New way to measure consumers' judgments

Conjoint measurement can help the marketing manager determine which of a product's or service's qualities are most important to the consumer

Paul E. Green and Yoram Wind

When developing new products or services—or even when repositioning an existing one—a company must consider two basic problems. First, it must know its market; second, it must understand the nature of the product. It may find both problems hard to solve, especially when the nature of the product under consideration has several disparate qualities, each appealing to a diverse number of consumers with diverse interests. Beyond the fundamental need that the product is to fill often lie several others that the marketing manager would do well to consider. But how does he evaluate those needs? How does he evaluate which of the product's attributes the consumer perceives to be the most important? In order to market the product most effectively, marketing managers must have the means to answer these kinds of questions. In this article the authors demonstrate one research technique that has been used in evaluating consumers' judgments and show how to apply it to a number of complex marketing situations.

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Taking a jet plane for a business appointment in Paris? Which of the two flights described below would you choose?

☐
A B-707 flown by British Airways that will depart within two hours of the time you would like to leave and that is often late in arriving in Paris. The plane will make two intermediate stops, and it is anticipated that it will be 50% full. Flight attendants are "warm and friendly" and you would have a choice of two movies for entertainment.
☐
A B-747 flown by TWA that will depart within four hours of the time you would like to leave and that is almost never late in arriving in Paris. The flight is nonstop, and it is anticipated that the plane will be 90% full. Flight attendants are "cold and curt" and only magazines are provided for entertainment.

Are you looking for replacement tires for your two-year-old car? Suppose you want radial tires and have the following three options to choose from:

☐
Goodyear's, with a tread life of 30,000 miles at a price of $40 per tire; the store is a 10-minute drive from your home.
☐
Firestone's, with a tread life of 50,000 miles at a price of $85 per tire; the store is a 20-minute drive from your home.
☐
Or Sears's, with a tread life of 40,000 miles at a price of $55 per tire; the store is located about 10 minutes from your home.

How would you rank these alternatives in order of preference?

Both of these problems have a common structure that companies and their marketing managers frequently encounter in trying to figure out what a consumer really wants in a product or service. First, the characteristics of the alternatives that the consumer must choose from fall along more than a single dimension—they are multiattribute. Second, the consumer must make an overall judgment about the relative value of those characteristics, or attributes; in short, he must order them according to some criterion. But doing this requires complex trade-offs, since it is likely that no alternative is clearly better than another on every dimension of interest.

In recent years, researchers have developed a new measurement technique from the fields of mathematical psychology and psychometrics that can aid the marketing manager in sorting out the relative importance of a product's multidimensional attributes.[1] This technique, called conjoint measurement, starts with the consumer's overall or global judgments about a set of complex alternatives. It then performs the rather remarkable job of decomposing his or her original evaluations into separate and compatible utility scales by which the original global judgments (or others involving new combinations of attributes) can be reconstituted.[2]

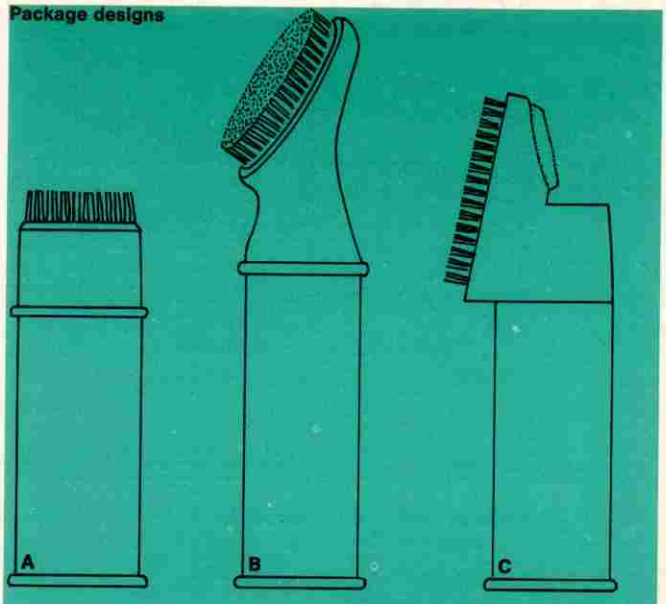
Being able to separate overall judgments into psychological components in this manner can provide a manager with valuable information about the relative importance of various attributes of a product. It can also provide information about the value of various levels of a single attribute. (For example, if price is the attribute under consideration, conjoint measurement can give the manager a good idea of how sensitive consumers would be to a price change from a level of, say, 85¢ to one of 75¢ or one of 95¢.) Indeed, some models can even estimate the psychological trade-offs consumers make when they evaluate several attributes together.

The advantages of this type of knowledge to the planning of marketing strategy are significant. The knowledge can be useful in modifying current products or services and in designing new ones for selected buying publics.

