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**MEASURING CONJOINT STATED PREFERENCES
FOR PHARMACEUTICALS:
A Brief Introduction**

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A Brief Introduction

The Uses Of Conjoint Stated-Preference Methods

Many pharmaceuticals and medical devices add value to treatments in addition to clinical efficacy. Understanding various dimensions of patient preferences requires a valid and reliable measurement method. Conjoint analysis (CA) is a stated-preference method that is one of the most powerful techniques available for quantifying patient or physician preferences and satisfaction. CA estimates can provide various quantitative measures of satisfaction, including relative importance score for treatment features, predicted preference share, money-equivalent value to patient, time-equivalent value to patient, and maximum acceptable risk.

CA studies provide useful information for several areas of product development and marketing.

- *Development strategies for new pharmaceuticals.* If the CA study is undertaken early in the development process, researchers can identify the relative importance that consumers place on particular drug attribute levels. Balancing expected cost with CA satisfaction measures can lead to improved product designs.
- *Formulary approval.* CA estimates can predict patient satisfaction for a study drug relative to actual and potential competing drugs. Unlike conventional QALY approaches, CA methods are adaptable to acute conditions as well as chronic conditions.
- *Risk management.* Risk-benefit analysis often requires determining how much risk is acceptable relative to therapeutic benefits offered. CA surveys can quantify physician and patient willingness to accept risk-benefit tradeoffs.
- *Product Promotion decisions.* CA preference studies can provide information in support of product promotion decisions, including market segmentation analysis and pricing simulations.

CA recognizes that products have value because of their characteristics or attributes. People have preferences for each attribute and are willing to accept tradeoffs among them. CA analysis examines these tradeoffs to assess the weight people assign to various product attributes. Analysts use CA to quantify preferences for a variety of market and nonmarket goods and services. These include medical interventions, pharmaceutical treatments, and environmental health risks (Bryan et al. 1988; Johnson et al. 2000; Johnson et al. 1998; Johnson and Desvousges 1997; Ryan and Hughes 1997; Viscusi, Magat, and Huber 1991; Wittink and Cattin 1989).

An important advantage of CA is that it can provide a value for the product as a whole as well as for the individual features of the product. Thus CA produces a total value for a given pharmaceutical or medical device as well as values for individual features. Traditional methods such as concept testing or quality of life surveys may provide little insight into the relative perceived importance of specific attributes.

In addition, CA encourages subjects to explore their preferences for various attribute combinations through a series of judgments. This process of explicitly trading off attributes encourages subject introspection. Finally, CA allows analysts to devise internal checks for attentiveness and consistency because each subject provides answers to multiple CA questions. Thus, CA is one of the most powerful and flexible survey techniques available. Implementing a valid and reliable CA study requires accurate product definition (attributes and levels),¹ attention to format selection (ratings, rankings, or choice), efficient experimental design, and careful statistical analysis. The remainder of this document considers each of these aspects in turn.

Defining Product Attributes

Measuring CA preferences for pharmaceuticals requires a systematic framework describing relevant products. Demand for pharmaceutical products arises directly from preferences for product attributes and indirectly from preferences for the health states realized by their use. Thus, attributes and levels must encompass the most important health outcomes and product attributes associated with drug administration in a particular disease state.

¹ An attribute is a qualitative characteristic of the product, while a level is one of several values the attribute may have. Color and price are attributes. Blue and \$25 are levels.

Once identified, health states potentially associated with these treatments must be defined in sufficient detail such that subjects can distinguish among them. In addition, these health-state definitions must be consistent with the ways that people think about their health. For instance, people often do not think of their health in terms of clinical outcome measures. Rather, they consider how the severity of symptoms associated with clinical outcomes limit or affect physical, social, and emotional functions. It is the job of survey developers to determine how subjects think about health outcomes for the intervention of interest and to identify salient attributes and levels. Focus groups and survey pretesting are a vital part of this process. Table 1 demonstrates a possible translation of pharmaceutical qualities into more meaningful health-state descriptions for hypothetical gastro-intestinal reflux disease (GERD) treatments.

Table 1
Example of Attributes, Attribute Levels, and Health-State
Descriptions for GERD Treatments

Attribute	Level	Description
Response Time	Fast	Immediate
	Medium	Within one hour
	Slow	Within three days
Relief Duration	High	24 hours
	Medium	8 hours
	Low	2 hours
Reversibility	Yes	Effect stops immediately after last dose
	No	Effect lasts for several days after last dose
Dose Frequency	Once	Once a day
	Twice	Morning and evening
	Three times	Before each meal
Cost	\$100	Medication cost is \$100 per month
	\$50	Medication cost is \$50 per month
	\$25	Medication cost is \$10 per month

Once attributes and levels are determined they can be combined into treatment profiles, which subjects evaluate in an CA exercise.² For example, Table 2 presents four potential GERD treatments. Three of these (A, B, and C) might represent existing treatments. The fourth (D) could be a hypothetical profile describing an optimum treatment. The experimental design

² A profile is a list of attribute levels describing a particular real or hypothetical product.

includes profiles for additional hypothetical treatments to help identify relative preferences for each attribute level.

