after a five-year, long-distance romance, Bower married Sharon Anthony, then a theater director and acting teacher at Louisiana State University. That summer, the Bowers honeymooned at Stanford Uni-

versity while Gordon attended a Social Science Research Council institute on mathematical psychology. There, Bower met and worked with psychologists who were to become key innovators in the mathematical psychology movement of the 1960s—Norman Anderson, Dick Atkinson, Bos Bush, William Estes, Eugene Galanter, Frank Restle, Saul Sternberg, and Patrick Suppes. Bower contributed two chapters to the conference volume, *Studies in Mathematical Learning Theory*. Back at Yale, he continued a lively correspondence with William Estes and worked increasingly with Frank Logan on his micromolar theory. Bower did his thesis with Logan, testing predictions of micromolar theory about how animals learned to adjust their response speed to minimize the total time elapsed before a correlated delayed reward could be obtained. The summer of 1959, after receiving his PhD, Bower worked with his friend Larry Stein, learning how to use Skinner boxes to study practically any question about learning or motivation.

In the fall of 1959, Bower began his first academic job, in the Psychology Department at Stanford University, where he has remained. As he notes, "Stanford has been very good for me, so there has been no reason to move elsewhere." At Stanford, he has been influenced and encouraged by many able colleagues and has benefited from a succession of brilliant graduate students and postdoctoral fellows. He notes, "My students are my collaborators, and without their stimulation and help I would have accomplished considerably less than I did." Some of his better known PhDs include (in alphabetical order) John Anderson, John Black, Art Flexser, Arnold Glass, Ted Grusec, Jim Hinrichs, Doug Hintzman, Keith Holyoak, Steve Kosslyn, Alan Lesgold, Frank Norman, Gary Olson, David Rimm, David Rosenbaum, David Stea, Bob Sternberg, John Theios, Perry Thorndyke, and Fred Wocher, and his postdoctoral fellows include Frank Bellezza, Tom Nelson, Judy Reitman, John Santa, Tom Trabasso, and Barbara Tversky.

Bower's research at Stanford began with studies of operant conditioning and animal learning, with an early interest in incentive motivation, reinforcement scheduling, and frustration theory. He gradually became more concerned with human learning, mathematical models, and computer-simulation models of learning. In the early 1960s he developed the "one-element model" of all-or-none

learning and successfully applied it to a range of examples of associative learning. This model was in certain respects the most elegant and powerful theoretical model of that era. Bower and Tom Trabasso extended the model to describe hypothesis-testing behavior of subjects learning concepts and summarized their research and theorizing in their book *Attention in Learning*. Starting in 1963, Bower was developing mathematical models of short-term memory considered as a capacity-limited storage medium for material being entered into or retrieved from long-term memory, and in early work he described both time-decay queuing models and fixed-space displacement models of how information in short-term memory might be processed and forgotten. In 1965 he began working out the consequences of the idea that the memory trace of an event was multifaceted and had many attributes or descriptors that could serve to differentiate and retrieve that memory.

In the late 1960s Bower was investigating how memorizing could be improved through mnemonics, imagery, and organizing strategies. That led to an increasing concern with how people learn by relating new material to things they already know; this led in turn to viewing propositions as new relational combinations of semantic concepts from long-term memory. These ideas on propositional learning and retrieval were developed with John Anderson and were set forth in their influential book *Human Associative Memory* (1973) which has become a "citation classic" in modern cognitive psychology. The book set forth a novel associative theory of how people learn and interrelate facts and answer questions about them. Bower's recent research has extended that work to deal with the way people learn coherent clusters of information, such as the event sequences described in simple narratives. He has been particularly concerned with how people's stereotypes and social-inference rules influence their interpretations and distort their memory of social interactions they witness or read about. Looking back over the road he has traveled, Bower sees his succession of research topics as characteristic of workers in cognitive psychology whose explanatory ambitions have been constantly expanding.

Along with his primary interest in memory, Bower has maintained two side interests: one concerns hypnosis, emotions, and subconscious influences on behavior; the other concerns behavior modification techniques applied to neurotic prob-

lems. His research on the first topic has found that hypnotically induced emotional moods serve as powerful attentional filters and as distinctive contexts for compartmentalizing learning, as well as potent triggers for stimulating recall of memories acquired while in that mood. Regarding the second topic, Bower teaches classes on applying behavior modification techniques and has lectured at behavior therapy conventions. His wife, Sharon, trained as a behavioral counselor as a second career, and based on her work in assertiveness training, the two of them wrote a popular self-help book, *Asserting Yourself*. "But," as Bower notes, "we consider that our most successful joint enterprise has been our children, Lori (20), Tony (16), and Julia (14), who have expanded and enriched our personal lives."

Bower has performed many professional duties. He has served as consulting editor of numerous professional journals, has edited an annual volume of research papers, *The Psychology of Learning and Motivation*, for 12 years, and has served on research grant review panels for the National Institute of Mental Health and the Social Science Research Council. He has also been awarded a number of professional honors. In 1965 he was elected to the prestigious Society of Experimental Psychologists, in 1973 to a fellowship at the Center for Advanced Study in the Behavioral Sciences, in 1974 to the National Academy of Sciences, in 1975 to the American Academy of Arts and Sciences, in 1975 to the Presidency of APA Division 3 (Experimental Psychology), and in 1972-1976 to the Governing Board of the Psychonomic Society (Chairman of the Board, 1975). In 1975 he was selected to deliver the Frederick Bartlett Honorary Lectures to the British Experimental Psychology Society, and in 1975 he was named as the first recipient of the Albert R. Lang Endowed Professorship Chair at Stanford University. He is currently Chairman of the Department of Psychology. Bower says he has two unfulfilled goals: "One is to write and publish creative fiction. The other is to strike out Joe DiMaggio with the bases loaded in a packed Yankee Stadium. My knuckleball still flutters, so I'm ready whenever Joe stops selling those coffee machines."

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### John Garcia

#### CITATION

"For his highly original, pioneering research in conditioning and learning. From his early radia-