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EMPIRICAL COMPARISON OF ALTERNATIVE METHODS FOR COLLECTING PROXIMITY JUDGMENTS

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by

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BACKGROUND OF THIS PAPER

This paper is part of a continuing research program in the area of multivariate analysis. It was prepared for presentation at the 1971 Fall Conference of the American Marketing Association held at Minneapolis, Minnesota, September, 1971.

Empirical Comparison of Alternative Methods for Collecting Proximity Judgments

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In this paper, the authors explain the procedures for transforming judgments from six data collection methods to an unconditional proximity matrix. In addition, these six methods are empirically compared on several dimensions.

Introduction

The purpose of this paper is two-fold. First, it will attempt to explain for six data-collection methods the step by step procedures necessary to transform the data into an unconditional proximity matrix. Second, it will discuss the nature of the "trade-offs" involved in selecting a particular method.

This paper constitutes an expansion of an earlier paper by Taylor.[1/] In the interest of brevity, the authors will assume the reader has a grasp of the concepts and terminology explained in this previous paper.

Data Collection Methods

A large number of procedures are available for collecting proximity judgments. Green and Carmone have presented a classification scheme for these alternative collection procedures.[2/] Using their classification scheme, this

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1/ James R. Taylor, "Alternative Methods for Collecting Similarities Data" Marketing Involvement in Society and the Economy, American Marketing Association Proceedings of the Fall Conference (1969), pp. 150-52.

2/ P.E. Green, and F.J. Carmone, Multidimensional Scaling and Related Techniques in Marketing Analysis, (Boston: Allyn and Bacon, Inc., 1970), p. 53.

paper will examine six "direct-judged" data-collection methods. These methods are: Dyads, Rank Order, Rating Scale, Conditional Rank and two versions of Triads.

To understand the differences between these methods, the concepts of conjoint and disjoint comparisons must be made clear. The comparison of the interpoint distance $\overline{AB}$ vs. $\overline{AC}$ constitutes a conjoint comparison as the element "A" is common to both distances. In contrast, a comparison such as $\overline{AB}$ vs. $\overline{CD}$ constitutes a disjoint comparison because there is no common element.

The method of Dyads requires the respondent to make both conjoint and disjoint comparisons. Triad methods involve only conjoint judgments. In this paper, the Triad I method involves all conjoint comparisons while Triad II involves only a portion of the conjoint comparisons. The methods of Rating Scale and Rank Order both require judgments equal to the number of interpoint distances in the object set. The conjoint and disjoint comparisons are implicit in the subjects' judgments for both of these methods. The Conditional Rank procedure includes only implicit conjoint comparisons. Here, the respondent is required to order N-1 objects N times. Under each of these methods the number of judgments required varies directly with the number of stimuli or objects being judged.[3/]

Nature of Judgments Required

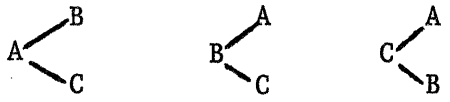
This section contains a summary of the type of judgments required under each of the six methods discussed in this paper. For example, suppose there are three objects under consideration: A, B, and C.

3/ Taylor, "Alternative Methods."

1. Dyads. For each of the following sets of pairs of objects, pick the most similar pair:

AB vs. AC
BC vs. AC
BC vs. AB

2. Triad I. In each of the following sets, pick the object that is most similar to the object on the left:



3. Triad II. In the following set select the most similar and least similar pair: 4/

4. Rank Order. Order the following pairs of objects from most similar to least similar:

AB, AC, BC

5. Rating Scale. For each of the following pairs indicate the degree of similarity in the elements of the pair by marking an appropriate number on the scale:

	Highly Similar				Not at all Similar
AB	1	2	3	4	5
AC	1	2	3	4	5
BC	1	2	3	4	5

4/ If $\overline{AB}$ is most similar and $\overline{AC}$ is least similar, it implies: $\overline{AB} < \overline{BC} < \overline{AC}$. The $\overline{BC}$ judgment must be made explicitly in Triad I while it is implied in Triad II.

