BOOK REVIEWS

Warren S. Torgerson, *Theory and methods of scaling.* NEW YORK: JOHN WILEY AND SONS, INC., 1958. Pp. 460.

IN 1950 the Social Science Research Council appointed a Committee on Scaling Theory and Methods to consider the use of scaling procedures in social science research. The Committee felt that the potential usefulness and wide applicability of psychological scaling methods was enough to justify preparation of a reference source on these methods. This book was therefore prepared under their auspices, with the hope that it would encourage the use of these techniques by social scientists and also lead to further development of the methods themselves.

The book is divided into three sections. The first three chapters discuss the nature of measurement and present a classification of scaling methods in terms of whether the information obtained is a *judgment* regarding the location of a stimulus on an attribute continuum, or is a *response* indicating a relation between the location of a person and the location of a stimulus on an attribute continuum. Chapters 4 through 11 are concerned with the judgment methods, and Chapters 12 through 14 with the response methods. In addition there are: a summary chapter, an Appendix containing two cumulative normal curve tables, and a 600-item Bibliography.

Perhaps the major contribution of Torgerson's book is the convenience of having, under one cover, discussions of many topics drawn from widely scattered sources, which are often difficult to obtain. But the gain is not only in the packaging and availability. For each procedure that is discussed in any detail there are four sections: the underlying theory, the experimental procedures for obtaining the observations, analytical procedures for estimating the parameters, and ways of evaluating goodness of fit. Some of the material presented is original and presented here for the first time; most of it is not. However, even though most of the material is available in other forms, there is a surprising amount to be gained from an abstract analysis of each of the methods, independent of any specific content, from one point of view, and in one consistent notation. For example, the author's development of the general normal ogive model for response data indicates direct analogies between that model and Thurstone's mental-age model, developed earlier for the same kind of data, and also with the model for the law of categorical judgment developed for judgment data.

Torgerson is especially thorough in his discussions of goodness of fit; in fact, the scope of the book is explicitly restricted to "fundamental" scaling procedures—that is, scaling methods to which the notion of goodness of fit is applicable. It is appropriate that more adequate goodness-of-fit tests should be developed for evaluating scaling techniques, since a scaling procedure is, in the most general sense, a form of descriptive statistics—a procedure for representing some large number of observables by some small number of parameters. If the procedures used to determine the parameters are appropriate (if the theory about the domain of interest is correct), then the small number of parameters will contain nearly the same information as the original data, but in a more compact form.

For example, suppose m people judge n stimuli r times, giving $m \times n \times r$ observations in the raw data. For dichotomous judgments, like "pass" and "fail," these are often summarized in terms of the proportion of times person i "passes" stimulus j, giving $m \times n$ observations of these proportions to be analyzed. One scaling procedure used with data of this type assumes that each person and each stimulus is represented by a position on the underlying attribute, with each position subject to random (normal) error. The end result of the analysis is m parameters corresponding to individuals' abilities, and n parameters

corresponding to the difficulty of the stimuli. Thus, we have achieved the economy of describing $m \times n$ observations of proportions with $m + n$ parameters. Even for moderate sized numbers of people and stimuli this represents a considerable savings—for $m = 100$, $n = 100$, we describe 10,000 proportions with 200 parameters. By working the entire scaling procedure in reverse we can compute the ideal proportions that are implied by the scale parameters, and the comparison of these "derived" proportions with the observed proportions is a test of goodness of fit. Statistical procedures enable us to express degrees of goodness of fit and to evaluate the probability of obtaining various degrees of goodness of fit by chance, assuming our theory is correct.

This book may be evaluated from two very different points of view. One is the point of view of the specialist in measurement psychology. Certain sections of the book were apparently written with this group in mind—for example, the long discussion of whether scaling is to be regarded as measurement of an object, or as measurement of an attribute or property of an object. For these people the principle function served by the book is to bring together, under one cover, a large amount of material with which most measurement psychologists must already be familiar. However, the system of scaling procedures developed is by no means complete. Only the judgment *vs.* response classification is regarded as basic; all other classificatory principles are introduced as needed under particular headings. The few original developments might, in some instances, have been presented to the field more appropriately through other channels. To this reviewer it seems unnecessary to spend 10 pages on a detailed example of color scaling from Torgerson's doctoral thesis, in view of the space allotted to other topics.

