# Perceptual Maps of Destination Characteristics Based on Similarities Data

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**Individual travel-choice behavior may be characterized by individual perceptions of travel alternatives, individual preferences for the attributes of these alternatives, and the availability of these alternatives. The research reported in this paper was part of a general study of how individuals choose locations for nongrocery shopping trips. It identifies a perceptual space that represents the way individuals perceive shopping locations and evaluates the stability of generality of the perceptual representation across independent samples. The perceptual space developed consists of three dimensions that represent (a) size and variety, (b) price and quality, and (c) environment and parking and is similar for two independent samples of individuals. These results characterize the underlying aspects that individuals use to summarize their perceptions of shopping locations, demonstrate the feasibility of developing perceptual spaces for destination choices, and support the use of perceptual spaces developed for small samples as representative of the population from which they are drawn. The results of the cumulative research of which this is a part indicate that it is feasible to develop choice models based on perceived, rather than on engineering, characterizations of transportation alternatives. Relating travel choices to perceptions provides the ability to evaluate the importance of attributes that are not measurable by direct (engineering) methods.**

The primary object of a research project at the Transportation Center of Northwestern University is the development of improved models of travel-destination choice behavior, particularly with respect to selection of shopping locations. The improvements proposed are based on an analysis of the processes by which individuals perceive, evaluate, and choose among the alternatives that are available to them. Extensive development of travel models based on the analysis of individual choice behavior has been made in recent years. These models predict expected individual choice probabilities for a set of alternatives on the bases of the characteristics or attributes of the available alternatives and the characteristics of the individual making the choice. The attributes of alternatives are normally measured or evaluated by objective or engineering means.

Confining the modeling process to objective performance measures only excludes consideration of characteristics for which there are no objective measures. Thus, attributes such as comfort, privacy, and security are excluded from the characterization of alternatives despite recent findings that it is appropriate to include them on behavioral grounds (3, 6, 8). The exclusion of these variables may lead to misspecification of the choice models being developed. Furthermore, this exclusion makes it impossible for planners to evaluate the potential impacts of strategies designed to change the excluded characteristics of transportation alternatives.

The present approach represents measurable characteristics at values determined by direct or engineering means. This fails to account for individual variations in perceptions that may have important effects on choice behavior and prevents policy makers from evaluating strategies designed to modify individual perceptions of travel alternatives.

The research of which this paper is a part is designed to correct these limitations by developing methods that describe individual perceptions of shopping locations and using these perceptions as input to a choice function. This paper describes that portion of the research designed to develop and characterize individual perceptions of shopping locations by using multidimensional scaling techniques. The results of research in the development of perception-based choice models and comparisons of alternative methods for the analysis of individual perceptions will be reported in other papers.

The approach taken here is to develop and describe a common perceptual space for groups of individuals and to locate shopping locations in this perceptual space. The perceptual space represents the underlying characteristics that individuals use in differentiating alternative shopping locations. The development and identification of the perceptual spaces for independent samples parallels methods described previously for the identification of aspects of comfort of transportation modes (6).

The primary object of this study is the identification of the perceptual space that describes the way individuals perceive shopping-location alternatives. This identification includes the number of dimensions necessary to represent individual perceptions of shopping locations and the underlying characteristics of each of these dimensions. The identification of the perception space is based on individual reported similarities between pairs of shopping centers.

The second object of this study is the determination of whether the perceptual space developed for a random sample of individuals is representative of the perceptual space for the population from which they are drawn. The method of analysis used is limited to the development of a perceptual space based on data collected for 100 individuals. It is hypothesized that this space is representative of the perceptual space for the entire group of individuals. This hypothesis is tested by comparison of the perceptual space developed for two randomly selected samples of individuals.

## METHODOLOGY

The methodology used in developing and comparing the perceptual maps of shopping-center attractiveness had four phases. The first phase was the construction of measures of similarity between pairs of shopping centers for each member of a representative set of individuals. These similarity measures were used in the second phase to develop a multidimensional perceptual space. The third phase was the identification of the dimensions of the perceptual space. The fourth phase compared the perceptual spaces developed for two different samples of individuals. The analysis was based on individual data related to perception preference and use of the seven shopping locations described below.

| Shopping Location | Description |
|---|---|
| Chicago Loop | Downtown Chicago central shopping district |
| Edens Plaza | Moderate-sized shopping center on major highways |
| Golf Mill | Moderate-sized shopping center on major highways |
| Korvette City | Small discount shopping area |
| Old Orchard | Relatively large suburban shopping center |
| Plaza del Lago | Exclusive shopping center characterized by Spanish architecture and specialty shops |
| Woodfield | One of largest shopping centers in Midwest |

