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MANAGEMENT EXPERIENCE WITH APPLICATIONS OF MULTIDIMENSIONAL SCALING METHODS

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by

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BACKGROUND OF THIS PAPER

This article is based on research sponsored by the Marketing Science Institute. It has been submitted for future publication in the Journal of Marketing.

MANAGEMENT EXPERIENCE WITH APPLICATIONS OF MULTIDIMENTSIONAL SCALING METHOD

James R. Taylor

Despite the fact that many marketing executives still rely heavily on their cumulative business experience and intuitive judgment to make decisions involving markets, in the final analysis it is the informed executive who holds the key to accurate decision making. Moreover, with the increasing trend toward diversification, marketing executives may find themselves confronted with decisions entirely new to their range of experience and intuitive perception.

In this situation, several basic marketing questions can arise. For example: How does the consumer perceive the brands in this new market? Which brands appear to have a high degree of substitutability and which do not? What is the buyer's preference for existing brands? Are there "holes" in the market which represent viable market segments? While marketing executives acquainted with this particular market may have developed sound answers to these questions, a company exploring entry to this new market may find these questions critical.

In recent years, important analytical techniques known as multidimensional scaling--or "mapping"--have been developed which purport to lend insight into such questions as: How do buyers perceive different brands in a market? And how do buyers' preference patterns relate to these perceptions?

The purpose of this paper is to introduce the mapping technique, and to present the findings of a small survey aimed at determining the reactions of companies that have had experience with this methodology.

Author's Note: Pioneering research in multidimensional scaling has been supported by the Marketing Science Institute under the designation of "Mathematical Analysis of Preference and Perceptions" (MAPP). In the interest of brevity, the term "mapping" is used for all techniques based on the same underlying models. While there are, of course, many variations in the specific procedures used to collect and organize data, no effort is made here to catalog or appraise these variations.

Here are the main findings that I am able to draw from my study analysis:

1. The extent of multidimensional scaling usage varies substantially among major users.

2. The appeal of mapping is in its usefulness in situations where the decision maker has limited information about a particular market.

3. Mapping is not an isolated research technique; rather, it is best used in combination with the company's regular research activity.

4. Two obstacles lie in the way of effective use of mapping: one is the lack of trained personnel to conduct the study and interpret the findings; the other is the difficulty of identifying the attributes that underlie the perceptual judgments of the buyer.

5. Further development of the mapping technique is required in order to determine how well it does or does not provide valid answers to specific questions about markets and marketing strategy decisions (e.g., what is the role of advertising in positioning a product in a particular market?).

WHAT IS MAPPING?

To date, only a handful of companies have had direct experience with mapping, and few articles have appeared which explain its basic concepts.[1] For the purposes of this nontechnical presentation, I shall separate mapping into areas, with on involving buyer perception of objects, and the other buyer preference for objects. The term "objects" can include an array of stimuli such as products, brand names, advertisements, company names, and so on.

Buyer Perception

A hypothesis central to much of this research on perception can be stated in this way: as two objects are perceived as becoming more similar

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1. See L.A. Neidell "The Use of Nonmetric Multidimensional Scaling in Marketing Analysis," Journal of Marketing, October 1969, p. 37 for a non-technical treatment of mapping.

to each other, the greater the probability that the individual's behavior toward each object will become more similar.[2] This is an intuitively appealing hypothesis, and one which has been supported in many fields of psychology.

In a marketing context, this hypothesis can be restated so that it reads: as two products become more similar, the greater the probability that the buyer will preceive the products as substitutes. This hypothesis argues, in effect, that buyer perception of the proximity of products can be used as a measure of product competition.

In 1962, R. N. Shepard of the Bell Telephone Laboratories developed the logic for a computer program that can represent a person's perception of the similarity between a set of objects in terms of a geometric space.[3] Subsequently, the Marketing Science Institute supported a project under the direction of Paul Green of the University of Pennsylvania which explored Shepard's work and that of others. This project resulted in a number of methodological contributions and a series of computerized programs for the analysis of buyer perception and preference for products.

1. Known Configurations: The basic concepts of the computerized programs just cited can be presented by means of a typical service station road map, which gives the mileage between cities. While the format of these kinds of charts differ, all contain the same information--namely, the distance between every city listed.

Table 1 presents a road mileage chart for several cities in the lower peninsula of Michigan in which it is possible to determine the distance between selected cities. This type of chart is technically known as a matrix

2. B. Berelson and G. Steiner, Human Behavior (New York, Harcourt, Brace & World, Inc., 1964), p. 138; also J. G. Holland and B. F. Skinner, The Analysis of Behavior (New York, McGraw-Hill, 1961), p. 137.
3. "The Analysis of Proximities: Multidimensional Scaling With an Unknown Distance Function," Parts 1 and 2, Psychometrika, XXVII (1962), pp. 125-139 and pp. 219-246.

Table 1

Road Mileage Chart

	Ann Arbor	Benton Harbor	Cheboygan	Dearborn	Grand Rapids	Grayling	Lansing	Ludington	Port Austin	Traverse City
Ann Arbor										
Benton Harbor	144									
Cheboygan	267	308								
Dearborn	36	180	273							
Grand Rapids	124	80	228	146						
Grayling	195	239	77	201	159					
Lansing	62	115	222	84	62	146				
Ludington	220	144	199	236	96	131	158			
Port Austin	156	267	238	125	199	166	152	209		
Traverse City	235	221	112	241	148	53	180	93	214	

of "interpoint distances"-- that is, the "points" are the cities and the "distances" are the road miles. In using Shepard's mapping procedure, this matrix could have brands of powdered soap as the objects analogous to points and the buyers' perceived similarity between brands as the distances. (I shall say more about this later, but first let us return to the road-map example.)

For the purpose of discussion, assume that the location of the ten Michigan cities shown in Table 1 is unknown to a certain individual. Given the information from this table, would it be possible for that person to determine the approximate location of these cities? The answer to this question is "Yes".

Of course, his task would be somewhat easier if he were to be told that Benton Harbor is in the southwestern part of the state. With this hint, he could then readily move the remaining nine points (cities) around on a sheet of paper until the interpoint distances were similar to the mileage distances shown in Table 1. Thus, when he found a good match, the configuration of points on the paper would be similar to the configuration of the cities on the map of Michigan.

The problem could be made more difficult by changing the situation somewhat. For example, suppose that Table 1 presented only the rank order of the interpoint distances instead of the actual miles between cities. The smallest interpoint distance between Dearborn-Ann Arbor (36 miles) would be ranked No. 1, while the largest interpoint distance between Cheboygan-Benton Harbor (308 miles) would be ranked No. 45.

Table 2 gives the rank interpoint data for all 45 pairs of cities. Ranks that are identical represent pairs of cities with identical interpoint mileages. For example, the mileage between Lansing and Ann Arbor is the same as the mileage between Lansing and Grand Rapids.

With the data in Table 2, would it now be possible for our example individual to determine the location of these ten cities? The answer is still "Yes". Shepard showed that, given just the rank order of interpoint distances, a configuration of points exists which nearly mathches the original rank order of interpoint distances.[4] Incidentally, this fact was not obvious to researchers up to the time of Shepard's paper; theyfelt intuitively that there could be different configurations of points which would fit the original rank order of interpoint distances.

J. B. Kruskal used Shepard's work and further developed a computer program which would find this unique geometric configuration.[5] Since then, numerous programs have been developed. To demonstrate the capabilities of Kruskal's computer program, I analyzed the ranked data from Table 2 with this program. Figure I indicates how closely the output configuration comes to the actual configuration of city locations. While the match is good, it is admittedly not perfect.