In this article, we first show how conjoint measurement works from a numerical standpoint. We then discuss its application to a variety of marketing

Exhibit I
Experimental design for evaluation of a carpet cleaner

Package designs



Orthogonal array

	Package design	Brand name	Price	Good Housekeeping seal?	Money-back guarantee?	Respondent's evaluation (rank number)
1	A	K2R	$1.19	No	No	13
2	A	Glory	1.39	No	Yes	11
3	A	Bissell	1.59	Yes	No	17
4	B	K2R	1.39	Yes	Yes	2
5	B	Glory	1.59	No	No	14
6	B	Bissell	1.19	No	No	3
7	C	K2R	1.59	No	Yes	12
8	C	Glory	1.19	Yes	No	7
9	C	Bissell	1.39	No	No	9
10	A	K2R	1.59	Yes	No	18
11	A	Glory	1.19	No	Yes	8
12	A	Bissell	1.39	No	No	15
13	B	K2R	1.19	No	No	4
14	B	Glory	1.39	Yes	No	6
15	B	Bissell	1.59	No	Yes	5
16	C	K2R	1.39	No	No	10
17	C	Glory	1.59	No	No	16
18	C	Bissell	1.19	Yes	Yes	1*

*Highest ranked

problems, and we demonstrate its use in strategic marketing simulations. The Appendix provides a brief description of how other research tools for measuring consumer judgments work, and how they relate to conjoint measurement.

How conjoint measurement works

In order to see how to apply conjoint measurement, suppose a company were interested in marketing a new spot remover for carpets and upholstery. The technical staff has developed a new product that is designed to handle tough, stubborn spots. Management interest centers on five attributes or factors that it expects will influence consumer preference: an applicator-type package design, brand name, price, a *Good Housekeeping* seal of endorsement, and a money-back guarantee.

Three package designs are under consideration and appear in the upper portion of *Exhibit I*. There are three brand names under consideration: *K2R*, *Glory*, and *Bissell*. Of the three brand names used in the study, two are competitors' brand names already on the market, whereas one is the company's present brand name choice for its new product. Three alternative prices being considered are $1.19, $1.39, and $1.59. Since there are three alternatives for each of these factors, they are called three-level factors. The *Good Housekeeping* seal and money-back guarantee are two-level factors, since each is either present or not. Consequently, a total of $3\times3\times3\times2\times2 = 108$ alternatives would have to be tested if the researcher were to array all possible combinations of the five attributes.

Clearly, the cost of administering a consumer evaluation study of this magnitude—not to mention the respondents' confusion and fatigue—would be prohibitive. As an alternative, however, the researcher can take advantage of a special experimental design, called an *orthogonal array*, in which the test combinations are selected so that the independent contributions of all five factors are balanced.[3] In this way each factor's weight is kept separate and is not confused with those of the other factors.

The lower portion of *Exhibit I* shows an orthogonal array that involves only 18 of the 108 possible combinations that the company wishes to test in this case. For the test the researcher makes up 18 cards. On each card appears an artist's sketch of the package design, A, B, or C, and verbal details regarding each of the other four factors: brand name, price, *Good Housekeeping* seal (or not), and money-back guarantee (or not). After describing the new product's functions and special features, he shows the respondents each of the 18 cards (see *Exhibit I* for the master design), and asks them to rank the cards in order of their likelihood of purchase.

The last column of *Exhibit I* shows one respondent's actual ranking of the 18 cards; rank number 1 denotes her highest evaluated concept. Note particularly that only *ranked* data need be obtained and, furthermore, that only 18 (out of 108) combinations are evaluated.

Computing the utilities

Computation of the utility scales of each attribute, which determine how influential each is in the consumers' evaluations, is carried out by various computer programs.[4] The ranked data of a single respondent (or the composite ranks of a group of respondents) are entered in the program. The computer then searches for a set of scale values for each factor in the experimental design. The scale values for each level of each factor are chosen so that when they are added together the *total* utility of each combination will correspond to the original ranks as closely as possible.

Notice that two problems are involved here. First, as mentioned previously, the experimental design of *Exhibit I* shows only 18 of 108 combinations. Second, only rank-order data are supplied to the algorithms. This means that the data themselves do not determine how much more influential one attribute is than another in the consumers' choices. However, despite these limitations, the algorithms are able to find a *numerical* representation of the utilities, thus providing an indication of each factor's relative importance.

1. R. Duncan Luce and John W. Tukey, "Simultaneous Conjoint Measurement: A New Type of Fundamental Measurement," *Journal of Mathematical Psychology*, February 1964, p. 1.

2. The first marketing-oriented paper on conjoint measurement was by Paul E. Green and Vithala R. Rao, "Conjoint Measurement for Quantifying Judgmental Data," *Journal of Marketing Research*, August 1971, p. 355.

3. A nontechnical discussion of this special class of designs appears in Paul E. Green, "On the Design of Experiments Involving Multiattribute Alternatives," *Journal of Consumer Research*, September 1974, p. 61.

4. As an illustration, see Joseph B. Kruskal, "Analysis of Factorial Experiments by Estimating Monotone Transformations of the Data," *Journal of the Royal Statistical Society*, Series B, March 1965, p. 251.

In general, more accurate solutions are obtained as the number of combinations being evaluated increases. Still, in the present case, with only 18 ranking-type judgments, the technique works well. *Exhibit II* shows the computer results.

