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A TRIBUTE TO L. L. THURSTONE*

Louis Leon Thurstone's contributions to the development of psychology as a quantitative rational science are among the major scientific achievements of the present century. Many of us here still remember the thrill of learning about his early developments in psychophysical scaling methods during the 1920's. The psychophysical measurement methods developed in the latter part of the nineteenth century were used to measure the functional relation between the physical intensity of a stimulus, such as a light or a sound, and the psychological intensity of the sensation—the brightness of the light, the loudness of the sound. Thurstone was among the first to point out that these methods could be modified to construct a scale for measuring psychological qualities that had no measurable physical correlate. He developed the law of comparative judgment and demonstrated that in conjunction with the method of paired comparisons it could be used to measure purely subjective attributes, such as the aesthetic merit of paintings or the strength of an attitude.

In all his work, he stressed the fact that as long as we have merely a rule of procedure for analyzing data, we have no science. He insisted that every theory must be so precisely stated that one of the possible conclusions would be that the data collected were in disagreement with the theory.

In particular for the law of comparative judgment, he developed the criterion of internal consistency for psychophysical scales. For linear scales this means that the distance from object i to object j (as determined from one set of judgments "i greater than j") plus the distance from j to k (as determined from *another* set of judgments "j greater than k") should give a sum in reasonable agreement with the distance from i to k (as independently given by judgments "i greater than k"). Such a statement must be true for all possible sets of three, so that if one has as many as ten or twenty objects in the scaling experiment the number of checks becomes very large.

This, of course, is merely one illustration of the application of the criterion of internal consistency. One of Thurstone's important contributions was his insistence that each experimental and analytical procedure must contain such internal checks.

In addition to devising the theoretical framework for such psychological measurement, we remember Professor Thurstone for numerous applications of these methods to practical problems that were carried out by him and

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his students. One of the early applications was to measurement of the effects of various movies on attitudes of children; other studies measured the effect of various propaganda devices in changing attitudes, or measured the changes in national opinions as reflected in newspapers over a period of years. This area of psychological scaling opened by Thurstone over thirty years ago is still developing both in its theoretical aspects and its uses. Applications of these methods to measurement of intensity of attitudes and to the precise comparison of value systems have been or are being made. The psychophysical scaling methods are important and powerful scientific tools. During the coming decades, prolific and fruitful use of these methods in the development of such fields as linguistics, sociology, cultural anthropology, political science and economics will probably be seen.

Thurstone's achievements in psychology cannot be properly appreciated unless seen against the backdrop of psychological developments of the last half-century. Today it is taken for granted that aptitude and achievement tests can predict various types of academic and job performance with a useful degree of accuracy. Throughout this country, some hundreds of thousands of persons take some millions of tests annually. How often do we stop to remember that prior to 1900 there were literally no aptitude tests available for prediction of academic or job performance? Prediction of educability of children was one of the critical unsolved problems of democratic society. Commissions were appointed in various countries to study the problem. The Binet test was developed in France and was useful in predicting school achievement but was an unwieldy and cumbersome instrument. During the First World War, the Army Alpha and Army Beta tests were developed and used in the first large-scale mass testing program in the history of the world. L. L. Thurstone, as a young psychologist, was active in this testing program.

Thurstone saw the inadequacies in the then widely accepted notions of "general" intelligence. He realized that new and more powerful methods must be developed to analyze the masses of data necessary for a thorough study of the different aspects of cognitive ability, or as we now say, the different factors, or primary mental abilities. He made a very simple change in the then current theory. Instead of assuming that each person was to be characterized by *one* number G (his general intelligence), Thurstone assumed that it might take a great many numbers to describe the person—one number for each of the primary mental abilities.

He outlined his development of this problem to mathematicians whom he knew and thus learned that a field of mathematics called "matrix theory" existed. At over forty years of age, he decided to master a new field of mathematics, because it might help him in analyzing the nature of human abilities. He tutored regularly, worked problems, studied different texts—the result was the development of the factor methods that have been applied exten-

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sively by Thurstone, his students, and others, not only in analyzing the domain of mental ability but also in studying blocs in a legislature, schools of thought among teachers regarding curriculum content, classifying allergies, analyzing anthropometric measurements, organizing psychotic symptoms, and so on. The factor methods are extremely powerful, and opportunities for their application in the study of human behavior seem to be limitless. These developments and applications stem in large measure from Thurstone's gift for seeing an important problem, defining it clearly, and then sparing no effort in his persistent search for a solution.

This development of testing over the past fifty years should be seen not only as a scientific achievement but also as a humanitarian accomplishment. Fifty years ago any young person who wished to enter on a given course of study had no alternative but to try, if he were permitted to, for months or even for years; eventually by trial and error he would succeed or be discouraged by repeated failures and cease trying. Now the inept student need not face the discouragement of tackling too high a goal, and the gifted student need no longer be dependent on attracting the attention of some influential person in order to obtain opportunity for advanced training. The unknown person of talent can be identified and encouraged to proceed with advanced training in some appropriate area. Such identification and utilization of various degrees of talent can be of enormous benefit to society and also a boon to the individual who derives added happiness from engaging in an occupation which matches his abilities.

Fifty years ago no aptitude tests were available for such prediction of various aspects of human performance. That we can now see our way reasonably clearly to this goal is in no small measure due to the theoretical and the practical contributions of Professor Thurstone to the field of psychological measurement. His outstanding contributions to the fields of factor analysis and psychophysical scaling by no means exhaust the range of his achievements toward developing psychology as a quantitative rational science. He worked on developing personality measures, and on a quantitative rational learning theory. His Ph.D. thesis of 1916 constitutes one of the early attempts to develop equations of the learning curve.

On his retirement from the University of Chicago, his work continued to be as productive and ingenious as ever. At the University of North Carolina he was leading projects concerned with developing new psychophysical scaling methods and developing a set of novel ideas for obtaining objective measurements of personality characteristics. It is to be hoped that these ideas will not be lost, but that some research worker or group of research workers will develop and validate personality tests along the lines indicated by Thurstone.

During more than a quarter century at the University of Chicago, in addition to making outstanding contributions in many scientific areas Pro-

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fessor Thurstone trained large numbers of students who came not only from the United States but also from various foreign countries to study with him—to learn the techniques he was developing, the general principles of scientific investigation, and the principles of the quantitative rational approach which he espoused.

Louis Leon Thurstone has a unique position among psychologists of this century as an original research worker and as an inspiring teacher. Many of us who were privileged to know him closely found him a helpful and understanding friend.

We, the members of the Psychometric Society, feel it our particular privilege to pay homage to his memory. He conceived of this Society and its journal, *Psychometrika*. To his efforts more than to those of any other individual, both the Society and *Psychometrika* owe their present status and even their very existence.

As psychologists, we feel that our past achievements and our future aspirations in the theory and practice of psychometrics have been greatly influenced by Thurstone's developments, by his insights, and by his standards. We feel ourselves pledged to further his ideal: the development of psychology as a quantitative rational science. The greatest honor we can accord him as an outstanding scientist lies in our resolve to continue the development of psychology in the rigorous tradition he did so much to establish.

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