Comparing Perceptual Mapping and Conjoint Analysis: The Political Landscape

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The Choice Between Conjoint Analysis and Perceptual Mapping

Choosing between conjoint analysis and perceptual mapping may appear to many to be trivial—a classic no-brainer. It is like the choice in a world championship between the LA Rams and the New York Mets. The outcome trivially depends on your choice of turf and rules of play. Perceptual mapping is played on a turf of image products, such as cigarettes and bourbon, and its rules specify that the competitive structure can be reduced to two-dimensional competitive maps, something that is only possible if the perceptions on products on attributes are strongly correlated with one another. By contrast, conjoint analysis plays on a conceptually different field. The soft turf of image products is replaced by the hard surface of functional products such as computers or forklift trucks. Further, the rules of conjoint keep the attribute sharply distinct, so that the impact of a change in any one of them is clearly discernible. Finally, the outcomes of the two systems are quite different. Perceptual mapping forms elegant spaces, which locate consumers' perception of the brand, while leaving obscure the relationship between attribute levels and preferences. Compare those maps with the partworth functions of conjoint analysis, which move effortlessly from attribute levels to preferences, apparently finessing the issue of perceptions altogether.

While perceptual mapping and conjoint analysis techniques have been traditionally quite different, the Adaptive Perceptual Mapping (APM) program of Sawtooth Software makes them much more similar. What is novel about the APM approach is that it forms maps at the individual level, and then uses these to predict preferences in a choice simulator. When its individual-level model is compared with the individual level model in conjoint, the differences between the two become much less pronounced.

Our plan today is to examine the similarities and differences between an individual-level perceptual map and a conjoint analysis. We will then describe a study in which both techniques are used to predict straw votes in the current presidential race. While the winner is the one that predicts the most votes for each individual, the main insights from this study will involve distinguishing when one system will be more appropriate than the other, and why.

Differences Between Conjoint Analysis and Perceptual Mapping

Table 1 summarizes the differences in inputs, outputs, and assumptions between individual models of choice reflected in the two systems. As we contrast perceptual mapping and conjoint analysis, we will focus on the particular versions, ACA (Adaptive Conjoint Analysis) and APM, although the conclusions apply to any conjoint system and any perceptual mapping system that is estimated at the individual level.

TABLE 1

DIFFERENCES IN INPUTS, OUTPUTS AND ASSUMPTIONS BETWEEN PERCEPTUAL MAPPING AND CONJOINT ANALYSIS

Inputs		
Unique to Perceptual Mapping	***Shared***	***Unique to Conjoint Analysis***
Identification of ideal attribute levels	Perceptions of products on attributes	Ranking of all attribute levels
		Tradeoffs among profiles
General importance of attributes		Importance of best vs. worst attribute levels
	Outputs	
Perceptual map containing products and ideal points	Simulation of product choices	Partworth values of each level of each attribute
	Assumptions	
Utility is symmetric around ideal point	Each attribute levels maps into unique utility	No constraint on form of partworths
Attribute weights are modified by principal components:	Attribute weights are independent	Attribute weights are modified by conjoint judgments:
More correlated attributes get more weight	The level on one attribute does not change the utility of another	More important attributes get more weight

In terms of inputs, both systems need to collect respondents' perceptions or ratings of products on attributes. In perceptual mapping these ratings are the basic material that is used to form the maps, while for conjoint analysis they allow one to use the partworth utility functions to estimate the utility of the products that have been rated. Both systems also collect some measure of the importance of each attribute. IN the APM system this measure tends to be vague and global while in ACA it is anchored at the best and worst levels of the attribute. Despite strong conceptual difference, both importance measures correlate very highly in practice. A big difference between the systems is the way they assess the utility of each attribute level. Perceptual mapping directly assesses the ideal level of each attribute and measures utility as a weighted deviation from that ideal. Conjoint analysis, by contrast, asks respondents to evaluate profiles or product descriptions and uses these judgments to infer the values of the attribute levels.