As can be observed in *Exhibit II*, the technique obtains a utility function for each level of each factor. For example, to find the utility for the first combination in *Exhibit I*, we can read off the utilities of each factor level in the five charts of *Exhibit II*: U (A) = 0.1; U (K2R) = 0.3; U ($1.19) = 1.0; U (No) = 0.2; U (No) = 0.2. Therefore the total utility is 1.8, the sum of the five separate utilities, for the first combination. Note that this combination was ranked only thirteenth by the respondent in *Exhibit I*.

On the other hand, the utility of combination 18 is 3.1 (0.6 + 0.5 + 1.0 + 0.3 + 0.7), which is the respondent's highest evaluation of all 18 combinations listed.

However, as can be easily seen from *Exhibit II*, if combination 18 is modified to include package Design B (in place of C), its utility is even higher. As a matter of fact, it then represents the highest possible utility, even though this specific combination did not appear among the original 18.

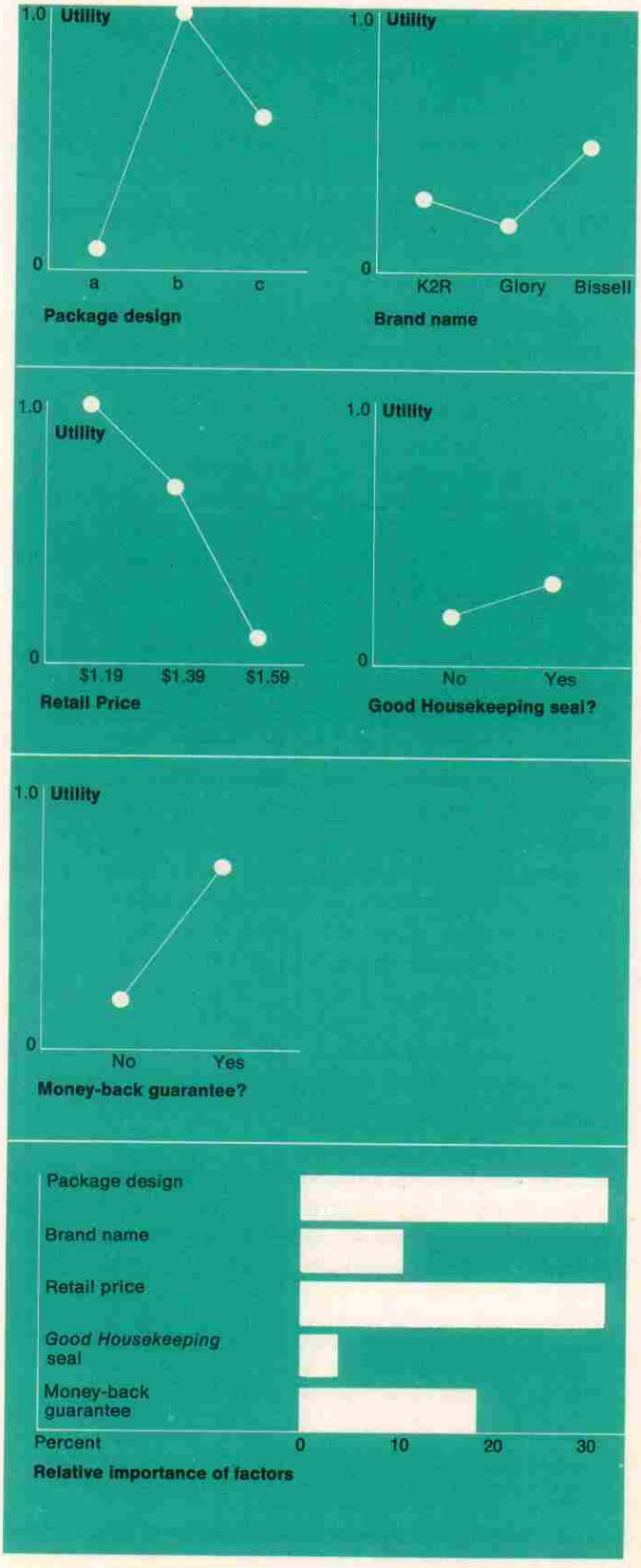
Importance of attributes

By focusing attention on only the package design, the company's marketing researchers can see from *Exhibit II* that Design B displays highest utility. Moreover, all utility scales are expressed in a common unit (although their zero points are arbitrary). This means that we can compare utility ranges from factor to factor so as to get some idea of their relative importance.

In the case of the spot remover, as shown in *Exhibit II*, the utility ranges are:

- Package design (1.0 − 0.1 = 0.9)
- Brand name (0.5 − 0.2 = 0.3)
- Price (1.0 − 0.1 = 0.9)
- *Good Housekeeping* seal (0.3 − 0.2 = 0.1)
- Money-back guarantee (0.7 − 0.2 = 0.5)

Exhibit II
Results of computer analysis of experimental data of Exhibit I



How important is each attribute in relation to the others? The lower portion of *Exhibit II* shows the relative size of the utility ranges expressed in histogram form. As noted, package design and price are the most important factors, and together they account for about two thirds of the total range in utility.

It should be mentioned that the relative importance of a factor depends on the levels that are included in the design. For example, had price ranged from $1.19 to a high of $1.89, its relative importance could easily exceed that for package design. Still, as a crude indication of what factors to concentrate on, factor importance calculations provide a useful by-product of the main analysis regardless of such limitations.

