

# Conjoint Analysis: a Review of Conjoint Paradigms and Discussion of the Outstanding Design Issues

By Roger Brice

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*The author expands on why much of the debate comparing conjoint paradigms is inappropriate and why some of the conclusions offered by research suppliers could well be incorrect. He offers two areas he believes deserve our attention in order to assist us in selecting or designing the most appropriate conjoint paradigms for individual marketing problems. Moreover, he focuses on the peculiarities of the pharmaceutical marketplace.*

Conjoint analysis has enjoyed increasing use by research practitioners over the last twenty-five years or so. It has probably never been used as much as it is today. Surveys of research agencies have shown that more than one-half of the applications of conjoint analysis involve consumer goods and that a major proportion of the remainder involve services. The purposes of conjoint studies conducted in Europe reported most frequently are pricing, new product or new concept identification, and market segmentation.

It is also apparent that the number of market research suppliers offering conjoint analysis as a commercial service has increased greatly. In a 1991 survey Wittink et al reported that of fifty-nine European firms conducting studies on behalf of clients, thirty-eight had started doing so since 1986.

Coinciding with this rapid increase in the number of conjoint studies being conducted and the number of suppliers offering them, have been major developments in the automation of the design, fielding and analysis of conjoint experiments. One developer, Sawtooth, has been at the forefront of this and two of this company's branded conjoint paradigms – Adaptive Conjoint Analysis (ACA) and Choice Based Conjoint (CBC) – now dominate the market for packaged conjoint paradigms. The appeal of these branded paradigms is easy to understand and Sawtooth deserves considerable credit for their development and ongoing enhancement. However, both market research suppliers and users must not fail to remember that these represent only a small proportion of the total number of possible conjoint paradigms and that, while these two between them cover many problems requiring a conjoint solution, restricting a conjoint solution, restricting the choice of paradigms to these two may not always lead to the best conjoint design being used.

During the course of this paper, I will expand further on why I think much of the debate comparing conjoint paradigms is inappropriate and why some of the conclusions offered by research suppliers could well be incorrect. I will end up offering the two areas I believe deserve our attention in order to assist us in selecting or designing the most appropriate conjoint paradigms for individual marketing problems. These will be supported by references to some of the many papers published on conjoint analysis and by some results from our own experience at Adelphi. I will also focus my comments on the peculiarities of the pharmaceutical marketplace we all work in. However, before doing this, it is useful to remind ourselves of what the components are that make up a conjoint paradigm.

## **What is Conjoint Analysis**

It is very important to remember that conjoint analysis is a generic term and a collective noun. All authors agree on this but perhaps not surprisingly, given that conjoint analysis has its origins in scientific psychometric theory but its development has been in the hands of the less scientifically rigorous market researchers, we do find a variety of definitions. However the definition used by the early developers and widely used today, is that

*'conjoint analysis refers to a family of paradigms for the algebraic representation of individual judgments of multi-attribute stimuli'*

*'(they) are concerned with the quantitative description of consumer preferences or value trade-offs'*

Common to all of these paradigms is a family algebraic models for analysis of the data gathered and for testing the 'correctness' of the one chosen. All require respondents to respond to multiple combinations of levels of product attributes, usually but not necessarily generated by some statistical design procedure – e.g. a fractional factorial design.

### **Why was conjoint analysis needed?**

Conjoint methods were developed in response to the view that the ranking of importance of product features through self-explication of the importance of individual features considered separately could, and did, lead to incorrect conclusions. Importantly what was the need to measure and understand the trade-offs that purchasers make among multi-attributed products or services. It has also been stated in favour of conjoint methods that they more realistically replicate the purchasing decision that does any exercise based on individual importance ratings. This may be so but conjoint analysis itself is still a long way from replicating the product choice decision. Consumers do not carry utility scores in their heads and sum them in order to make marginal decisions. Does this matter though if the theory fits and replicates the decisions made? Almost certainly it does not and therefore any argument for one model over another on the basis of replicating reality is only relevant if predictability capabilities are equal. We will return to this point.

As I stated earlier, conjoint analysis is a collective term for a family of paradigms. Bring a family, the paradigms have a number of characteristics in common.