The two systems use these inputs to produce apparently different outputs. As mentioned earlier, both ACA and APM define utility at the level of the individual and perform "what if" simulations. These simulations allow the analyst to estimate what would happen to market share if market composition, or people's perception of a brand, changed. In terms of unique

outputs, APM derives images of competitive structure through perceptual maps. These summarize both the perceptions of the competing brands and the location of ideal points within one space. Conjoint analysis cannot directly produce maps but generates partworth functions that allow the analyst to visualize how much value an individual or a segment attaches to various attribute levels.

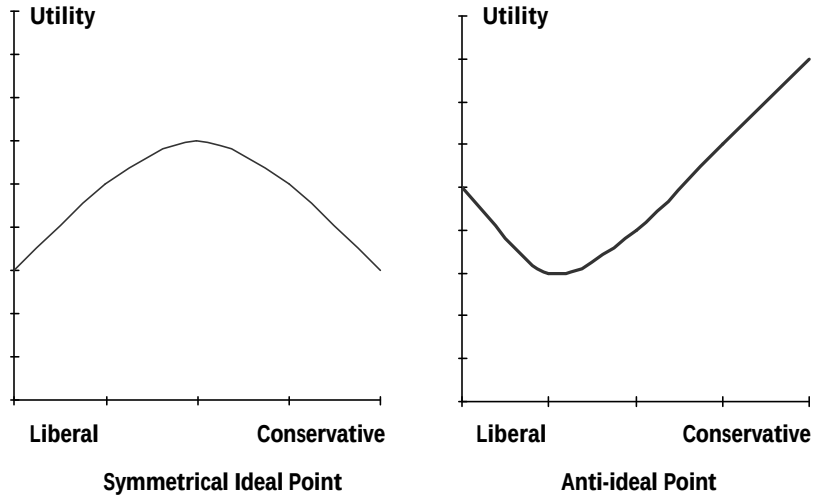
It needs to be stressed that these output differences are not very binding. Thus, while conjoint analysis doesn't product spaces, the information is there and, with commonly available discriminant analysis software, one could produce perceptual maps. Further, ideal points or vectors reflecting the partworth utility functions could be positioned in this space. Thus the input to most conjoint analyses can be used to produce perceptual spaces. For its part, the information in perceptual mapping can generate individual or aggregate partworth functions. Although, it is considered next, each of these will be in the inverted "U" shape rather than the unconstrained form of the conjoint partworth functions.

Thus, although the two techniques do not differ critically with respect to their inputs or outputs, they do differ in important ways in their assumptions—and it is these assumptions that are likely to make a difference in the predictive power of the models. Two important differences are the form of the utility function and the way of weighting the different attributes.

FIGURE 1

ILLUSTRATING PARTWORTH FUNCTIONS FOR

PERCEPTUAL MAPPING AND FOR CONJOINT ANALYSIS



Both conjoint analysis that perceptual mapping assume that each attribute level maps into one utility value and that this utility is independent of the levels of the other attributes. Perceptual

mapping further assumes that the form of this mapping is an ideal point with preferences decreasing symmetrically as one moves away from the ideal level. Conjoint analysis puts no constraint on the shape of this function. The partworth functions in Figure 1 illustrate this difference. In the left graph the ideal candidate is between liberal and conservative, and the least liked candidates are at the extreme. The right hand graph illustrates a respondent who dislikes moderate candidates relative to either strong liberals or conservatives. The important point is that this latter pattern of preferences (sometimes termed an anti-ideal) cannot be represented by an ideal point model. Only conjoint analysis could capture these utilities. Thus the utility function in conjoint analysis is more general than for perceptual mapping.

