When, Where and How: The Use of Multidimensional Scaling Methods in the Study of Negotiation and Social Conflict

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Abstract. MDS (multidimensional scaling) is a technique that enables researchers to uncover the spatial representation or "hidden structure" that underlies and defines behavioral data – such as negotiator or disputant perceptions and preferences. Although MDS has wide-ranging theoretical and applied appeal, it has been highly underutilized in the conflict and negotiation literature. In this paper, we seek to illustrate the promise that MDS offers in the study of conflict and negotiation. We begin with a discussion of how MDS can be differentiated from other multivariate techniques, such as factor analysis. Next we provide a brief overview of multidimensional scaling techniques – highlighting the various methods available for collecting proximity data and the computer analysis programs that can be used to analyze them. We further

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review the nature of the results and the ways in which they are interpreted. We conclude with some examples of the types of questions that have been addressed using MDS in the conflict and negotiation literature and a discussion about the promise this technique has for future research.

Keywords: Multidimensional scaling; statistical methods; multivariate techniques.

Multidimensional scaling (MDS) like other multivariate procedures is a data-reduction technique that allows us to discover *how* and *why* variables are related. As such, the purpose of MDS is to uncover the spatial representation or "hidden structure" that underlies and defines behavioral data – such as nego-tiator or disputant perceptions and preferences (Kruskal & Wish 1978). A fun-damental aspect of human behavior is the tendency to make judgments about the degree of similarity and difference among the myriad stimuli with which we are faced (Green & Carmone 1970). For example, scholars reading this journal are certain to have beliefs about how this journal and others are related to one another; although they may not fully recognize the criteria they are using to make such judgments. Multidimensional scaling techniques allow us to uncover the perceived attributes or "dimensions" that account for correla-tions among these judgments and label the criteria used for making them.

The ultimate goal of MDS techniques is to produce a geometric map that illustrates the underlying structure of complex psychological phenomena. The distance between the stimuli in a spatial map represents judgments regard-ing how similar or dissimilar each stimuli is to others. The smaller the distance between two stimuli, the greater their proximity and thus, the greater the sim-ilarity between them. By producing a map of the evaluated stimuli, MDS tech-niques are able to illuminate the "hidden structure" and thus, the cognitive framework or underling dimensions that distinguish one class or category of stimuli from another.

MDS has been applied in a variety of disciplines, including psychology (e.g., Johnston 1995), economics (e.g., Black 1991), sociology (e.g., Beardsworth & Keil 1992), political science (e.g., Lieske 1993), anthropology (e.g., Bernard 1994), and organizational behavior (e.g., Robinson & Bennett 1995; Jehn 1994). Indeed, MDS has been used to understand a wide range of phenomena – ranging from perceptions of nations (Wish, Deutsch, & Biener 1971), to perceptions of visual patterns (Hirschberg, Jones, & Haggerty 1978). Like factor analysis, MDS may be applied to any matrix of data, as long as the elements of the matrix provide information about the relation among the objects, events, or behaviors (which we will refer to as stimuli) that comprise the rows and columns of the data matrix (Young & Hamer 1987). Unlike fac-tor analysis, however, MDS does not require metric data, allowing for the use

of both metric (interval or ratio) and nonmetric (ordinal) data. Given that data reflecting attitudes and cognitions are nonmetric, MDS is ideally suited to the study of conflict and negotiation.

Although MDS has wide-ranging theoretical and applied appeal, it has been highly underutilized in the conflict and negotiation literature, which has tended to rely on factor analysis to understand hidden data structures. In this paper, we seek to illustrate the promise that MDS has in the study of conflict and negotiation. We begin with a discussion of how MDS can be differentiated from other multivariate techniques, such as factor analysis, illustrating its distinct advantages to conflict scholars. Next we provide a brief overview of multidimensional scaling techniques – highlighting the various methods available for collecting proximity data and the MDS computer analysis programs that can be used to analyze them. We further review the nature of the results and the ways in which they are interpreted. We conclude with some examples of the types of questions that have been addressed using MDS in the conflict and negotiation literature, highlighting the promise this technique holds for future research.