### **The components of a conjoint paradigm**

There are four components to a conjoint paradigm essential in order for it to achieve the required objectives of understanding the importance purchasers place on various product attributes and the trade-offs they make among them. These four components are:

1. the conjoint question that respondents must answer,
2. the stimulus material used for the conjoint question,
3. the statistical model used to analysis the data gathered, and
4. the presentation of the output, which affects how the user may apply the results.

To this list I would add a fifth that I call the 'missing' component, but first we need to be very briefly consider the alternatives that exist for each of the four essential components. We then have the basis for any discussion of the relative merits and areas of greatest utility for the various paradigms available to us.

### **The conjoint question**

This consists of respondents reviewing a list of alternative product profiles or concepts typically, but not necessarily, expressed as a bundle of product features. This list forms the conjoint stimuli material and the individual items are then either:

- ◆ ranked,
- ◆ rated – individually or in pairs,
- ◆ allocated across a fixed resource or

the most likely to be purchased is selected

## The conjoint stimuli material

This is a set of product alternatives where traditionally each product is expressed as a bundle of features – a feature being an attribute and level combination. The set of alternatives is usually, but not necessarily, an orthogonal fraction of the full factorial design of all attribute and level combinations. Clearly, when the list of attributes is long, the product profile can be quite daunting and the ability of respondents to assimilate the profiles and distinguish between them on a consistent basis has to be questioned. ACA and other hybrid models, or bridging models, offer solutions to this problem.

## The statistical analysis model

Most frequently, nowadays, the data analysis is conducted through ordinary least squares regression with dummy variables (OLS) or multi-nominal logit analysis (MNL). Other utility theory models are also used as is linear programming and analysis of variance, but these are less common.

There are some very important differences between ordinary least squares regression and multinomial logit analysis which affect the choice between them and, consequently, between the main branded paradigms. Ordinary least squares regression assumes independent product attributes – e.g. price and performance are not related in the minds of respondents. This is the analytical method used in the traditional full-profile paradigms and the hybrid paradigm, ACA. Perhaps its main advantage is that it allows us to consider individual respondents' preference sets and to segment the customer base on these preference sets. This latter consideration can be important if the relative prevalence of customer segments is expected to change. You may feel this consideration in pricing research where the proportion of price sensitive physicians may change over the planning and/or forecasting period.

Multinomial logit analysis does not assume independent product attributes and also allows interactions to be identified. This has been suggested by some as the reason why Sawtooth's CBC appears to perform better than ACA in pricing research. Later I will suggest that this may not be the reason and that the basis on which CBC is preferred to ACA may not be sound and that, therefore, the common preference for CBC over other conjoint paradigms for pricing research may not be universally correct.

My objective in this very brief overview of the three alternatives in designing the data collection and analysis components of a conjoint paradigm is to illustrate the extent to which there is a choice within each. This, in turn, indicates the number of possible conjoint paradigms that are possible – and thus before we even consider the choices for the output to be given to the client. We should now give some consideration to this.

## The conjoint output

The original designers of conjoint analysis intended that the output should provide:

- ◆ an understanding of current product preferences and the trade-offs made in product choice,
- ◆ provide importance measures for attribute ranges,
- ◆ assesses preferences among new products and to
- ◆ design new products.

It is important to remember that most applications of conjoint analysis are in consumer product or service markets where, unlike many pharmaceutical applications, the 'new' product or service is often really only a development of a current one and therefore can be made to order.

Nowadays, users of conjoint analysis are not content with this list of outputs and want to use the conjoint model to stimulate markets and to predict future market structures, particularly new product market shares. Along with the suitability of conjoint paradigms for pricing research, this question of market share versus preference share make up the two major issues I feel need further attention from conjoint practitioners. The preference share and market share debate follows on from consideration of what I term the 'missing' component in debates on conjoint paradigms; that of model validity.

### The 'missing' 5th component

To date most practitioners of conjoint analysis have relied on internal indicators of model validity, namely including holdout cards (product profiles) within the data gathering exercise and considering the ability of the model derived from the main set of cards to predict the stated preferences for these holdout cards. This is fine if the traditional objectives of conjoint analysis remain the limit of our needs. However we must recognise the needs of our clients. This is increasingly not just to understand customer preferences and trade-offs, which conjoint does admirably, but to prioritise between product development priorities based on their likely share of their respective market places. Conjoint would appear to them to do this as preference share is one of the outputs we can obtain. This is the first of two issues I would like to focus on after first spending only a few minutes on the subject of the best conjoint paradigm.

