

Lee J. Cronbach (1916–2001)

Lee Joseph Cronbach made major contributions in the fields of educational psychology, psychological testing, and program evaluation throughout a career that spanned more than five decades. Harbingers of his career in testing were evident at an early age in Fresno, California, where he was born on April 22, 1916, to a homemaker and salesman. According to his sister, Lee was overheard at age 4 years in a grocery market calculating the unit price of potatoes, drawing the conclusion that the market his mother shopped at charged far more than did the market of his babysitter. The feat was reported to Blanche Cummings, a school psychologist and disciple of Lewis Terman, who gave Lee an IQ test in 1921 and enrolled him in Terman's longitudinal study of gifted children. Pushed through school by his mother, Lee graduated from Fresno High School at 14 years of age and Fresno State Teachers College (majoring in chemistry and mathematics) at 18.

Lee's awareness of Terman and IQ testing attracted him to psychology, and, as a college junior, he came across a monograph by L. L. Thurstone and E. J. Chave, *The Measurement of Social Attitudes* (1931). The connection between psychology and education came in a course at Fresno State on the history of American education. Asked to review and present a curriculum-improvement study to his fellow students, he dissected the study with the scorn of a chemistry student. After the presentation, the professor asked if he had thought of a career in education research; Lee asked if there were such a thing. The suggestion came at a time when he had decided against pursuing chemistry, and the path was set toward educational psychology.

Lee taught high school from 1936 to 1938 while earning a master's degree from the University of California, Berkeley (1938). He then completed a doctorate in education at the University of Chicago (1940). During this period, Lee married, and he and his wife, Helen, had five children between 1941 and 1956.

Beginning in 1940, Lee held a number of academic positions before finally settling at Stanford University in 1964, where he became the Vida Jacks Professor of Education. From 1940 to 1946, he was an assistant professor at Washington State University. Toward the end of World War II, he served as a military psychologist at the U.S. Navy's sonar school in San Diego, California. Lee was an assistant professor at the University of Chicago from 1946 to 1948, then professor at the University of Illinois from 1948 to 1964. During this period, he also served as the Office of Naval Research's science liaison in London (1955–1956), as a member of Princeton's Institute for Advanced Study (1960–1961), and as a fellow at the Center for Advanced Study in the Behavioral Sciences in Palo Alto, California (1963–1964).

Lee's research can be clustered into three areas: measurement theory, program evaluation, and instruction. His most widely cited measurement article was "Coefficient Alpha and

the Internal Structure of Tests" (1951). The coefficient, known as *Cronbach's alpha*, proved useful for (at least) three reasons. First, it provided a measure of reliability from a single test administration so that repeated occasions or parallel forms of a test were not needed to estimate a test's consistency. Second, the formula was general; it could be applied to dichotomously scored multiple-choice items or polytomous attitude scales. And third, it was very easily calculated from statistics well-known by students with only a first course in statistics.

A book Lee wrote with Goldine Gleser, *The Dependability of Behavioral Measurements* (1972), addressed some of the issues he believed were crucial in measurement theory. He and Gleser revealed the underlying assumptions of the various approaches to reliability and how they related to each other. They showed how one could design an experimental procedure and analyze data obtained thereby using a random model analysis of variance to estimate the contributions to the error variance from various sources for a specified true score. This information could then be used to develop an improved testing procedure for decision making. What started out to be a handbook on measurement with Gleser became a major reconceptualization of reliability theory in the form of generalizability theory, or G theory. G theory provided a melding of the psychological with the mathematical and produced a comprehensive framework and statistical model for identifying sources of measurement error.

Lee's work on validity theory—the extent to which an interpretation of a test is conceptually and empirically warranted—was no less significant. With Paul Meehl, he placed this idea at the center of psychological, educational, and social testing. Validation, a never-ending process, examined a proposed test interpretation—a construct—by testing it logically and empirically against counterinterpretations. Moreover, what was validated, according to Lee, was not the test itself, for a test could be used for many purposes (e.g., prediction, diagnosis, or placement). Rather, what was validated was a proposed interpretation. Moreover, although reliability was an important characteristic of a test, Lee believed that ultimately reliability served its master, validity, where sometimes trade-offs were necessary between broadly gauging a construct and narrowly constructing a homogeneous set of items to improve reliability. The Cronbach and Meehl (1955) article "Construct Validity in Psychological Tests" laid the groundwork for further work on validity.