Multidimensional Scaling (MDS) versus Factor Analysis (FA)

Conflict researchers have typically used factor analysis to understand the structure of data. Given that MDS techniques provide a number of advantages over the use of factor analysis and other multivariate techniques, it is important to gain an understanding of the relationship between the two. First, while each uses a very different set of statistics, the principle behind each method is quite similar. Factor analysis and multidimensional scaling are both based on the premise that when a bunch of variables (or in the case of MDS, a number of stimuli) are correlated with each other, they have something in common (Bernard 2002). In the case of factor analysis, that "something" is referred to as a factor, while in multidimensional scaling, it is referred to as a data cluster or category.

Regardless of whether we are referring to factors, data clusters or categories, they are all "supervariables" or latent variants that subsume a number of variables (or stimuli) into fewer, broader variable classes. Thus, both factor analysis and multidimensional scaling are used to identify the *structure* or interrelationships among these supervariables. For example, factor analysis is used to illuminate factors that capture the interrelationship among variables. Similarly, MDS uses dimensions to illustrate the structure among variable clusters and categories. This is beneficial, because when "we can discover (or, more correctly, intuit) these underlying supervariables, we can explain the

variance in the dependent variable of interest, with a small number of independent variables" (Bernard 2000: 635).

Despite the principle that underlies both statistical techniques, there are some notable differences between them. In the case of FA, factors represent the underlying relationships of a set of attributes with respect to a sample of individuals. As such, one subject's attribution is not sufficient for the application of factor analysis. In contrast, MDS uses individuals as the unit of analysis. This means that one respondent's evaluation of stimuli is sufficient (although rarely used) for the use of an MDS analysis, allowing researchers to obtain a solution for each individual. Thus, MDS focuses on how an individual perceives the objects, rather than on the objects themselves.

Another important difference between FA and MDS is the nature of the responses that can be obtained from participants. There are generally two approaches to obtaining participants' assessment of stimuli: attribute-free and attribute-based approaches (Hair, Anderson, Tatham, & Black 1998). As discussed below, both approaches may be employed with MDS, whereas only attribute-based approaches can be used with Factor Analysis.

Attribute-free data are based on participants' direct assessment of the similarity (or dissimilarity) between stimuli. With this approach, the investigator does not provide any criteria on which these judgments are to be made. For example, Gelfand Triandis, & Chan (1996) asked respondents to judge the degree to which 15 different concepts were each similar to one another, for a total of 105 paired comparisons. Likewise, Pinkley (1990) asked respondents to sort conflict stimuli into categories based on their similarity. In both studies, participants were free to judge the similarity between stimuli based on their own criteria, enabling their own mental models of the stimuli to surface. In this respect, because the attribute-free approach asks respondents to provide similarity judgments without the researchers' criteria being provided, it is less likely to be contaminated by the preconceptions or hypotheses of the researcher.

By contrast, *attribute-based* approaches ask participants to assess stimuli on a pre-defined set of attributes. For example, Hensen, Sarma, & Collins (1999) asked participants to rate their preferences on items reflecting Holland's six occupational themes. These preferences were later transformed into Euclidean Distances for input into an MDS analysis. Importantly, MDS studies can use either attribute-free or attribute-based approaches, whereas factor analysis can only be applied to the attribute-based approaches. That is, FA requires subjects to rate stimuli on some list of attributes provided by the researcher. Accordingly, it retains a higher risk of contamination by the researcher's own criteria.

A second advantage of using MDS techniques is that they provide a mechanism for detecting, quantitatively categorizing and labeling people's perceptions and preferences, even when the criteria used to make such judgments are implicit or cognitively unavailable to respondents (Pinkley 1990). While people can readily compare and evaluate stimuli, they are often less able to conceptualize their perceptions and judgments in terms of specific categories or identify the dimensions that underlie them.