Managerial implications

From a marketing management point of view the critical question is how these results can be used in the design of a product/marketing strategy for the spot remover. Examination of *Exhibit II* suggests a number of points for discussion:

- Excluding brand name, the most desirable offering would be the one based on package Design B with a money-back guarantee, a *Good-Housekeeping* seal, and a retail price of $1.19.
- The utility of a product with a price of $1.39 would be 0.3 less than one with a price of $1.19. A money-back guarantee which involves an increment of 0.5 in utility would more than offset the effect of the higher price.
- The use of a *Good Housekeeping* seal of approval is associated with a minor increase in utility. Hence including it in the company's product will add little to the attractiveness of the spot remover's overall offering.
- The utility of the three brand names provides the company with a quantitative measure of the value of its own brand name as well as the brand names of its competitors.

Other questions can be answered as well by comparing various composites made up from the utilities shown in *Exhibit II*.

The air carrier study

What about the two Paris flights you had to choose between? In that study, the sponsor was primarily interested in how air travelers evaluated the B-707 versus the B-747 in transatlantic travel, and whether relative value differed by length of flight and type of traveler—business versus vacation travelers. In this study all the respondents had flown across the Atlantic at least once during the preceding 12 months.

Exhibit III shows one of the findings of the study for air travelers (business and vacation) flying to Paris. Without delving into details it is quite apparent that the utility difference between the B-707 and the B-747 is very small. Rather, the main factors are departure time, punctuality of arrival, number of stops, and the attitudes of flight attendants.

The importance of type of aircraft did increase slightly with length of flight and for business-oriented travelers versus vacationers. Still, its importance to overall utility was never greater than 10%. It became abundantly clear that extensive replacement of older aircraft like the B-707 would not result in major shifts in consumer demand. On the contrary, money might better be spent on improving the scheduling aspects of flights and the attitudes and demeanor of flight personnel.

The air carrier study involved the preparation of some 27 different flight profiles (only two of which appear at the beginning of the article). Respondents simply rated each flight description in terms of its desirability on a seven-point scale. Only the order properties of the ratings were used in the computer run that resulted in the utility scales appearing in *Exhibit III*.

The replacement tire study

The conjoint measurement exercise in the replacement tire study was part of a larger study designed to pretest several television commercials for the sponsor's brand of steel-belted radial tires. The sponsor was particularly interested in the utility functions of respondents who expressed interest in each of the test commercials.

The respondents considered tread mileage and price as quite important to their choice of tires. On the other hand, brand name did not play an important role (at least for the five brands included in the

study). Not surprisingly, the most popular test commercial stressed tread mileage and good value for the money, charactertistics of high appeal to this group. What was surprising was that this group represented 70% of the total sample.

This particular study involved the preparation of 25 profiles. Again, the researchers sorted cards into seven ordered categories. The 25 profiles, also constructed according to an orthogonal array, represented only one twenty fifth of the 625 possible combinations.

Potential uses of conjoint measurement

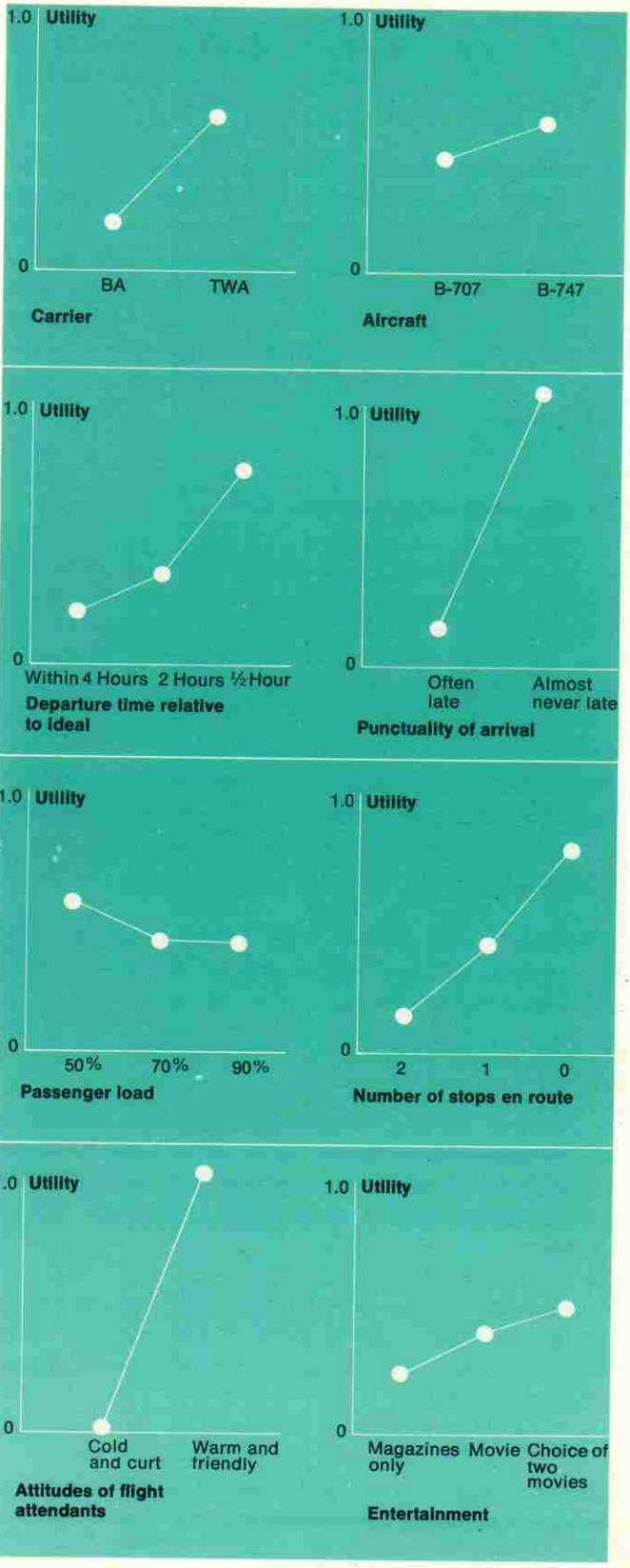
The three preceding studies only scratch the surface of marketing problems in which conjoint measurement procedures can be used. For example, consumer evaluations can be obtained on:

- ☐ New product formulations involving changes in the physical or chemical characteristics of the product
- ☐ Package design, brand name, and promotional copy combinations
- ☐ Pricing and brand alternatives
- ☐ Verbalized descriptions of new products or services
- ☐ Alternative service designs

Moreover, while the three preceding examples emphasized preference or likelihood-of-purchase orderings, any explicit judgmental criterion can be used. For example, alternatives might be ordered by any of these criteria:

- ☐ Best value for the money
- ☐ Convenience of use
- ☐ Suitability for a specified type of consumer or for a specified end use
- ☐ Ruggedness, distinctiveness, conservativeness, and other "psychological images"

Exhibit III
Utility functions for air travelers to Paris



Designing bar soaps

In one recent study researchers related the psychological imagery of physical characteristics of actual bars of soap to end-use appropriateness; this study was conducted for the laboratory and marketing personnel of a diversified soap manufacturer.

While the designing of a bar of soap—by varying weight, size, shape, color, fragrance type and intensity, surface feel, and so on—may seem like a mundane exercise, the fact remains that a cleverly positioned bar soap (for example, Irish Spring) can rapidly become a multimillion-dollar enterprise. Still, the extent of knowledge about the importance of such imagery is woefully meager. The researchers formulated actual bars of soap in which color, type of fragrance, and intensity of fragrance were constructed according to a design in which all possible combinations of the experimental factors appeared. All the other characteristics of the soap were held constant.

Respondents examined the soaps and assigned each bar to the end use that they felt best matched its characteristics—moisturizing facial soap, deep-cleaning soap for oily skin, woman's deodorant soap, or man's deodorant soap. The data were then analyzed by conjoint measurement techniques, leading to a set of psychophysical functions for each of the characteristics.

The study showed that type of fragrance was the most important physical variable contributing to end-use appropriateness. Rather surprisingly, the type of fragrance (medicinal) and color (blue) that appeared best suited for a man's deodorant soap were also found to be best for the deep-cleaning soap, even though deep-cleaning soap had been previously classed for marketing purposes as a facial soap. On the other hand, fragrance intensity played a relatively minor role as a consumer cue for distinguishing among different end uses.

In brief, this study illustrated the feasibility of translating changes in various physical variables into changes in psychological variables. Eventually, more detailed knowledge of these psychological transformations could enable a laboratory technician to synthesize color, fragrance, shape, and so forth to obtain soaps that conjure up almost any desired imagery. Moreover, in other product classes—beers, coffees, soft drinks—it appears possible to develop a psychophysics of taste in which such elusive verbal descriptions as "full-bodied" and "robust" are given operational meaning in terms of variations in physical or chemical characteristics.

5. Richard M. Johnson, "Trade-Off Analysis of Consumer Values," *Journal of Marketing Research*, May 1974, p. 121.

Verbalized descriptions of new concepts

In many product classes, such as automobiles, houses, office machines, and computers, the possible design factors are myriad and expensive to vary physically for evaluation by the buying public. In cases such as these, the researcher usually resorts to verbalized descriptions of the principal factors of interest.

To illustrate, one study conducted among car owners by Rogers National Research, Inc. employed the format shown in *Exhibit IV*. In this case the researchers were interested in the effects of gas mileage, price, country of manufacture, maximum speed, roominess, and length on consumer preferences for new automobiles. Consumers evaluated factor levels on a two-at-a-time basis, as illustrated in *Exhibit IV*. Market Facts, Inc. employs a similar data collection procedure.[5]

In the Rogers study it was found that consumer evaluations of attributes were highly associated with the type of car currently owned and the type of car desired in the future. Not surprisingly, gas mileage and country of manufacture were highly important factors in respondent evaluations of car profiles. Somewhat surprising, however, was the fact that even large-car owners (and those contemplating the purchase of a large car) were more concerned with gas economy than owners of that type of car had been historically. Thus, while they fully expected to get fewer miles per gallon than they would in compact cars, they felt quite strongly that the car should be economical compared to others in its size class.

Organizations as consumers

Nor is conjoint measurement's potential limited to consumer applications. Evaluations of supply alternatives by an organizational buyer are similar to benefits sought by the consumer. Thus, one can argue, these evaluations are among the most important inputs to industrial marketing strategy.

