Idiogrid: Software for the management and analysis of repertory grids

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Idiogrid is a computer program for analyzing repertory grids in both research and applied settings. With this software, which runs under the Windows operating system, grids of virtually any size can be managed and analyzed. Grids can be transformed, manipulated, merged, and subjected to a host of statistical analyses. Descriptive statistics, principal components analysis, grid comparison techniques, and coordinate grid analysis are all available in the software. A number of indices commonly applied to repertory grids are also computed by Idiogrid, such as measures of ordination, cognitive complexity, and intensity. Text output as well as high-resolution graphics are produced by the software, and grids themselves can be exported to other statistical programs for further analysis.

George Kelly's (1955) personal construct theory is based on two general premises. The first is that humanity's progress through the centuries can be described as a continual search for greater prediction and control characterized by a process of building, evaluating, and revising mental representations of the world. The second is that individuals freely create and sustain their own unique interpretations of the world. People can thus be viewed metaphorically as personal scientists with their own theories, hypotheses, and unique methods of testing the accuracy of their predictions. From these two premises, Kelly developed a fundamental postulate and 11 corollaries, creating not only an integrated theory of personality but also a comprehensive framework for conducting psychotherapy. He presented his theory and clinical methods in his major work, *The Psychology of Personal Constructs*, as well as in a number of papers (Maher, 1969). His theory has since spawned its own journal, the *International Journal of Personal Construct Psychology* (now the *Journal of Constructivist Psychology*), as well as a book series, *Advances in Personal Construct Psychology*, and countless research articles and book chapters. A searchable database of published work in personal construct psychology is available on the World-Wide Web (<http://www.psyc.uow.edu.au/research/pcp/citedb/index.html>), and Fay Fransella (1995) recently wrote a biography of George Kelly's life.

One of Kelly's significant methodological contributions was the introduction of the grid form of the Role

Construct Repertory Test, a technique he devised for exploring the unique perspectives, or personal construct systems, of individuals. Since its inception, Kelly's original grid method (1955, chap. 6) has undergone numerous modifications, resulting in a wide variety of measurement procedures referred to generically as "repertory grids." In the typical repertory grid, an individual is asked to rate or rank a number of elements—usually people or tangible things—along a series of bipolar construct (descriptive adjective) scales. The elements and constructs can be directly elicited from the individual or provided by the examiner, and any number of elements or constructs can be included in a particular grid. A two-dimensional matrix of numerical values results from the rating or ranking processes, which can subsequently be subjected to a host of statistical analyses and graphing procedures. For example, principal components or cluster analyses can be performed on the data, and two-dimensional plots of the components or dendograms of the clustered elements can be created. Bivariate statistics such as Pearson's product-moment correlations, Euclidean distances, or Jaccard proximities, as well as a host of univariate statistics, can also be computed for the constructs or elements in the grid. Finally, a number of numerical indices particular to repertory grids have been developed that purportedly measure different features (e.g., complexity and integration) of individuals' construct systems. Beail (1985; see chap. 1), Fransella and Bannister (1977), and Easterby-Smith (1980) offer readable introductions to repertory grid methods.

Although SAS, SPSS, and other mainstream programs can perform many of the analyses commonly applied to repertory grids, these programs are not specifically designed to manage large numbers of grids simultaneously, nor can they conduct analyses that are particular to repertory grid data. Consequently, a wide variety of computer programs have been developed over the years by researchers

The author thanks three reviewers and the editor for their helpful comments on an earlier version of this manuscript. It should also be noted that the author maintains a financial interest in the software described herein. Correspondence concerning this article should be sent to J. W. Grice, Department of Psychology, 215 North Murray Hall, Oklahoma State University, Stillwater, OK 74078-3064 (e-mail: jgrice@okstate.edu).

