

Scale Development: Theory and Applications, by Robert F. DeVellis. Newbury Park, CA: Sage, 1991. 121 pp. \$28.50 cloth. ISBN: 0-8039-3775-X. \$13.95 paper. ISBN: 0-8039-3776-8.

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This book has the practical aim of teaching social science researchers how to develop their own scales. Robert DeVellis defines a scale as measuring a construct underlying "effect indicators," while an index, in contrast, consists of "cause indicators" (p. 9). The difference is whether observed variables are treated as dependent variables (in which case they are effect indicators) or as independent variables (in which case they are cause indicators) in a set of regression equations (Bollen, *Structural Equations with Latent Variables*, 1989, pp. 64-65). Thus, the book is mostly limited to measurement issues framed within factor analytical models.

This limitation is unfortunate, particularly because many important scaling techniques, such as those of Thurstone and Guttman (Maranell, *Scaling*, 1974) are only briefly mentioned. The author postpones the classical question of whether a scale is ordinal or interval or ratio to the end, where he simply quotes Nunnally's statement that "it is permissible to treat most of the measurement methods in psychology and other behavioral sciences as leading to interval scales" (DeVellis, p. 112).

The author's definition of a scale has the virtues of allowing for measurement errors and of linking measurement with theoretical concerns. However, if his definition is followed strictly, a scale cannot yield numerical measures for individual observations. Let us take the author's example (p. 27) with three indicators. The measurement model should be

$$\begin{aligned} X_1 &= Y + \epsilon_1 \\ X_2 &= Y + \epsilon_2 \\ X_3 &= Y + \epsilon_3 \end{aligned} \quad (1)$$

where X_1 , X_2 , and X_3 are three observed indicators for the underlying construct Y , which is to be measured by a scale. Thus defined, Y exists only in the model and cannot be ascertained for different observations. The author's solution is to sum the scores of the three indicators:

$$Y = X_1 + X_2 + X_3. \quad (2)$$

Clearly, Y is a composite of three indicators and thus an index, rather than a scale by the author's definition, because it consists of "cause indicators." To escape from this contradiction, the author avoids equation 2 by a verbal statement that "the items, X_1 , X_2 , and X_3 , when added together make up a scale we will call Y " (p. 27). A careful examination of the mathematical formulas and the cited literature (Nunnally, *Psychometric Theory*, 1978) following this statement leaves one with no doubt that equation 2 is in fact intended.

I also found the chapter on factor analysis confusing, if not misleading. There is no discussion on such essential topics as identification and assessment of goodness-of-fit. The illustration of a two-factor model with three indicators (p. 95) seems to be severely underidentified without equality constraints, which are not well explicated.

The book is divided into two parts, as the subtitle "Theory and Applications" implies. I found the applications part superior to the theory part. It is clear from the applications part that DeVellis is an experienced researcher and has meaningful insights to share with us on scale development. He appropriately emphasizes the importance of measurement for subsequent data analysis and the role of theory in developing scales. His numerous suggestions should be useful for researchers intending to develop their own scales. Mostly reflecting his own research experience, his advice covers a wide range of topics, from the ratio of potential to actual items to the acceptable level of Cronbach's alpha. This aspect of the book, I believe, is what will make it most useful to sociologists.