The reason the fit is not perfect illustrates a key assumption in the computer program that the interpoint distances are straight-line distances between two points. In terms of our road-map example, this assumption is incorrect because roads rarely are straight lines between cities. Since the mileage between Grayling and Port Austin reflects a detour around Saginaw Bay, the computer program consequently plotted the point for Port Austin farther to the southeast than it should have, because of the assumption that the distances were straight-line. If the airline distances between cities had been used, the computer configuration would have represented a better fit. However, even with this obvious violation of the distance function, the computer configuration still is a good representation of the configuration of cities.

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4. Shepard, op. cit.
5. See his articles, "Multidimensional Scaling by Optimizing Goodness of Fit to a Nonmetric Hypothesis," Psychometrika, XXIX (1964), p. 1; and Numerical Method, Psychometrika, XXIX (1964), p. 115.

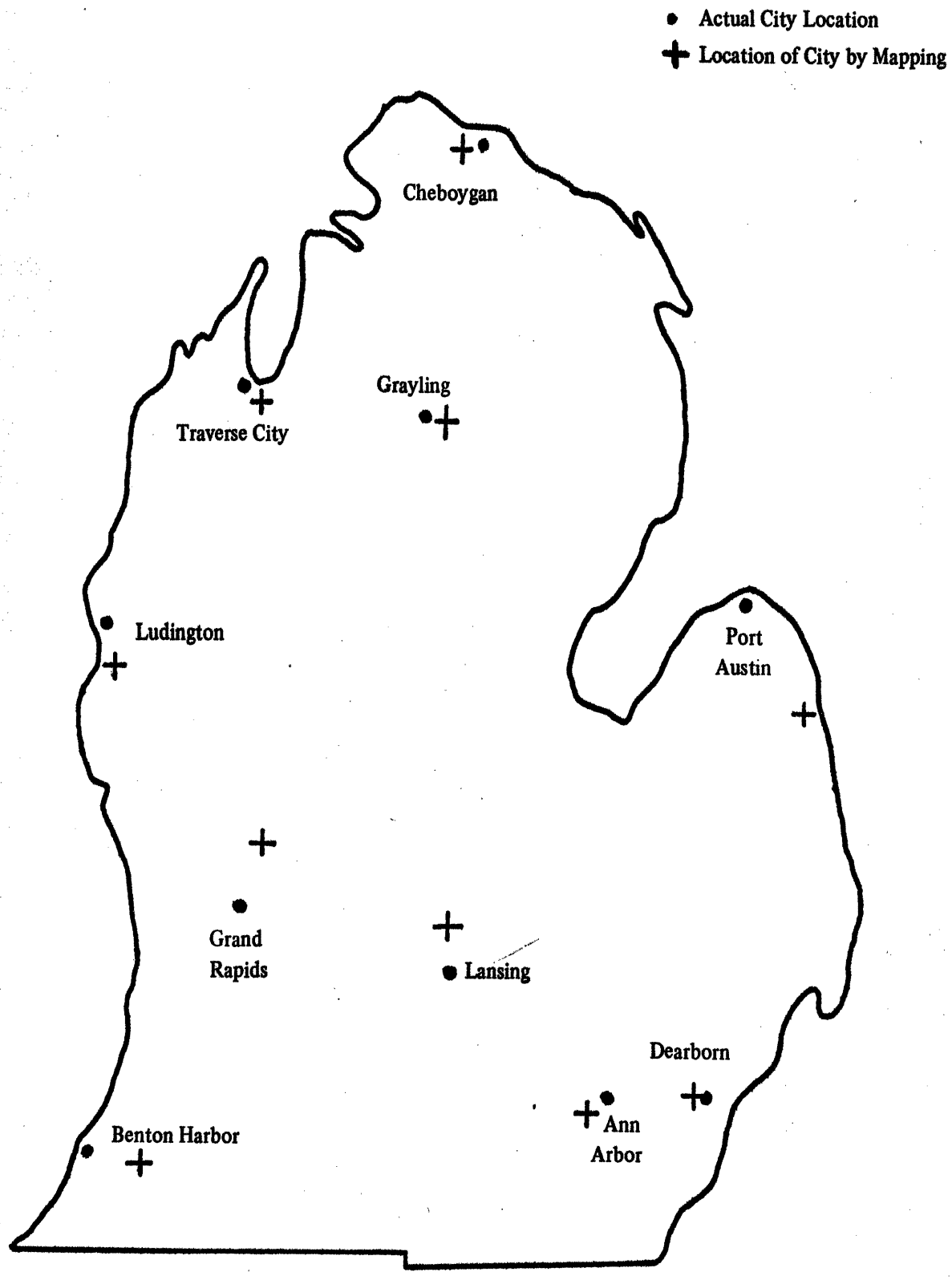
Table 2

Ranked Interpoint Distances for Road Mileage Data

	Ann Arbor	Benton Harbor	Cheboygan	Dearborn	Grand Rapids	Grayling	Lansing	Ludington	Port Austin	Traverse City
Ann Arbor										
Benton Harbor	15.5									
Cheboygan	42.5	45								
Dearborn	1	25.5	44							
Grand Rapids	12	6	36	17.5						
Grayling	27	40	5	30	23					
Lansing	3.5	11	35	7	3.5	17.5				
Ludington	33	15.5	28.5	38	9	14	22			
Port Austin	21	42.5	39	13	28.5	24	20	31		
Traverse City	37	34	10	41	19	2	25.5	8	32	

Figure 1

Comparison of Actual Location of Ten Michigan Cities
with the Locations Defined by Mapping



Recent computer programs allow the researcher to use an array of different distance functions, rather than restricting him to the straight-line assumption. The problem, however, is that the researcher may not know which distance function is appropriate for a given situation. Consequently, the straight-line function is usually used.

Another central concept of mapping relates to configuration dimensionality. In the case of any road map, we know that the configuration of cities is two dimensional; obviously, there is both latitude and longitude. Since the computer program was not told how many dimensions were involved in our Michigan road map example, how did it arrive at the two-dimensional solution?

