why structural equation modeling

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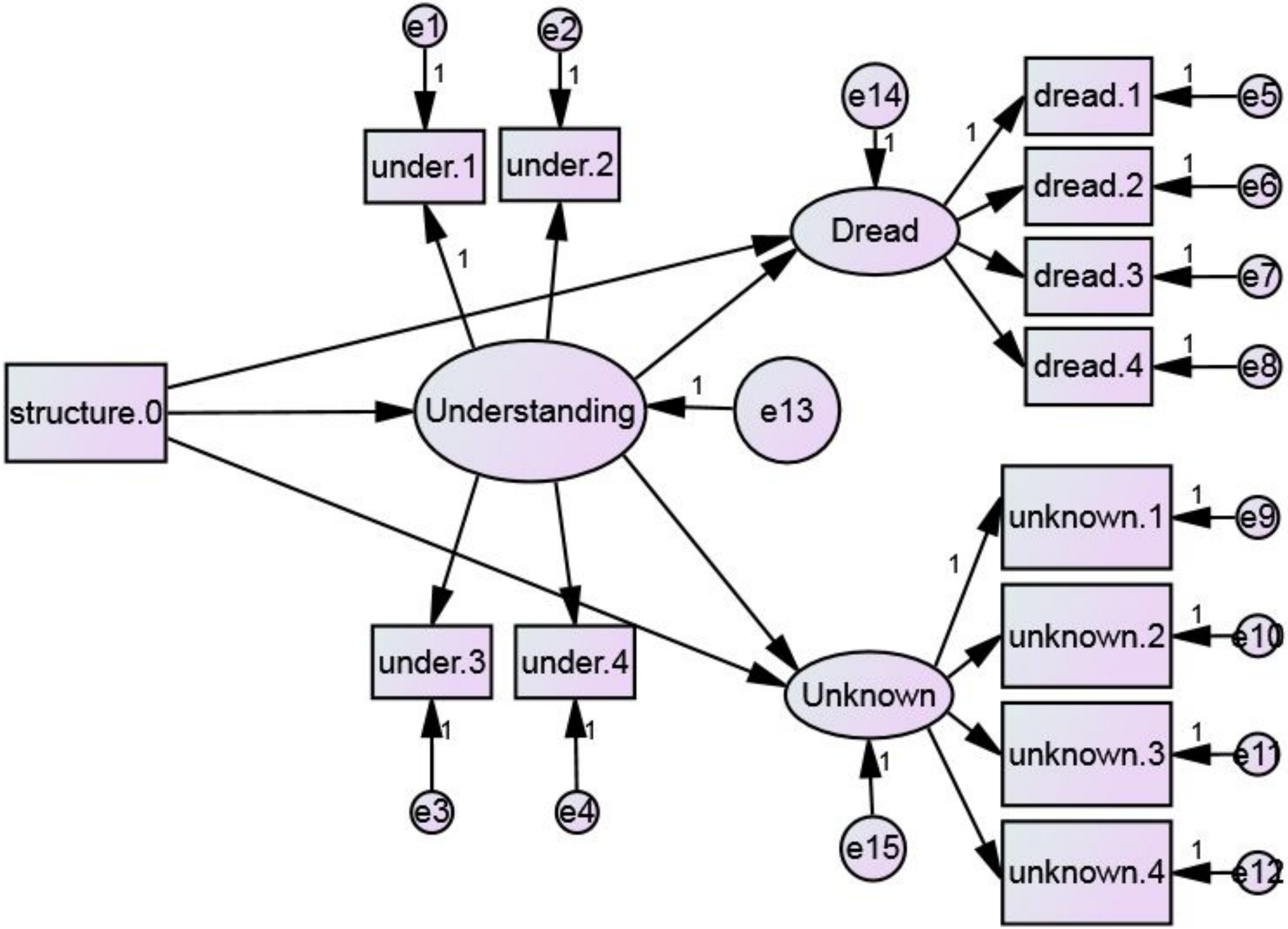
Structural equation modeling (SEM) is a form of causal modeling that includes a diverse set of mathematical models, computer algorithms, and statistical methods that fit networks of constructs to data. SEM includes confirmatory factor analysis, confirmatory composite analysis, path analysis, partial least squares path modeling, and latent growth modeling.[2] The concept should not be confused with the related concept of structural models in econometrics, nor with structural models in economics. Structural equation models are often used to assess unobservable 'latent' constructs. They often invoke a measurement model that defines latent variables using one or more observed variables, and a structural model that imputes relationships between latent variables.[1][3] The links between constructs of a structural equation model may be estimated with independent regression equations or through more involved approaches such as those employed in LISREL.



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Why is structural equation modeling popular?

There are at least four major reasons for the popularity of SEM. The first reason suggests that researchers are becoming more aware of the need to use multiple observed Y102005.indb 6 3/22/10 3:24:45 PM Introduction 7 variables to better understand their area of scientific inquiry. Basic statistical methods only utilize a limited number of variables, which are not capable of dealing with the sophisticated theories being developed. The use of a small number of variables to understand complex phenomena is limiting. For instance, the use of simple bivariate correlations is not sufficient for examining a sophisticated theoretical model. In contrast, structural equation modeling permits complex phenomena to be statistically modeled and tested. SEM techniques are therefore becoming the preferred method for confirming (or disconfirming) theoretical models in a quantitative fashion.

A second reason involves the greater recognition given to the validity and reliability of observed scores from measurement instruments. Specifically, measurement error has become a major issue in many disciplines, but measurement error and statistical analysis of data have been treated separately. Structural equation modeling techniques explicitly take measurement error into account when statistically analyzing data. As noted in subsequent chapters, SEM analysis includes latent and observed variables as well as measurement error terms in certain SEM models.

A third reason pertains to how structural equation modeling has matured over the past 30 years, especially the ability to analyze more advanced theoretical SEM models. For example, group differences in theoretical models can be assessed through multiple-group SEM models. In addition, analyzing educational data collected at more than one level—for example, school districts, schools, and teachers with student data—is now possible using multilevel SEM modeling. As a final example, interaction terms can now be included in an SEM model so that main effects and interaction effects can be tested. These advanced SEM models and techniques have provided many researchers with an increased capability to analyze sophisticated theoretical models of complex phenomena, thus requiring less reliance on basic statistical methods.

Finally, SEM software programs have become increasingly userfriendly. For example, until 1993 LISREL users had to input the program syntax for their models using Greek and matrix notation. At that time, many researchers sought help because of the complex programming requirement and knowledge of the SEM syntax that was required. Today, most SEM software programs are Windows-based and use pull-down menus or drawing programs to generate the program syntax internally. Therefore, the SEM software programs are now easier to use and contain features similar to other Windows-based software packages. However, such ease of use necessitates statistical training in SEM modeling and software via courses, workshops, or textbooks to avoid mistakes and errors in analyzing sophisticated theoretical models.