6. Conditional Rank. For each object on the left, rank order the other objects in terms of similarity to that object:

	1st	2nd	
A	_____	_____	(B and C)
B	_____	_____	(A and C)
C	_____	_____	(A and B)

Analysis Sequence Leading to an Unconditional Proximity Matrix

Most multidimensional scaling and clustering algorithms require the input data to be in the form of an unconditional proximity matrix. Figure 1 presents the steps involved in transforming the data from each of the six methods into an unconditional proximity matrix.

Figure 1 illustrates that the data-collection methods which involve judgments on only conjoint comparisons require more intermediate data analysis steps than the methods which collect both disjoint and conjoint comparisons. For example, the method of Triads involves only conjoint comparisons. Consequently, triangularization procedures are needed to infer the missing disjoint comparisons.[5/] In addition, triangularization is needed to identify and resolve those judgments which are intransitive. In contrast, the methods of Rank Order and Rating Scale involve implicit judgments on both conjoint and disjoint comparisons but do not allow a check on the transitivity of the judgments.

5/ For a discription of the triangularization procedure, see C.H. Coombs, A Theory of Data, (New York: John Wiley & Sons, Inc., 1964), p. 352. Triangularization procedures can be performed by computer programs such as TRICON. See F.J. Carmone, P.E. Green and P.J. Robinson, "Tricon-An I.B.M. 360/65 FORTRAN IV Program for the Triangularization of Conjoint Data," Journal of Marketing Research, Vol. 5, (May, 1968), pp. 219-20.