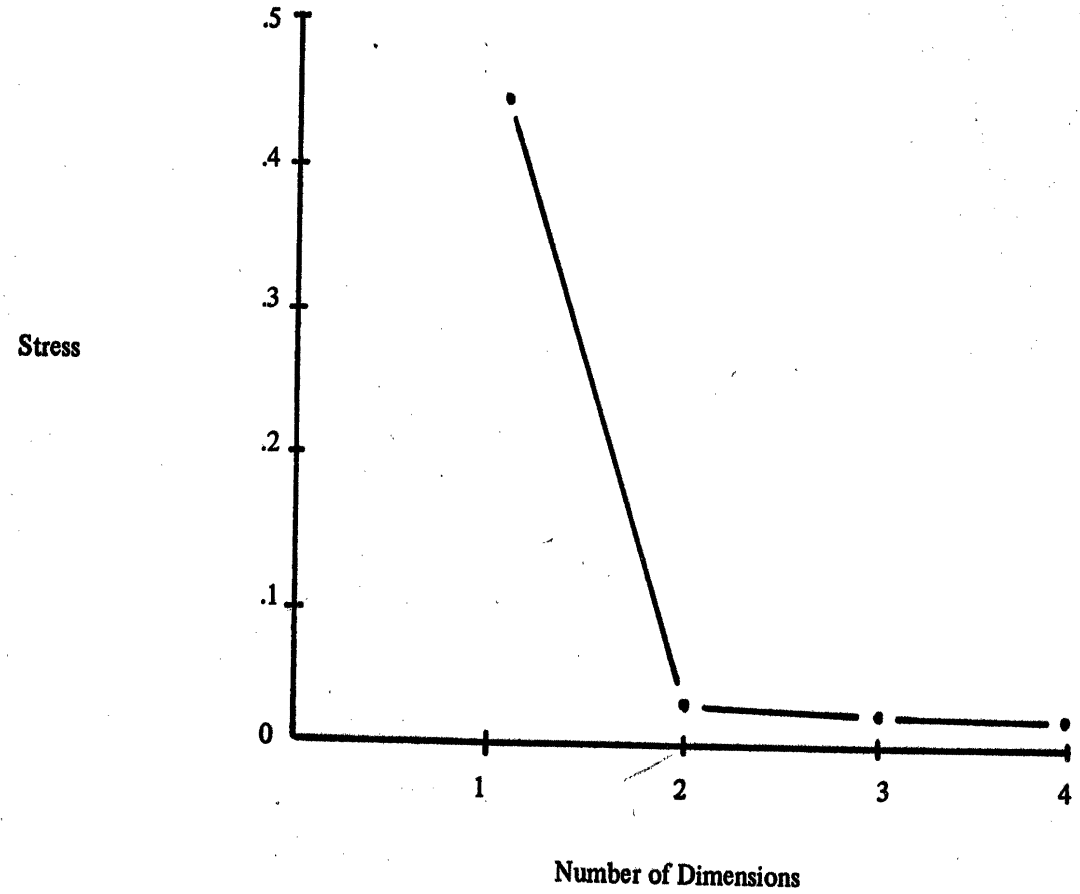
A full answer to this question requires a technical explanation that would be beyond the scope of this discussion. Suffice to say, however, is that the program tries to find a configuration of points in one dimension (line) which best fits the original rank order of inter-point distances. Then, the program does this for two dimensions, three dimensions, and so on, and a measure of the lack-of-fit is computed for each of these dimensions. The lower the lack-of-fit index, the more similar the computer configuration is to the actual configuration.

Different computer programs have different names for their own lack-of-fit index; in our road map example, it is called "stress", and Figure II gives the stress index for the final configuration of dimensions one through four.

Figure 2 indicates that the stress is high for a one-dimensional representation. This suggests that the original configuration--that is, the map of Michigan--is not one dimensional. In two dimensions, however, the stress index falls to a low level, thereby suggesting a good fit. Since stress does not drop significantly when the number of dimensions is increased to three and four, this indicates that the original configuration is two dimensional.

Figure 2

Lack-of-fit Index (Stress)
for Road Mileage Data



2. Unknown Configurations: The discussion has thus far been based on the ability of the Shepard-Kruskal method to recover a known configuration of two dimensions as we have seen in our road map example. What happens when we are confronted with a situation where the nature of the original configuration is unknown? This is the type of problem that is most interesting to both marketing executives and researchers.

For example, assume that we show the map of the ten Michigan cities to a citizen of Michigan, and ask him to judge which pairs of cities are more similar to each other. He uses his own definition of "similarity", and makes judgments for all pairs of cities. When he has completed his judgments, a matrix of similarity rankings can be developed. Now let us further assume that the matrix in Table 3 represents this person's similarity judgments.

At this point, several questions can be raised: (1) How many dimensions underlie this citizen's perceptual judgments about the similarity and dissimilarity of Michigan cities?; (2) What does the configuration look like--that is, which cities are most similar and which are most dissimilar to each other?; and (3) is it possible to identify the attributes underlying this configuration?

The answer to the first question of dimensions can be found by mapping--that is, by looking at each of the various stress figures. Figure III indicates that the configuration is a good fit in one dimension. The stress indexes in dimensions two through four are not significantly lower than they are in one dimension. Stress in one dimension is also low in an absolute sense (below .05). Consequently, it appears that our citizen of Michigan used one dimension or one attribute in his appraisal of the similarities among these ten road map cities.

The second question relates to the nature of the configuration, and this can also be answered by mapping. Figure IV shows the one-dimensional

Table 3

Ranked Interpoint Distances
for Similarity Judgments of Cities.

	Ann Arbor	Benton Harbor	Cheboygan	Dearborn	Grand Rapids	Grayling	Lansing	Ludington	Port Austin	Traverse City
Ann Arbor										
Benton Harbor	20									
Cheboygan	22	12								
Dearborn	17	26	32							
Grand Rapids	39	40	43	27						
Grayling	23	14	4	33	44					
Lansing	18	29	36	9	25	37				
Ludington	21	10	3	30	42	6	35			
Port Austin	24	16	5	34	45	2	38	7		
Traverse City	19	1	11	28	41	13	31	8	15	