## Phase One: Constructing the Similarities Measures

The measure of similarity between two stimuli can be considered to be the perceived psychological proximity between the stimuli. Thus, the lower the rating of similarity, the closer two stimuli should appear on a perceptual map. When n stimuli exist, there are $n(n - 1)/2$ distinct pairs for which similarity measures can be computed. There are several techniques for obtaining data on direct-pair comparison similarities (4). The method used in this study required individuals to rate the similarity between pairs of shopping locations on a scale of one to seven as described by Stopher in a paper in this Record. These ratings were transformed to a scale that ranked the dissimilarity between pairs of shopping locations (tied dissimilarities received the average rank of all tied pairs). The result of this transformation was the normalization of the similarity ratings across individuals so that each individual's transformed ratings sum to the same number $(1 + 2 + \ldots + 21 = 231)$.

## Phase Two: Generating the Perceptual Configurations of Shopping Locations in Multidimensional Space

Multidimensional scaling methods were used to define the number of dimensions needed to represent the individual's perception space and place the shopping center locations in the perception space. The multidimensional scaling program used in this study, INDSCAL (1), identifies a common perception space for a group of individuals. Differences in perceptions among individuals are represented by the relative influence of each spatial dimension in the individual's overall determination of dissimilarities between pairs of stimuli. There are two basic assumptions in the INDSCAL program. First, all individuals are assumed to perceive the shopping locations in terms of the same underlying dimensions. This assumption is necessary for the development of a common perceptual space. Second, the similarity judgments of each individual are assumed to be related to the group similarity space by differential weighting of the underlying dimensions. In this manner, individual similarity measures for pairs of stimuli, shopping locations, are given by

$$d^i_{jk} = \left[ \sum_{t=1}^{r} w_{it}(x_{jt} - x_{kt})^2 \right]^{1/2} \quad (1)$$

where

$d^i_{jk}$ = estimated similarity distance between stimuli j, k for individual i;
r = number of dimensions in the perception space;
$w_{it}$ = weight that individual i places on dimension t, and
$x_{jt}$ = coordinate of stimulus j along dimension t.

This expression differs from the usual Euclidean distance formula by the inclusion of the weights that represent the importance that an individual associates with a dimension in forming his or her similarity judgment. These weights represent idiosyncratic differences in perception along each axis of the stimulus space. The coordinates of stimuli in the perceptual space and the individual weights are estimated by an iterative least-squares procedure (1). This estimation procedure is designed to maximize the portion of the total variance in representation of dissimilarities that is explained by the stimuli coordinates and individual weights.

The determination of the correct dimensionality of the perception space is based on both the relative fit of the different dimensional solutions and the usefulness or reasonableness of the resultant space in interpreting perceptions.

## Phase Three: Identification of Coordinate Axes for INDSCAL Solutions

The INDSCAL procedure provides a spatial configuration of group and individual perceptions for a set of stimuli, but to characterize this perceptual space, its dimensions must be identified. Although technical tools are available to assist in this task, the identification of the underlying dimensions is based, at least partially, on judgment.

One approach to the identification of the dimensions is based on an examination of the configuration of the stimuli in the perceptual space (3). This examination identifies the important characteristics that differentiate the stimuli along each of the dimensions. This approach must be used when there is no other basis for determining the characteristics of the dimensions in the perceptual space, but its effective use depends on the available information on the characteristics of the stimuli included.

In this study, the identification of the dimensions in the group perceptual space was aided by the use of additional information that consisted of ratings of the shopping centers for each of 16 attributes as discussed by Stopher in a paper in this Record. The ratings information was represented by a vector of average ratings of each shopping center for each attribute. A property-fitting program, PROFIT (2), was used to place each of these 16 attribute vectors in the group perceptual space provided by the INDSCAL solution by using linear regression procedures such that the projections of the stimuli in the perceptual space on these vectors most closely match the stimulus values on the attribute vectors. The orientation of the attribute vectors in the perceptual space helps to identify the underlying characteristics of each perceptual dimension.

## Phase Four: Comparison Among Perceptual Spaces

Perceptual spaces for the shopping-center stimuli were developed for two independent samples of 100 observations each. The generality of the perceptual space developed was tested by comparison of the perceptual spaces for the different samples. When perceptual spaces to be compared appear to have a common configuration and orientation, a direct comparison may be made by (a) the coordinates of the stimuli in the perceptual space, (b) the rank ordering of the stimuli along each of the dimensions in the perceptual space, and (c) the orientation of the attribute vectors in the perceptual space.

