

# **AUTOMATED ORDERING IN THE PHARMACEUTICAL INDUSTRY<sup>1</sup>**

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The survival of business and other institutions in society is largely dependent upon their ability to economically provide goods and services which satisfy people's needs. In the past, many new goods and services involved only minor modifications of existing practices. They were quite simple. Today, the promise of productivity gains achieved through the application of new telecommunications and computer technologies is motivating institutions toward the introduction of more complex innovations. While such innovations may produce great savings, development and implementation can be quite costly making the need to understand and accurately predict the diffusion of these innovations through society critical.

In "An Associational Model for the Diffusion of Complex Innovations" (chapter 4), Barnett (1978) advocates using metric multidimensional scaling (MMDS) to study socio-cultural change particularly that associated with the Innovation-Decision Process (Rogers and Shoemaker, 1971). Using the range of technologically mediated product ordering methods available to consumers of the pharmaceutical industry, as an example of simple to more complex innovations, this chapter presents the results of a MMDS analysis with individuals at various stages in the Innovation-Decision Process.

## **STATEMENT OF THE PROBLEM**

### **The Innovations--Automated Ordering**

The prescription drug market is similar to many other good and service markets in that retail and hospital orders can be placed directly with the original sources (manufacturers) or indirectly through intermediary sources (wholesalers). Following historical channel developments, order-taking communication has shifted over time from predominately face-to-face to the use of mail, telephone, and telecommunication-computer technology (electronic ordering). Having fairly obvious customer service advantages, simple telephone enhancements like inward WATS or toll-free numbers, and telephone answering tape recorders were readily adopted by many product sources and customers in the 1960s. Electronic ordering methods, include Touch-Tone/Voice Response, portable terminal, and computer-to-computer ordering, became available in the early 1970's and have been growing in use ever since. Because electronic ordering produces a change in the communication structure of a social system, it may be considered a complex innovation (Barnett, 1975, 1978).

The diffusion of electronic ordering operates on two levels. First, product sources must choose to accept orders through one or more electronic channels. Here an adoption decision tends to be prompted by an organization's perception of channel impact on

internal labor and cost factors as well as their expectations regarding customer adoption. Then, based on availability, customers choose which channel(s) they wish to use. Having chosen to study the latter, assessments of the full diffusion process have been left for future research. Some discussion, however, will be devoted to current product source adoption trends to acknowledge the interrelationships between product source and customer behavior.

With the exception of limited manufacturer activity, Touch-Tone/Voice Response, portable terminal and smaller customer access to computer-to-computer ordering have been offered only by wholesalers. Since order-taking is the main focus of most wholesaler operations, they appear to be more sensitive to, and earlier adopters of, innovation which provide order-taking cost efficiencies. Wholesalers are also motivated by the expectation that they stand a better chance of receiving customer support than manufacturers because it is easier to cost justify special equipment when it can be used placing multi-brand orders than for single brands. This issue could be resolved through the development, of compatible order entry systems, but the competitive nature of the market has thus far resulted in exclusive systems. Furthermore, wholesalers are in a more favorable position for marketing additional electronic services like inventory control or patient profile software, thereby producing attractive bundles or packages of innovations (Rogers & Shoemaker, 1971). The main form of electronic ordering accepted by manufacturers at this time was computer-to-computer orders placed by large customers or customer groups. Any analysis of electronic ordering adoption among customers would thus expect to find a stronger association between such ordering and wholesalers than manufacturers. Within this setting, past research on the influence of innovation attributes has been used to establish hypotheses regarding the relative diffusion status of telephone and electronic ordering methods at a fixed point in time.

### **Attribute Influence**

In a recent paper on computer-mediated communication as an innovation in organization Rice and Rogers (1981) stated, "innovations that are perceived as high in relative advantage, low in complexity, and high in compatibility, communicability and divisibility, have a more rapid rate of adoption." Wishing to base some of our hypotheses on the trends noted by Rogers and Shoemaker, attribute ratings were needed for each method of ordering. Table 1 displays the ratings assigned by the authors as a result of the following discussion.

### **Telephone Order Entry**

In comparison with waiting for a manufacturer's or wholesaler's representative to take an order, telephone order-takers initially offered a tremendous advantage to customers. For people accustomed to telephone conversations, the extension to telephone order calls was a simple, compatible procedure that

was easily discussed and tried. Simple innovations stemming from the telephone order-taking concept also offered advantages. Inward WATS number provided the customer with free telephone order entry, while tape recording devices expanded customer order access from business hours to 24 hours a day, seven days a week. The transition to communicating with a tape recorder was perhaps a bit more complex and less compatible than talking to an order-taker because immediate feedback was not available. However, this ordering method retained a high degree of communicability and divisibility.

### **Electronic Ordering**

Touch-Tone/Voice Response order entry, though still conducted via telephone, presented customers with a significant departure from human voice interactions or recordings. Initiated by calling a number linked directly into a product source's computer, customers press their telephones' buttons to enter numeric codes for customer identification, product order requirements and any special features. The entry sequence is prompted and verified through the playback of programmed voice messages or tones (a shortcut version for more experienced customers). Entry mistakes result in error statements. Most systems allow for three tries on any code entry before taking further action (abort or continue with the next section). Although transaction is associated with a familiar communication instrument, it requires new behaviors for successful communication. This new behavior is not extremely difficult to understand because the human-telephone-computer-telephone-human exchange is easy to explain and demonstrate, especially when customers desire faster order turnaround and order accuracy "ownership".

The compatibility and complexity of portable terminals or computer-to-computer ordering varies across people having more or less exposure to, and knowledge of computer equipment. On the average, computer-to-computer ordering deviates the most from past experience, with communicability frequently operating at the "Black Box" level. The complexity of this ordering method is relatively high, particularly when it is directly linked with additional functions like inventory control with automatic reorder points. Such automatic ordering can be perceived as advantageous by those who understand it, since it tends to greatly reduce stock and labor requirements. However, for those who fear losing control to the computer, portable terminals offer a somewhat stronger sense of personal involvement. Portable terminals, requiring typewriter or calculator style data entry, have the advantage of information storage. The storage feature permits customers to accumulate product information as needs arise over the course of a day or week. Then, at their convenience, the terminal can be linked by telephone to the product source computer for order placement. If desired, a compromise between labor and involvement issues can be achieved by attaching product bar code reading wands to portable terminals. This permits one to enter product information by the

wave of the band past product or shelf label. Potentially compounding the anxiety associated with computer-to-computer ordering, is the high cost of trial. With the exception of promotional equipment loans, experimentation depends upon access to reasonably priced short-term leases and lease/purchase arrangements. Terminals are relatively inexpensive and are fairly easy to obtain and learn to use. Computer installation, operation, and maintenance may, in contrast, require long lead times, extensive user training and physical site modifications.

Looking across Table 1, all of the ordering methods, except computer-to-computer appear to have advantages relative to the other methods at the time of their introduction. In general, electronic ordering methods are higher in complexity and lower in compatability, communicability and divisibility than telephone ordering methods. Combining this trend with the fact that telephone ordering has been available longer than electronic ordering, one would expect a greater degree of familiarity with telephone ordering. However, there is also the issue of displacement, those instances where the newer electronic ordering methods are trading off against telephone methods. From a communication perspective, inward WATS order-taking is the only method involving direct contact with another person. Assuming that access to the electronic method's computer system is on the same 24 hours, 7 days a week basis as the inward WATS tape recorder method, and that people have general preferences for interfacing with automated systems as opposed to other people, it seems most likely that the use of tape recorder ordering would decline as more electronic ordering is adopted. Moving to the electronic methods, Touch-Tone/Voice Response and portable terminals differ only slightly on most attributes and both appear more acceptable than computer-to-computer ordering. Considering that the slightly higher communicability and divisibility of Touch-Tone/Voice Response might not win out over the terminal's advantage of information storage and the compatability issue of using a calculator or typewriter-like portable terminal versus the less familiar keys of a Touch-Tone telephone, it was speculated that portable terminal ordering would be found to be more readily adopted.