It should be emphasized, however, that this greater generality of the conjoint methodology is not always an advantage. To the extent that the most of the partworths can be closely approximated by a symmetric and positive ideal, then utility functions constrained to that shape are less affected by respondent error and results in more precise utility estimates. Conjoint analysis has an advantage in the case that significant numbers of partworths are bowl-shaped or jagged and thus cannot be approximated by the positive ideal point.

A second important difference between the two techniques is the way attributes are weighted. The explicit weights which are collected by both techniques have one well-known disadvantage: they tend to overweight the less important attributes. For example, suppose a person indicates that knowledge of international affairs is moderately important in a political candidate. It has often been found that these moderately important attributes are given very little weight when actually selecting a candidate. Generally speaking, almost any attribute seems important in isolation, but its actual importance may be far less when it has to be traded off against other attributes. Conjoint copes with this problem by altering the weights to correspond to one's judgments of profiles, since in those judgments one tends to place most weight on only a few attributes.

Perceptual mapping deals with this "bias" another way. By first performing principal components on the ratings data, many attributes are replaced by a few components. These few components tend to have their highest loadings on a few attributes. Those attributes that get the most weight tend to be "central" in the sense of being most highly correlated with the others. Thus both perceptual mapping and conjoint tend to limit the impact of unimportant attributes. However, perceptual analysis used correlations with other attributes as its criterion for re-weighting while conjoint uses the judgments on profiles.

In summary, a close examination of the individual choice models of conjoint and perceptual mapping reveals that they are not that disparate. While they have somewhat different inputs and assumptions about the relationships between the attributes and utility, both present reasonable theoretical models of choice. Accordingly, the appropriate question is which system works best at predicting choice, and that is the topic of the next section.

A Study to Compare Perceptual Mapping and Conjoint Analysis

To compare the two systems we built one large questionnaire that provided the inputs needed by each. We then asked a number of holdout choice questions to test their relative ability to predict each individual's choices.

TABLE 2

A STUDY OF POLITICAL PREFERENCES

8 PRESIDENTIAL HOPEFULS

REPUBLICANS	DEMOCRATS
George Bush	Jesse Jackson
Robert Dole	Gary Hart
Jack Kemp	Michael Dukakis
Pat Robertson	Albert Gore

For the category we selected the hotly contested presidential race in the fall of 1987. We selected this area because of the interest in the candidates and because we could not predict whether conjoint or perceptual mapping would do a better job. Candidates were reasonably well known, although the race was still fluid enough that voters could conceive of candidates as "bundles or attributes." We used the four Democratic and four Republican hopefuls shown in Table 2. We needed attributes that could be considered continuous and could also be broken into discrete levels for conjoint analysis. These attributes and their levels are shown in Table 3.

TABLE 3

A STUDY OF PRESIDENTIAL ASPIRANTS

9 Attributes, 4 Levels for each

1. Ability to get things done
   FAIR, GOOD, EXCELLENT, OUTSTANDING
2. Ability to inspire confidence in the White House
   FAIR, GOOD, EXCELLENT, OUTSTANDING
3. Has a clear view of the future
   LITTLE, SOMEWHAT, VERY, EXTREMELY
4. Lets ideals, rather than politics, dictate solutions to problems
   IDEALS ALWAYS, SOEMTIMES, POLITICS SOMETIMES, ALWAYS
5. Emphasizes workers and their welfare over economic growth in business
   STRONG ON WORKERS, MODERATE, MODERATE ON ECONOMY, STRONG
6. Has a conservative political ideology
   VERY CONSERVATIVE, SOMEWHAT, SOMEWHAT LIBERAL, VERY
7. Is a strong advocate of protectionism
   STRONG FREE TRADE, MODERATE, MODERATE PROTECTIONIST, STRONG
8. Emphasizes world affairs over domestic affairs
   STRONG ON WORLD, MODERATE, MODERATE ON DOMESTIC, STRONG
9. Emphasizes religious and moral values
   RARELY, OCCASIONALLY, SOMETIMES, OFTEN

The inputs to each system are summarized in Table 4. For perceptual mapping we collected general importance of each of the nine attributes on a 5-point scale ranging from "Extremely important to have this" through "This really isn't important to me," to "Extremely important NOT to have this." Then respondents rated each of the 8 candidates and a ninth "ideal candidate" on the 9 attributes.