When perceptual spaces to be compared do not have a common orientation, it is first necessary to rotate one of the perceptual spaces. This is accomplished by use of the C-MATCH program (7), which determines the rotation necessary to best match the two different perceptual spaces. After rotation, the perceptual spaces can be compared as described above.

## ANALYSIS

The data were collected from approximately 7500 individuals who mailed back questionnaires that were distributed at four shopping centers in the North Shore area of metropolitan Chicago (9). These data were screened to eliminate individuals who indicated that they were not familiar with one or more of the seven shopping locations or who did not respond to all the questions required for this analysis. This left approximately 1600 questionnaires from individuals who had answered all the questions and indicated that they had at least some familiarity with each of the shopping-center stimuli. A further reduction was necessary because the INDSCAL program can analyze simultaneously only up to 100 individuals. Two random and mutually exclusive samples of 100 observations each were selected to develop the required perceptual spaces and to conduct the analysis.

The following procedure was used:

1. Develop and interpret the perceptual spaces for one sample at different levels of dimensionality and select the best on bases of judgment and fit statistics.
2. Identify the perceptual spaces of varying dimensions for the other sample.
3. Compare the perceptual spaces from the two samples and determine the consistency between the samples.

Figure 1. Variance in similarities-data explained.

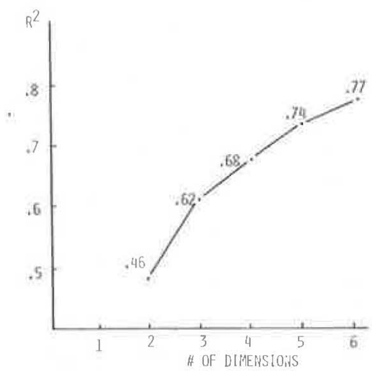
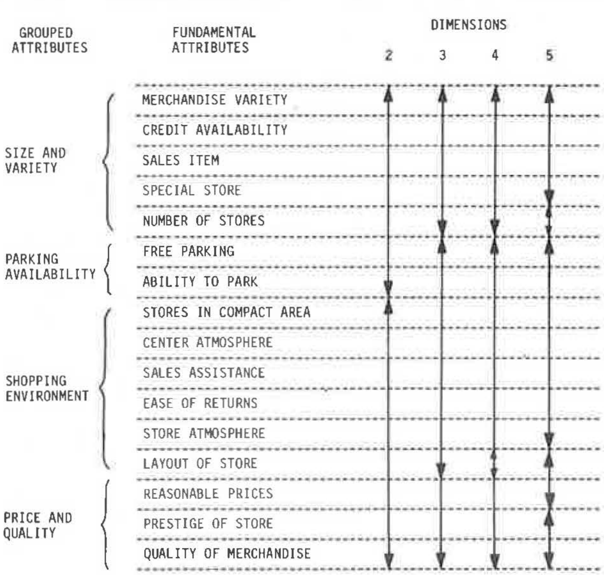



Figure 2. Attribute groupings and perception dimensions.




### Perceptual Spaces for Sample One

Perceptual spaces were developed for sample one for two to six dimensions. The portion of the overall variance explained by each perceptual space is described in Figure 1. As expected, the increase in the variance explained by each added dimension decreases. There are elbows (changes in slope) for the three and five-dimensional solutions.

The individual dimensions in the various perceptual spaces were interpreted by fitting the 16 attribute-rating vectors for the seven shopping locations in each of the perception spaces. These vectors of attributes were grouped together for each dimensional space by assigning each attribute to that dimension with which it has the largest vector cosine. Figure 2 summarizes these groupings for the two through five-dimensional spaces and categorizes those attributes that tend to group together. The effect of increasing dimensionality of the perceptual space can be examined by following the changes in groupings.

The two-dimensional solution combines size and variety (group 1) and parking quality (group 2) on one dimension and environment (group 3) and price and quality (group 4) on the second dimension. The three-dimensional solution restructures the clustering of groups to produce a more distinctive pattern of dimensions: One dimension consists of size and variety (group 1) alone; the second dimension combines parking quality (from group 2) with environment (from group 3) and may be interpreted as an overall measure of environment including ease of parking; and the third dimension includes price and quality only. The four-dimensional solution is similar to the three-dimensional solution except that store layout is separated from group three to identify the fourth dimension. This attribute also loads heavily on the same dimension as the other attributes in the convenience group, which suggests that little improvement in perceptual understanding is obtained by use of the fourth dimension.