Different Types of MDS

MDS techniques can be used with both homogeneous and heterogeneous samples. When individual differences are not of interest or assumed to be nonexistent (i.e., the respondent population of interest is assumed to be homogeneous), a traditional two-way matrix (sometimes referred to as in-group scaling) should be used. This would be the case, for example, if an experimenter wanted to determine the dimensions that underlie and account for scholar perceptions (with an n = 50 scholars) of 40 scholarly journals (to extend our earlier example), but was unconcerned with how individual differences or scholar characteristics might affect such judgments. In this case, the design would be a 40 × 40 design with a Cartesian product of < stimuli × stimuli > (i.e., a 40 × 40 matrix), with every journal compared to every other journal.

When large or heterogeneous sample sizes are used however, it is dangerous to assume that all respondents will share the same point of view and thus, by extension that it is safe to assume homogeneity of similarity judgments across people (Green & Carmone 1970). As a consequence, a three-way MDS, or individual differences scaling procedure is often used in the place of the more traditional two-way procedure, because it allows researchers to examine the pattern of each respondents (or subgroup of respondents) perception of the stimuli. When this approach is used, homogeneity can be uncovered through analysis, instead of mandated by assumption, leading to the aggregation of subject judgments.

The most widely used three-way MDS procedure is the INDSCAL model developed by Douglas, Green, and Schaffer (1986). This method develops both a common or "group" space (which is very similar to the solution obtained using a two-way MDS method) and a set of respondent weights allowing the experimenter to examine how each point of view is related to the others (i.e., the dimensions that each demographic type has in common). Differences in dimension saliency (i.e., points of view) can then be related to

individual differences and respondent/situation characteristics to test for hypothesized relationships. As a consequence, research investigates whether respondents who have high weights on a particular dimension (i.e., the dimension accounts for much of the variance in their judgments) are different from those with low weights on that dimension. Returning to our example, this technique would allow researchers to discover that scholars affiliated with research institutions weight a dimension labeled "rigor" more heavily than those affiliated with teaching colleges, and that those at teaching colleges weight a dimension labeled "corporate application" more heavily than those at research institutions. In this case, the design would be a "40 journals × 40 journals × 50 respondents" design with a Cartesian product of < stimuli × stimuli × respondents > (i.e., a 40 × 40 × 50 matrix), with each journal compared to every other journal.

A three-way MDS is also an appropriate technique for comparing the perceptions of one or more groups to another. For example a three-way MDS could be used to determine if the perceptions of Japanese scholars varied from those of Latin American scholars and US scholars. In this case, the matrix would resemble 40 journals × 40 journals × 3 cultures.

The INDSCAL model can also be used to evaluate the *goodness of fit* for each respondent (or demographic type) stimulus configuration (i.e., the amount of variance in respondent judgments explained by the multidimensional solution). An alternative method for aligning individual differences with points of view is to determine which respondent characteristics predict the pattern of dimension weight scores. For example, Jones and Young (1972) use discriminate function analysis to distinguish groups in terms of their different dimension patterns.

In addition to INDSCAL, numerous other computing programs have been developed for multidimensional scaling and other related tasks such as cluster analysis. These programs include, but are not limited to ALSCAL (Takane, Young & Deleeuw 1976), M-D-SCAL (Kruskal 1968), TORSCA (Young & Torgerson 1968), and PROXSCAL (Young & Hamer 1987). The ALSCAL multidimensional scaling program is included in the SPSS 10.0 Base package and is also available in the SAS ALSCAL procedure. ALSCAL performs metric or nonmetric MDS and has individual differences scaling options and thus can compare the differences of several individual or group matrices. PROXSCAL, another multidimensional scaling program, is also available with SPSS 10.0 Categories package. PROXSCAL offers several improvements upon ALSCAL, including algorithmic strategies that better ensure convergence, a wide range of data transformations, and a number of different options for fitting models to the data (see Busing, Commandeur, & Heiser 1997, for further discussion).

Data Collection Methods

Regardless of the type of stimuli presented to respondents (e.g., objects, people, behavior, events) the input for MDS techniques is the similarity data, referred to as relational or *proximity data*. MDS handles all kinds of proximity data matrices including metric or nonmetric; matrices with or without missing proximity data; rectangular (i.e., two-way) or square matrices; and unequally replicated matrices (Young & Hamer 1987). Since most of the MDS computer analysis programs possess "missing data" features, missing cells pose no problem as long as the absolute number of proximity data entries is large relative to the number of dimensions necessary to account for the relationships among them.