### The best conjoint paradigm

Having gone through this brief explanation of the alternatives within the components of a conjoint paradigm, it is tempting to attempt to decide on a 'best' design. Of course, there is no such thing; certainly not in the context of a universal best to be applied to all situations. At best we can come up with a checklist of the type shown in Table 1.

**Table 1 When branded paradigms are appropriate?**

When one is Appropriate for Objectives: A Possible Checklist			
Consideration	ACA	CBC	Full Profile
Number of attributes	Up to 30	Up to 6	Up to 10
Sample size	'smaller'	'larger'	'smaller'
Individual level utilities	Yes	No	Yes
Interactions identified	No	Yes	No
Price as an attribute	No	Yes	With care
Computerised q'aire	Required	Yes	Yes
Paper q'aire	No	Yes	Yes
Segmentation from data	Yes	No	Yes

The number of paradigm options across the table are very few, and I am sure that the considerations shown down the table do not cover all situations. However, such a table may have applicability in many conjoint design situations. The key, though, is to recognise all the considerations that may affect your design decision, and then decide whether such a table comparing standard choices is appropriate or whether a customised conjoint paradigm is required. Our experience is that the latter is becoming increasingly more common.

I would now like to use the remaining time to discuss two issues that I think are important within the conjoint analysis debate. These are assessing the reliability and accuracy of conjoint models and simulations, and the role of conjoint analysis in pricing research.

### Assessing accuracy and reliability

Relying on holdout analyses and comparing alternative paradigms is clearly not sufficient if market simulations and predicting new product uptake is the output required.

In 1990 Green and Srinivasan stated that

*'above all, conjoint analysis is a model for predicting choice (or at least intended choice)'*

Our own experience is that most conjoint studies include objectives that require market share predictions. Indeed, in pricing studies based on conjoint data such predictions are essential as the output from the pricing market research study usually forms part of the input into an internal financial model. The following example summarises the new product market share predictions from a conventional conjoint study we conducted some two and a half years ago. The new products whose share was predicted were subsequently launched and we have had the opportunity review the predictions from the conjoint model in the light of market events.

The objectives of our 1994 study included estimating the impact that a series of new products would have entering a chronic market that, until recently, had been characterised by long established branded and generic products that were very similar in therapeutic performance. There had been three recent new product introductions. These products represented a new sub-class with a different mechanism of action and improved performance compared to the traditional products. The future new products we wished to model were related to these recent introductions but could be argued to offer some additional benefits.

The study was conducted in three countries: France, the United Kingdom and the United States. Full product profile stimuli were used. There were seven attributes, including price, each with four or five points across the range to be tested. An orthogonal function of the full factorial design was used and the conjoint question was to rank the product profile cards in terms of their suitability for the last two qualifying patients seen. Additionally we obtained profiles of current products on the attribute and level grid that formed the basis of the stimuli design. Analysis was by Simgraf from Bretton-Clark.

Simgraf uses ordinary least squares regression but allows both a standard first choice model and a probability model to be used in the data analysis. The probability model explicitly recognises the presence of measurement error in the calculated utility function. It assumes that the likelihood of purchasing a product increases as the utility of that product increases relative to others in the simulation scenario. Experience shows that first choice models do not give sufficient recognition to purchases' second choices (in terms of utility scores) which, of course, on occasions are purchased. This is certainly true for pharmaceutical prescribing.

We first attempted to replicate the current market. As our final objective as to predict market uptake, we chose this measure of model validity rather than using holdout cards. There was, of course no reason why both could not have been used.

The standard first choice model did not perform well in terms of replicating the current markets consisting of the traditional products and the three recent introductions. However the probability model did perform well. This is summarised for the United Kingdom and United States in Table 2 and Table 3.