The five-dimensional solution is similar to the four-dimensional solution except that the fifth dimension was loaded only with number of stores, which was previously included in the size-and-variety group, and price was shifted from the price-and-quality group to the dimension that previously included only store layout. The resulting dimensions do not lend themselves to useful interpretations. The six-dimensional solution was not analyzed as none of the 16 attributes were associated with the sixth dimension.

The ease of interpretation of the three-dimensional perceptual space and the small change indicated by the four-dimensional solution suggest that this space is appropriate to represent shoppers' perceptions of shopping places. The characterization of the dimensions is based on the length of the attribute-vector projections on each dimension.

The selection of the three-dimensional solutions is supported by the elbow in the variance-explained curve at this point (Figure 1). The selection of the three-dimensional solution also is supported by the ability to represent the attribute vectors in this space. The PROFIT model produces Pearson correlations for the goodness of fit of each attribute vector in the perception spaces, which increased markedly between the two and three-dimensional spaces, but little between the three and four-dimensional spaces (Table 1). The locations of the attribute vectors in the three-dimensional spaces are illustrated in the two-dimensional projections shown in Figures 3, 4, and 5.

Perceptual Spaces for Sample Two

Perceptual spaces were developed for sample two for two to four dimensions. The portion of the overall variance explained for the different spaces is almost identical to that for the corresponding spaces for sample one. As with sample one, there is an elbow for the three-dimensional space.

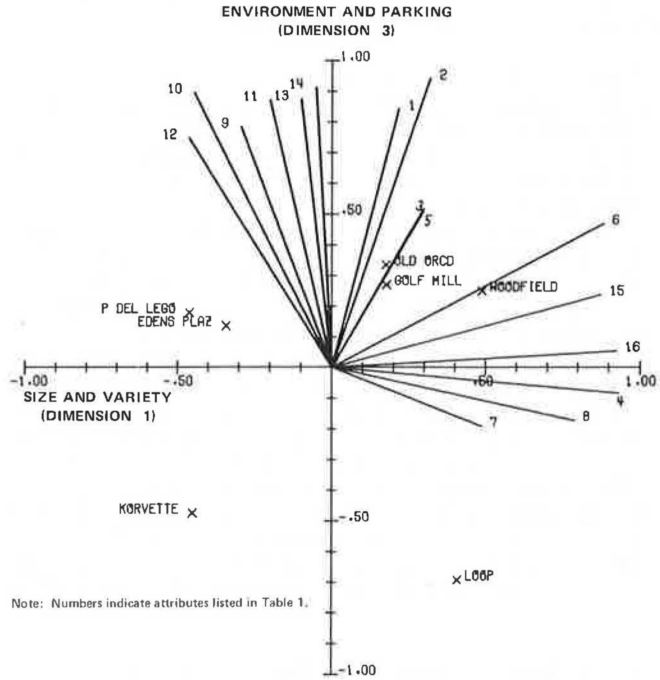
The two and three-dimensional perception spaces are very similar to the corresponding spaces for sample one. The same attribute groups load on the same dimensions. Thus, the interpretations of the two and three-dimensional spaces for sample two are identical to those for sample one. The four-dimensional solution is similar to the three-dimensional solution except that credit availability is separated out to identify the fourth dimension. This attribute also loads heavily on dimension three (price and quality), which suggests again that the fourth dimension does not provide useful additional information. As with sample one, the Pearson correlations for the goodness of fit of the attribute vectors in the stimuli spaces increased markedly between the two and three-dimensional solutions, but little between the three and four-dimensional solutions.

Thus, the analysis of sample two is similar to that of sample one. The two and three-dimensional solutions provide similar interpretations of the perceptual spaces for both samples. The four-dimensional solutions do not produce significant additional information on perceptual structure in either sample and have different structure between samples.