A number of methods are available for converting stimuli into proximity data. The most common method is to obtain direct, pair wise comparisons, by having respondents judge the degree to which each stimulus is similar to every other stimulus on a Likert-type scale (see Gelfand, Triandis, & Chan 1996 for an example). An alternative method is to randomly select a subset of the stimuli (say for example 10 out of our stimulus set of 40 journals) to be designated as "target" stimuli, against which all other stimuli must be compared (Pinkley, Brittain, Neale & Northcraft 1995). When this method is used, respondents are presented with one of the target stimuli (for example, one out of the 10 randomly selected target stimuli) and then asked to rank order the remaining stimuli (the remaining 39 out of 40 using our example) in terms of similarity in ascending or descending order (see Pinkley 1990 or Pinkley, Neale, Brittain, & Northcraft 1995 for examples). A third method, called the subjective clustering method, (Green & Carmone 1970) requires respondents to sort stimuli into groups so that those in the same group are more similar to each other than those in other groups (see Johnson 1995; Gelfand, Nishii, Holcombe, Dyer, Ohbuchi, & Fukuno 2001 for examples). Correlations among variables or any other indication of the interrelationship among stimuli are also acceptable for input.

Interpreting the MDS Configuration and Labeling the Dimensions

There are two issues that scholars face when interpreting MDS configurations: 1) determining the number of dimensions that best represents the actual proximities between the data, and 2) labeling each dimension or determining the interpretability of each dimension. Each issue is discussed in turn below.

Determining Dimensionality. Three criteria are used to determine the optimum number of dimensions needed to describe the stimulus space. While

reliance on these methods varies, experimenters typically use all three crite-
ria for determining dimensionality.

The first criterion used for determining dimensionality, is Kruskal's (1964)
STRESS index or goodness of fit, which indicates how the distances displayed
in the configuration reflect the actual proximities in the similarities data.
Technically speaking, it is the square root of a normalized residual sum of
squares, which exhibits the amount of variance that remains unaccounted for
by the MDS model. Although measurements of STRESS vary from analysis
program to analysis program (such as M-D-SCAL, TORSCA, KYST, or
ALSCAL), the meaning of STRESS is always the same: *Small STRESS indi-
cates good fit*, with good fit nearing zero and poor fit nearing one. As the num-
ber of dimensions increase, STRESS becomes closer to zero. It should be
noted that a number of factors affect stress values. For example, when the num-
ber of stimuli (I) and the number of dimensions (R) of stress are similar, the
STRESS index can be distorted, resulting in undue influence of the interpre-
tation R. As a result, a good rule of thumb is to use at least four times as many
stimulus items as the number of dimensions likely to underlie the stimulus
space (i.e., $I > 4R$).

A second criterion for evaluating the number of dimensions necessary and
sufficient to adequately represent the stimulus space, is the *RSQ index* or
squared multiple correlation between the proximities in the similarities data
and the distances plotted by the MDS model. The RSQ index describes how
much of the variance in the proximity data is accounted for by the MDS model.
As with any squared correlation, a one indicates a perfect fit and a zero indi-
cates no fit at all.

To determine the appropriate number of dimensions, researchers typically
plot the first two criteria (i.e., STRESS and RSQ) against the number of
dimensions to discover an *elbow* or bend, which is designated by a sudden rise
in RSQ and fall in STRESS. The number of dimensions that correspond with
the elbow represent a particularly good fit of the MDS model to the proxim-
ity data (Young & Hamer 1987). The elbow test is usually accompanied by an
assessment of how well the raw data fits the MDS model by examining the
amount of variance accounted for by the MDS procedure. If no elbow is
found, the appropriate number of dimensions cannot be selected on that basis.

A third criterion for selecting dimensionality, is the number of dimensions
most easily interpreted (using the interpretation procedures discussed below),
with the goal being to "select the space with the fewest dimensions and the
richest interpretation" (Young & Hamer 1987: 205).