Table 1

INNOVATION ATTRIBUTE RATINGS FOR ORDERING METHODS AS THEY HAVE BEEN INTRODUCED

Ordering Methods

<u>Attributes</u>	<u>Inward WATS Order-Taker</u>	<u>Inward WATS Tape Record</u>	<u>Touch-Tone Voice Resp</u>	<u>Hand-Held Terminal</u>	<u>Computer Computer</u>
Relative Advantages	5	5	5	5	3
Complexity	1	2	3	3	4
Compatibility	4	3	1	2	1
Communicability	5	5	4	3	1
Divisibility	5	5	4	3	1

- 5 = very high compared to alternatives at introduction
- 4 = high
- 3 = medium
- 2 = low
- 1 = very low

**Theory**

**Innovation-Decison Process**

In Communication of Innovations, Rogers and Shoemaker (1971) describe the traditional adoption process as consisting of five stages. (1) Awareness, the individual learns of the existance of a new idea. (2) Interest, the individual develops interest in the innovation and seeks additional information. (3) Evaluation, the individual makes a mental application of the innovation and decides whether or not to try it. (4) Trial, the individual applies the new idea on a small scale in order to determine its utility. And, (5) Adoption, the individual uses the new idea continuously on a full scale. The authors criticize this model because, (1) it implies that the process always ends in adoption whereas rejection may be just as likely an outcome. (2) The stages do not always occur in the specified order. Evaluation, for example, occurs through out the process. (3) The model does not reflect the on going cycle of decision, confirmation or rejection which often lead to new adoption decisions.

As an alternative, they present the Innovation-Decision Process. It consists of four stages. (1) Knowledge, the individual is exposed to the innovation and gains some understanding of how it functions. (2) Persuasion, the individual develops attitudes toward the innovation. (3) Decision, the individual engages in activities which lead to the choice to adopt or reject the innovation. (4) Confirmation, the individual seeks additional information which

may reinforce the adoption decision or lead to rejection or discontinuence of its use.

Rogers and Shoemaker identify many factors which effect this process. Among them are individual differences in potential adopters (psychological, demographic and position in the communication structure), social system variables (norms, toleranace of deviance and change) and the characteristics of the innovation. Further, they provide generalizations which indicate that the greater the innovation's relative advantage, the greater its compatability, the less its complexity, the greater its trialability and the greater its observability, the greater will be the likelihood of its adoption and the faster the adoption process will be. They provide considerable support for all of these theoretical hypotheses through a review of empirical research.

Rogers and Shoemaker's review suggests a strong cognitive component to the diffusion process. Perceptions, attitudes and beliefs change as individuals gain new information about the innovation, its relationships to existing practices, its attributes (be they advantages or disadvantages) and its relationship to the individual's self. In other words, the innovation-decision process may lead to a redefinition of the user's self image. Am I the kind of person who uses the innovation? If so, how does this affect my relations with other people or objects in my world? Such questions lead to the expectation that systematic differences in cognitive structure of the relations among the innovation, its attributes, existing practices and the self occur at various stages in the innovation-decision process.

### **An Associational Model for the Diffusion of Innovatiors**

Barnett (1975, 1978) theorizes that the diffusion of innovations and the acceptance (or rejection) of a new product, practice or idea may be viewed as an associational process taking place on a mental plane. Associationists view the mind from a holistic perspective--with each simple element (stimulus) interacting through its relations with other elements, to organize the mind. Cognition and the process of organizing simple ideas into novel and complex ones are assumed to be governed by three principles, (1) similarity, (2) contiguity, and (3) contrast. Although, the later two principles may be considered special cases of the first (Barnett, 1976). The principle of similarity states that objects which are conceptually similar are associated in an individuals' mind and that synchronous associations lead one from the construction of simple ideas to more complex ones. This is a structural concept because concepts are related through patterns into a single coherent series of relations or structures.

Following the associational model, the process of innovation may then be seen as a cognitive process, with an innovation viewed as a combination of associative elements. Given that ideas are defined within the symbolic structure of the adopter's culture, an innovation provides an opportunity for new linkages

or rearrangements of elements that have not been previously associated. Most often, this involves the addition of new concepts into a culture's language. As an innovation spread throughout a society, the conceptual configuration shared by members about an innovation changes. In other words, associative structure of the adopter is altered.

### **Measurement of the Associational Model**

The degree of reorganization in the associative structure of a social system is a function of the amount of information members of that system receive about the innovation (Woelfel & Saltiel, 1978 [chapter 3]). Communication scientists have long been interested in the effect of message variables on the adoption process. Indeed, it is these messages which must alter the existing associations and form new ones. The associations formed with the innovation must indicate compatibility with "...existing values, past experiences and the needs of the receiver" (Rogers & Shoemaker, 1971, p. 145). Rogers and Shoemaker (1971) present many examples of innovations which failed to be adopted by a society because compatible associative links were not formed. The more compatible an innovation is with existing associations, as perceived by members of a social system, the faster its rate of adoption. From an associational perspective, compatibility is the cognitive introduction of a novel element which minimizes the configuration's change at the cultural level.

The associational model demands a measurement system for the study of the diffusion of innovation that meets the following requirements.

1. Associational links among a set of elements must be measured in terms of the relationship or similarity among the set of elements. The measurement system must be capable of relating existing practices and the innovation to that constellation of concepts used to define the new idea.

2. It must be holistic. That is, the system must be capable of simultaneously measuring all integrating dimensions to produce a total description of the complex innovation rather than just describing separate aspects of the relationship. Such attributes must not be imposed by the researcher but must emerge from measurements of the adopting society.

3. In describing the cognitive state of a social system, measurements must take place on a societal or cultural level. It must involve consensual measures which allow predictions about the degree of adoption to be made.

4. Finally, the measurement scheme must be capable of measuring the changing conception in a culture's associational structure, as the members of the social system become exposed to information about the innovation. It must describe the adoption process. This means that ratio measures must be used to make possible descriptive calculations of the rate of change in the associational structure of the members of society.

Theoretically, the scale must be infinite and it must be

infinitely dense, that is, capable of measuring the most miniscule changes in the configuration (Barnett, et al, 1981).

### **The Galileo System for Metric Multidimensional Scaling**

One measurement system which satisfies these demands of the associational model is metric multidimensional scaling as proposed by Woelfel and Fink (1980) and applied to the diffusion process by Barnett (1975, 1978). It is known as the Galileo System. Briefly, the associational structure for any set of concepts may be represented by a  $N \times N$  dissimilarity or distance matrix ( $N$  = the number of measured concepts). Each vector of this matrix describes a concept's relationship with all the other concepts. For the diffusion of innovations, the scaled concepts may include the innovation itself, previous products or ideas which the innovation may displace, cultural objects which have well established relations with the previous practices and/or the innovation, and attributes of the innovation. These are generally selected through a content analysis of indepth interviews with a sample of potential adopters.

The precise measurement of the relationships among the concepts is performed using the method of pair-comparisons (Thurstone, 1927). Randomly selected subjects from the same population as in the preliminary interviews complete a series of direct pair-comparisons among all possible pairs of concepts. They estimate the dissimilarity or distance between  $N(N-1)/2$  pairs of concepts. The researcher provides a criterion pair or metric standard for the subjects to use as a unit measure when making the comparisons. Subjects make direct magnitude estimates of the distances among the concepts as ratios to the criterion metric.

The matrix **S** is typically collapsed across subjects to form an  $N$  by  $N$  concepts matrix, **S**, where any entry,  $s_{ij}$ , is the mean distance between concepts  $i$  and  $j$ . Alternative measures of central tendency may be applied in those instances where the distribution is not normal but highly skewed (Dinkelacker, 1980).

Matrix **S** may be converted to a multidimensional space with each concept located on a series of projections on orthogonal references axes or dimensions. Mathematically, this process is analogous to converting a matrix of intercity distances to a Cartesian coordinate system where latitude, longitude and altitude form the reference axes and the cities' locations on each of these dimensions are given. From the coordinates a graphic representation such as a map may be drawn. In that special case, an  $N$  by  $N$  matrix of cities could be reduced to a two-dimensional configuration with little loss of information as altitude (the third dimension) is negligible in comparison to the first two dimensions (latitude and longitude). This process is known as metric multidimensional scaling (Torgerson, 1958). The algorithms to perform this analysis are described by Serota (1974) and Woelfel and Fink (1980) and they are part of the Galileo computer program (Woelfel, et al, 1976).