**Table 1. Correlation of attribute vectors with perceptual spaces.**

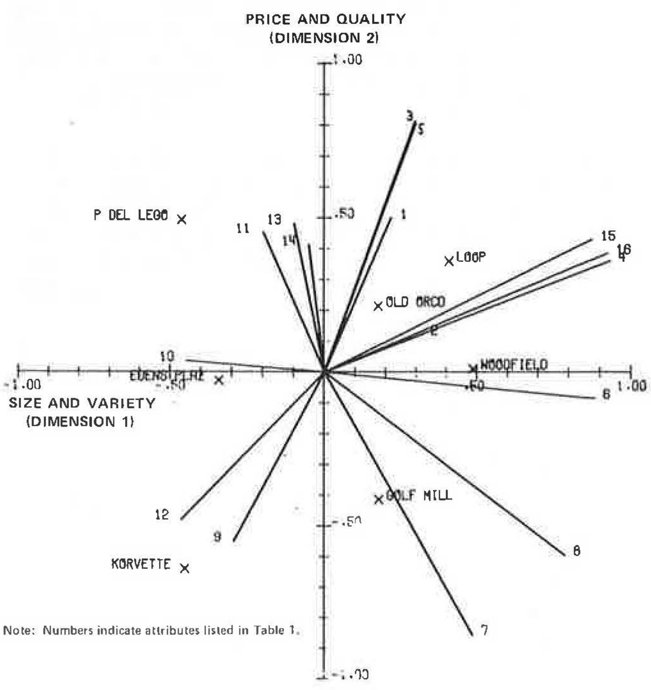
| | | Dimension of Perceptual Space | | |
|---|---|---|---|---|
| No. | Attribute | 2 | 3 | 4 |
| 1 | Layout of store | 0.87 | 0.92 | 0.92 |
| 2 | Ease of returning merchandise | 0.73 | 0.94 | 0.94 |
| 3 | Prestige of store | 0.99 | 0.99 | 0.99 |
| 4 | Variety of merchandise | 0.98 | 0.99 | 0.99 |
| 5 | Quality of merchandise | 0.98 | 0.98 | 0.98 |
| 6 | Credit availability | 0.80 | 0.94 | 0.95 |
| 7 | Reasonable prices | 0.80 | 0.92 | 0.95 |
| 8 | Availability of sales items | 0.81 | 0.89 | 0.94 |
| 9 | Free parking | 0.49 | 0.94 | 0.99 |
| 10 | Stores in compact area | 0.78 | 0.94 | 0.94 |
| 11 | Store atmosphere | 0.91 | 0.97 | 0.97 |
| 12 | Ability to park | 0.64 | 0.97 | 0.99 |
| 13 | Shopping-center atmosphere | 0.90 | 0.96 | 0.98 |
| 14 | Sales assistance | 0.89 | 0.97 | 0.98 |
| 15 | Availability of special stores | 0.96 | 0.97 | 0.97 |
| 16 | Number of stores | 0.97 | 0.98 | 0.99 |

**Figure 4. Projection on dimensions 1-3 plane.**



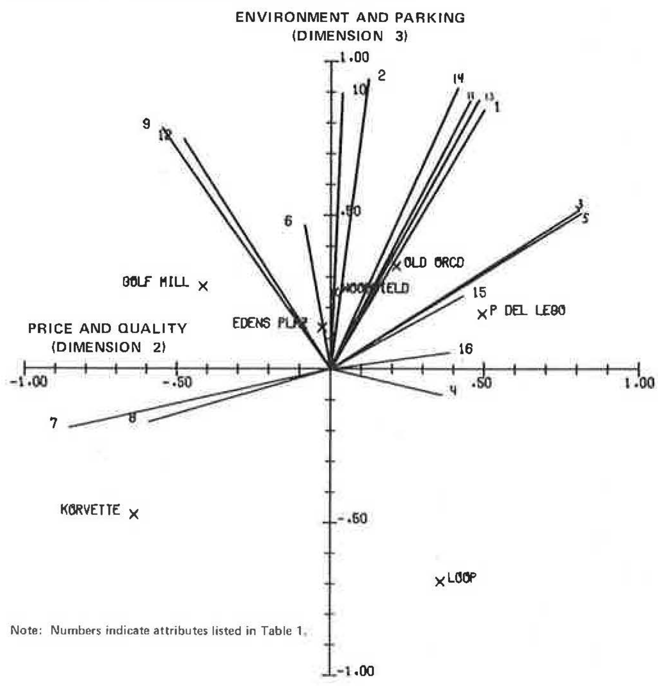

Note: Numbers indicate attributes listed in Table 1.

**Figure 3. Projection on dimensions 1-2 plane.**




Note: Numbers indicate attributes listed in Table 1.

**Figure 5. Projection on dimensions 2-3 plane.**




Note: Numbers indicate attributes listed in Table 1.

## Comparison Between Sample One and Sample Two

One of the objects of this research was the determination of the existence of a common perceptual space for shopping centers among residents of the North Shore area in which the sample was collected. One method of testing this hypothesis is to construct perceptual spaces by using independent samples and compare the spaces for consistency. Comparisons were made between perceptual spaces with two, three, and four dimensions for two independent samples. The comparisons are based on

1. Correspondence between the coordinates of the stimuli (shopping centers) in the perceptual space and
2. Correspondence between the directions of the attribute vectors in the perceptual spaces.