Interpretability of Dimensions. After selecting dimensionality, the dimen-
sions must be interpreted and labeled. One common method for labeling

dimensions is to visually inspect the spatial maps produced by the MDS analysis to look for patterns in the attributes of stimuli clustered around one end of a dimensions continuum to those at the other end. This "massaging" of the data, can lead to interesting insights.

As a complement to this subjective procedure, researchers often employ more rigorous, objective techniques to aid in the interpretation of the multi-dimensional space (configuration). One common technique is to have the participants who made the proximity judgments rate the stimuli on a number of unidimensional attributes and then use multiple regression to regress the unidimensional attributes onto the coordinate values in the multidimensional space. In order for an attribute to be useful in interpreting the space, it must have a: 1) significant multiple correlation and F-value, indicating that the configuration "explains" the attribute well, and 2) significant Beta weight (normalized regression coefficient) on a dimension, indicating that the attribute corresponds well with the multidimensional space (Kruskal & Wish 1978). The task of assigning a label to a particular dimension is simplest when each label loads on only one dimension (Pinkley, et al. 1995).

An alternative method is to ask the participants making the proximity judgments to specify the criteria they use for making these judgments. If this is done, a second set of subjects can be given the original set of stimulus objects and the criteria list provided by the proximity-rating participants and asked to rate the degree to which each criteria describes each stimulus object on a Likert-type scale.

MDS and Research: Examples and Prospects for Future Research in Conflict and Negotiation

Several examples may further illustrate the inherent benefits of using MDS techniques in the study of conflict and negotiation. Although we provide only a couple examples here, a handful of scholar's have used MDS techniques to address such issues as negotiatior perceptions of conflict situations (Pinkley 1990), mediation tactics (Carnevale & Pegnetter 1985; McLaughlin, Carnevale, and Lim 1991), managerial third-party dispute intervention strategies (Pinkley et al. 1995), cross-cultural studies (Gelfand et al. 2001), and international conflicts (Druckman 1997; Druckman, Martin, Nanand, & Yagcioglu 1999). A survey of these studies will demonstrate the varied techniques for collecting proximity data, as well as, determining situations and labeling the dimensionality.

Example 1

Pinkley, Brittain, Neale, & Northcraft (1995) used MDS to conduct an inductive analysis of managerial third-party dispute intervention strategies. The objective of this study was to identify the dimensions that distinguish one class or category of intervention strategies from others. In addition, the authors examined the relationship between strategy selection and the nature of the conflict (i.e., managerial dispute intervention goals, dispute intensity, time pressure, dispute importance, managerial power, and the relative power of the disputants). To fulfill this objective, the authors used a five-step method to collect and analyze the data. In step one, alumni from four universities filled out a survey in which they provided a description of the last time they intervened in a corporate conflict, as well as, specifics regarding the nature of the conflict. Of the 142 obtained descriptions, 40 were randomly chosen as step 2 stimulus materials.

In step two, ten of the remaining 40 conflict descriptions were randomly selected as target descriptions. One hundred participants, were randomly separated into ten groups, each of which was assigned target description, such that ten participants were given the first target description, ten the second target description and so on. Each group was asked to rank-order the remaining 39 descriptions, in terms of how similar they were to their assigned target description. Participants were also asked to specify the criteria they used for making their similarity judgments.

A three-way MDS analysis using SAS's alternative least squares scaling (ALSCAL, see Takane, Young, & DeLeeuw 1977) implementation of the individual differences scaling model (Carroll & Chang 1970). A new set of allowed experimenters to test the hypothesized relationship between managerial strategy selection (as defined by dimensionality) and the nature of conflict. Two criteria were used to determine the optimum number of dimensions: 1) Kruskal's (1964) STRESS index and 2) an elbow test accompanied by an examination of the amount of variance accounted for by each dimensional solution. Both procedures suggested that a six-dimensional solution did not significantly improve on the five-dimensional solution, which accounted for 95% of the variance.