Figure 3

Lack-of-fit Index (Stress)
for Similarity Judgments of Cities

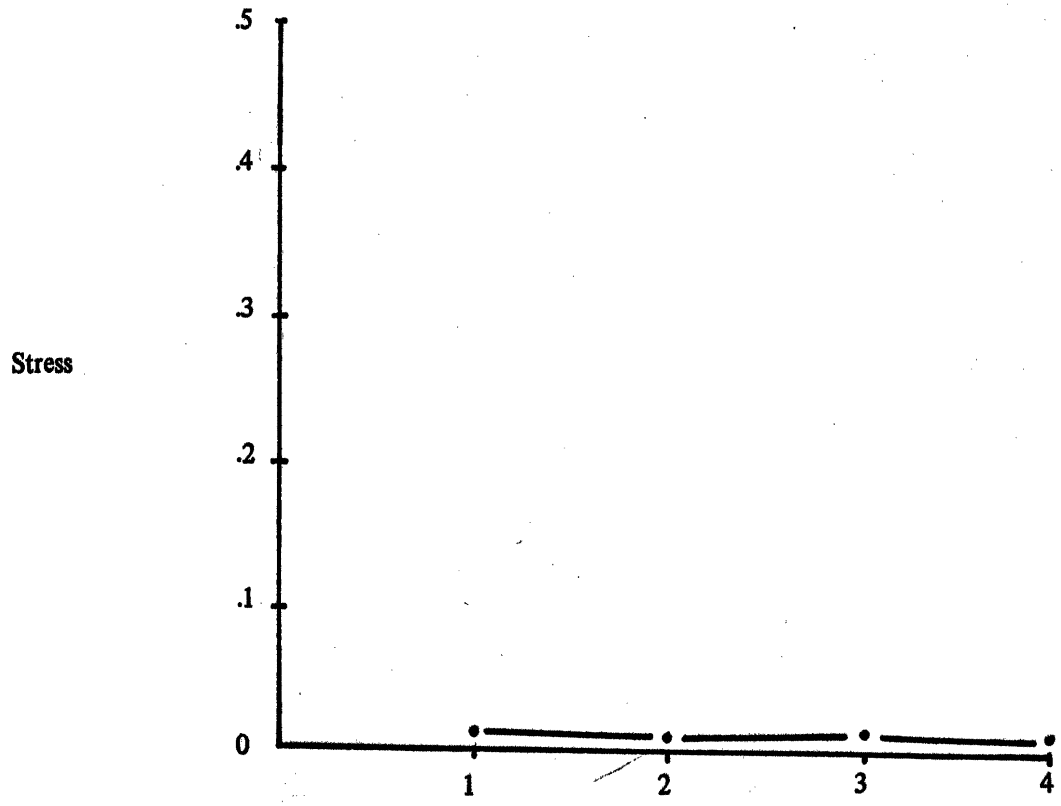
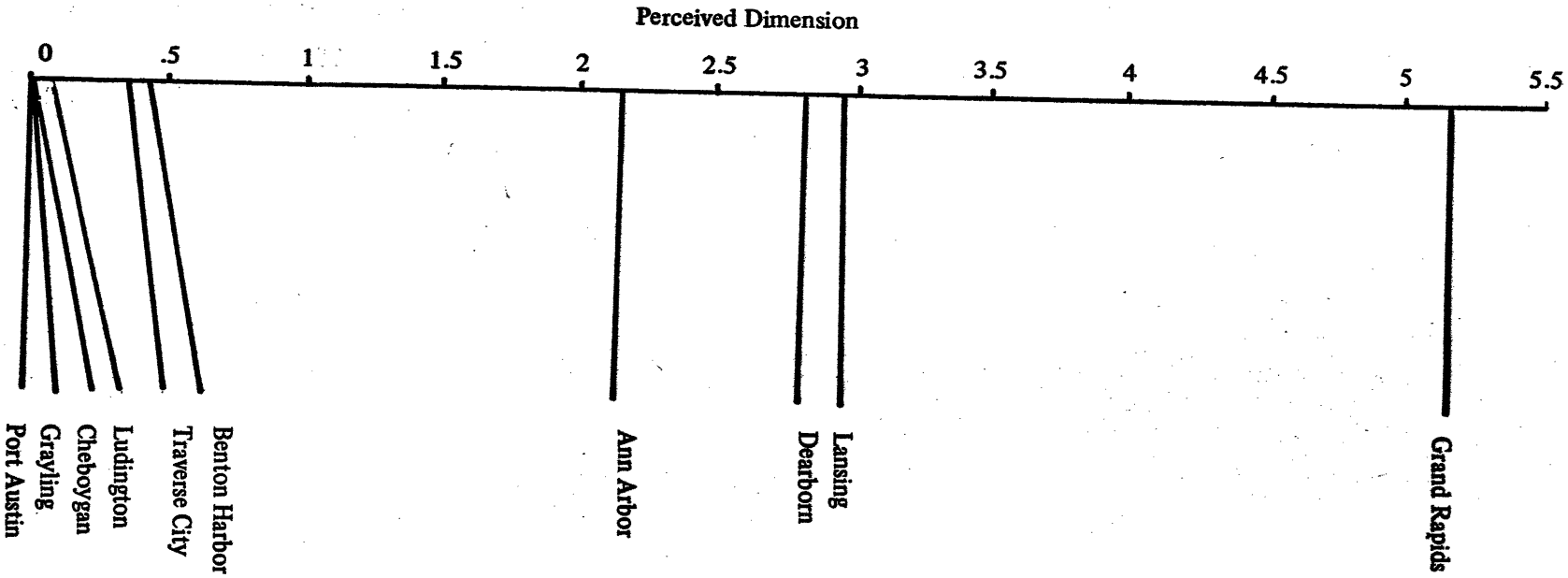


Figure 4

Perceptual Map of Ten Michigan Cities



configuration for the ten selected cities. It appears that Port Austin, Grayling, and Cheboygan are perceived as being very similar on this unknown attribute. The city of Grand Rapids, however, is seen as quite dissimilar from these three cities.

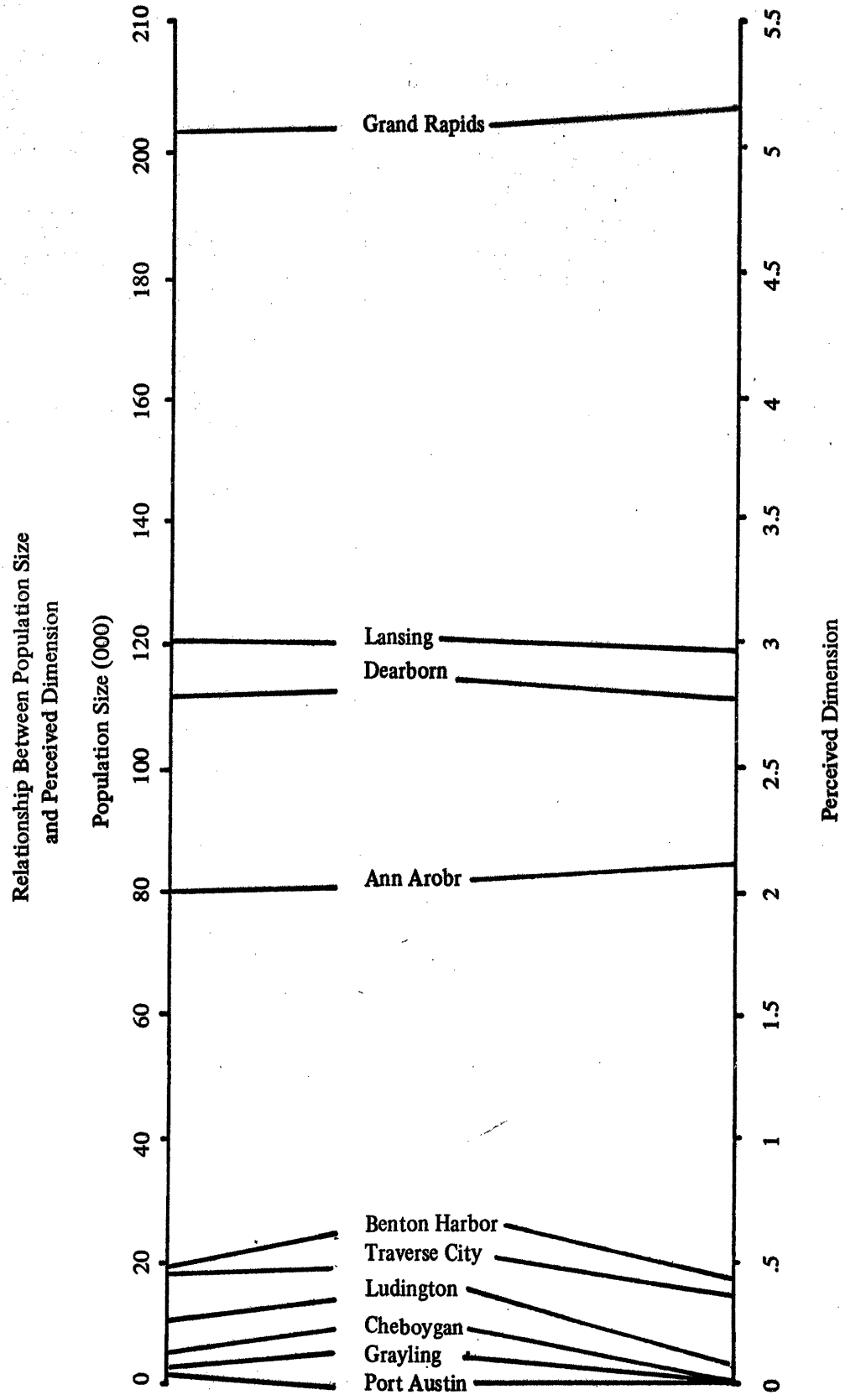
The third question concerns the nature of the attributes underlying these perceptions, and here a number of methods can be used to derive the answer. Buyers can be asked to evaluate the objects in terms of several defined attributes, and the attribute scales then correlated with the perceived dimensions. Another approach is to have the manager or researcher interpret the dimensions on the basis of his experience and related research findings. Still another method is to relate the perceived dimension to some known physical attribute of the objects. An example of this latter approach would be to relate the perceived one-dimensional scale of cities to some know physical attribute of the cities. In this case, after looking at the cities, we might hypothesize that they are arrayed in terms of their population size.