These comparisons assume a common orientation of the perceptual spaces developed for the two samples. This parallels the INDSCAL assumption that the perceptual space that is developed has a unique orientation, so that no rotation of the axes is needed to recover the underlying perceptual dimensions.

The common orientation of the perceptual spaces for the two samples was tested by determining the rotation necessary to obtain maximum correspondence between spaces of common dimensionality. The two, three, and four-dimensional perceptual spaces were compared by using the C-MATCH program (7). This procedure takes two configurations of a common set of stimuli, orthogonally rotates either or both of them to obtain the maximum congruence between them, and computes the rotation matrix required to obtain this congruence. The rotations required to obtain the maximum correspondence between each pair of spaces are shown in Table 2. Little rotation is necessary to match the two and three-dimensional spaces between samples (as indicated by the closeness of these rotation matrices to the identity matrices). However, the four-dimensional spaces require substantial rotation to achieve maximum congruence. As was indicated above, the INDSCAL solution is intended to produce a perceptual configuration that represents a unique orientation in the perceptual space. The fact that rotation is required to achieve maximum congruence suggests that there are underlying differences between the perceptual spaces for the two four-dimensional solutions. The lack of correspondence between these spaces is a probable result of increasing the degrees of freedom of the perceptual spaces to the point where the program is fitting the random elements of the particular data set rather than the underlying perceptual structure. That is, the higher dimensionality exhausts the structural information in the data set. Green and Wind (5) have suggested that for metric solutions, the determinancy of the space will be high when the number of stimuli is three or more times the number of dimensions in the perceptual space, and on this basis, the discrepancy between the four-dimensional solutions for spaces based on only seven stimuli is not surprising.

The very small amount of rotation required to obtain maximum congruence between the pairs of two and three-dimensional spaces confirms the common orientation between these pairs of perceptual spaces. The C-MATCH program also produces a measure of the correlation of interpoint distances (which is independent of rotation) between spaces of like dimension. These correlation measures were 0.87, 0.94, and 0.86 for the two, three, and four-dimensional spaces respectively.

Further comparisons of the INDSCAL solutions for the two samples are given for the two-dimensional spaces in Tables 3 and 4 and for the three-dimensional spaces in Tables 5 and 6. Tables 3 and 5 compare the coordinates and rank order of each of the stimuli on each axis in the perceptual spaces. Tables 4 and 6 compare the dominant loadings of the attribute vectors along each axis in the perceptual space. Tables 3 and 4 indicate a high degree of correspondence between the two-dimensional spaces generated by the two samples. The locations of the various shopping centers in the perceptual spaces are similar, although there is some disparity in rank ordering. The dominant loadings of the attribute vectors are similar with the exception of the stores-in-a-compact-area attribute, which loads almost equally in the two dimensions. Tables 5 and 6 indicate a high degree of correspondence between the three-dimensional spaces. The locations of shopping centers is similar, the number of rank differences is less than that for the two-dimensional spaces, and the dominant attribute loadings are very similar.

This analysis indicates an extremely strong correspondence between the three-dimensional spaces developed for the two independent samples. This strong correspondence has two important implications: First, it is possible to develop a perceptual space for a population group based on analysis of data for a small repre-

**Table 2. Rotation matrices to obtain maximum correspondence between samples.**

| | Sample 1 | | | |
|---|---|---|---|---|
| Sample 2 | 1 | 2 | 3 | 4 |
| Two-dimensional space | | | | |
| 1 | 0.99 | 0.11 | — | — |
| 2 | -0.11 | 0.99 | — | — |
| Three-dimensional space | | | | |
| 1 | 0.99 | 0.04 | -0.05 | — |
| 2 | -0.03 | 0.99 | 0.05 | — |
| 3 | 0.06 | -0.05 | 0.99 | — |
| Four-dimensional space | | | | |
| 1 | 0.94 | 0.21 | 0.25 | -0.02 |
| 2 | -0.03 | 0.82 | -0.57 | -0.04 |
| 3 | -0.31 | 0.52 | 0.74 | 0.29 |
| 4 | 0.11 | -0.13 | -0.25 | 0.96 |