In step three, one-hundred and forty potential labels were generated from two sources: 1) the labels suggested by the criteria used by step two participants to rank-order the intervention strategy descriptions, and 2) the third-party intervention categories used by past scholars such as Thibaut and Walker (1975) and Carnevale (1986). A third group of participants rated the degree to which each of the 40 intervention strategy descriptions reflected each of the

140 potential labels on a 9-point Likert-type scale. Two criteria were used to label the dimensions: 1) multiple-correlations and F-tests revealed that 22 of the 140 potential labels related to the dimensions at the p-value level of .01 or better and 2) multiple regression produced direction cosines (beta weights) to relate each potential label to each dimension. Ten labels most closely related to each of the five dimensions and were thus, used to label the configuration.

In step four, the authors used confirmatory analysis to verify the appropriateness of each of the ten labels by asking five trained raters (unaware of the step one – three results) to rate the step one intervention strategy descriptions in terms of each label. Cronbach's alpha was used to assess interrater reliability (found to be quite high at .85). The F values and beta weights found that all ten of the selected labels loaded onto the five-dimensional solution with reliability ranging from .77 to .97. As a result, the five dimensions were labeled: 1) Attention to the stated versus underlying problem, 2) Disputant commitment forced versus encouraged, 3) Manager decision control versus disputant decision control 4) Manager approaches conflict versus avoids conflict, and 5) Dispute handled publicly versus privately.

Finally, step five used multiple regression to relate the five-dimensional solution to the intervenor goals and perceptions of conflict specified by the step one participant surveys. This step allowed the authors to evaluate when and under what circumstances various intervention strategies are used by managers.

Example 2

Gelfand, Nishii, Holcombe, Dyer, Ohbuchi, and Fukuno, M. (2001) used MDS to examine the dimensions that are used to construe conflicts across cultures. The purpose of the study was to discern if there are universal (or etic) dimensions of conflict construal and if there are culture-specific (emic) construals that are consistent with prevailing cultural values and practices. This study involved five steps. In step one, students from the U.S. and Japan were asked to write a description of a conflict that they had experienced in the recent past. Consistent with Pinkley (1990), they were told they could describe any incident they chose, regardless of its nature, the type of relationship, or the degree of severity of the dispute. Participants were asked to describe the conflict situation in terms of the following two questions: 1) Briefly, what is the conflict *really* about? and 2) What is at the heart of the conflict? In both countries, instructions were given in the native language, English or Japanese. All materials were first translated into Japanese, and then back-translated by another translator into English to check for discrepancies.

In step two, 28 conflicts in the U.S. and 28 conflicts in Japan were randomly selected for the MDS portion of the study. Selected episodes had to be 1) brief (2–3 sentences); 2) clear and unambiguous as to the exact nature of the conflict; and 3) relevant in both cultural contexts. Japanese conflict episodes were translated into English (for U.S. participants), and U.S. conflict episodes were translated into Japanese (for Japanese participants) and were then back-translated by different translators.

In step three, a new set of respondents from the U.S. (N = 94) and Japan (N = 130) were given a set of 28 index cards, each of which contained a description of a conflict situation. Participants in both countries were randomly assigned to sort either the U.S. conflict episodes or the Japanese conflict episodes, and were unaware of the source of the conflict episodes (i.e., Japan or U.S.). Participants were asked to sort the conflict cards into as many piles as they desired, based on their perceived similarity. This design resulted in four MDS spaces: 1) American cognitive representations of U.S. conflicts; 2) Japanese cognitive representations of U.S. conflicts; 3) American cognitive representations of Japanese conflicts; and 4) Japanese cognitive representations of Japanese conflicts. This design enabled Gelfand et al. (2001) to use stimuli that were derived naturally in each culture (in the spirit of an *emic* approach) yet also allow for cross-cultural comparisons of cognitive construals of identical conflict episodes (in the spirit of an *etic* approach). It also enabled the identification of strong universals of conflict construal (i.e., dimensions of construal that are found regardless of the source of conflict and the cultural background of the participants).