and practitioners who use repertory grids. Unfortunately, many of these programs have become outdated, are limited with respect to their features, or are not available for the Windows operating system for the personal computer. Omnigrid-PC (Sewell, Mitterer, Adams-Webber, & Cromwell, 1991), for example, works with two different types of grid data, but offers only a handful of analyses. Circumgrids (Chambers & Grice, 1986) manages a variety of different repertory grids and offers a host of analyses, but the number of elements or constructs is limited to 16, only a single grid can be analyzed, and grids cannot be saved to a diskette or the computer's hard drive. GridStat (Bell, 1999) analyzes several types of repertory grids and provides a host of analyses, but it is written for the antiquated DOS operating system. Compu-Grid (Baldwin, Greene, Plank, & Branch, 1996), Enquire Within (Stewart & Mayes, 2000), GridCor (Pacheco, Botella, Feixas, & Cornejo, 1997), and GridLab (Walter, 1999), by comparison, are all written for the Windows operating system. None of these programs, however, offers the combined features that most researchers or practitioners are looking for in grid software, such as the ability to (1) manage different types of grid data, (2) manipulate large numbers of grids of indeterminate size, (3) compare and merge grids, or (4) conduct a wide variety of univariate and multivariate statistical analyses. For example, Compu-Grid offers only one analysis procedure on a single grid, and Enquire Within offers only a limited number of analyses on a single grid. By comparison, GridCor offers a larger number of analyses, but it is limited to a single grid, whereas GridLab provides methods for comparing two grids but performs only a specific set of multivariate procedures on a single grid. None of these programs can manage or merge large numbers of grids with different types of data (e.g., rankings or ratings). The purpose of the present article is to introduce a Windows-based computer program, Idiogrid, that was written to fill the current void in available repertory grid programs.

Grid Management

Grid characteristics. Idiogrid allows users to view, enter, and manipulate a wide variety of repertory grids. Grids with rating or ranked data are recognized, as well as grids with binary or continuous data. Depending on the type of data entered, different analyses are made available under the various options in the program. Idiogrid also recognizes and provides analyses for the coordinate grid (Chambers, 1985), a particular type of grid that measures logical inconsistencies in an individual's construct system. Regardless of the type of data, a particular grid can be of any dimension (e.g., 8 constructs and 16 elements), and grids with more than 500 constructs and elements can be managed easily. The user will be restricted only by the available resources (e.g., RAM) of his or her computer. Missing values can be entered into a given grid, and a single system-missing value can be set by the user. Finally, the constructs can be entered as bipolar adjectives (e.g., "happy-sad") or as single descriptive adjective terms (e.g., "happy") and can be easily pasted into Idiogrid from

other programs that are currently active in the Windows environment. Elements can also be pasted from other programs, and both the constructs and the elements can be easily edited and saved.

Grid manipulations. A large number of grids can be simultaneously loaded and manipulated in Idiogrid. The exact number of grids that can be entered will be limited only by the resources of the computer, but experience with typical modern computers (e.g., Pentium II processor with at least 64K RAM) suggests that at least 200 grids of normal size—12 constructs and 12 elements—can easily be loaded. Large numbers of grids can also be merged when the constructs or elements are matched or when both the constructs and elements are matched. Merging grids is particularly useful when one is studying group processes, because individual grids can be compared and contrasted with the merged group grid. Merging is also useful for studying grids that have been collected from the same individual over time. Prior to merging, each grid can be transformed, with the constructs, elements, or complete set of grid values thereby standardized, normalized, or centered. These transformations help ensure that the scaling across different grids is equivalent according to some criterion or criteria. Individual grids can also be transformed, saved, and added to the list of grids currently loaded into Idiogrid; and a single grid can be transposed so that the rows (constructs) and columns (elements) of the matrix are switched.

Idiogrid stores the grids, along with the constructs, elements, grid data type, and other information, as ASCII files (instructions for creating an appropriately formatted file from existing ASCII text are provided in the program's manual). Clinical or research notes that are written for a particular grid are also stored and retrieved when the grid is loaded. As mentioned above, a large number of grids can be loaded simultaneously into Idiogrid, and any given grid can be printed with its constructs, elements, and clinical or research notes. Finally, individual grids can be exported as SAS IML, SAS text, or SPSS syntax files for additional analyses. These exported files are fully formatted and ready for immediate analysis in SAS or SPSS.