**Table 3. Sample comparison: stimuli coordinates and rank order (two dimensions).**

| | Dimension 1 | | | | Dimension 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Sample 1 | | Sample 2 | | Sample 1 | | Sample 2 | |
| Shopping Location | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order |
| Chicago Loop | 0.50 | 1 | 0.46 | 1 | -0.17 | 6 | 0.11 | 3 |
| Edens Plaza | -0.35 | 5 | -0.13 | 5 | 0.10 | 4 | 0.01 | 5 |
| Golf Mill | 0.08 | 4 | 0.13 | 3 | -0.11 | 5 | -0.30 | 6 |
| Korvette City | -0.46 | 7 | -0.45 | 6 | -0.76 | 7 | -0.73 | 7 |
| Old Orchard | 0.16 | 3 | 0.12 | 4 | 0.34 | 2 | 0.30 | 2 |
| Plaza del Lago | -0.40 | 6 | -0.58 | 7 | 0.48 | 1 | 0.51 | 1 |
| Woodfield | 0.46 | 2 | 0.44 | 2 | 0.12 | 3 | 0.10 | 4 |

Table 4. Sample comparison: attribute vector loading along axes (two dimensions).

| Attribute | Dimension 1 Sample 1 | Dimension 1 Sample 2 | Dimension 2 Sample 1 | Dimension 2 Sample 2 |
|---|---|---|---|---|
| Layout of store | — | — | 0.98 | 0.93 |
| Ease of returning merchandise | — | — | 0.97 | 0.84 |
| Prestige of store | — | — | 0.94 | 0.90 |
| Variety of merchandise | 0.98 | 0.98 | — | — |
| Quality of merchandise | — | — | 0.94 | 0.92 |
| Credit availability | 0.95 | 0.98 | — | — |
| Reasonable prices | — | — | -0.92 | 0.75 |
| Availability of sales items | 0.76 | 0.92 | — | — |
| Free parking | -0.96 | -0.93 | — | — |
| Stores in compact area | — | -0.80 | 0.75 | — |
| Store atmosphere | — | — | 0.97 | 0.91 |
| Ability to park | -0.96 | -0.93 | — | — |
| Shopping-center atmosphere | — | — | 0.99 | 0.99 |
| Sales assistance | — | — | 0.99 | 0.99 |
| Availability of special stores | 0.89 | 0.89 | — | — |
| Number of stores | 0.96 | 0.93 | — | — |

Table 5. Sample comparison: stimuli coordinates and rank order (three dimensions).

| | Dimension 1 | | | | Dimension 2 | | | | Dimension 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample 1 | | Sample 2 | | Sample 1 | | Sample 2 | | Sample 1 | | Sample 2 | |
| Shopping Location | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order | Coordinate | Rank Order |
| Chicago Loop | 0.41 | 2 | 0.45 | 1 | 0.35 | 2 | 0.31 | 2 | -0.69 | 7 | -0.67 | 7 |
| Edens Plaza | -0.34 | 5 | -0.13 | 5 | -0.03 | 5 | -0.09 | 5 | 0.14 | 5 | 0.25 | 3 |
| Golf Mill | 0.18 | 3 | 0.14 | 3 | -0.41 | 6 | -0.37 | 6 | 0.27 | 2 | 0.24 | 4 |
| Korvette City | -0.45 | 6 | -0.44 | 6 | -0.64 | 7 | -0.65 | 7 | -0.47 | 6 | -0.49 | 6 |
| Old Orchard | 0.18 | 4 | 0.12 | 4 | 0.21 | 3 | 0.23 | 3 | 0.33 | 1 | 0.35 | 1 |
| Plaza del Lago | -0.46 | 7 | -0.59 | 7 | 0.49 | 1 | 0.53 | 1 | 0.18 | 4 | 0.06 | 5 |
| Woodfield | 0.49 | 1 | 0.45 | 2 | 0.01 | 4 | 0.04 | 4 | 0.25 | 3 | 0.26 | 2 |

Table 6. Sample comparison: attribute vector loading along axes (three dimensions).

| Attribute | Dimension 1 Sample 1 | Dimension 1 Sample 2 | Dimension 2 Sample 1 | Dimension 2 Sample 2 | Dimension 3 Sample 1 | Dimension 3 Sample 2 |
|---|---|---|---|---|---|---|
| Layout of store | — | — | — | — | 0.84 | 0.80 |
| Ease of returning merchandise | — | — | — | — | 0.94 | 0.95 |
| Prestige of store | — | — | 0.80 | 0.73 | — | — |
| Variety of merchandise | 0.93 | 0.97 | — | — | — | — |
| Quality of merchandise | — | — | 0.81 | 0.77 | — | — |
| Credit availability | 0.88 | 0.75 | — | — | — | — |
| Reasonable prices | — | — | -0.85 | -0.76 | — | — |
| Availability of sales items | 0.79 | 0.90 | — | — | — | — |
| Free parking | — | — | — | — | 0.78 | 0.81 |
| Stores in compact area | — | — | — | — | 0.89 | 0.91 |
| Store atmosphere | — | — | — | — | 0.87 | 0.79 |
| Ability to park | — | — | — | — | 0.75 | 0.71 |
| Shopping-center atmosphere | — | — | — | — | 0.87 | 0.88 |
| Sales assistance | — | — | — | — | 0.91 | 0.90 |
| Availability of special stores | 0.87 | 0.87 | — | — | — | — |
| Number of stores | 0.92 | 0.93 | — | — | — | — |