In step four, participants rated the conflicts on a number of unidimensional items to assist in the labeling of the dimensions. These items were derived from previous studies of conflict construal conducted in the U.S. (i.e., Pinkley 1990) as well as from literature on conflict in Japan and the U.S. Due to time restrictions and the cognitive load of the ratings (28 conflicts × 21 ratings would require 588 ratings), participants were randomly assigned to rate either the first 14 conflicts or the last 14 conflicts on the 21 unidimensional items.

In step five, a conflict episode by conflict episode (28 × 28) diagonal matrix of dissimilarities was created for each set of the U.S. and Japanese participants, resulting in four upper triangular matrices. KYST 2-A statistical program was used to analyze the matrices. An elbow test of Kruskals' measure of stress suggested that stress values did not decrease substantially from the three to four dimensional solutions, yet did decrease substantially from the two to three dimensional solutions for all of the MDS spaces. The three dimensional solution was also chosen because it allowed for the most comprehensible interpretations for all of the MDS solutions.

In step six, the dimensions were labeled based on a) an examination of the conflicts in the MDS spaces as well as b) multiple regression analyses which examined how well the location of each conflict on these unidimensional items was predicted by its location in the multidimensional space. Items with a significant multiple correlation and significant Beta weights indicate that the configuration "explains" the item well. Items that load on multiple dimensions, however, are not as useful for labeling the dimensions. The results demonstrated that Japanese and American participants construed both U.S. and Japanese conflicts through a *Compromise* versus *Win* frame (Pinkley 1990), providing evidence of a universal dimension of conflict construal. The results also illustrated that Japanese perceived both sets of conflicts to be more *Compromise* focused, as compared to Americans. In addition, there were unique dimensions of conflict construal among Americans and Japanese (e.g., *Infringements to Self* and *Giri Violations*, respectively), suggesting that identical conflict episodes can be perceived differently across cultures.

Example 3

Druckman, Martin, Nan, & Yagcioglu (1999) used MDS to examine the structure of actual cases of international negotiation. The objective of the study was to test whether Iklé's (1964) typology of international negotiation could account for similarities among the actual negotiations. This typology distinguished among five objectives in international negotiations, including extension, normalization, redistribution, innovation, and side effects, which were construed as distinct types of negotiations with particular processes and outcomes. Although the taxonomy had been widely discussed in the literature, Druckman et al. (1999) set forth to directly test the validity of Iklé's notions using MDS.

This study involved six steps. In step one, 30 cases were randomly selected from the Pew Case Studies in International Affairs (approximately 17% of the cases available). Cases that were sampled differed along numerous characteristics, including region and type of issue (e.g., economic cases, security issues, environmental, hostage negotiations). All cases were approximately ten to fifteen pages and of a common format, consisting of background information, a discussion of the unfolding of the negotiation, and an analysis of the processes and the outcomes of the negotiation. After selecting the cases, the authors categorized the conflicts in terms of Iklé's five objectives. Final decisions were reached by a consensus between at least two people (the first author and another student familiar with Iklé's theory). The authors found that the cases that were chosen were representative of the five objectives identified

by Iklé's theory (eight innovation cases, five normalization cases, ten redistribution cases, five extension cases, and two side effect cases).

In step two, the 30 cases were divided randomly into approximately four equal sets and who were assigned to one of four coders were unfamiliar with the taxonomy being examined. The cases were coded for sixteen categories, including characteristics of the parties (e.g., number, power, length and type of relationship), number and type of issues, the process of negotiation (e.g., length and types of exchanges), negotiation outcomes (e.g., type of agreement) and conditions surrounding the negotiation (e.g., time pressure and media coverage). A smaller sample of cases was subject to inter-rater reliability. There were high levels of agreement (generally over 90%) and disagreements were resolved through a refinement of the definitions of variables.

In step three, correlations were computed among the 30 cases across the 16 coded variables. These correlations were used as an indication of similarity among the cases. Subsequently, a 30×30 matrix of correlations was subject to MDS analysis. Based on stress values as well as interpretability, the authors chose a two-dimension solution.