Since Figure V indicates that the attribute of population size appears to correlate extremely well with the perceived dimension from Figure IV, we might thus conclude that our citizen of Michigan perceived differences in Michigan cities in terms of their population size. Obviously, he was not using geographic location as the basis for making his perceptual judgments because mapping did not recover a two-dimensional configuration like that shown in Figure I.

Up to this point, the discussion has demonstrated the types of questions mapping is intended to answer. The key feature of the program is its ability to recover a n-dimensional configuration from just the rank order of interpoint distances. Since buyers can be asked which pairs of objects (products, advertisements, and so on) are more similar than other pairs, researchers can develop matrices like that shown in Table 2 for those

Figure 5

Relationship Between Population Size and Perceived Dimension



objects of managerial interest. Mapping can determine the dimensionality underlying these judgments and indicate the nature of the configuration of objects.

However, the identification of the attributes does not come from mapping. Attribute identification requires the collection of additional data relating to attributes or the intuitive identification of attributes by those persons involved in the mapping study.

A final distinction relates to the ability to analyze the perceptions of a single person. This was the case in the previous example when a hypothetical citizen of Michigan was asked what his perception of the similarity of various cities was. If a group of Michigan citizens had been asked to make these judgments, we could compare their configurations and determine the degree of similarity in their perceptions of Michigan cities. Conceivably, all could have identical one-dimensional configurations. Alternatively, they could have quite different configurations. Possiby various segments of persons with similar perceptions could be identified. Those citizens who live in large cities may have different configurations than citizens in small cities. Such questions can be answered by mapping and possibly they relate to decisions about market segmentation strategies.

Buyer Preferences

The second aspect of mapping concerns buyer preference patterns for objects. These concepts can be explored more clearly by returning to our hypothetical citizen of Michigan. We previously learned through use of mapping that he perceives differences in the ten Michigan cities in terms of the attribute of population size. The question of whether this attribute is of prime importance in formulating his preference judgments can now be investigated.

Table 4

Ordering of Cities by Preference and Population Size

Preference	Population Size
Most Preferred	Largest
1. Grand Rapids	1. Grand Rapids
2. Lansing	2. Lansing
3. Dearborn	3. Dearborn
4. Ann Arbor	4. Ann Arbor
5. Benton Harbor	5. Benton Harbor
6. Traverse City	6. Traverse City
7. Ludington	7. Ludington
8. Cheboygan	8. Cheboygan
9. Grayling	9. Grayling
10. Port Austin	10. Port Austin
Least Preferred	Smallest

Suppose he is asked to rank the ten cities from "most preferred" to "least preferred". By comparing his preference rank order to the ordering of cities on the attribute of population size, we can determine whether population size appears to be the basis for his judgments.

Table 4 shows the preference ordering of cities by the Michigan citizen, plus the ordering of cities on the attribute of population size. Since the preference ordering is consistent with the ordering of cities in terms of population size, we can conclude that the attribute of population size underlies this person's preference judgments. In addition, we can conclude that his ideal city has a large population.

Whereas in the preceding discussion we have concerned ourselves with equating one person's judgments to the attribute identified through his perceptual judgments of similarity, by expanding the discussion to include more Michigan citizens, we can now illustrate another key element of mapping. Let us assume that a total of 100 citizens are asked to rank the cities in terms of preference. Assume also that their perceptual judgments of similarity are identical to those of our original citizen--that is, the attribute of population size best explains their similarity judgments.

We could view each of these citizens as having an ideal population size for a city that could be located anywhere on the perceived attribute of population size. In technical terminology, the ideal population size is referred to as a person's "ideal point," and the location of the cities on the perceived attribute is known as a "stimulus point." Consequently, the sample of 100 Michigan citizens can be viewed as having 100 ideal points that can be arrayed along the perceived attribute of population size. Some citizens may prefer large cities, others very small cities, while still others may have ideal points between these extremes.

Figure 6

Ideal Point Location on Population Size Dimension

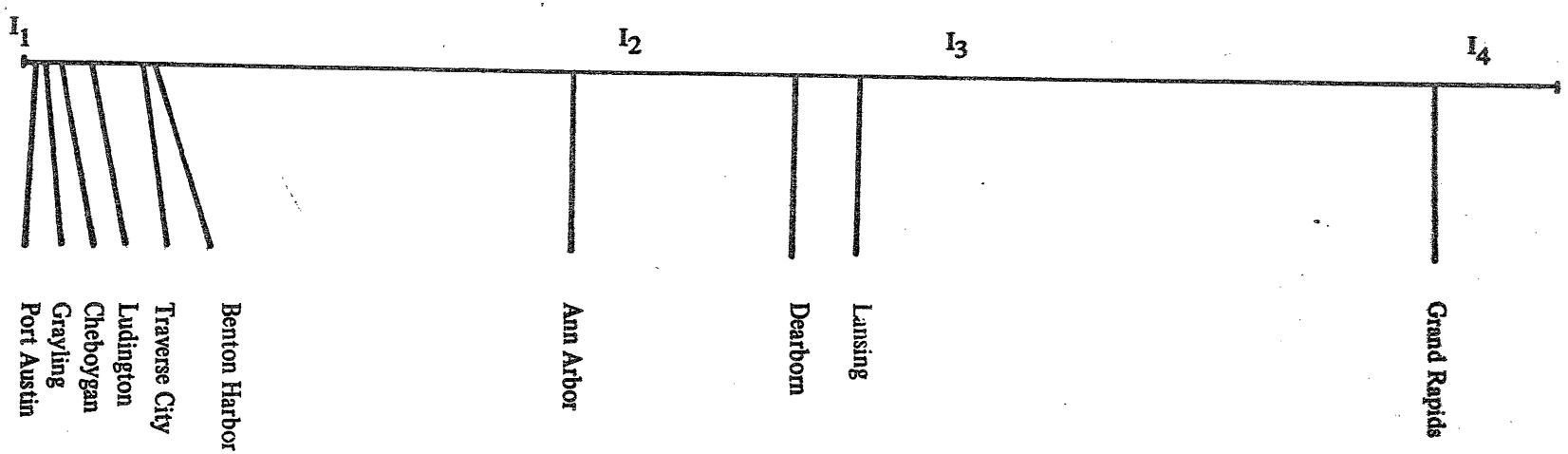


Table 5

Ideal Point Preference Orderings

	Most Preferred		
I_1	I_2	I_3	I_4
1. Port Austin	Ann Arbor	Lansing	Grand Rapids
2. Grayling	Dearborn	Dearborn	Lansing
3. Cheboygan	Lansing	Ann Arbor	Dearborn
4. Ludington	Benton Harbor	Grand Rapids	Ann Arbor
5. Traverse City	Traverse City	Benton Harbor	Benton Harbor
6. Benton Harbor	Ludington	Traverse City	Traverse City
7. Ann Arbor	Cheboygan	Ludington	Ludington
8. Dearborn	Grayling	Cheboygan	Cheboygan
9. Lansing	Port Austin	Grayling	Grayling
10. Grand Rapids	Grand Rapids	Port Austin	Port Austin
	Least Preferred		

Since the question arises as to how the ideal points and stimulus points interrelate to form a preference pattern, we may now hypothesize that the nearer a stimulus point is to the ideal point, the more preferred it becomes.

Figure VI shows the location of four ideal points (I_1 to I_4) on the perceived attribute of population size. Thus if our hypothesis is true, I_2 should prefer Ann Arbor first, Dearborn second, Lansing third, and so on. Table 5 lists the complete preference ordering for each of the four ideal points.