As an illustration, the management of a clinical laboratory was concerned with the problem of how

to increase its share of laboratory test business. It had a study conducted to assess how physicians subjectively value various characteristics of a clinical laboratory in deciding where to send their tests.

Each physician in the study received 16 profiles of hypothetical laboratory services, each showing a different set of characteristics, such as reliability of test results, pick-up and delivery procedures, convenience of location, price range of services, billing procedures, and turnaround time. Utility functions were developed for each of these factors. On the basis of these results the management of the laboratory decided to change its promotion by emphasizing a number of convenience factors in addition to its previous focus on test reliability.

Marketing strategy simulations

We have described a variety of applications of conjoint measurement, and still others, some in conjunction with the other techniques outlined in the Appendix, could be mentioned.[6] What has not yet been discussed, and is more important, is the role that utility measurement can play in the design of strategic marketing simulators. This type of application is one of the principal uses of conjoint measurement.

As a case in point, a large-scale study of consumer evaluations of airline services was conducted in which consumer utilities were developed for some 25 different service factors such as on-ground services, in-flight services, decor of cabins and seats, scheduling, routing, and price. Moreover, each utility function was developed on a route (city-pair) and purpose-of-trip basis.

As might be expected, the utility function for each of the various types of airline service differed according to the length and purpose of the flight. However, in addition to obtaining consumers' evaluations of service profiles, the researchers also obtained information concerning their *perceptions* of each airline (that is, for the ones they were familiar with) on each of the service factors for which the consumers were given a choice.

These two major pieces of information provided the principal basis for developing a simulation of airline services over all major traffic routes. The purpose of the simulation was to estimate the effect on market share that a change in the service configuration of the sponsor's services would have, route by route, if competitors did not follow suit. Later, the sponsor used the simulator to examine the effect of assumed retaliatory actions by its competitors. It also was able to use it to see what might happen to market share if the utility functions themselves were to change.

Each new service configuration was evaluated against the base-period configuration. In addition, the simulator showed which competing airlines would lose business and which ones would gain business under various changes in perceived service levels. Thus, in addition to single, ad hoc studies, conjoint measurement can be used in the ongoing monitoring (via simulation) of consumer imagery and evaluations over time.

Prospects and limitations

Like any new set of techniques, conjoint measurement's potential is difficult to evaluate at the present stage of development and application. Relatively few companies have experimented with the approach so far. Capability for doing the research is still concentrated in a relatively few consulting firms and companies.

Conjoint measurement faces the same kinds of limitations that confront any type of survey, or laboratory-like, technique. First, while some successes have been reported in using conjoint measurement to predict actual sales and market share, the number of applications is still too small to establish a convincing track record at the present time.

Second, some products or services may involve utility functions and decision rules that are not adequately captured by the models of conjoint measurement. While the current emphasis on additive models (absence of interactions) can be shifted to more complex, interactive models, the number of combinations required to estimate the interactions rapidly mounts. Still, little is known about how

6. Paul E. Green and Yoram Wind, *Multiattribute Decisions in Marketing: A Measurement Approach* (Hinsdale, Ill.: Dryden Press, 1973).

Exhibit IV
A two-at-a-time factor evaluation procedure

What is more important to you?

There are times when we have to give up one thing to get something else. And, since different people have different desires and priorities, the automotive industry wants to know what things are most important to you.

We have a scale that will make it possible for you to tell us your preference in certain circumstances – for example, gas mileage vs, speed. Please read the example below which explains how the scale works – and then tell us the order of your preference by writing in the numbers from 1 to 9 for each of the six questions that follow the example.

Example:
Warranty vs. price of the car

	Years of warranty		
Price of car	3	2	1
$3,000	1		
$3,200			
$3,400			

Step 1 (Explanation)

You would rather pay the least ($3,000) and get the most (3 years). Your first choice (1) is in the box as shown.

Procedure:
Simply write the number 1 in the combination that represents your first choice. In one of the remaining blank squares, write the number 2 for your second choice. Then write the number 3 for your third choice, and so on, from 1 to 9.

	Years of warranty		
Price of car	3	2	1
$3,000	1		
$3,200	2		
$3,400			

Step 2

Your second choice is that you would rather pay $3,200 and have a 3-year warranty than pay $3,000 and get a 2-year warranty.

	Years of warranty		
Price of car	3	2	1
$3,000	1	3	
$3,200	2		
$3,400			

Step 3

Your third choice is that you would rather pay $3,000 and have a 2-year warranty than pay $3,400 and get a 3-year warranty.

	Years of warranty		
Price of car	3	2	1
$3,000	1	3	6
$3,200	2	5	8
$3,400	4	7	9

Sample:

This shows a sample order of preference for all possible combinations. Of course, your preferences could be different.

For each of the six questions below, please write in the numbers from 1 to 9 to show your order of preference for your next new car.