While physical space uses only three dimensions, cognitive or associational structure is generally more complex. Typically,

the variance in cognition is accounted for by N-1 dimensions, although in some cases it may be less (Barnett & Woelfel, 1979). Further, some of the dimensions may have negative eigenroots. Thus, the space is not Euclidean but Riemannian (Woelfel, et al, 1978). Woelfel, et al (1978) have shown that these imaginary dimensions (those with negative roots) are reliable and that they may be explained by the degree of inconsistencies in attitudes. A statistic warp, indicates the degree of inconsistency. It is expressed as a ratio of the total (real and imaginary) variance to the real variance. A value of 1.0 would indicate a consistent attitude structure (an Euclidean space). The sources of the inconsistency may be determined by examining the concepts' locations on the imaginary dimensions.

The coordinate matrix makes it possible to generate message strategies which will rearrange the associational structure as desired (Woelfel, et al, 1976b [chapter 13]; Serota et al, 1977). This can be used to facilitate the adoption process. Vector analysis is applied to determine the optimal message strategy for the measured concepts. First, a target vector is described between the innovation whose position one desires to alter and its desired location. Typically, this location is the position of the average self. Then, the Galileo program searches all possible combination of concepts' locations whose resultant vectors will move the concept toward its desired location. To determine the best message, the resultant vectors of the various message combinations are compared with the target vector. The optimal message is that one which produces the smallest angle between the target and the resultant vector and whose final position is closest to the desired location.

The effectiveness of this message may be evaluated through overtime measurement and adjustments may be made based upon the concept's later location. Algorithms to perform the development of message strategies are part of the Galileo program.

Change in associational structure is examined by repeating the pair-comparison phase and transforming the data for each point in time into multidimensional spaces. To compare several points in time or different groups at the same time, the spaces must be rotated to a least squares best fit which minimizes the departure from congruence among the spaces. Change (difference) in position of the concepts may then be calculated by subtracting the coordinate values across time (or among groups). From these change scores one can fit trajectories of motion to describe the relative changes in attitudes.

When no additional information about the relative stability of the concepts exists, the ordinary least squares procedures may be applied. When the knowledge of the concepts' information history is known, alternative rotational algorithms should be applied (Woelfel, et al, 1979 [chapter 12]). The ordinary least squares procedure has the effect of overestimating some changes while underestimating others. This may lead to erroneous conclusions. The alternative rotational schemes use theoretical or "extra" information which simplifies the apparent motion. Since it is independent of the coordinate values, it may be

treated as invariant under rotation and translation of the coordinates.

### **The Hypotheses**

The following hypotheses may be derived from Barnett's Associational Model when the stages of Rogers and Shoemaker's Innovation-Decision Process are considered.

H<sub>1</sub>: The associational structure for the domain of concepts related to an innovation (in this case, automated ordering methods), will be contingent on an individual's position in the innovation-decision process. That is, the degree of dissimilarity or distance between the self concept and the various ordering methods will be ordered, no knowledge, knowledge, adoption, with adopters closest to the innovations.

Support for this hypothesis comes from Barnett, et al, (1976), Barnett and McPhail (1980), Woelfel and Fink (1980 and Woelfel, et al, (1980a) who report that the more favorable one's attitudes or the more frequently one's behavior toward an object, the shorter the distance between the concept and the self. Related to H<sub>1</sub>,

H<sub>2</sub>: Individuals who reject or discontinue using the innovation (automated ordering) will be further from the innovation than the current users.

The associational structure for the domain of concepts related to the innovation should also be contingent upon the perceptions of the relative advantages of the various innovations. This suggests the following hypothesis,

H<sub>3</sub>: The distance between the various innovations (automated ordering) and the attributes which describe the advantages will be ordered, no knowledge, knowledge, adoption, with the current users placing the innovations closest to the attributes of advantage.

In this case the attribute of advantage is flexibility as to when an order may be placed. Automatic methods allow one to place an order on weekends and in the evening. Therefore operationally, the hypothesis becomes,

The distance between the methods of automated ordering and the time concepts (weekends and evenings) will be ordered no knowledge, knowledge, adoption, with the distance being the least for the adopters.

Related to H<sub>3</sub>,

H<sub>4</sub>: Individuals who reject or discontinue using the innovation will place the automated ordering methods further from the time concepts (weekends and evenings) than individuals who currently use the innovations.

Attempting to account for the trends in manufacturer and wholesaler order method offerings, perception of order method attributes and the differences in time since each method was introduced, it seemed reasonable to expect users to have weaker associations with inward WATS order-takers and stronger ones with all the automated methods. Within the automated methods group, inward WATS tape recorders would have a moderately strong set of associations, similar to the portable terminal (the electronic ordering method most likely to be used and, therefore, most likely to be perceived as substitutable for tape recorders), followed by respectively weaker associations with Touch-Tone/Voice Response and computer-to-computer ordering. To test the authors' perceptions of the differences among the ordering methods as described in Table 1, the following hypotheses were suggested for the individuals who currently use the innovations.

H<sub>5</sub>: The distance between inward WATS order-taker and the self concept will be greater than the distance between inward WATS tape recorder and the self concept.

H<sub>6</sub>: The distance between inward WATS tape recorder and the self concept will be greater than between portable terminals and the self concept.

H<sub>7</sub>: The distance between portable terminals and the self concept will be less than the distance between Touch-Tone/Voice Response and the self concept.

H<sub>8</sub>: The distance between Touch-Tone/Voice Response and the self concept will be less than between computer-to-computer and the self concept.

Two final hypotheses were suggested by Barnett (1975). Variance in perception of the domain of concepts related to an innovation should resemble a U-shaped curve during the innovation-decision process. That is, when there is no knowledge about the innovation, the variance in the distance estimates should be large due to uncertainty about the innovation. As people become aware of the innovation, this variation should become smaller due to the common information about the product or practice. This variance will increase upon adoption due to individuals' unique experience with the innovation. Support for this relationship comes from Barnett (1981) who found that the variance in the perception of a set of political concepts decreased during a campaign. He suggested that this was due to the population's exposure to common information from the mass media. After the campaign was over the variation in perception about the campaign issues and the candidate increased.

The same relation may be expected regarding the population's ability to differentiate among the concepts in the domain. Initially, there is a great deal of differentiation due to uncertainty. How do these concepts relate? As common information is made available, the knowledge group will be able to relate all the concepts in the domain and the degree of differentiation will be less. When use of the innovation begins, they will learn the differences among the concepts through direct experience and the differentiation will increase. Total differentiation may be represented by the trace of the spatial coordinates matrix (Danowski, et al, 1977; Stoyanoff, 1981).

H<sub>9</sub>: The variance in the associational structure for the domain of concepts related to an innovation (automated ordering) will resemble a U-shaped curve. It will be large for individuals with no knowledge, and large for adopters, relative to the knowledge group.

H<sub>10</sub>: The trace of the spatial coordinates matrix for the domain of concepts related to an innovation (automated ordering) will resemble a U-shaped curve. It will be large for individuals with no knowledge, and large for adopters, relative to the knowledge group.

## **METHODS**

This section describes the instrumentation, sample design and data collection procedures used to test the hypotheses presented above.

### **Survey Design**

The survey instrument was designed in conjunction with the Market Research Group of a major pharmaceutical manufacturer. Its purpose was to gather information on a variety of practices concerning automated ordering techniques and services, demographic information, and a set of items for paired comparison metric multidimensional scaling analysis. These items generated a preference mapping of respondents' attitudes concerning both automated ordering methods and major pharmaceutical manufacturers.

To perform the metric multidimensional analysis, the following concepts were selected.