Table 2 Comparisons with market data – USA

Product/Product Class	Market Share (Dec 94)	Pref. Share (Conjoint)
Established Products	44.0%	43.5%
New Entrant A	27.0%	26.1%
New Entrant B	17.5%	18.1%
New Entrant C	11.5%	12.3%

Table 3 Comparisons with market data – United Kingdom

Product/Product Class	Market Share (Dec 94)	Pref. Share (Conjoint)
Established Products	58.0%	56.5%
New Entrant A	21.0%	21.1%
New Entrant B	13.0%	13.0%
New Entrant C	8.0%	9.4%

For the reasons of confidentiality we have aggregated the established products. This does not detract from the purposes of this paper.

Having been able to replicate the current market we entered into prediction scenarios with a feeling of confidence. Our model predictions for those products that have been launched, together with actual market share figures, are shown in Table 4 and Table 5.

Table 4 Comparisons with market data – USA

Product/Product Class	Market Share (Dec 96)	Pref. Share (Conjoint)
Established Products	44.0%	43.5%
New Entrant A	27.0%	16.1%
New Entrant B	17.5%	18.1%
New Entrant C	11.5%	12.3%
New Product 1	4.7%	11.7%
New Product 2	3.4%	6.3%

**Table 5 Comparisons with market data – United Kingdom**

Product/Product Class	Market Share (Dec 96)	Pref. Share (Conjoint)
Established Products	63.5%	50.0%
New Entrant A	10.5%	15.1%
New Entrant B	12.2%	8.9%
New Entrant C	5.0%	6.4%
New Product 1	1.4%	4.2%
New Product 2	0.9%	20%
New Product 3	0.7%	8.4%

The market concerned is very different in France and the number of new product introductions much fewer. I cannot show the detail for this country but, as shown in Table 6, we were able to predict the relative shares of the new product introductions very well. Their total share of the market was also accurate.

**Table 6 Comparisons with market data – France**

	Product	Market Share (1991)	Preference Share (Conjoint)
<b>Different Market Structure – none of the newer products at time of study</b>	New Prod 1	63.3%	65.8%
<b>Analysis's shown limited in relative use of 2 new products</b>	New Prod 2	36.7%	34.2%

All of the usual caveats when comparing predictions with reality have to apply when looking at these data. However, even allowing for the obvious structural changes in the poorest performing set of data (the United Kingdom) the differences between France and the other two countries are marked. The one distinguishing difference between France and the other two countries, so far as the therapy class is concerned, is the much fewer new product introductions that have taken place.

Consumer research colleagues were not surprised by our findings and suggested that a new product familiarity factor comes into play when subsequent later introductions are not sufficiently differentiated from the earlier new products. This is a plausible theory.

A Sawtooth sponsored advanced symposium, held in Banff in 1991 and attended by experienced practitioners, concluded that predictive reliability was a key area where further work is needed. Yet in the June 1996 edition of Sawtooth Solutions the following statement is made:

*'Conjoint simulation results often look so much like market shares that people sometimes forget that they are not .... (they) seldom include ... marketing activities (and) ... presume every buyer has complete information about every product.'*

However, if our customers require predictions (and why should they not) then we must not ignore this. We must though avoid leading ourselves to a situation where we incorrectly ignore conjoint analysis through wrongly assessing its worth. Equally it would be wrong to continue advocating the technique, or a particular version of it, should it not be the most appropriate. A lot more work needs to be done in this area.

## Conjoint analysis and pricing research

The second area where I would urge increased research is the role of conjoint analysis in pricing research. Many researchers appear to be happy to accept that a choice-based model is universally superior to any other and use Sawtooth's excellent Choice Based Conjoint (CBC). However, from my review of the literature, I think there is a foundation for challenging the basis for this assumption.

Papers that conclude the superiority of CBC typically compare CBC with ACA and (quite correctly) conclude that CBC is the superior of the two for pricing research. This does not necessarily mean that CBC is the best possible paradigm overall, nor that it is the best in all situations.