Table 2
GERD Treatment Profiles

Drug	Response Time	Relief Duration	Reversibility	Dose Frequency	Cost
A	Slow	High	No	Twice	\$50
B	Medium	Medium	No	Twice	\$25
C	Fast	Low	Yes	Three times	\$25
D	Fast	High	Yes	Once	\$100

Alternative CA Formats

Choosing the question format is an important step in developing an CA survey. Ranking, rating, and discrete-choice formats have been used in CA surveys. Figure 1 is an example of a choice format and Figure 2 is an example of a graded-pair format. In a ranking study, subjects may be given cards, each showing a product profile. Subjects are asked to order these cards from most preferred to least preferred. There currently are no examples of the ranking format in the health-valuation literature. In a graded-pair comparison rating, the subjects are presented with two product profiles and asked to indicate how strongly they prefer one to the other on a scale of, for example, 1 to 5. Viscusi, Magat, and Huber (1991) used this approach to measure the value of avoiding an increase in the risk of contracting chronic bronchitis. Alternatively, discrete choice provides subjects with several different products or programs simultaneously and simply asks them to identify the most-preferred option in each choice set. Ryan and Hughes (1997) used the discrete-choice format to value women's preferences for miscarriage management. Johnson et al. (2000) used both formats to value avoiding cardio-respiratory symptoms.

Figure 1. Choice Format

Feature	Treatment A	Treatment B
Response Time	Immediate	Within three days
Relief Duration	8 hours	24 hours
Reversibility	Yes	No
Dose	Twice a day	Once a day
Cost	\$100	\$25
Please check the box that indicates which treatment you prefer:	<p>Prefer Treatment A</p> <input type="checkbox"/>	<p>Prefer Treatment B</p> <input type="checkbox"/>

Figure 2. Graded-Pair Format

Feature	Treatment A	Treatment B			
Response Time	Immediate	Within three days			
Relief Duration	8 hours	24 hours			
Reversibility	Yes	No			
Dose	Twice a day	Once a day			
Cost	\$100	\$25			
Please check the box that indicates your preference:	<p>Strongly Prefer B</p> <input type="checkbox"/>	<p>Somewhat Prefer B</p> <input type="checkbox"/>	<p>About the same</p> <input type="checkbox"/>	<p>Somewhat Prefer A</p> <input type="checkbox"/>	<p>Strongly Prefer A</p> <input type="checkbox"/>

Each of these approaches has its advantages and limitations. Graded pairs provide much more information but also may be more burdensome for subjects. In addition, subjects may react differently to the scale, such that a response of 2 may not mean the same thing to different subjects.³ Discrete-choice experiments do not face these limitations and frame the problem in a utility-theoretic way. However, this format provides much less information on intensity of preferences. Such information may be essential for detecting relatively subtle effects.

Although different CA task formats appear similar, marketing applications demonstrate that different subject decision heuristics across methods mean that results can vary among CA techniques. Johnson et. al's (2000) survey is the only published example of a health-outcomes CA survey jointly utilizing both discrete-choice and graded-pairs methodologies. Their analysis provides strong evidence that lessons learned from marketing surveys can be transferred to health-outcomes applications. Thus, the CA elicitation method should be context specific and study objectives should play a role in format selection (Huber 1997).

Experimental Design

Full-factorial experiments generate data based on all possible combinations of attribute levels. Such designs typically are impractical for CA surveys because subjects' cognitive and time limitations do not allow consideration of a large number of profiles. For example, a full factorial design of the treatment attributes considered earlier contains 5 attributes, 4 with 3 levels and one with two levels leading to 162 ($3^4 \times 2^1$) possible combinations. In addition, subjects do not rate these options individually. Rather, subjects compare two or more options at a time. Considered in pairs, the number of possible combinations is 13,041, clearly an impossible task.

Most current marketing CA applications use an approximately orthogonal design to reduce the number of paired comparisons to the smallest number necessary for efficient estimation of utility weights (Dey 1985). Huber and Zwerina (1996) list three properties of efficient designs:

³ Statistical methods are available for testing and controlling for such variation across subjects.

- Level balance: levels of an attribute occur with equal frequency
- Orthogonality: the occurrences of any two levels of different attributes are uncorrelated
- Minimal overlap: cases where attribute levels do not vary within a choice set should be minimized

Most current health-outcomes CA studies only investigate small attribute-level spaces. Unfortunately, it is often not possible to achieve both level balance and orthogonality in small designs. Thus, design optimality generally requires trading off potential incompatibilities between these criteria. However, Kuhfeld, Tobias, and Garratt (1994) show that it is possible to produce relatively efficient designs that are neither balanced nor orthogonal. Such efficient designs can be produced using an iterative computer algorithm. RTI Health Solutions has adapted these market-research procedures to the special requirements of health-outcomes valuation.