- |                              |                  |
|------------------------------|------------------|
| 1. Inward WATS order-taker   | 6. Wholesaler    |
| 2. Inward WATS tape recorder | 7. Manufactaurer |
| 3. Touch-Tone/Voice Response | 8. Evenings      |
| 4. Portable terminal         | 9. Weekends      |
| 5. Computer-to-computer      | 10. My orders    |

The first five concepts were selected to represent systems or methods of automated ordering. The concepts wholesaler and manufacturer refer to the various sources from which one can order pharmaceuticals. Evenings and weekends were selected to

represent the time advantages of automated ordering. My orders represents the self concept for this study.

To further clarify the value of ordering methods relative to the particular manufacturer sponsoring this study along with several competitors, four company names were added to the concept list. To protect the proprietary rights of the companies, they will be referred to as

11. Company A  
12. Company B

13. Company C  
14. Company D

These fourteen concepts were paired against one another to provide the matrix required by MMDS. The pairs were put into a survey format which asked the respondents, "If the difference between red and white is 50 units, how different are \_\_\_ and \_\_\_?" The data allowed for the examination of both the distances between the concepts and the variances in these estimates as well as the generation of a multidimensional space to test the theoretical hypotheses.

To determine the individual's position in the innovation-decision process, the initial question in the survey asked:

Through the use of Touch-Tone telephone, portable computer terminals and/or large computer systems, many pharmaceutical wholesalers currently provide pharmacies with a variety of automated ordering capabilities. Do you use, or have you had any experience using any form of automated ordering from a wholesaler?

1. Yes, I currently use automated ordering.
2. Yes, I have had experience with but do not currently use any automated ordering.
3. No, but I am familiar with this type of ordering.
4. No, and I am not familiar with this type of ordering.

One represented the adoption or the current use group. Two indicated membership in the discontinuence group. Three indicated that the respondent was at the knowledge stage. Four represented a lack of knowledge about the innovation.

### **The Sample and Data Collection Procedures**

A stratified sampling procedure was used to generate three general classes of pharmacies: chain drugstores, hospitals and independent drugstores. This sample was provided by the company and designed according to the following criteria. For independent and hospital pharmacies, a stratified random sampling procedure was used. The independent sample was generated by a random 3% selection of current customers and stratified by four sales regions and by categories of sales volume. The hospital sample was generated by a random 5% sample of non-government, non-psychiatric hospitals, stratified by four sales regions and by three bed size categories. The chain store sample was

generated from a custom list of chain headquarters personnel drawn from several chain association membership lists.

A total of 1,479 surveys were mailed to pharmacists throughout the United States, including Alaska, Hawaii and Guam. Each survey packet included the survey instrument, a personalized cover letter describing the study, a return envelope, and a \$1.00 token of appreciation. Table 2 presents the breakdown of the number of surveys mailed, the number returned, and the percentage return rate for each class as well as the overall return rate. The mailing occurred on February 9, 1981 and the questionnaires were collected until March 16, 1981.

TABLE 2  
Pharmacist Mail Survey Response Characteristics

	Mailed	Returned	Percentage
Total Sample	1,479	508	34.3
Chain Drugstores	168	41	24.4
Hospital Pharmacies	417	192	46.0
Independent Drugstores	894	275	30.8

Table 3 presents a breakdown of the sample by position in the innovation-decision process and pharmacy class. A total of 487 respondents provided data concerning their current automated ordering practices. Overall, 63.0% indicated that automated ordering was currently in use. This strong use of automated ordering was found throughout the three pharmacy classes. 78% of the chains, 53% of the hospitals and 67.3% of the independents indicated current use of automated ordering. Of those respondents who did not currently use automated ordering, 8.2% overall indicated that they had experience with but did not currently use automated ordering. The second largest category of respondents were those familiar with but did not currently use automated ordering. 18.7% fell into this category. 10.1% of the respondents indicated that they were unfamiliar with this type of ordering.

TABLE 3  
Current Usage of Automated Ordering by Pharmacy Class

	Chains (N=41)	Hospitals (N=186)	Independents (N=260)	Total (N=487)
Current Use				
Currently Using Automated Ordering	78.0%	53.8%	67.3%	(N=307) 63.0%
Experience with, Not in Current Use	4.9%	10.8%	6.9%	(N=40) 8.2%
Familiar with, Not in Current Use	12.2%	21.0%	18.1%	(N=91) 18.7%
Unfamiliar	4.9%	14.5%	7.7%	(N=49) 10.1%

Table 4 presents a breakdown of the different methods of automated ordering which were currently in use. The dominant method was the portable terminal, followed in rank order by the Touch-Tone telephone, the Touch-Tone key pad and finally computer-to-computer ordering.

TABLE 4  
Method of Automated Ordering Used in Percentages

	Chains	Hospitals	Independents	Total
Touch-Tone Telephone	9.8	12.5	19.5	(N=49) 16.0
Touch-Tone Key Pad	7.3	11.5	10.5	(N=33) 10.6
Portable Terminal	56.1	33.3	48.1	(N=132) 43.0
Computer-to-Computer	9.8	4.2	5.3	(N=16) 5.2

Table 5 shows the differences between users and non-users. A greater percentage of users order more than one order at a time than non-users. Further, users tend to order a greater number of product lines than non-users. Specifically, 59.6% of the current users indicated that an average order was of more than 25 products. In contrast, for non-users only 38.3% indicated an average of greater than 25 products. A similar effect can be seen in the average frequency of order placement between users and non-users. Current users and non-users most frequent interval of ordering was more than once a week. However, for the current users, 71.3% indicated that orders were placed more than once a week, while for the non-users, only 62.8% indicated this frequency.

In summary, automated ordering of pharmaceuticals was common place to many of the survey respondents. Further, there were systematic differences between users and non-users. Users placed more than one order at a time, they placed larger orders than non-users and they did so more frequently than did non-users.

## RESULTS

The results of the MMDS analysis which follow were obtained after certain extreme pair-comparison estimates were removed via a smoothing operation (Dinkelacker, 1980). 57 values of 30,136 or less than .2% of the estimates were eliminated. The overall mean per cent relative error for these data was 7.02%. This is considerably better than one could obtain with Likert-type items which build 20% error into the measurement process (Woelfel, et al, 1980b). The means and multidimensional spaces for the four groups combined were first calculated. A graphic representation of the first three dimensions is presented in Figure 1. It accounts for 88.3% of the variance in the pair-comparisons and is presented here for heuristic purposes only.

TABLE 5  
 Current User and Non-User Characteristics  
 Multiple Orders, Average Order Size and Frequency

	Current Users				Non-Users			
	C (32)	H (100)	I (175)	T (307)	C (9)	H (86)	I (85)	T (180)
More than 1 order at a Time								
Yes	40.7	37.0	17.7	26.4	22.2	20.9	12.9	17.2
No	12.5	43.0	16.6	24.8	11.1	62.8	21.2	40.6
No ans	46.9	20.0	65.7	48.9	66.7	16.3	65.9	42.2
Average Order size								
1-5	0.0	3.0	1.1	1.6	0.0	11.6	4.7	7.8
6-12	6.3	19.0	5.1	9.8	0.0	26.7	4.7	15.0
12-25	15.6	27.0	14.3	18.6	33.3	27.9	29.4	28.9
25+	71.9	40.0	68.6	59.6	33.3	27.9	49.4	38.3
No ans	6.3	11.0	10.9	16.9	33.3	5.8	11.8	10.0
Average Order Frequency:								
> Than Once/Week	53.1	74.0	73.1	71.3	44.4	58.1	69.4	62.8
Weekly	28.1	12.0	14.3	15.0	11.1	15.1	9.4	12.2
2-3 Times /Month	12.5	4.0	1.7	3.6	11.1	14.0	2.4	8.3
12 Times or less/ year	0.0	0.0	0.6	0.3	0.0	4.7	0.0	2.2
No ans	6.3	10.0	10.3	9.8	33.3	8.1	18.8	14.4