ACA has acquired the reputation of understanding the importance of price. The reasons why this particular paradigm may do this are well summed up by Pinnell in his 1994 paper. He states that:

*1 'this could be due to less than full profiles being shown and a lack of independence between non-price attributes' (which is logical when a long list of attributes is being used – authors note).*

*2 'focusing on a larger number of attributes may lead to the (calculated) importance of attributes being similar.'*

Full-profile rating based conjoint is often attributed to providing an over-estimation of the importance of price. However this may not be due to some inherent feature of the conjoint paradigm but more to how it is used. How often do we seem to be encouraged by clients to have more points on our price attribute range than any other attribute? Wittink et al suggest a number-of-levels effect is present.

We are all aware that conjoint analysis leads only to conclusions on the importance of the attribute-range and not attribute itself. Wittink et al showed that increasing the number of levels within a given fixed range also affected the calculated importance measure for the attribute.

These considerations then lead to thoughts on why CBC might be considered to be the most appropriate method of pricing research, particularly when compared to ACA. Again it may well not be due to any inherent fixed property of the general choice-based paradigm. It may be due to particular design limitations imposed by the CBC software and how the price attribute is often expressed. CBC limits the user to a very small number of attributes (and refer you to the SPSS version if more are required) and again we have the 'length' of the price attribute range relative to others possibly being present. I stress that I am not attempting to recommend that CBC, or any other model, not be used for pricing research. We must not forget that the MNL analysis model allows for interactions to be identified which always needs to be tested for in pricing applications.

With recognition of the work of Pinnell I would recommend the following as a preliminary conclusion for pricing research in pharmaceutical markets:

- ◆ First, and very importantly, is conjoint analysis the correct approach?
- ◆ If it is, then try to minimise the number of attributes.
- ◆ If 'brand' can be an attribute, and the number of attributes are few, consider a choice-based conjoint paradigm (in many applications in consumer markets, and this is the area where paradigm development is focused, the objective is to 'improve' a brand. Clearly in this situation, brand can be an attribute. However, this has to be questioned in many pharmaceutical studies).  
\*If segmentation is required for future scenario testing, use an orthogonal design and include a second rating question (see Pinnell).

- ◆ If 'brand' cannot be an attribute and/or the number of attributes is not small, consider a full-profile design with a rating, rather than a ranking, question.
- ◆ If the number of attributes is large, consider a hybrid model (e.g. ACA) or, possibly, a bridging design but consider whether a non-price study is required first to reduce the attribute list.

I have termed this preliminary recommendation as, like the preference share/market share issue referred to earlier. I suggest that a lot more experimentation and sharing of experiences is required. It also doesn't take into account the implications of the particular market situation which so often affects the design of the question and stimuli design components of the conjoint paradigm.

## Conclusions

In conclusion I would like to leave the following thoughts.

- ◆ First, the reminder that conjoint analysis is a collective term.
- ◆ No one paradigm can be described as the best; certainly if by the best we mean being suitable for all occasions – but guidelines for use can be drawn up.
- ◆ The choice of conjoint paradigm depends on the problem to be addressed and its objectives.
- ◆ The role of conjoint analysis in pricing research requires further debate, particularly in the case of pharmaceuticals where we are frequently not improving brands and determining incremental pricing.
- ◆ The reliability of future market simulations derived from conjoint models requires further research. In this respect I would welcome a forum for the exchange of experiences.

For the future, I would urge this forum to the following:

- ◆ encourage independent comparisons of conjoint paradigms where alternatives are applied to the same respondent sample,
- ◆ establish a mechanism for the exchange of experiences, particularly on the topic of market simulations and the use of preference share as a predictor of market share,
- ◆ further the debate on the role of conjoint analysis and the choice of conjoint paradigm in pharmaceutical pricing research.

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## **Footnote**

Roger Brice presented this paper originally at the EphMRA/ESOMAR Pharmaceutical Marketing Research Conference held in Rome in June 1997. The full book of proceedings from this Conference entitled 'Sharpening Tools for the Future' is available from the ESOMAR Secretariat in Amsterdam.

## **Summary**

This paper discusses the components of a conjoint paradigm and the alternatives within each. This is done to introduce a discussion of three issues: the concept of a 'best' paradigm, the use of preference share as a predictor of market share, and the role of conjoint analysis in pricing research and the choice of paradigm for this. The preference share and market share discussion includes data from a recent pharmaceutical study and a literature review is referred to throughout. The paper concludes with recommendation for pricing research.

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