Assuming the 100 citizens do follow this hypothetical rule, so that we can relate the perceived attribute to the preference data, then a distribution of ideal points can be plotted on the attribute. Figure VII illustrates what this distribution could look like. There appears to be a viable segment of the sample that prefers small cities, while another segment prefers large cities.

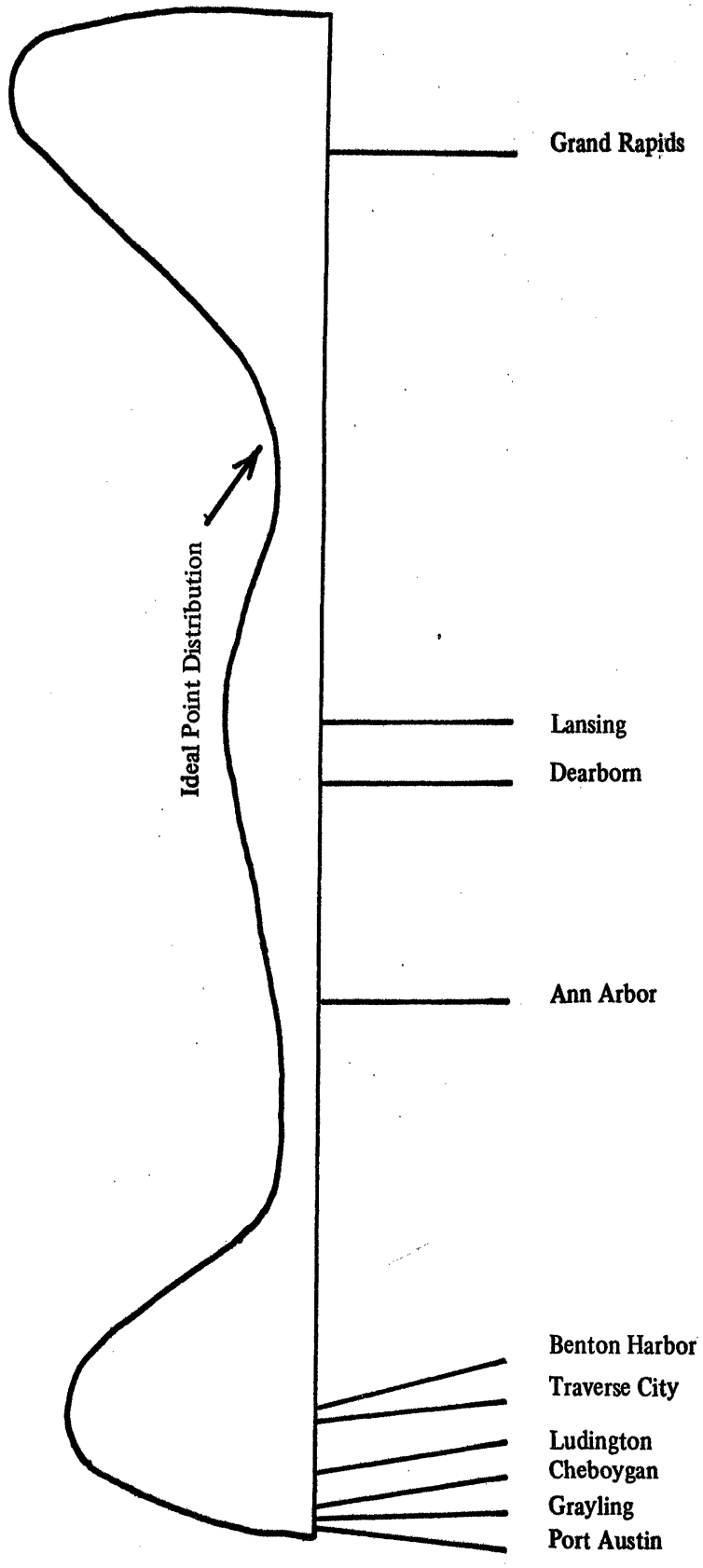
In Summary

Let us review the basic concepts we have covered thus far in our greatly simplified discussion of mapping. First, we saw the perceptual aspect of mapping. From a person's judgments about which objects are more or less similar to other objects, we noted that mapping can basically determine the number of dimensions or attributes underlying these perceptions, and indicate the nature of the configuration of these objects. The Michigan road map was an attempt to illustrate this feature of mapping.

Second, we examined a person's preference for objects by hypothesizing that his preference judgments can be related to his perceptual judgments of similarity. We noted a rule for testing this hypothesis and saw an example for a one-dimensional situation. We also learned that these same concepts can be extended to an n-dimensionl configuration, and that

Figure 7

Distribution of Ideal Points
on Population Size Dimension



the addition of preference data to the dimensional configuration of objects allows us to identify viable segments of the market. In addition, we recognize that there is a possibility of predicting how market shares might change, given the entry of a new product or the movement of an existing product in the configuration.

USAGE OF MAPPING

While a great deal of technical literature pertaining to mapping methodology is available, little has been done to document the reactions and experiences of firms that have used this multidimensional scaling technique. Since both the business community and academia are areas in which substantial technical development is taking place, now is the time to shed some light on the managerial implications of mapping and questions related to it.

The Marketing Science Institute recently initiated a short field investigation of current business applications of mapping to explore the actual, and/or potential, managerial implications of this technique. The purpose of the research was to examine how mapping is currently being used in industry, why companies are using it, and what their experiences and reactions are to it.

The bulk of the survey information was provided by in-depth interviews with five companies known to have conducted mapping projects. Personal interviews were arranged with marketing executives and research personnel who were directly involved in the projects. Companies participating in the survey included Du Pont, General Mills, Johnson and Johnson, Procter and Gamble, and Elrick and Lavidge.

To What Extent?

I doubt that any major significance can be attributed to the mere fact that the five companies surveyed had used mapping per se, since they are continually exploring new research methodology. As leaders in new methodology,

however, the reactions to mapping and the expectations of continued usage which these companies represent can indeed have major significance.

Du Pont is by far the largest user of mapping methodology. Its interest has not only been stimulated by David H. Doehlert of the company's Engineering Service Division, but he has personally pioneered many of its applied aspects. Approximately 45 mapping projects, involving many different product categories, have been conducted under his direction since 1963. According to D. J. Gluck, head of marketing research at Du Pont, management's reaction to these studies has been favorable and the usage of mapping is expected to increase.

Du Pont's marketing executives have been actively involved in mapping projects, and especially in interpreting the findings of perceptual mapping studies of objects similar to the road map example we saw earlier. Preference data has been related to the perceptual maps in order to develop a density distribution of ideal points on the configuration. Doehlert indicated that Du Pont has been very successful in relating such preference judgments to the perceptual mapping of similarity judgments.

The Procter and Gamble Company is the next leading user of mapping. Dr Marshall Greenberg, formerly of the company's Professional Services Department, directed the majority of P & G's mapping projects. He is recognized as a leading authority on the applied aspects of mapping methodology.

Procter and Gamble, which has conducted several mapping studies across many of its product divisions, has put a great amount of emphasis in the past on developing perceptual maps and exploring different methods for identifying the attributes underlying those perceptions. Emphasis has currently shifted to exploring the preference aspects of mapping.

While most of the projects at Procter and Gamble have been exploratory, certain ones have been conducted that called for the involvement of marketing

executives and which concerned definite marketing implications. J. D. Henry, Director of Marketing Research anticipates increased P & G usage of mapping in the future.