TABLE 4

A STUDY TO COMPARE CONJOINT AND PERCEPTUAL MAPPING

INPUTS	
PERCEPTUAL MAPPING	CONJOINT ANALYSIS
Identification of Ideal Attribute Levels	Rankings of Attribute Levels
General Attribute Importances	Importance of Best vs. Worst Levels
Perceptions of Candidates on Attributes	Tradeoffs between Profiles

We then collected the conjoint input. Each respondent rank-ordered preferences for the four levels of the attributes. Then we, or more appropriately ACA, asked for the importance of the difference between the best and worst level of each attribute. Finally, in the core of the conjoint section, respondent indicated relative preferences for 18 pairs of profiles each defined on two attributes. An example of that tradeoff question is shown in Table 5.

TABLE 5

AN EXAMPLE OF A TRADEOFF QUESTION

STRONG PREFER TOP	INDICATE YOUR PREFERENCE
1	STRONG ON WORKER'S WELFARE
2	VERY WEAK ON ECONOMIC GROWTH
3	SOMWHAT LIBERAL
4	
5	OR
6	MODERATE ON WORKERS' WELFARE
7	WEAK ON ECONOMIC GROWTH
8	SOMEWHAT CONSERVATIVE
9	
STRONG PREFER BOTTOM	(PRESS NUMBER KEY TO ANSWER)

Utility functions for each system then predicted choice for each candidate at the individual level. The conjoint estimates come directly out of ACA, although the APM model reflects a departure from its standard output. Instead of weighting deviations from the ideal levels, we used unit weights. Further, we did not use principal components to reduce the space but simply added each deviation. Thus, our version of APM is a far simpler than that which is automatically offered. Thus if there is a bias in this study it is against APM. We are currently testing a number of alternative models. However, out experience with the form of the weighting function indicates that it will make relatively little difference (one or two percentage points) in the hit rate.

These two systems were tested against 16 straw votes comparing candidates as if the election were held today. Half of these were pairs of candidates, one from each party. The second group were triples, two from one party and one from another. Each of the pairs gives one prediction, while each triple generates two. For example, if Bush is preferred in a three-way race between Bush, Kemp and Hart, then there are two predictions: Bush over Kemp, and Bush over Hart.

Results

Forty-two registered voters took part in the study, about half from Columbia University and bout half from Duke University. Our emphasis here is not on their preferences but on the ability of perceptual mapping and conjoint analysis to correctly predict their straw votes. This should be relatively unaffected by political orientation, although it may be affected by the high level of education in the samples.

Thus for each respondent we have 8 predictions from the pairs and 16 from the triples. The hit rates from the two are given in Table 6.

TABLE 6

HIT RATES FOR CONJOINT AND PERCEPTUAL MAPPING

	PERCENT OF STRAW VOTES CORRECTLY PREDICTED:		
	CONJOINT ANALYSIS	PERCEPTUAL MAPPING	N =
PAIRS	65%	76%	336
TRIPLES	635	80%	672
	PERCENT OF RESPONDENTS WILL BETTER PREDICTIONS		
	CONJOINT ANALYSIS BETTER	PERCEPTUAL MAPPING BETTER	BOTH TIED
STRAW VOTES (n=42)			
PAIRS	21%	52%	27%
TRIPLES	17%	76%	7%

The results reflect an unexpectedly striking victory for perceptual mapping. For pairs there was an 11-point improvement in hit rates using perceptual mapping (65% vs. 76%), while for triples this improvement is 17 points (63% vs. 80%). Further, as indicated by the percentage of individuals who were better predicted by one system over another, perceptual mapping is more than twice as likely to achieve greater accuracy for pairs, and more than four times as likely to do so when predicting triples. The increased gain for perceptual mapping in triples indicates perceptual mapping is particularly effective in making predictions within party since those predictions were only required for the triples.