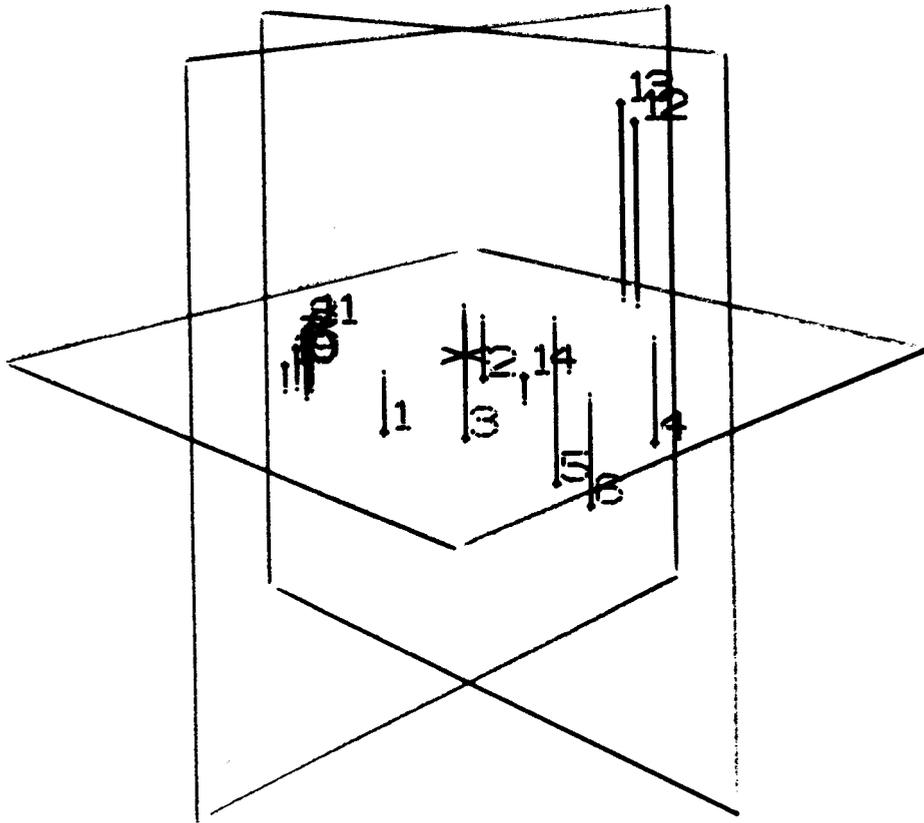


FIGURE 1

THREE DIMENSIONAL SPACE FOR ALL GROUPS COMBINED

The means and standard deviations for the four groups (no knowledge, knowledge, current users and discontinuence) are presented in Table 6. From these means, the multidimensional spaces were generated. If traditional methods for determining the underlying dimensionality of the configuration were applied (scree test), a two dimensional solution would be considered the "best" estimate of the dimensionality (Barnett & Woelfel, 1979). But since these procedures are arbitrary, they will be used here only to compare the structures of the individual spaces. All further analysis will use all 13 dimensions. On the average, the two dimensions account for 68% of the variance. They range from 62.7% to 74.7%.

The correlations among the loadings of the concepts on the two dimensions indicates that the subjects used the dimensions consistently to analyze the domain of concepts. The average correlation for the four groups for the first dimension was .97, and for the second, it was .91. A graphic representation of these two dimensions for all four groups is presented in Figures 2a, b, c, and d.