Johnson and Johnson, Inc., has conducted one study using mapping methodology on buyer perception and preference patterns in a specific female-oriented toiletry market. R. D. Hardesty, Director of Consumer Research, Health Care Division, worked closely with marketing executives in designing and interpreting the findings of the project, which was conducted in conjunction with the Marketing Science Institute. The reaction of those marketing executives involved was favorable, and Hardesty anticipates that Johnson and Johnson will continue to use mapping in future research projects.

General Mills, Inc., has conducted two mapping studies that were considered to be exploratory but which did directly involve marketing executives. Larry Gibson and John Nylander, both of General Mills' Marketing Research Department, participated in the projects in which the product categories of snacks and dips were investigated. Difficulties in robust identification of the dimensions were encountered in both projects. Consequently, at the time this field interview took place, General Mills did not anticipate conducting additional large-scale mapping projects in the near future.

Elrick and Lavidge, Inc., has conducted several mapping projects for clients. Alvin Silk, formerly of the University of Chicago and now at the Massachusetts Institute of Technology, participated in designing and analyzing the findings. The projects at Elrick and Lavidge involved mapping both consumers' perceptions and preferences for products and companies. Robert Lavidge reported success in relating consumer preference judgment to the perceptual maps. In addition, he did find that relating existing market-share data to the perceptual maps aided in interpreting the results. The clients' reactions to the mapping analyses were favorable, and Lavidge himself anticipates that he will continue to recommend mapping projects to clients.

It appears that the extent of mapping varies substantially among the companies interviewed. Du Pont is a substantial user. Procter and Gamble and Elrick and Lavidge are moving in this direction. Johnson and Johnson and General Mills have had preliminary experience with mapping and with the exception of the latter, anticipate conducting future mapping studies.

What Is Its Appeal?

The amount of appeal that mapping has is directly related to its potential for lending insight to some basic questions about markets. Those marketing executives interviewed reported that mapping was directed to these types of questions:

1. What are the salient product attributes perceived by buyers in a market?

2. What combination of attributes does the buyer most prefer?

3. What products are viewed as substitutes, and which are differentiated?

4. What are the viable segments in a market?

5. Are there "holes" in the market which can support a new product venture?

While the answers to such questions may be well known to companies that are firmly established in a market, such questions can be frustrating to a new company. With the trend continually increasing toward diversification, these questions frequently confront marketing executives.

This is the situation in which Du Pont currently finds itself. With management's emphasis on finding new markets, basic questions of this kind arise. Because of limited experience in many of these new markets, Du Pont's executives have viewed mapping as a way to facilitate their decision making.

While mapping can appeal to a company that is considering entry into new markets, it can also be of interest to others for the analysis of estab-

lished markets. Mapping is appealing because it relates to exploring more specific questions of marketing strategy. Here again, marketing executives interviewed expressed interest in using mapping to investigate questions of this kind:

1. Is my brand positioned where I think it should be?
2. How can I move my product to make it more profitable?
3. How has the market changed over time?
4. How did a new competitor position itself in the market?
5. Did this new entry change the positioning of other brands?

An example of a mapping project involving a company in an established market is a Procter and Gamble detergent study.[6] This study was viewed as exploratory: mapping findings were to be evaluated in the light of P&G's existing knowledge of the detergent market. It was hoped that the mapping findings would be in agreement with this knowledge. In addition, interest was directed to exploring the more specific marketing strategy questions just discussed.

The Procter and Gamble study, which involved eight brands of detergents, was conducted in a metropolitan market in the norther part of New York State during 1967. In all, some 200 homemakers made similarity judgments concerning various pairs of detergent brands. Subsequently, there judgments were used to develop an 8 x 8 matrix of ranks similar to the one presented in the road map example discussed previously.

In addition to making the similarity judgments, the homemakers evaluated the brands in terms of several attributes that were selected by marketing executives and research personnel as being the most likely dimen-

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6. Marshall G. Greenberg, "Some Applications of Nonmetric Multidimensional Scaling," Paper presented at the 129th Annual Meeting of the American Statistical Association, New York, August 19-22, 1969.

sions used by the homemaker in evaluating the eight brands of detergent. From this data, the eight brands were then scaled on each of the attributes.

The P&G results indicated that the perceptual map could best be explained in two dimensions. The attribute scales were then correlated with this two-dimensional map of homemakers' perceptions. For example, the attribute scale of "suds" was found to correlate highly (.97) with one dimension, while the remaining attribute scales seemed to correlate well with the second dimension. Since the attribute of "harshness" had the highest correlation of the remaining attributes (.93), this attribute was used in interpreting the second dimension.

The positioning of the eight brands in the two-dimensional configuration was supported by the knowledge of marketing executives and research personnel about the performance characteristics of the brands. Further, other marketing research data on detergent usage and product attributes supported the mapping findings. The results of this study were later replicated successfully in other markets.

The appeal of mapping at Procter and Gamble appears consistent with Robert Lavidge's experience with the technique:

"We continue to make use of multidimensional scaling from time to time. On each occasion when we have used it, it seems to me that its primary value has been in helping clients to understand and develop some confidence in information about the positioning of their products in relation to those of competitors. In each instance, it has confirmed opinions about the product positioning which has been developed on the basis of other information."

In addition, Lavidge commented that mapping methodology is basically simple and inexpensive to use. He observed that clients were often intrigued by the methodology and wanted to know how perceptual maps

were developed. Subsequently, the perceptual maps which were developed seemed to make sense in that the attributes could be identified by looking at the map's configuration of products.

R. D. Hardesty of Johnson and Johnson made similar comments about mapping. He believed that it is easier to obtain answers to these types of marketing questions with mapping than with survey questionnaires. In addition, the presentation of results in a dimensional configuration suggested a more integrated interpretation of the findings of a study.

While Du Pont has found mapping useful in the evaluation of new markets, this technique also has appeal in product development work. In commenting on mapping's value in product development, David Doehlert said he finds it useful "to assess where we stand relative to competition at the beginning of development. And it can be used to measure our progress as we vary the product (or its package or its advertising). Finally, it can be used to estimate market shares when we have concluded development."[7]

Doehlert also emphasized that mapping tends to guide the development work and pull together the research findings about a new product. For example, researchers and management at Du Pont believed there were eight attributes of a new product which would be important to its market success. Research and development spent several months trying to incorporate these attributes into the product with varying degrees of success. The results of a mapping study on the product category indicated that only two dimensions explained buyers' perception of the product category. In addition, it was discovered that all eight attributes correlated with one of these dimensions, leaving the other dimension a mystery. Additional research identified this second dimension, and research and development started to work

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7. David H. Doehlert, "Similarity and Preference Mapping: A Color Example," Marketing and the New Science of Planning, Proceedings of the American Marketing Association, No. 28, 1969, p. 250.

on incorporating it into the new product. Less emphasis was given to perfecting each of the original eight attributes, since all were perceived as similar to the customer.

Du Pont also finds mapping helpful in identifying viable market segments. Doehlert commented that the "study of the preference map gives us guidance in research as to what items to market. If a preferred item does not exist, the similarity map indicates the directions in which we should move to make items that will fall into the preferred regions of the map."[8]

Johnson and Johnson is another company which conducted a mapping study in a market where marketing executives had substantial background information. The purpose was to explore the usefulness of the technique in a situation in which the position of a new product relative to competition was of primary concern. The results of the study were consistent with the executives' expectations and with additional research findings. Thus the reaction of the marketing executives involved was highly favorable toward mapping, and they anticipated using mapping on other projects.