Why Perceptual Maps Made Better Predictions

The overwhelming success of perceptual mapping over conjoint analysis is all the more remarkable because of the biases against it. In this case the model was not even the normal one but a far simpler one which simply added the deviations from each individual's ideal point. However, the reasons why it won provide important insights into the predictive abilities of both models. We will examine three reasons why perceptual mapping did so well: its position in the questionnaire, the location of the ideal point questions, and finally, and most importantly, some difficulties subjects had with the conjoint questions.

The simplest hypothesis for the reduced effectiveness of the conjoint analysis is that it came after the evaluation of 8 candidates (and an ideal) on 9 attributes. These 81 judgments were not simple or easy. Thus, when respondents got to the conjoint questions they may have no longer been able to put in the required effort.

A second, somewhat subtler, hypothesis for why mapping did well deals with the location of the ideal candidate question for each attribute. These questions occur right after one has rated all of the candidates. Thus is it easy for respondents to rate their ideal candidate as close to the candidates they like. In other words, the placement of the question makes it easy for respondents to make their ratings consistent with their choices later on. By contrast, in the conjoint task one may have forgotten whether the candidates one likes have a moderate emphasis on domestic affairs, or a strong one. This is a particular problem in this study since the adverb modifiers in the levels, such as "moderate" or "strong," have little meaning except relative to one another. In the perceptual mapping task it is easy to keep this relative ranking straight, whereas in the conjoint profiles it can be quite difficult.

A third problem, related to the second, is that respondents found the conjoint tradeoffs difficult to answer. This problem came in a number of forms. Sometimes the profile attributes were inconsistent with one another, other times the level of one affected the meaning of another, and generally respondents found it hard to evaluate a candidate from a partial description. Since these are very important issues relevant to the validity of any conjoint exercise, they are considered separately.

Attribute conflict is best illustrated in the conjoint question shown in Table 7. In that tradeoff the respondent is asked to evaluate a candidate who is good at inspiring confidence but for whom politics always dictate solutions to problems. For many respondents such a candidate is a contradiction in terms. This may result in confusion, greater error, and occasionally resentment that degrades responses to later questions.

TABLE 7

ILLUSTRATING CONFLICTING ATTRIBUTES IN A CONJOINT TASK

STRONG PREFER TOP	INDICATE YOUR PREFERENCE
1	IDEALS ALWAYS DICTATE SOLUTIONS TO PROBLEMS
2	FAIR AT INSPIRING CONFIDENCE IN THE WHITE HOUSE
3	
4	
5	OR
6	
7	POLITICS ALWAYS DICTATE SOLUTIONS TO PROBLEMS
8	GOOD AT INSPIRING CONFIDENCE IN THE WHITE HOUSE
9	
STRONG PREFER BOTTOM	(PRESS NUMBER KEY TO ANSWER)

A second, and perhaps more dangerous, problem with the tradeoff questions occurs when the level of one attribute alters the meaning of another. This violates the assumption of utility independence. Consider the tradeoff given in Table 8. In that tradeoff one must choose between a strong liberal who is outstanding at getting things done and a conservative who fair at getting things done. The problem here is in determining the value of "getting things done." Generally, it has a strong positive value. However, if it is attached to a cause in which one does not believe, then its value can be negative. Thus, the utility of one attribute level depends on the level of the other. This utility dependence violates the assumptions of the conjoint model and results in unstable conjoint estimates and poor predictions.