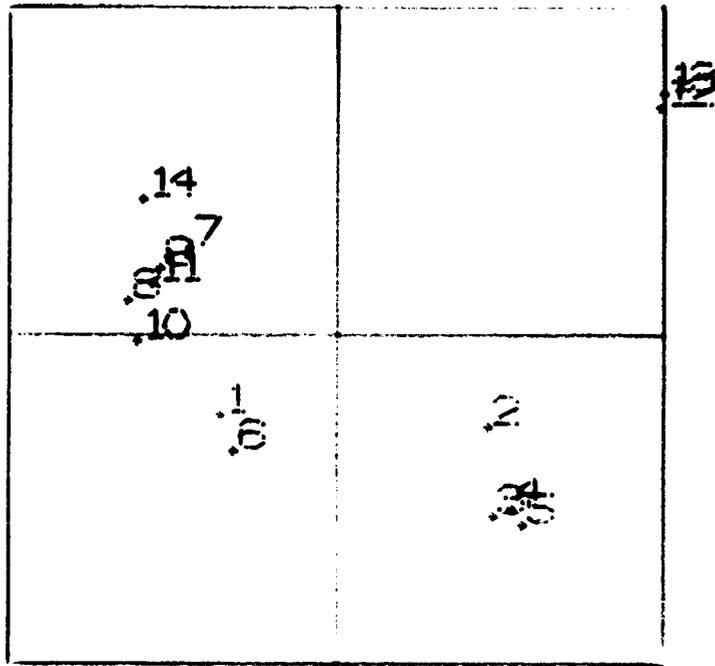


FIGURE 2A

TWO DIMENSIONAL CONFIGURATION FOR NO KNOWLEDGE GROUP

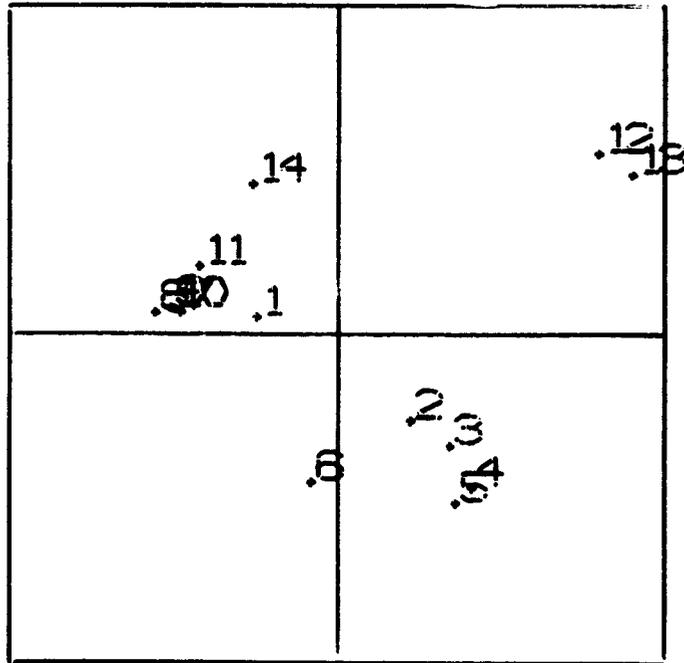


FIGURE 2B

TWO DIMENSIONAL CONFIGURATION FOR KNOWLEDGE GROUP

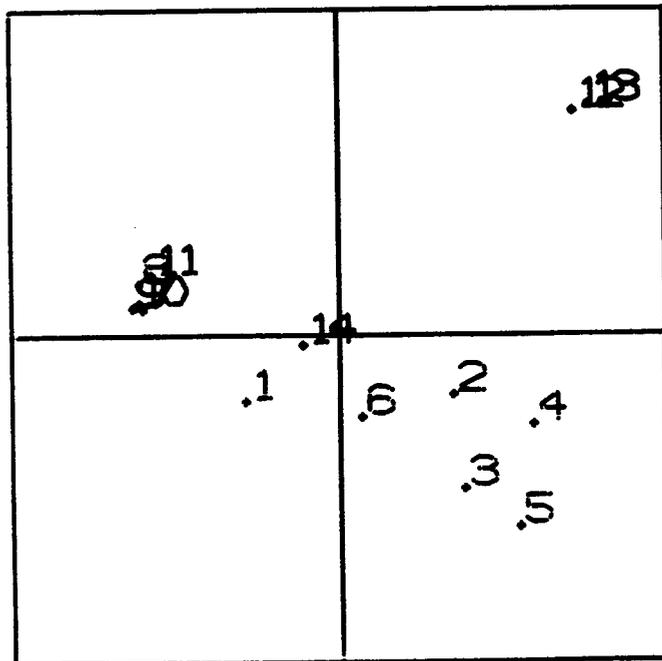


FIGURE 2C

TWO DIMENSIONAL CONFIGURATION FOR USERS GROUP

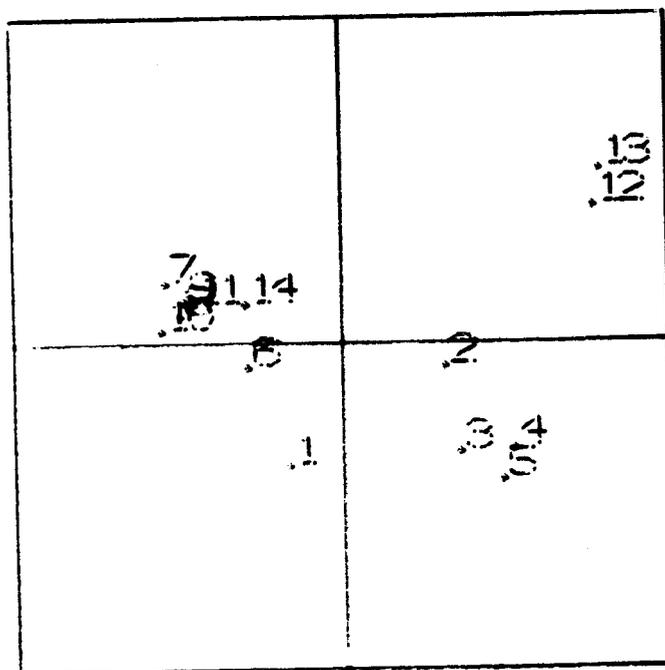


FIGURE 2D

TWO DIMENSIONAL CONFIGURATION FOR DISCONTINUENCE GROUP

The four spaces were almost Euclidean rather than Riemannian. The warp, the ratio of the total variance to the variance accounted for by those dimensions with positive eigenroots, for all groups were approximately 1.0 (1.01, 1.05, 1.05 and 1.05). This indicates that there is little inconsistency regarding the domain of measured concepts.

The four groups' spaces were rotated to a least-squared congruence in two different ways to determine the differences among the spaces. The first was an ordinary least-squares rotation with each space compared to the one which theoretically occurred before it in the innovation-decision process. That is, the knowledge group was compared with the no knowledge group and the rejection or discontinuence group to the current users. In the second comparison, the spaces of all groups were compared to the current users. For this comparison the concept my orders was treated as a stable concept.

Overall, most of the differences among the groups concerned the electronic ordering methods, terminals and computers. The mean difference between the knowledge and no knowledge group was 8.1 units. Inward WATS order taker (10.1), computer-to-computer ordering (9.8) and weekends (10.0) changed to a greater degree. The mean differences between the knowledge and current users was 12.5 units. Portable terminal ordering (28.7) and computer-to-computer (20.5) changed to a greater degree. The mean difference between the current users and the discontinuence group was smaller, only 10.4 units. The Touch-Tone system (12.8) and portable terminals (22.1) were more different than the average. The mean difference between the no knowledge group and the current users was 16.1 units. Portable terminals (46.1) and computer-to-computer ordering (26.2) changed to greater degree. These differences should be considered along with the relative size of the reported values. In this case, the overall mean reported value was 33.5. The average resultant differences among the groups are between 24 and 48% of the average reported differences.

### **The Hypotheses**

H<sub>1</sub>: The reported distances between my orders and the various innovations are reported in Table 6. The hypothesis cannot be supported for inward WATS order taker, inward WATS tape recorder or for the Touch-Tone system. The mean values for the no knowledge group were 55.9 for terminals and 59.0 for the computer based method. They were 42.4 and 49.5 for the knowledge group and 23.3 and 41.2 for the current users. Statistically, the differences between the users and the two groups is significant. For portable terminals, the difference between the users and the knowledge group was 19.2 units ( $t=4.29$ ,  $p<.001$ ). The difference between users and the no knowledge group was 32.7 units ( $t=4.68$ ,  $p<.001$ ). Between the knowledge and no knowledge group the difference was 13.5 units ( $t=1.67$ ,  $p<.05$ ). For computers, the difference was 14.3 units ( $t=2.20$ ,  $p<.025$ ). Between the knowledge and no knowledge group 3.1 units ( $t=.42$ ,  $p>.10$ ). In

summary, the results support the hypothesis only for the electronic methods and not for the telephone based systems.

TABLE 6

Means and Standard Deviations for Pair Comparisons

Knowledge (N=91)				No Knowledge (N=49)			
Pair		Mean	S.D.	Pair		Mean	S.D.
1	2	31.49	26.36	1	2	36.92	27.00
1	3	34.25	26.04	1	3	36.11	25.16
1	4	34.60	28.43	1	4	33.42	21.27
1	5	39.18	32.25	1	5	32.76	18.95
1	6	27.06	29.13	1	6	23.26	23.45
1	7	26.73	28.32	1	7	21.42	23.57
1	8	23.40	28.19	1	8	25.40	27.67
1	9	22.27	28.50	1	9	20.64	20.65
1	10	22.43	28.40	1	10	22.56	24.17
1	11	23.16	28.78	1	11	21.32	23.00
1	12	43.40	33.26	1	12	54.64	27.20
1	13	45.50	34.07	1	13	57.36	28.81
1	14	26.46	33.25	1	14	24.88	25.71
2	3	23.85	24.33	2	3	27.44	25.66
2	4	26.24	23.09	2	4	27.12	26.80
2	5	32.51	28.63	2	5	27.36	28.20
2	6	30.83	27.84	2	6	36.68	28.69
2	7	31.32	25.99	2	7	39.83	28.39
2	8	36.03	28.89	2	8	47.16	27.01
2	9	35.52	29.37	2	9	44.44	26.44
2	10	32.94	29.44	2	10	38.44	24.06
2	11	35.94	29.25	2	11	42.00	21.58
2	12	40.27	33.98	2	12	41.28	30.96
2	13	41.20	34.44	2	13	44.52	29.59
2	14	34.92	32.47	2	14	46.25	31.26
3	4	22.35	23.87	3	4	28.58	29.48
3	5	27.94	27.47	3	5	35.41	30.65
3	6	37.16	35.34	3	6	43.50	28.15
3	7	37.87	34.85	3	7	45.50	30.05
3	8	38.20	35.81	3	8	50.79	28.47
3	9	37.38	36.56	3	9	48.44	26.20
3	10	36.74	37.10	3	10	48.16	27.27
3	11	38.20	36.10	3	11	47.72	27.03
3	12	42.65	39.67	3	12	51.28	28.46
3	13	39.92	33.09	3	13	51.48	29.04
3	14	35.75	28.80	3	14	54.72	30.81
4	5	18.20	22.77	4	5	21.40	26.40
4	6	30.83	27.98	4	6	41.96	26.44
4	7	37.38	28.43	4	7	44.40	22.28
4	8	37.38	30.18	4	8	49.36	24.92
4	9	37.01	30.51	4	9	44.44	22.28
4	10	37.29	30.03	4	10	44.24	22.43
4	11	36.35	30.28	4	11	45.84	22.78