	Miles per gallon		
Price of car	22	18	14
$3,000			
$3,200			
$3,400			

	Miles per gallon		
Roominess	22	18	14
6 passenger			
5 passenger			
4 passenger			

	Miles per gallon		
Maximum speed	22	18	14
80 mph			
70 mph			
60 mph			

	Miles per gallon		
Made in	22	18	14
Germany			
U.S.			
Japan			

	Miles per gallon		
Length	22	18	14
12 feet			
14 feet			
16 feet			

	Price of car		
Made in	$3,000	$3,200	$3,400
Germany			
U.S.			
Japan			

good an approximation the simpler models are to the more elaborate ones.

Third, the essence of some products and services may just not be well captured by a decomposition approach that assumes that the researcher can describe an alternative in terms of its component parts. Television personalities, hit records, movies, or even styling aspects of cars may not lend themselves to this type of reductionist approach.

While the limitations of conjoint measurement are not inconsequential, early experience suggests some interesting prospects for measuring consumer trade-offs among various product or service characteristics. Perhaps what is most interesting about the technique is its flexibility in coping with a wide variety of management's understanding of consumers' problems that ultimately hinge on evaluations of complex alternatives that a choice among products presents them with.

Appendix: Other techniques for quantifying consumers' judgments

Conjoint measurement is the latest in an increasing family of techniques that psychometricians and others in the behavioral and statistical sciences have developed to measure persons' perceptions and preferences. Conjoint measurement can often be profitably used with one or more of the following:

Factor analysis. Factor analysis in marketing research has been around since the 1940s. However, like all the techniques to be (briefly) described here, factor analysis did not reach any degree of sophistication or practicality until the advent of the computer made the extensive computations easy to carry out. A typical input to factor analysis consists of respondents' subjective ratings of brands or services on each of a set of attributes *provided by the researcher.* For example, a sample of computer systems personnel were asked to rate various computer manufacturers' equipment and services on each of the 15 attributes shown in *Table I.*

The objective of factor analysis is to examine the commonality across the various rating scales and find a geometric representation, or picture, of the objects (computers), as well as the attributes used in the rating task. As noted in *Table I,* International Business Machines (IBM) was ranked highest on virtually all attributes while Xerox (XDS), a comparatively new entrant at the time of the study, National Cash Register (NCR), and Central Data Corporation (CDC) were not perceived as highly as the others with regard to the various attributes of interest to computer users.

The tight grouping of the attribute vectors also suggests a strong "halo" effect in favor of IBM. Only in the case of price flexibility does IBM receive less than the highest rating, and even here it is rated a close second. Thus as *Table I* shows, factor analysis enables the researcher to develop a picture of both the things being rated (the manufacturers) and the attributes along which the ratings take place.

Perceptual mapping. A somewhat more recent technique—also abetted by the availability of the computer—is perceptual mapping. Perceptual mapping techniques take consumer judgments of *overall* similarity or preference and find literally a picture in which objects that are judged to be similar psychologically plot near each other in geometric space (see *Table II*). However, in perceptual mapping the respondent is free to choose *his own* frame of reference rather than to respond to explicitly stated attributes.

The perceptual map of the 11 automobiles shown was developed from consumers' judgments about the relative similarity of the 55 distinct pairs of cars that can be made up from the 11 cars listed. The dimension labels of *luxurious* and *sporty* do *not* come from the technique but rather from further analysis of the map, once it is obtained from the computer. Ideal points I and J are shown for two illustrative respondents and are fitted into the perceptual map from the respondents' preference judgments. Car points near a respondent's ideal point

Table I
Factor analysis of average respondent ratings of eight computer manufacturers' images on each of 15 attributes

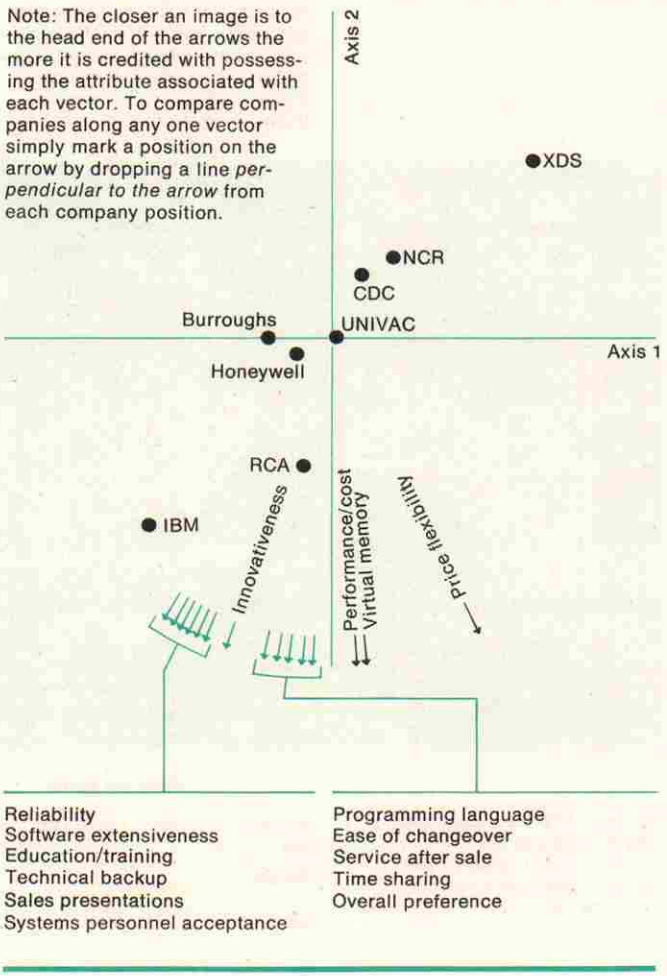


Table II
Perceptual mapping of respondents' judgments of the relative similarity of 11 cars and two respondents' preference orderings