sentative sample drawn from that group. This means that perceptual representations can be extended beyond the sample of estimation to the population it represents in the same way that choice models are presently extended and implied. Second, in contrast to earlier expectations, it is possible to develop a representative perceptual space with a high degree of determinacy even when the number of stimuli is less than three times the number of dimensions. This is important because the number of relevant stimuli (alternatives) in transportation-choice situations is often small. However, the lack of correspondence between the four-dimensional spaces confirms that there is a close limit to the exploitation of small data sets.

## CONCLUSIONS

There were two primary objects of this research. The first was an investigation of the feasibility of constructing a representative perceptual space of shopping locations based on a small sample of individuals by analyzing reported measures of similarity. The second was the identification of underlying perceptions of shopping locations and an understanding of the policy implications indicated by these perceptual aspects.

With respect to the first object, the analysis demonstrated the ability to develop perceptual spaces in two and three dimensions that are subject to reasonable interpretation and similar for two independent sets of observations. These results indicate both that the development of perceptual spaces for destination attractiveness characteristics is feasible, and that the perceptual space developed is representative.

With respect to the second object, the perceptual space that has the best interpretability has the following three underlying characteristics: (a) size and variety, (b) price and quality, and (c) environment and parking. These three characteristics, therefore, suggest themselves as appropriate attractiveness measures to be used in destination-choice modeling. The common practice of representing alternative shopping locations in terms of measures of size and variety (such as retail employment or floor space) alone will define underspecified choice models. The results of this research suggest directions for objective quantification of shopping-location attributes that represent other characteristics that are important in formulating perceptions of shopping locations and provides decision makers with information about present perceptions. Discrepancies between these public perceptions and management perceptions suggest directions for changes in policies that may improve public perceptions. This is particularly critical when lack of information or misinformation causes incorrectly poor perceptions and consequently low utilization. Finally, this research confirmed the potential for measuring characteristics of consumer alternatives that are not measurable by direct or engineering means. Such consumer measurements could provide a basis for extending the scope of transportation policy analysis to include consideration of improvements in subjective characteristics of transportation alternatives.

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*Abridgment*

# Instrumental and Life-Style Aspects of Urban Travel Behavior

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The travel behavior of social groups has been discussed in the literature on the basis of several conceptual approaches. The first, the logistic-operational approach, emphasizes the prediction of flows in constrained transportation networks. Thus, trip-generation models have been developed that account for the trip-making rates of various population groups, which is sometimes referred to as a category analysis of travel demand (9). The second, the spatial-activity approach, relates travel purposes to urban forms and functions. Given the various preferences of social groups in terms of their activity space within a citywide opportunity field, different population groups are presumed to have distinctive residential choices and trip patterns, so as to overcome the friction of distance caused by the spatial differentiation of urban areas (3). The third, the market-segment approach, focuses on the varying needs of special groups in society. In this approach, the travel behavior of the disadvantaged, such as the poor, the aged, or the disabled, is investigated with the aim of identifying potential ways to overcome their mobility deprivation.

This increasing interest in the travel patterns of social groups has been accompanied by a closer investigation of the behavioral aspects of travel demand. Theoretically, travel is considered as an intermediate good, for which the demand is derived from the demand for the activity performed at the trip destination. In a broader sense, this function of transportation is known as the instrumental aspect of travel, where the activity of traveling ought to be related to a set of various tangible needs or requirements of households that necessitate movements between real-world locations. The instrumental aspect of transportation has been widely used in the methodological formulation of travel research, partly because of its obvious linkage to postulates of the theory of consumer behavior (1).

It is common practice to provide an operational definition of the instrumental function of transportation by a classification of trip purposes. Three main categories of trip purposes can be defined on an increasing scale of elasticity:

1. Subsistence trips (i.e., work and business trips) are characterized by their inelasticity in terms of periodicity, time, and location;
2. Maintenance trips (i.e., those for personal affairs and shopping) have more elasticity as far as the need it-