4	12	39.10	34.34	4	12	46.88	30.54
4	13	38.92	34.04	4	13	47.64	30.55
4	14	42.38	31.07	4	14	55.92	33.59
5	6	34.30	29.82	5	6	43.16	29.79
5	7	36.00	30.41	5	7	45.00	28.28
5	8	36.35	31.12	5	8	51.84	26.33
5	9	36.17	31.24	5	9	48.04	26.71
5	10	36.62	30.84	5	10	48.32	26.70
5	11	36.14	31.24	5	11	47.84	26.30
5	12	40.65	36.27	5	12	48.92	33.13
5	13	41.29	35.78	5	13	49.14	33.42
5	14	49.45	31.87	5	14	58.96	30.84
6	7	34.93	29.23	6	7	33.00	20.68
6	8	38.61	29.00	6	8	40.48	24.28
6	9	36.17	30.45	6	9	39.44	20.01
6	10	37.29	29.05	6	10	41.80	21.30
6	11	38.26	28.89	6	11	39.16	17.17
6	12	50.62	31.32	6	12	60.80	23.86
6	13	52.60	31.32	6	13	63.00	23.40
6	14	29.84	30.54	6	14	26.08	22.57
7	8	11.05	21.84	7	8	13.20	25.21
7	9	11.31	22.40	7	9	10.80	22.74
7	10	11.13	22.21	7	10	9.20	18.03
7	11	8.67	18.99	7	11	11.20	19.61
7	12	46.71	32.52	7	12	49.40	34.36
7	13	49.92	32.17	7	13	52.20	32.56
7	14	28.29	32.92	7	14	29.00	26.79
8	9	14.25	22.49	8	9	23.12	30.20
8	10	12.93	22.41	8	10	25.68	30.03
8	11	13.63	23.85	8	11	27.16	34.26
8	12	50.46	33.25	8	12	62.40	29.39
8	13	51.98	33.13	8	13	61.00	29.90
8	14	24.40	31.03	8	14	38.80	30.96
9	10	16.48	23.47	9	10	22.92	27.42
9	11	14.32	22.51	9	11	15.12	23.08
9	12	49.12	31.71	9	12	56.20	28.29
9	13	50.19	32.45	9	13	56.80	28.03
9	14	22.91	31.20	9	14	29.40	30.40
10	11	16.13	25.78	10	11	21.12	26.80
10	12	48.67	33.06	10	12	61.80	26.41
10	13	50.46	33.03	10	13	62.40	26.00
10	14	23.72	30.29	10	14	31.20	28.47
11	12	44.92	32.41	11	12	58.40	29.41
11	13	47.07	31.57	11	13	57.40	28.57
11	14	23.52	29.45	11	14	27.00	27.20
12	13	26.68	30.17	12	13	27.20	36.90
12	14	39.39	35.47	12	14	56.52	29.13
13	14	43.05	35.16	13	14	57.72	31.81
Grand Mean		33.71	29.80			40.20	26.50

Current Users (N=307)			
Pair	Mean	S.D	
1 2	32.15	31.17	
1 3	36.14	33.47	
1 4	41.02	41.28	
1 5	45.47	37.16	
1 6	29.67	30.79	
1 7	32.28	33.70	
1 8	29.11	34.60	
1 9	29.22	34.64	
1 10	28.11	33.83	
1 11	26.25	34.30	
1 12	49.74	44.71	
1 13	50.29	44.80	
1 14	27.33	29.15	
2 3	34.55	32.49	
2 4	33.31	31.59	
2 5	38.17	37.53	
2 6	35.17	32.91	
2 7	40.53	33.98	
2 8	43.76	34.81	
2 9	43.36	35.25	
2 10	41.97	35.33	
2 11	40.09	35.93	
2 12	40.61	43.17	
2 13	42.47	44.09	
2 14	36.12	33.17	
3 4	35.16	31.93	
3 5	38.39	33.84	
3 6	37.21	35.49	
3 7	43.99	32.80	
3 8	46.66	34.74	
3 9	45.95	37.86	
3 10	46.02	39.03	
3 11	46.17	39.03	
3 12	46.33	39.48	
3 13	48.47	43.36	
3 14	41.17	39.16	
4 5	24.87	36.31	
4 6	19.61	27.01	
4 7	42.64	32.61	
4 8	45.79	35.30	
4 9	44.70	33.87	
4 10	45.12	35.29	
4 11	45.19	34.93	
4 12	36.62	37.55	
4 13	37.91	39.84	
4 14	23.24	33.15	
5 6	37.21	37.35	
5 7	47.49	36.49	
5 8	49.76	39.39	
5 9	48.45	38.07	
5 10	49.24	38.08	

Discontinuance (N=40)			
Pair	Mean	S.D.	
1 2	20.81	18.23	
1 3	27.58	21.17	
1 4	25.16	21.15	
1 5	28.45	25.66	
1 6	22.83	23.40	
1 7	27.33	27.07	
1 8	26.29	30.21	
1 9	22.67	26.60	
1 10	22.83	26.03	
1 11	21.94	26.11	
1 12	44.31	28.90	
1 13	44.48	31.13	
1 14	22.26	24.65	
2 3	20.32	19.79	
2 4	24.34	24.77	
2 5	23.80	23.47	
2 6	30.33	24.49	
2 7	34.67	26.95	
2 8	29.31	23.29	
2 9	31.07	21.76	
2 10	31.43	24.99	
2 11	30.86	23.34	
2 12	28.21	28.38	
2 13	29.82	28.26	
2 14	30.33	23.27	
3 4	16.21	21.36	
3 5	17.86	22.41	
3 6	33.97	24.85	
3 7	35.35	25.01	
3 8	35.52	26.85	
3 9	31.85	23.45	
3 10	35.00	25.67	
3 11	30.93	24.44	
3 12	32.22	25.65	
3 13	36.85	27.68	
3 14	34.46	27.68	
4 5	13.39	22.00	
4 6	31.72	23.38	
4 7	38.45	26.78	
4 8	38.33	29.67	
4 9	38.28	27.26	
4 10	38.10	26.17	
4 11	37.17	27.46	
4 12	28.39	27.77	
4 13	31.25	27.63	
4 14	34.57	28.45	
5 6	37.04	27.19	
5 7	39.81	28.36	
5 8	36.85	29.66	
5 9	38.33	27.88	
5 10	39.81	30.07	

5	11	48.64	38.13	5	11	37.59	27.93
5	12	49.18	54.08	5	12	33.46	30.12
5	13	48.04	48.79	5	13	35.77	29.73
5	14	41.21	37.51	5	14	35.00	27.35
6	7	33.54	29.61	6	7	22.22	18.32
6	8	33.22	31.88	6	8	24.11	22.08
6	9	32.94	33.96	6	9	24.29	23.40
6	10	36.02	36.39	6	10	24.63	22.23
6	11	33.28	32.21	6	11	23.75	23.20
6	12	43.08	38.47	6	12	41.90	31.98
6	13	45.68	34.90	6	13	46.55	30.43
6	14	19.65	26.29	6	14	21.67	21.65
7	8	12.80	25.12	7	8	6.67	15.51
7	9	12.99	25.67	7	9	5.69	13.30
7	10	14.10	29.27	7	10	7.76	15.54
7	11	10.79	23.75	7	11	4.50	11.71
7	12	49.40	39.83	7	12	44.82	33.92
7	13	52.23	38.03	7	13	46.43	34.22
7	14	28.30	28.02	7	14	22.67	26.44
8	9	18.58	29.58	8	9	9.66	17.75
8	10	19.28	27.39	8	10	12.41	19.45
8	11	19.22	26.53	8	11	12.33	20.44
8	12	49.67	40.06	8	12	44.11	32.01
8	13	51.36	40.14	8	13	48.21	31.68
8	14	28.63	31.58	8	14	23.83	29.48
9	10	17.65	25.82	9	10	12.68	19.34
9	11	13.61	22.08	9	11	11.80	20.82
9	12	51.12	39.28	9	12	43.70	29.70
9	13	52.12	40.70	9	13	45.37	30.24
9	14	26.12	31.36	9	14	15.89	23.07
10	11	19.29	29.12	10	11	12.50	17.90
10	12	51.27	39.48	10	12	47.41	30.86
10	13	52.20	41.16	10	13	48.33	31.53
10	14	27.43	28.93	10	14	20.00	23.91
11	12	47.75	40.41	11	12	44.48	32.91
11	13	49.31	43.43	11	13	43.35	34.43
11	14	25.99	35.19	11	14	16.00	23.95
12	13	23.45	38.78	12	13	21.79	29.43
12	14	41.50	37.25	12	14	41.60	31.90
13	14	44.12	41.53	13	14	40.81	31.96
Grand Mean		37.10	35.40			29.56	25.30

Key to Table 6 and Figures 1 and 2

- |                              |               |
|------------------------------|---------------|
| 1. Inward WATS Order Taker   | 8. Company A  |
| 2. Inward WATS Tape Recorder | 9. Company B  |
| 3. Touch-Tone Voice Response | 10. Company C |
| 4. Portable Terminal         | 11. Company D |
| 5. Computer-to-Computer      | 12. Evenings  |
| 6. Wholesaler                | 13. Weekends  |
| 7. Manufacturers             | 14. My Orders |

H<sub>2</sub>: H<sub>2</sub> is not supported by the data. With the exception of portable terminals, the discontinuence group placed my orders closer to the innovations than current users. For the discontinuence group the distances were 22.3 (Inward WATS order taker), 30.3 (Inward WATS tape recorder), 34.5 (the Touch-Tone system), 34.7 (portable terminals) and 35.0 (computer-to-computer ordering). The distances for the current use group were respectively, 27.3, 36.1, 41.2, 23.2 and 41.2. Statistically, the discontinuence group was not significantly closer on any of the ordering systems. However, for terminals, the current users were significantly closer. The difference was 11.5 units ( $t=2.19$ ,  $p<.025$ ). Thus, while the hypothesis is generally not supported, it is for portable terminal ordering.