Lee was skeptical of the sterile view of evaluation as detached, objective, scientific activities with test content matched to curricula, appropriate experimental designs, and proper statistical tests. In the 1970s, he directed the Stanford Evaluation Consortium, a research, service, and training organization sponsored by the Stanford University School of Education that included faculty from the education, communications, and psychology departments. The consortium worked

with the state of California to examine its relationships with local school districts, among other projects. The evaluation research influenced program evaluations across many fields, from health programs to juvenile delinquency programs; his work recognized the merits and limitations of randomized field trials, the importance of local contexts to performance, and the social and political aspects of program evaluation. Two influential books resulted from this work: *Towards Reform of Program Evaluation* (1980), which was written by a team of consortium faculty led by Lee, and a parallel volume, *Designing Educational Evaluations* (1982), in which Lee extended his own ideas.

Lee's instructional research with Dick Snow focused on matching learning environments with students' aptitudes (Cronbach & Snow, *Aptitudes and Instructional Methods*, 1977). This research can be traced to early work with Goldine Gleser, first published as *Psychological Tests and Personnel Decisions* (1957), and his presidential address to the American Psychological Association (APA; 1957). In the work on personnel placement, he and Goldine concluded that optimal decisions about person-job matches must acknowledge the interaction of individual differences with job demands. Individuals with one profile of characteristics would be expected to perform well in one type of job, whereas individuals with a second profile would be expected to perform well in another job with different task demands.

The work on personnel theory provided a fresh look at the schism in scientific psychology, one that formed the basis of Lee's presidential address to the APA, "The Two Disciplines of Scientific Psychology" (Cronbach, 1957). He called for a rapprochement between the two major investigative approaches of psychologists, the correlational work that was most characteristic of individual-differences research and the experimental work that focused on differences between situations or treatments. Lee pointed out that these individual differences might be highly predictive of performance in one type of instructional condition (situation) and much less so in another. If individual-difference and experimental psychology came together, he reasoned, it just might be possible to find a link between these individual differences and performance in different learning environments.

Lee's work on personnel decisions and his presidential address sent him and Dick Snow on a 10-year trek in search of aptitude-treatment interactions (ATIs) or statistical interactions (different regressions of learning outcome on aptitude under different instructional treatments). The strongest ATIs involved general ability, where students with above-average intellectual development profited from instruction that provided them with considerable responsibility for organizing and interpreting, whereas those below average profited from a highly structured learning environment. In 1975, Lee revisited his presidential address in the article "Beyond the Two Disciplines of Scientific Psychology," where he revealed that he had come to recognize that ATIs were highly complex—as if a simple ATI were reflected in a hall of mirrors—sometimes rapidly changing, and context bound, far more than he had imagined earlier on. He concluded that "our troubles do not arise because human events are in principle unlawful; man and his creations are part of the natural world. The trouble, as I see

it, is that we cannot store up generalizations and constructs for ultimate assembly into a network" (Cronbach, 1975, p. 123, italics in original).

In the end, Lee found himself caught between science and practice, whether in the classroom or in policy. Science took him just so far, and he demanded science as far as it would take him. But he also recognized the contributions that other ways of knowing had to make in understanding teaching and learning, as well as human action more generally:

The special task of the social scientist in each generation is to pin down the contemporary facts. Beyond that, he shares with the humanistic scholar and the artist in the effort to gain insight into contemporary relationships, and to align the culture's view of man with present realities. To know man as he is is no mean aspiration. (Cronbach, 1975, p. 126)

It was not for acclaim that Lee took on most offices but rather out of a deep sense of responsibility, as well as the belief that he had something to add. His contributions to APA were many. He chaired the first committee on test standards from 1950 to 1953. These standards were endorsed by the American Educational Research Association and the National Council on Measurement in Education and resulted in a collaboration that sponsored all subsequent revisions of test standards. From 1951 to 1953, Lee served as chair of the Publications Board. He was on the Board of Directors from 1952 to 1958 and was president of the association in 1956.

Lee's professional honors were numerous. He was president of the American Educational Research Association and the Psychometric Society. Lee was elected to membership in the National Academy of Sciences, the National Academy of Education, the American Philosophical Society, and the American Academy of Arts and Sciences. He received many honorary degrees, including ones from Yeshiva University; the University of Gothenburg, Sweden; and the University of Chicago. And he was honored by, for example, the Educational Testing Service for contributions to educational measurement, the APA for distinguished scientific contributions, the American Psychological Society as a William James Fellow, the American Educational Research Association for contributions to research in education, and the Evaluation Research Society for contributions to evaluation methodology.

Lee retired in 1980 but remained intellectually active right up until the time of his death. For example, he was writing an article on the 50th anniversary of the coefficient alpha paper, in which he reflected on the uses, misuses, and misunderstandings of the reliability coefficient—an article that, unfortunately, will never be finished.

Lee J. Cronbach died of congestive heart failure in his Palo Alto home on October 1, 2001. Lee's wife, Helen, and three of his five children—Janet, Bob, and Joyce—survive him, as does his sister, also named Helen.

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