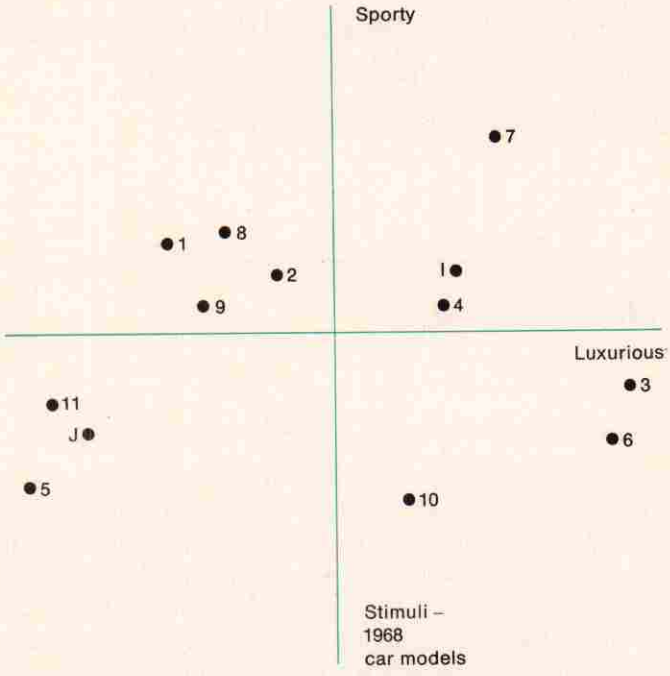
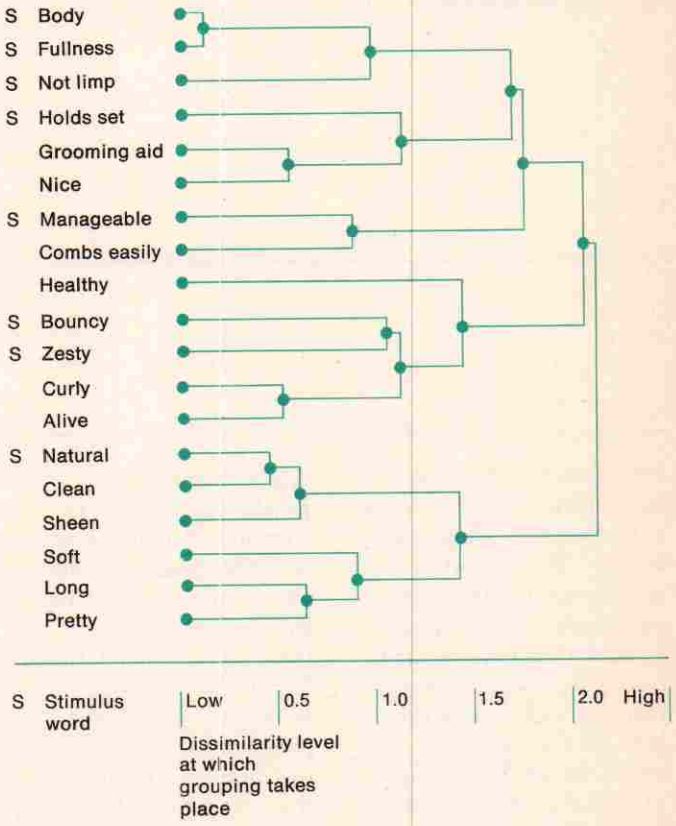


Table III
Hierarchical cluster analysis of 19 phrases evoked in a free association task involving women's hair shampoos



are preferred to those farther away. Thus respondent I most likes Ford Thunderbird, while respondent J most likes Chevrolet Corvair. In practice, data for several hundred respondents might be used to find regions of high density for ideal points.

Cluster analysis. Still another way to portray consumers' judgments is in terms of a hierarchical tree structure in which the more similar a set of objects is perceived to be, the more quickly the objects group together as one moves from left to right in the tree diagram. Thus the words *body* and *fullness* are perceived to be the two most closely associated of all of the descriptions appearing in *Table III* that characterize hair. Note further that smaller clusters become embedded in larger ones until the last cluster on the right includes all 19 phrases. The words in this example were based on respondents' free associations to a set of 8 stimulus words. The researchers assumed that the more a stimulus evoked another word, the more similar they were.

Relationship to conjoint measurement: These three methods are best noted for their complementarities —both with each other and with conjoint measurement. Factor analysis and perceptual mapping can be used to measure consumers' perceptions of various products or services, while conjoint measurement can be used to quantify how consumers trade off some of one attribute to get more of another. Cluster analysis can be used in a variety of ways, either as a comparison technique for portraying the similarities of various objects or as a basis for grouping people with common perceptions or preferences. In short, all these techniques can—and frequently are—applied in the *same* study. As such, their combined use can heighten different aspects of the same general types of input data.