H<sub>3</sub>: As with H<sub>2</sub>, there is support for H<sub>3</sub> only for portable terminals. For all other innovations, the knowledge group places these ordering systems closer to weekends and evenings than the current users. These values are presented in Table 6. The mean distance between portable terminals and evenings and weekends were 46.8 and 47.6 for the no knowledge group, 39.1 and 38.7 for the knowledge group and 36.6 and 37.9 for the current users. Statistically, these differences are not significant.

H<sub>4</sub>: H<sub>4</sub> must be rejected. For the discontinuence group, the mean distance between all innovations and evenings and weekends were less than the current users.

H<sub>5</sub>: H<sub>5</sub> must also be rejected. For current users, the distance between inward WATS order taker and my order was 27.3. For inward WATS tape recorder, the distance was 36.1.

H<sub>6</sub>: H<sub>6</sub> is supported by the data. For current users, the distance between inward WATS tape recorders and my order was 36.1. The distance for portable terminals was 23.2. The difference is statistically significant ( $t=4.11$ ,  $p<.001$ ).

H<sub>7</sub>: H<sub>7</sub> is also supported. The mean distance for current users for portable terminals and my orders was 23.2. The distance between Touch-Tone/Voice Response and my orders and my orders was 41.2.

H<sub>8</sub>: H<sub>8</sub> must be rejected. The reported distance for the current users, between Touch-Tone/Voice Response and my orders and computer-to-computer ordering and my orders was equivalent, 41.2 for both pairs.

H<sub>9</sub>: H<sub>9</sub> cannot be supported by the data. The mean standard deviation for the 91 pair-comparisons for each of the groups was, no knowledge, 26.4, knowledge, 29.8, and 35.4 for the current users.

H<sub>10</sub>: H<sub>10</sub> can be supported by the data. The traces for each of the groups were no knowledge, 11,726, knowledge, 8,130 and 9,757 for the current users. This suggests that there is a change in an individual's ability to differentiate concepts related to an innovation during the diffusion process.

## DISCUSSION

This paper was written to further demonstrate the utility of MMDS for describing the diffusion of innovations. Past research has clearly shown how these methods may be used in the study of

socio-cultural change and for designing message strategies for marketing commercial products and political campaigns (Woelfel, et al, 1980a). However, in this case, equivocal results occurred. The only automated ordering method which behaved as predicted by Barnett's (1978) Associational Model was the portable terminal. It was the most widely adopted and preferred ordering method. These facts may account for the reason why the predicted relations were obtained with this innovation and none of the others. Inward WATS order taker, inward WATS tape recorder, Touch-Tone/Voice Response, and computer-to-computer ordering did not behave as predicted.

There are a number of reasons for these inconclusive results. The results reported here were a secondary analysis of market research conducted by a major pharmaceutical manufacturer. The study was not designed to test Barnett's model. Rather, it was designed and data collected as a preference mapping of the clients attitudes for not only automated ordering methods but to determine the market positioning of several major pharmaceutical manufacturers.

These divergent goals lead to a problem regarding the domain of selected concepts. They were chosen by the company, not through interviews with the potential adopters. As a result, four of the scaled concepts were manufacturers, which were irrelevant to the reported analysis. There were only two concepts scaled which related the innovations to a single descriptive attribute, the relative advantage of flexibility in the time when an order may be placed. Concepts which would have provided a better description of the process and test of the model such as, complexity, ease, cost, and familiarity, were not measured.

Another cause for the inconclusive results was the manufacturer's attempt to determine the relative preferences for the various automated ordering systems. For that reason, all five systems that make up the package of innovations were scaled. The preferred method among current users was the portable terminal. It was significantly closer to my orders than the next closest method, inward WATS order taker ( $t=1.45$ ,  $p<.10$ ) and had the greatest level of adoption, 43%.

Despite learning that the portable terminal was the preferred system, more information could have been gained if the attributes which the population used to differentiate the innovation were also included. In that way, the manufacturer could have determined how the potential adopters and current users evaluate the ordering methods and how each of the methods compared on these attributes. If the goal of the original research had been to determine the utility of the associational model for describing the innovation process, the preferred method would have been to take a single focal innovation rather than a variety of ordering systems varied on a number of dimensions. Among these, only time flexibility was measured because the attributes to describe these other factors were not included. The various innovations were only practically differentiated in the associational structure. The result was that intervening variables rendered the conclusion uncertain.

Still another weakness of this study was the question which sorted the sample into the categories of no knowledge, knowledge, current user and discontinuator. This analysis implied that members of the last group have made a conscious individual decision to stop using automated ordering. This may not have been the case. The individual could have changed employment or the organization in which he/she was employed may have made the decision to discontinue automated ordering (Rogers & Agarwala-Rogers, 1976). The question which sorted the sample was too imprecise to determine the reasons for discontinuence.

It should be pointed out that the cognitive changes during the innovation-decision process are continuous rather than categorical. Rather than treating knowledge and usage as simply categories, they should have been measured as continuous ratio scaled variables, such as, amount of time being aware of and amount of time using automated ordering. This would have produced greater differentiation among subjects and provided a more accurate description of the diffusion process.

This study did not measure the diffusion process over time, but rather it examined differences between categories which stood for the stages in the innovation-decision process. As a result, its time measurement may be considered a pseudo-process. That is, measurements were made at one point in time and theory or some independent variable used to simulate change over time. This procedure is common in developmental research where children are sorted by chronological age. It is assumed that the development process can be revealed by examining differences among these groups. A similar set of assumptions were made here. It was thought that the diffusion process could be examined by looking at differences between knowers, adopters and so on. Some justification for this approach may be found by examining the relative differences among the groups. We would expect that the differences between the no knowledge and knowledge groups would be smaller than between the no knowledge and current user groups. Similarly, we would expect the differences between the knowledge and the current users to be less than between the no knowledge and use groups. This would preserve the theoretical order among the groups. Indeed, this order was preserved. The average difference between the first two groups was 8.1 units. Between the later two groups it was 12.5. It was 16.1 between the first and the third. Thus, the order is preserved.

This use of the data for the reasons reported in this chapter were opportunistic. They provide an initial application, however poor, of Barnett's Associational Model for the Diffusion of Complex Innovations. Further research should follow a single innovation from initial awareness through adoption or rejection and its discontinuence. Concepts scaled for this purpose should come from a content analysis of in-depth interviews with potential adopters. In this way all attributes which they use to differentiate the innovation from past products, practices or ideas can be used to observe the changes in the associational structure of potential adopters. In this way, the utility of MMDS and the associational model for the study of the diffusion process can be better examined.

## SUMMARY

This chapter examined the differences in perception of a number of communication technologies known as automated ordering methods by individuals at different stages in the innovation-decision process. Following Barnett's (1978) Associational Model for the Diffusion of Complex Innovations, a survey was described which applied MMDS to measure the cognitive structure of potential adopters toward a domain of concepts related to automated ordering with the pharmaceutical industry. Despite reporting equivocal results, the study demonstrated the utility of this approach for the examination of the diffusion process. The results suggested that the portable terminal was the preferred automated ordering system and that this method showed the clearest differences in associational structure at the different stages in the diffusion process. Reasons for the inconclusive results were discussed.

## NOTES

1. An earlier version of this chapter was presented to the Human Communication Technologies Interest Group of the International Communication Association, Boston, May, 1982.

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