TABLE 8

ILLUSTRATING UTILITY DEPENDENCE

STRONG PREFER TOP	INDICATE YOUR PREFERENCE
1	OUTSTANDING AT GETTING THINGS DONE
2	VERY LIBERAL
3	
4	
5	OR
6	
7	FAIR AT GETTING THINGS DONE
8	SOMEWHAT CONSERVATIVE
9 STRONG PREFER BOTTOM	(PRESS NUMBER KEY TO ANSWER)

A final problem with conjoint questions relates to the others. That is, a number of respondents would examine a profile and then think, "Ah, that's Jimmy Carter," or "That's George Bush." Once identified, it was easy to evaluate the profile. The important point here is the evaluation of a candidate is more primitive or basic to these respondents than is an evaluation of the candidate's attributes. In such cases evaluation does not follow from attributes, but rather the other way around. IN such a context, it is perhaps no surprise that conjoint's focus on the utility of each attribute level does less well.

Conclusions

The important lessons here are methodological, dealing with the meaning of perceptual mapping and conjoint analysis and when each should be used. On these areas there are three important conclusions.

1. PERCEPTUAL MAPPING AND CONJOINT ANALYSIS ARE FORMALLY QUITE SIMILAR

This paper began by acknowledging that until recently distinguishing the uses of perceptual mapping and conjoint analysis was on the order of distinguishing football from baseball. However, if one examines the individual choice models that underlie the new versions, they are formally quite similar to one another. Thus, while there are still product classes or

problems for which the choice between systems is a "no-brainer," it is important to understand that there is an increasingly broad range of problems for which either or both are acceptable. The critical question then is to determine which system has merit for a given problem.

2. USE CONJOINT ANALYSIS WHEN ATTRIBUTES ARE NOMINAL AND PERCEIVED AS HAVING INDEPENDENT VALUE BY THE RESPONDENT.

A major difference between the formal structure of conjoint and perceptual mapping is that the former permits any shape in its partworth functions. This flexibility implies that nominal attributes, such as brand names or style types, generally can only be represented by conjoint analysis. However, if one has continuous attributes such as horsepower or durability, the increased flexibility of the conjoint functions may lead to greater error relative to perceptual mapping which constrains their shape.

There is a second, more important issue. Conjoint assumes that respondents evaluate products on the basis of each individual attribute. To the extent that this is not done, conjoint will do a poor job of predicting choice. This problem clearly occurred in our study of presidential candidates. A test of whether conjoint would be appropriate involves showing potential respondents tradeoffs and evaluating their response. If the questions are difficult, reflecting conflicting attributes, unstable utilities, or if respondents need to identify the product's identity prior to making an evaluation, then conjoint methodology is unlikely to work.

3. USE PERCEPTUAL MAPPING FOR CONTINUOUS ATTRIBUTES TRAT ARE CORRELATED WITH ONE ANOTHER.

Perceptual mapping will be most successful when attributes are continuous and highly correlated with one another. The idea of continuousness stems from the need to represent utility as an ideal point within each attribute. Most continuous attributes can be represented by single-peaked ideal points, although this assumption needs to be checked for each attribute.

The high level of correlation means that a small number of dimensions will account for the large number of attribute judgments, thus permitting a great deal of information to be conveyed in a few maps. It also means that one cannot change perceptions on one attribute without changing perceptions on a group of others. These interrelations become apparent in the reduced space and account for much of their managerial value.

It must be acknowledged, however, that this adaptability comes at a price. Perceptual mapping accounts for brand preferences primarily because the inputs are structured in such a way that ideal points are placed where one's favorite brands are located. This circularity means that there will be pretty good correspondence between utilities assigned to brands and subsequent choices, just as we found in the political study. However, if one plans to use these maps to evaluate new offerings it is important that the new offerings correspond to current offerings in two senses. First the new offerings should be close to current ones. Since ideal points are close to current favorites any new offering that is dissimilar will do poorly in a choice simulator, even though it might do quite well in the marketplace. Second, and perhaps more important, the new offerings cannot upset the current correlational structure. Thus, if one alters a candidate on one attribute without changing the other attributes that are believed

to be correlated with it, then regardless of what the model says, very little change will take place.