This book may be evaluated in a very different light in terms of the goal originally sought by the Social Science Research Council. The expressed hope was that this book would help to bring about a greater use of psychological scaling methods in various areas of social science. It does not appear that this book brings us much closer to this goal. This is not to say that recent and esoteric developments in psychological scaling are not of potential interest to workers in other areas of social or behavioral science. On the contrary, it seems very likely that the multidimensional and qualitative scaling techniques, developed almost entirely in the past 10 or 15 years, are the most suitable techniques for many applied areas of research, due to the complexities of the problems and the nature of the data available. This book is largely concerned with certain frontiers of psychological scaling. Perhaps the problem lies in the fact that social science disciplines, unlike neighboring countries, don't meet at their frontiers. Furthermore, Torgerson provides no help in the difficult multilingual feat of translating the methods from the variables of psychology—from color and intelligence and loudness and lifted weights—to the variables of interest to social scientists. Even a cursory examination would indicate that Torgerson's book, in contrast with a book like Guilford's *Psychometric methods* (McGraw-Hill, 2nd ed., 1954), is not a handbook of scaling techniques. Guilford's book (which has drawbacks of its own), for example, supplies 13 statistical tables and many graphs necessary for the application and interpretation of several of the particular techniques; Torgerson's book offers only two tables, both of them being percentage points of the cumulative normal distribution function. Torgerson's book could be recommended in preference to Guilford's only for the material on multidimensional methods or for the derivations of particular techniques.

One other limitation adds to the difficulty of using the book—the 600-item Bibliography is not indexed, nor is it itself used as the subject index; that is, there is no notation of the page on which reference to a particular item appears. For this reviewer, such an omission considerably reduces the value potentially inherent in such an extensive bibliography.

It would seem that two books still need to be written: one a complete systematization for the expert, the other a handbook for the social scientist. In the meantime,

Torgerson's book will serve some of the needs of both groups.

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Brown, Clinton C. and Saucer, Rayford T., *Electronic instrumentation for the behavioral sciences.* SPRINGFIELD, ILL.: CHARLES C THOMAS, 1958.

THIS book is intended to bring knowledge about electricity and electronics within the understanding of those who must use these tools in their research. It begins with a discussion of fundamental components such as resistors and capacitors; discusses vacuum tubes, power supplies, amplifiers, oscillators, timing circuits, switching circuits, stimulus generators, test instruments, and, as an after thought, transistors. The book is evidently intended to be a set of directions and not a theoretical treatment and so an account of its theoretical shortcomings is probably not relevant. Nonetheless, the continued carelessness of presentation, the misuse of standard terms, the misinformation on technical matters render it worse than useless. For an uninitiate to be exposed to this book might well set back his understanding of the subject rather than enhance it.

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Suppose that we were asked to arrange the following in two categories—*disiance, mass, electric force, entropy, beauty, melody.* I think there are the strongest grounds for placing entropy alongside beauty and melody and not with the first three. Entropy is only found when the parts are viewed in association, and it is by viewing or hearing the parts in association that beauty and melody are discerned. All three are features of arrangement. It is a pregnant thought that one of these three associates should be able to figure as a commonplace quantity of science. The reason why this stranger can pass itself off among the aborigines of the physical world is, that it is able to speak their language, viz. the language of arithmetic. It has a measure-number associated with it and so is made quite at home in physics. Beauty and melody have not the arithmetical pass-word and so are barred out. This teaches us that what exact science looks out for is not entities of some particular category, but entities with a metrical aspect. When science admits them it really admits only their metrical aspects and occupies itself solely with that.

—A. S. EDDINGTON in *The Nature of the Physical World*