FIGURE 1

ANALYSIS SEQUENCE FOR DATA COLLECTION METHODS

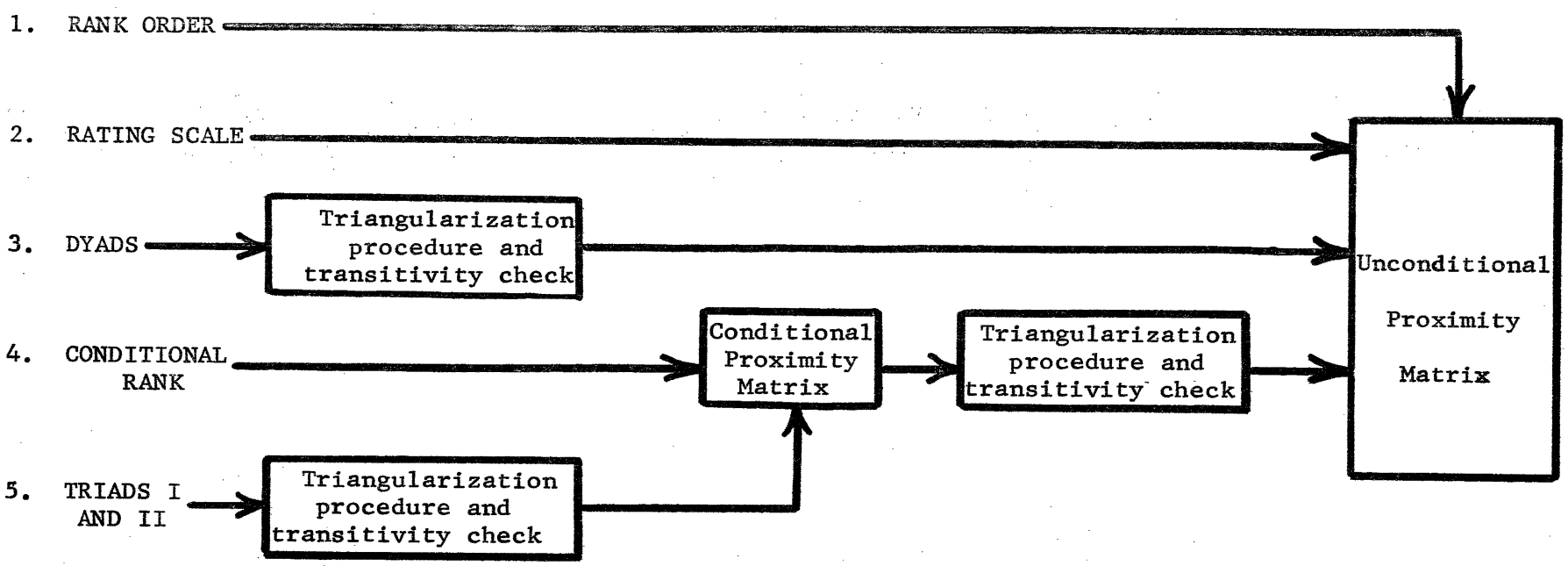


Figure 1 demonstrates that in selecting a method the researcher must be concerned with whether transitivity checks are important in his study. In addition, he must decide if he is willing to sacrifice the disjoint comparisons and substitute more intermediate analysis steps and assumptions. The remainder of this paper explores the empirical implications of these trade-offs.

Study Design

Fourteen college students using each of the six data collection methods made proximity judgments relating to seven automobiles. The subjects evaluated each of the methods in terms of the perceived difficulty and accuracy of their judgments as well as their enjoyment of the method. In addition, the time required by each subject to complete each of the methods was recorded.

Results

Table 1 presents the average rank order correlation between the six data-collection methods. These statistics were determined by calculating Spearman's Rho coefficient for the fifteen pair combinations of the six methods and averaging over the fourteen subjects. This analysis determines the similarity of the ranked interpoint distances between methods. Table 1 indicates that the intercorrelations ranged from rho = .76 to rho = .92. The median of this range was rho = .84.

The Table 1 data was further analyzed using a cluster analysis algorithm.[6/] The results of this analysis are presented in Table 2. The first level of clustering involves the combination of the Dyads and Rank Order methods. At

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6/ S. C. Johnson, "Hierarchical Clustering Schemes," Psychometrika Vol. 32 (September, 1967), pp. 241-54.

TABLE 1

DATA COLLECTION METHODS INTERCORRELATION MATRIX

	RATING SCALE	DYADS	CONDITIONAL RANK	TRIAD II	TRIAD I
DYADS	.85				
CONDITIONAL RANK	.77	.82			
TRIAD II	.80	.83	.88		
TRIAD I	.76	.82	.86	.82	
RANK ORDER	.84	.92	.83	.84	.84

TABLE 2

RESULTS OF THE CLUSTER ANALYSIS PERFORMED

ON THE DATA COLLECTION METHODS INTERCORRELATION MATRIX

DIAMETER METHOD	Conditonal Rank	Triad II	Triad I	Rating Scale	Dyads	Rank Order
0.10000000E 01	.	.	.	.	.	XXX
0.20000000E 01	XXX	.	.	.	.	XXX
0.60000000E 01	XXX	.	XXXXX			
0.11000000E 02	XXXXX	XXXXX				
0.15000000E 02	XXXXXXXXXXX					

the second level, a new cluster was formed involving Conditional Rank and Triad II. At the third level, the method of Rating Scale joined the Dyads and Rank Order cluster. At the fourth level, the method of Triad I joined the Triad II and Conditional Rank cluster.

Table 3 presents summary measures of the subjects' completion times for and evaluations of each of the six methods. The method of Dyads had the longest completion time of 21.7 minutes. This is contrasted with the method of Rating Scale which had the shortest time of 1.8 minutes. The remaining methods had somewhat similar completion times ranging from 4.4 to 7.2 minutes.

The subjects evaluated the difficulty of each method by means of a seven point scale ranging from extremely easy (scored 1) to extremely difficult (scored 7). The mean scores of the methods ranged between very easy (scored 2) and neutral (scored 4). The method of Dyads was the most difficult with a score of 3.9 while Triad I was the easiest with a score of 2.4.

The subjects were asked to judge the perceived degree of accuracy of their proximity judgments. The five point accuracy scale ranged from very good throughout (scored 1) to very poor throughout (scored 5). The mean scores of the methods ranged near good throughout (scored 2) and good at the beginning but poor towards the end (scored 3). The method of Dyads was lowest in perceived accuracy while the other methods were higher and quite similar in score.