Text Output

Text output generated by Idiogrid is sent to an active window in the program where each analysis is clearly labeled, and the construct and element labels are used effectively to facilitate interpretation of the results. The text output can be edited in a number of ways. For example, the font of the text can be manipulated, and text can be deleted and copied to or pasted from the Windows clipboard. The text can be printed, saved as an ASCII text file, or saved as a rich text file (.rtf) that will preserve the different font characteristics. ASCII and rich text files can also be loaded into the text output window of Idiogrid. The number of decimals printed for numerical output can also be changed (0 to 10 decimals) for greater precision.

Graphics Output

A number of analyses generate graphical displays (e.g., a two-dimensional plot can be created from the results of

a principal components analysis) that are sent to an active window in the program. These graphs are generated as high-resolution bitmap (.bmp) files and can be printed, deleted, or saved to diskette or the computer's hard drive. Once saved, the files can be edited with standard graphics programs, such as the paint program packaged with Windows. Finally, bitmap files produced by other programs can be loaded and viewed in Idiogrid's graphics window.

Analyses

Univariate statistics. Basic descriptive statistics can be computed for the entire grid or for each construct or element. These statistics comprise the mean, median, mode, total sum of squares (*SS*), standard deviation, kurtosis, skewness, minimum value, and maximum value. The percentage of the total *SS* computed for the entire grid is also reported for each construct and element. Simple but effective frequency histograms can also be requested for the entire grid, constructs, and elements. Idiogrid also produces an extremity analysis option that provides different statistics for assessing the degree to which the respondent uses the extreme ends of the construct rating scales. Such statistics may reflect the extent to which the respondent finds the constructs to be meaningful or, in some circumstances, may indicate rigidity or even pathology (see, e.g., R. A. Neimeyer, 1985). Statistics for this analysis comprise the mean of the absolute deviations from the scale midpoint, frequencies and proportions of responses for each scale end point, and frequencies and proportions of responses using either scale end point.

Bivariate statistics. The relationships between pairs of constructs or between pairs of elements can be assessed via a number of statistics: Pearson product-moment correlations, angles reported in degrees, Euclidean distances, city block distances, and Jaccard proximities for binary data. Idiogrid employs a pairwise deletion strategy for each of these analyses, and the pairwise sample sizes can be requested and viewed. The matrices generated from these results are sent to the output window, and their rows and columns are clearly labeled with the construct or element names. Measures of relationship are useful for a variety of purposes. For example, distance measures such as Euclidean distances or Jaccard proximities are often used to study the discrepancy between an individual's self and ideal self (e.g., Hart, Field, Garfinkle, & Singer, 1997; G. J. Neimeyer & Hall, 1988).

Summary indices. A number of indices commonly computed for repertory grid data can be requested from Idiogrid. Several of these indices have been explicitly derived for use with grids. Bieri's (1955) matching score is a measure of cognitive differentiation, arguably indicating the degree of complexity in the grid ratings. Landfield's (Landfield & Cannell, 1988) ordination score, also popular among grid enthusiasts, measures the extent to which constructs discriminate among the elements in the grid; Fransella and Bannister's (1977) intensity reflects the degree of integration/differentiation in the grid. Finally, an analysis of variance can be conducted on the grid responses, from which Cronbach's alpha can be computed

for both the constructs (rows of the grid) and elements (columns of the grid). Bell (1990) suggests that these indices might be interpreted as measures of complexity.

Principal components analysis (PCA). A complete PCA can be conducted on the correlations or covariances computed from the constructs. Idiogrid uses listwise deletion for this analysis; hence constructs with missing values are removed. Constructs with zero variance are also automatically deleted, since the correlations and covariances involving such variables are undefined. The user can request a report of the complete eigenvalue decomposition as well as a scree plot of the eigenvalues. The number of components extracted can be specified, and the components can be rotated using orthogonal (varimax) or oblique (promax) transformations. The structure, pattern, and component score coefficients can be requested as well as the communalities, component intercorrelations, and component scores. Two-dimensional plots of pairs of extracted components can also be requested from Idiogrid. Both the elements and constructs are plotted in the component spaces formed in these graphs. These graphs are particularly useful in clinical settings where they provide a useful picture of how a client views himself or herself in relation to others along the construct dimensions (see Beail, 1985).