The outlook at General Mills toward mapping is less optimistic. There, as we noted earlier, the appeal of mapping had related to its potential for discovering new product ideas, but technical problems had been encountered in the identification of the dimensions which emerged. Although Larry Gibson admitted that mapping might be useful in generating hypotheses as a kind of quantified depth interview, he stated that other questions could be answered better by the company's current research methodology.

In summary, the appeal of mapping relates to its emphasis on gathering pertinent information pertaining to markets. It is especially useful in situations where the decision maker has little background information about a market. In addition, mapping can explore interesting questions pertaining

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8. Doehlert, Ibid.

to marketing strategies involving established markets. Mapping appears to be used most frequently in connection with problems involving new products and the identification of viable market segments. Little use has been made of mapping in connection with promotion and pricing decisions.

How Best Utilized?

In the previous section, a number of companies indicated that the mapping results were consistent with the findings of their regular research techniques. But the question may arise: Why use mapping if other current research tools can supply similar conclusions?

Johnson and Johnson's R. D. Hardesty's response to this question was: "I prefer to look at a problem a number of different ways with different approaches. If I get the same answer with all approaches, I have more confidence with my findings."

Johnson and Johnson marketing executives concurred with this position. From their point of view, the face validity of mapping was substantially strengthened by relating the findings of mapping to their regular research tools. They felt that mapping would be used in conjunction with regular survey questionnaires. Actually, they were interested in how the mapping results related to many of their regular indexes of product acceptance such as rating scales, intent to buy, blind product testing, and so forth.

Elrick and Lavidge's Robert Lavidge expressed similar sentiments when he said that he viewed mapping as a supplement to the company's regular data collection methods. He felt that most clients were reluctant to base major decisions on unfamiliar research methodology. However, combined with more familiar methods, he foresaw that mapping could add a new element to the analysis of marketing problems.

Another distinguishing feature of mapping is its focus on the interrelationships among all brands within a product category. Johnson and

Johnson marketing executives pointed out that most research studies focus on only a few of the brands in a market. While it might be possible to evaluate all brands with regular research procedures, mapping appears to be more efficient and less costly. D. J. Gluck of Du Pont also cited this as an advantage of mapping when he pointed out that current projects at Du Pont call for studying from 40 to 100 products within a category.

Still another feature of mapping is emphasized by Dr. Marshall Greenberg of Procter and Gamble. With mapping, he said, the respondents are not told which attributes to consider in making their evaluations of similarity. Consequently, mapping reveals the number of salient attributes which underlie the similarity judgments. Executives at Johnson and Johnson, Du Pont, and Elrick and Lavidge also cited this point as a distinguishing feature of mapping.

On the other hand, these companies emphasized that regular survey questions must accompany mapping studies to aid in identifying the nature of the underlying attributes. Again, mapping is not seen as an isolated research tool; rather, it can best be utilized by combining it with regular research methods.

What Obstacles Lie Ahead?

The dominant characteristic in the survey which differentiates the more successful users of mapping from those who encountered obstacles is the availability of trained personnel to conduct and interpret the findings of a mapping project. It is not by chance that the more successful users (Du Pont and Procter and Gamble) also have the leading researchers in mapping methodology working for them.

At this state of development, the expertise of a trained researcher is needed to effectively use mapping methodology. Special knowledge is required to design, execute, and interpret the results. Both Elrick and

Lavidge and Johnson and Johnson had employed the services of outside consultants to analyze and interpret the findings of their mapping projects.

Another obstacle to the effective use of mapping is the identification of attributes underlying buyer similarity judgments. A number of different approaches have been used to tackle this problem. Du Pont reported success in relying on the expertise of the marketing executive to identify the attributes. When the marketing executive was confronted with a perceptual map, he was asked whether the configuration of products seemed to make sense on the basis of his knowledge of the market. If so, he was asked to identify the attributes involved.

In this connection, Du Pont's D. J. Gluck emphasized that the cooperation of the marketing executive was essential in conducting such research. Further, if the marketing executive worked with the researcher in developing the interpretation of the mapping findings, both the analysis and the manager's enthusiasm for the findings were substantially improved.

An effective approach, which Procter and Gamble has used, was speculation by marketing executives and researchers about the nature of the key attributes in a given product category. The buyers were then asked to evaluate each of the products in the category in terms of these attributes. Attributes scales were subsequently developed and correlated with the mapping configuration, and used as a best estimate of the attributes underlying the similarity judgments.

Elrick and Lavidge reported success in using a similar approach to this problem. Instead of asking marketing executives or researchers to identify possible attributes, consumer-group interviews were conducted in which the participants were asked to identify the attributes present in a product category. These, in turn, were then used to aid in the interpretation of the mapping results.

Another obstacle to the effective use of mapping relates to a problem experienced by Johnson and Johnson. While exploring the usefulness of mapping as a research technique, the company's marketing executives encountered difficulties in obtaining the needed computer programs. Ideally, they would have liked to make these programs available on their terminal system. While this problem was short run, lack of available programs can be an obstacle for a company currently interested in exploring mapping.

What Remains to be Done?

The companies interviewed expressed interest in having more information on how well mapping addresses itself to certain questions about markets and marketing strategy decisions. Can mapping predict market shares for an established product category? Can mapping predict the market share a new product will capture? Can a product be moved successfully in the perceptual map? What role does advertising play in positioning a product in the perceptual map? How does the issue of price enter into mapping?

P&G's Marshall Greenberg cited the need for a longitudinal mapping project involving established markets. Such a study could determine whether mapping can detect market changes resulting from strategy decisions and environmental influences. For example, changes in advertising strategy, product formulation, new product entry, price changes, and so forth, could be monitored by mapping. Greenberg also saw the need for more work on the relation of preference data to the perceptual map. He was concerned with studying alternative approaches to the problem and with evaluating which methods work best.

Du Pont's D. J. Gluck extended this discussion to include the study of "acceptance zones." He was concerned with developing a procedure that could determine a zone around the ideal point, within which products are considered acceptable by the buyer. Possibly additional questioning of

buyers could identify such zones.

The surveyed companies were also interested in more studies which would evaluate alternative approaches for identifying the attributes underlying the similarity judgments. Gluck questioned whether it is best to try to identify or label dimensions in the perceptual map. It is perhaps more meaningful to identify clusters of products in the perceptual map.

The participants also expressed interest in studying different methods for collecting similarity judgments,[9] and in the trade-offs involved in selecting a particular method. In addition, they would like to evaluate the best way to design projects involving large sets of objects.

Finally, companies are interested in knowing whether it is best to develop one "average" perceptual map, which tries to summarize the similarity judgments of all respondents, or to segment the respondents into homogeneous groups and develop perceptual maps for each group. The problem is one of determining a criterion and developing a method for segmenting the respondents.

CONCLUDING NOTE

The purpose of this paper has been to introduce the reader to mapping and to report on the findings of a survey involving companies that have used this technique. As with any new research methodology, mapping's virtues can be exaggerated, but hopefully I have not fallen victim to such a bias in this report.

As a concluding note, let me offer a comment by Robert Lavidge which seems especially appropriate:

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9. James R. Taylor, "Alternative Methods for Collecting Similarities Data," Marketing Involvement in Society and the Economy. Proceedings of the American Marketing Association, No. 30, 1970 (forthcoming publication).

"Our experience with mapping indicates that it does not bring light to an otherwise dark situation. Rather, it brings additional illumination to situations where there already was some light. Consequently, we have not experienced major surprises from the mapping results. We have found mapping a very helpful research tool that managers and researchers should make use of."