The final evaluation scale involved the subjects' overall reaction to the methods. Judgments were recorded on a four point scale consisting of fun (scored 1), fun at beginning but boring toward end (scored 2), neutral (scored 3), and boring (scored 4). The mean scores of the methods ranged from fun to neutral. The method of Rank Order was the most fun with a score of 1.6 while the method of Triad I and Rating Scale were least fun with scores of 2.7.

TABLE 3

SUBJECTS' EVALUATION AND COMPLETION TIME

FOR EACH OF THE DATA COLLECTION METHODS

N = 14

	Time (min.)	Difficulty	Accuracy	Reaction
Rating Scale	1.8	3.2	2.1	2.7
Conditional Rank	4.4	2.7	1.9	1.9
Triad II	5.4	2.5	1.9	2.1
Rank Order	5.9	3.9	2.1	1.6
Triad I	7.2	2.4	2.1	2.7
Dyads	21.7	3.9	2.7	2.5

As indicated in Figure 1, the methods of Dyads, Conditional Rank and Triads allow transitivity checks. For these three methods, the subjects' judgments resulted in very few intransitivities. No consistent differences were observed between methods.

Discussion

The Table 1 results, involving the matrix of intercorrelations, indicate that the data-collection methods are correlated to a high degree. This finding supports the position that the researcher can select any of these methods with the assurance that his study results are not highly dependent on a particular data-collection method.

While the data-collection methods are highly correlated, the Table 2 results suggest that there are differences in the methods. Two clusters of data-collection methods were identified. Cluster one includes Dyads, Rating Scale and Rank Order while cluster two includes Triad I, Triad II and Conditional Rank. It is interesting to observe that the methods included in cluster two involve only conjoint judgments while the methods in cluster one include both conjoint and disjoint comparisons. This observation leads the authors to conclude that the cluster one methods approximate the true interpoint distances slightly better than the cluster two methods. This conclusion is based on the assumption that the more complete the method (in terms of comparisons made), the better it approximates the true parameters.

The difference between methods for completion times reflects differences between methods in terms of the total number of judgments and the nature of the judgment task. The method of Dyads had by far the largest number of judgments, which is reflected in its long completion time. In contrast, the method of Rating Scale involves a minimum number of judgments which is reflected in its very short completion time. Between these extremes, the remaining methods are similar.

It is interesting to observe that the cluster one methods (Rating Scale, Dyads and Rank Order) had similar difficulty scores. The cluster one methods were evaluated as somewhat more difficult than the cluster two methods. The authors speculate that the subjects found the disjoint comparisons more difficult than the conjoint comparisons.

While the perceived accuracy of the Dyads method was somewhat higher than the other methods, this concern was not reflected in terms of the intransitivity of the subjects' judgments. The subjects were possibly reacting more to the large number of judgments rather than the true inaccuracies in their judgments.

The methods of Rank Order and Rating Scale, in the judgment of the authors, possess some advantages over the other data-collection methods. First, both Rank Order and Rating Scale have reasonable completion times. If a short completion time is critical, then the Rating Scale method offers a special advantage. Second, both of these methods are in cluster two which also includes the Dyads method. Since the Dyads method involves explicit judgments on both disjoint and conjoint comparisons, the result of this method is assumed to be the best estimate of the true interpoint distances. Third, the subjects' evaluations of the two methods were equal to or better than some of the other methods. For example, the method of Rank Order was the best liked of the methods.

While the method of Dyads has the advantage of conceptually being a better estimate of the true interpoint distances, it has the major disadvantage of requiring a large number of judgments which result in a very long completion time. Consequently, the authors believe the method of Dyads is the least practical of the six methods.

The above conclusions are to be taken as statements which are somewhat conditional on such factors as the object set used (automobiles), the number of objects in the set (seven), and the fact that very cooperative subjects were involved. Given a different situation, the results and conclusions presented here may not be sufficient or even decisive in the researcher's final choice of a data collection method.

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