In step four, the authors examined whether the negotiation cases clustered according to Iklé's taxonomy. First, they visually inspected the clustering of the cases and found initial support for the notion that negotiations cluster according to their focus on innovation, redistribution, extension, side effects, and normalization. They also found a new negotiation category, labeled "multilateral regimes," which they noted had not existed at the time of the publication of Ilké's book. Next, they performed a Kruskal-Wallis ANOVA to test for significant differences among the clusters, and also performed a K-means cluster analysis. This analysis revealed three clusters (multilateral and normalization cases), innovation cases, and redistribution cases.

In step five, the authors checked to see whether their initial categorization of the cases could be verified. In order to do so, they performed discriminant analyses that examined whether the sixteen coded variables could distinguish among Iklé's categories. These analyses illustrated that a high percentage of cases were classified accurately.

Finally, in step six, the authors created profiles of the clusters of types of negotiations along the sixteen variables, providing a parsimonious understanding of the processes that characterize different types of international negotiations. This analysis showed, for example, that normalization negotiations generally consisted of a highly visible negotiation process, and frequent breakdowns that led to impasses or compromise outcomes.

Example 4

McLaughlin, Carnevale, and Lim (1991) used MDS to identify the dimensions underlying professional mediators' categorizations of mediation tactics. The authors had four phases to achieve their research purpose: (a) data collecting, (b) multidimensional scaling analyses, (c) regression analyses, and (d) cluster analyses. In step 1, surveys were mailed to 230 mediators sampled randomly from a list of members of the Society of Professionals Involved in Dispute Resolution (SPIDR). The mediators were asked to sort 36 stimulus tactics, taken from Carnevale and Pegnetter's (1985), into as many mutually exclusive categories as they wanted. After the sorting task, the mediators rated each tactic on five bipolar scales: friendly-unfriendly, assertive-passive, controlling-uncontrolling, use frequently-use infrequently, and effective-ineffective. All materials were mailed back to the researchers.

In the next step, researchers created a tactics × tactics (36 × 36) diagonal matrix of similarities. The similarity of each pair of tactics was presented by the number of times across mediators that both tactics were included in the same category. The tactics × tactics diagonal matrix was used in MDS analyses and clustering analyses. A two-way nonmetric MDS program, KYST2A (Kruskal, Young, & Seery 1977) scaled the similarities data. Kruskal's stress values were obtained for the one- through six-dimensional solution and the elbow criterion was used to determine the number of dimensions. Because stress values dropped greatly from the two- to three-dimensional solution and decreased minimally beyond the three-dimensional solution, the three-dimensional solution appeared to be closest to the true structure of mediation tactics.

In the third step, unidimensional scales were regressed onto the MDS configuration to label the dimensions. Those unidimensional scales, with (a) relatively large squared multiple correlations and (b) a large weight on one of the three dimensions but not on the other two, proved most useful for interpreting the dimensions. Based on these analyses, researchers labeled the three dimensions substantive versus reflexive, affective versus cognitive, and forcing versus facilitating.

In the last step, the tactics similarities matrix was clustered hierarchically with the CLUSTER procedure in SPSS. The results of cluster analyses were compared with MDS results. In addition, the authors found that the cluster and MDS results were compatible with the results of factor analyses of mediation tactics.

Conclusion

Multidimensional scaling is a powerful method to uncover the hidden struc-
tures that underlie peoples' judgments about themselves and their environ-
ments. In the domain of conflict and negotiation, MDS enables scholars to
understand phenomena at multiple levels of analysis – from the individual, to
the group, to the international level. It enables researchers to inductively
study many issues in conflict and negotiation, such as modeling disputant per-
ceptions of conflicts, characterizing the types of negotiation and mediation tac-
tics that are used to resolve social conflict, and organizing the features or
characteristics of conflicts and negotiations, among other issues. It also holds
much promise to illuminate how individual differences – such as personality,
education, and gender, as well as organizational or cultural differences –
affect conflict and disputing. At the same time, compared to its cousin, factor
analysis, MDS has been highly underutilized in the field. In this article, we
hope we have begun to show the unique benefits that this technique can bring
to the science and practice of conflict and negotiation.

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