Preference Estimates

The CA experimental design determines a sequence of profile evaluations for each subject. Responses to these choices form the data necessary for estimating the relative importance of each attribute level. Our earlier example considered a set of five attributes that described GERD treatment profiles. For simplicity, we now assume that the only relevant attributes and levels are reversibility (yes or no), dose frequency (once or twice), and cost (\$100 or \$25). In this case, the following eight (2^3) possibilities describe all the possible profiles. Thus, the eight alternatives in Table 3 represent the full-factorial design. In a graded-pairs format, there are 28 possible profile pairs. These could be divided into four blocks or survey versions so that each subject would evaluate seven pairs.

The CA technique allows recovering the relative importance of each of these attributes such that utility differences and resultant market implications across all profiles can be estimated. After collecting the tradeoff data, it is possible to statistically estimate a utility function. This utility function is the foundation for analyzing a variety of patient-satisfaction and marketing questions. For example, one possible question of interest could be how much patients would be willing to pay for a drug under development.

Table 3
GERD Treatment Choices

Choice	Reversibility	Dose	Cost
1	Yes	Once	\$100
2	No	Once	\$100
3	Yes	Once	\$25
4	No	Once	\$25
5	Yes	Twice	\$100
6	No	Twice	\$100
7	Yes	Twice	\$25
8	No	Twice	\$25

Again in the interest of simplicity, suppose we estimate a simple linear function with the three attributes

$$U = \alpha_i \text{ Reversibility} + \beta_j \text{ Dose} + \delta \text{ Cost}$$

The subscripts i and j take on values 1 and 2 corresponding to the number of levels for the attributes. . Here Reversibility₁ is Yes, Reversibility₂ is No, while Dose₁ is Once, and Dose₂ is Twice. U is thus the utility of some combination of Reversibility₁ or Reversibility₂, Dose₁ or Dose₂, and Cost. The coefficients α_1 , α_2 , β_1 , β_2 , and δ are the utility weights associated with the attribute levels.⁴ Assume the utility weight estimates are:

$$\alpha_1 = 0.6; \quad \alpha_2 = 0.2; \quad \beta_1 = 0.2; \quad \beta_2 = -0.2 \quad \delta = -0.01$$

Table 4 shows the combined utility weights for four possible attribute combinations.⁵ For example, the utility corresponding to combination (Reversibility=Yes, Dose=Once) is

$$\alpha_1 + \beta_1 = 0.6 + 0.2 = 0.8$$

⁴ If the attributes are dummy-variable coded, we would have to include a constant and omit one category for each qualitative variable. If the attributes are effects coded, we include no constant and the coefficient for the omitted category is (-1) times the coefficient of the included category.

⁵ CA utility weights are derived from ordinal utility theory and are not scaled from zero to 1 as QALY cardinal utility weights are.

Table 4
GERD Treatment Utilities

	Reversibility = Yes	Reversibility = No
Dose = Once	0.8	0.4
Dose = Twice	0.4	0

A one-dollar decrease in cost is equivalent to a one-dollar increase in money. Therefore, the marginal utility of money is the negative of the utility weight for cost. In this simple example, the coefficient on cost indicates that one more dollar is worth 0.01 units of utility. Thus we can convert the utility units in Table 3 to money-equivalent value to patient (VTP) by dividing each cell in Table 1 by 0.01 dollars per utility unit, as shown in Table 5.

Table 5
GERD Money-Equivalent Value to Patient

	Reversibility = Yes	Reversibility = No
Dose = Once	\$80	\$40
Dose = Twice	\$40	\$0

Fortunately, a single CA survey supports a variety of additional analyses to support product-development and product-promotion decision making. VTP or willingness-to-pay estimates provide an intuitive measure of strength of preferences for both individual drug features and complete drug profiles and may help inform pharmaceutical pricing decisions. In addition, Table 6 shows the predicted preference shares for the four combinations shown in Table 5. Of course, these estimates alone will not determine the success or failure of a particular compound. The environment in which a drug is introduced, including pricing of competing treatments, must be considered as well, so predicted preference shares may not correspond to actual market shares.

Table 6
Predicted Preference Shares

	Reversibility = Yes	Reversibility = No
Dose = Once	36%	24%
Dose = Twice	24%	16%

Finally, CA surveys can provide information on other kinds of tradeoffs. For example, including a measure of symptom duration or response time makes it possible to estimate generalized time-tradeoff QALYs for acute conditions (Johnson, et al., 2006). If we had included the risk of serious adverse events as a treatment feature, we could estimate patients' maximum acceptable risk for a given improvement in efficacy (Johnson, et al., 2006). Thus, when attributes and levels are carefully selected, the resulting estimates can answer a variety of "what is" and "what if" questions decision makers often ask. Realizing these potential benefits of an CA study demands rigorous implementation from survey development through parameter estimation and interpretation.

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