

Neuendorf
Multidimensional Scaling

Model:

I can't draw that!

Assumptions:

1. The decomposition approach (the focus here) assumes that you want to uncover dimensions of discrimination/differentiation among concepts or "objects." These concepts can be anything you wish--countries, brand names, racial groups, attributes (e.g., "expensive," "intelligent"). Typically, data are collected by simple paired comparisons, asking respondents to indicate perceived similarities or relative preferences between concepts, and the dimensions emerge from these data. Thus, ordinarily, the dimensions that are discovered are data-based, and not defined by the researcher. More generally, we assume that people (respondents) can and do think about a pool of concepts in a multidimensional fashion, either observing Euclidean geometry (e.g., SPSS's ALSCAL, found under Analyze \equiv Scale \equiv Multidimensional Scaling) or not (e.g., the GALILEO program). (SPSS also offers another procedure, PROXSCAL, written by faculty at Leiden University in The Netherlands.) SPSS has a variation on ALSCAL called AINDSCAL@ that examines individual cognitive spaces.
2. Any level of measurement will do if you use SPSS's ALSCAL procedure. (The routine itself asks for ordinal, interval, or ratio, but nominal data may be adjusted to work.) However, this technique assumes that the solution adheres to Euclidean laws, and also for some reason limits the solution to 6 dimensions. The program GALILEO will assess as many dimensions as you have concepts, will account for non-Euclidean judgments (via imaginary dimensions), but it does assume metric data.
3. Homogeneity of respondents' comparisons. Usually (but not always), data are aggregated across respondents, by using their mean (or geometric mean) distances between concepts. GALILEO does not test for homogeneity. If using the AINDSCAL@ option in SPSS's MDS, the output will give a measure of fit for each respondent.
4. Dimensions [in real space] will be orthogonal.

Decisions to Make:

1. Which program? In the School of Communication at CSU, you can choose between SPSS's ALSCAL/INDSCAL, SPSS's PROXSCAL, and GALILEO. GALILEO is installed on only a small number of machines, as needed.
2. What concepts will be included. Usually decided by theory, researcher fiat, or via pilot testing (e.g., "What are the most important political issues in American today?") Some researchers choose to include only object-type concepts (e.g., brands), while others mix object-type concepts and attribute-type concepts (e.g., brands, plus "expensive," "sweet-tasting," etc.). Caution--in the latter case, you sometimes get two bunches of concepts: The objects and the attributes.

3. Whether or not to use an ideal point in the data collection (e.g., Me, My purchase, My preference, My vacation, The Best, Good, etc.). The choice of wording of this ideal point matters (Neuendorf et al., 1987).
4. Whether to collect data as similarities or preferences. This decision may be related to #3. See Hair et al. p. 654 for a discussion.
5. What measure of proximity/similarity/preference will be used--bounded paired comparison, unbounded paired comparison, "confusion" data, correlations, etc.
6. In collecting the data, you may choose between decompositional (attribute-free) and compositional (attribute-based) approaches (see Hair p. 643). The compositional way is, in my opinion, flawed, and rather defeats the whole idea of MDS.
7. In collecting the data, whether to also measure "external" attributes that can then be correlated with the emergent dimensions to help you "make sense" out of the dimensions. This introduces a little of the value of the compositional method, without contaminating the paired-comparison ratings with the researcher's judgments. The attribute measures should *follow* the paired-comparison ratings in the questionnaire.
8. Whether or not to aggregate the data. MDS is unique in its ability to provide single-case solutions. However, aggregating the data is most common.
9. In GALILEO, if you have more than one "space," whether to rotate them to congruence in order to see a conservative indication of how concepts have "moved" between the spaces. GALILEO even allows you to specify "stable" and "free" concepts for such a rotation.
10. In SPSS, how many dimensions to specify (max=6). You may use a dimension-by-stress evaluation, much like a scree test.

Statistics: (There are few Areal@ numeric statistics.)

1. The perceptual map--not really a statistic, but it=s the main feature of MDS. For SPSS, you need to copy the 3-dimensional coordinates to a new data set, and then run Graphs=Interactive=Scatterplot. In GALILEO, you must submit the saved .CRD file to ATV32@ (Thought View 32), another program produced by the Galileo Co. ATV32@ allows on-screen manipulation of the map=s orientation, and even has a 3-D option (you need to bring your own 3-D glasses).
2. The map=s dimensionality (decompositional model)--Hair et al. call the interpretation of dimensions Amore an art than a science,@ a subjective judgment based on common knowledge about the concepts in the map. If Aexternal@ variables have been measured, you may examine correlations between the Aexternal@ variables and concept coordinates on each dimension. This makes the interpretation of dimensions more Aobjective,@ according to Hair et al.
3. Stress measure--available in SPSS, not in GALILEO. Indicates the proportion of the variance of

the interconcept distances that is not accounted for by the MDS solution (with its certain number of dimensions). In GALILEO, the proportion is 0%, because it calculates as many dimensions as concepts, and accounts for 100%.

4. Warp factor--available in GALILEO, not in SPSS (Beam me up, Scotty.). Larger values indicate a greater importance or presence of imaginary dimensions (those dimensions with negative eigenvalues, accounting for non-Euclidean relationships among concepts). Warp is calculated by dividing the sum of the real eigenvalues by the sum of all eigenvalues (real and imaginary).

Selected references:

Kruskal, J. B., & Wish, M. (1978). *Multidimensional scaling*. Beverly Hills, CA: Sage.

Neuendorf, K. A., Kaplowitz, S. A., Fink, E. L., & Armstrong, G. B. (1987). Assessment of the use of self-referent concepts for the measurement of cognition and affect. In M. McLaughlin (Ed.), *Communication Yearbook 10* (pp. 183-199). Beverly Hills, CA: Sage.

Woelfel, J., & Fink, E. L. (1980). *The measurement of communication processes: Galileo theory and method*. New York: Academic Press.

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