Slater analysis (single grid). Slater (1977) pioneered and refined the application of empirical data reduction techniques to repertory grids. Idiogrid faithfully reproduces Slater's approach (which he referred to as a principal components analysis) by performing an eigenvalue decomposition on the cross-products of the construct deviation scores. The results of the eigenvalue decomposition are reported, along with a scree plot, and two-dimensional graphs can be created from the extracted components. Idiogrid also reports Slater's bias and variability indices for rating grids (p. 88) as well as element and construct descriptive statistics, element direction cosines, construct correlations, element-construct direction cosines, and element Euclidean distances in both raw and standardized form. Finally, the construct ratings can be normalized prior to conducting any of the analyses in the Slater analysis option. Watson (1977) has described a case study based on these different analyses and demonstrates how they can be utilized in a clinical setting.

Slater analysis (two grids). Slater (1977) has also described a number of methods for comparing pairs of repertory grids with the same constructs and identical elements. Rowe and Slater (1976) have shown how such analyses can be used to study an individual over time or to assess the degree of accuracy in a therapist's predictions of a client's grid responses. Again, Idiogrid faithfully reproduces Slater's approach. Descriptive statistics for differences between grids can be requested as well as descriptive statistics for each individual grid. The correlations between individual constructs and between individual elements across the two grids can be obtained as well as the overall, general degree of correlation between the two grids. Differences between the element and construct means can also be evaluated and tested for statistical significance.

Self-identity plots. Norris and Makhlof-Norris (1976) have reported a graphical method of examining standardized Euclidean distances derived among elements in a repertory grid. In their technique, two elements are used to form a two-dimensional space. For example, "self-unlike self" and "ideal self-unlike ideal self" may be used to form the two dimensions. The standardized Euclidean distances (Slater, 1977) between the elements in the grid are then plotted in this two-dimensional space. In this manner, the relationships among the elements can be summarized, and different patterns in the graph may be identified as instances of self-isolation, social isolation, and self-convergence. Self-identity plots for any pairwise combination of elements can be created in Idiogrid.

Coordinate grid analysis. Chambers (1985) has described a novel repertory grid technique in which a single set of figures (usually people) are rank ordered in terms of their general similarity to one another. This ranking process results in a square matrix from which a number of novel statistics can be computed. For instance, logical inconsistencies between pairs of figures can be identified by comparing explicit and implicit rankings. These inconsistencies might represent points of conflict within the person's construct system (Chambers, 1985). The logical inconsistencies generally associated with each figure can also be computed, as well as the overall degree of consistency found in the entire grid. The degree of integrative complexity for each figure and for the entire grid can also be calculated. These values indicate the extent to which the person's constructions are integrated and balanced. Idiogrid reports the logical inconsistency and integrative complexity statistics as well as implicit rankings, descriptive statistics for the figures, and figure rank-order correlations.

Minimum System Requirements

Idiogrid will run in Windows 95 or later versions. A 486 processor (Pentium I or faster is recommended), 64K RAM, and 1.4 MB of disk space are required. Performance for large grids (e.g., 100 elements and 100 constructs) will be particularly slow with these minimum specifications. For typical sized grids (e.g., 16 elements and 16 constructs), performance will not be hindered greatly.

Availability

An examination copy of Idiogrid can be requested from the author or can be downloaded from the author's Web site (www.idiogrid.com). A user's manual and example repertory grids are also available or can be viewed at and downloaded from the same Web address. A majority of the analyses and a number of grid manipulation features (e.g., the merge functions) have been permanently deactivated in the examination copy. Otherwise, the full version and the examination copy of the software are identical. The full version of Idiogrid is available at minimal cost, and ordering information can be found at the Web address above.

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