# Using conjoint analysis to elicit preferences for health care

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Traditionally the extent of patients' involvement in medical decision making has been minimal. This has been true at both the micro level of the patient consultation with a doctor and the macro level of planning and developing healthcare services. Since 1989, however, greater involvement of patients and the community in these processes has been advocated.[1–5] In principle, the elicitation of patients' and the community's values represents a big step forward in terms of enhancing the benefits from the provision of health care. For the exercise to be worth while, however, the information obtained must be useful and scientifically defensible.[6] During the 1990s, conjoint analysis was developed to elicit patients' and the community's views on health care.

## Methods

This paper explains conjoint analysis, provides examples of applications in health care which were obtained from a systematic review of databases between 1989 and 1999 (Medline, Embase, HealthSTAR, PsychLIT, EconLIT), and uses a study in orthodontic care to show the uses and pitfalls of the technique.

## Conjoint analysis

The survey method of data collection and analysis known as conjoint analysis was developed in mathematical psychology and has a strong theoretical basis.[7–9] It has been successfully used in market research,[10] transport economics,[11] and environmental economics[12 13] and was recommended to the UK Treasury for valuing quality in the provision of public services.[14] Within these areas it has been well received by policymakers.[12 14] The technique is gaining widespread use in health care and has been applied successfully in several areas, including eliciting patients' and the community's preferences in the delivery of health services[15–22]; establishing consultants' preferences in priority setting[23]; developing outcome measures[24 25]; determining optimal treatments for patients[26 27]; evaluating alternatives within randomised controlled trials[28 29]; and establishing patients' preferences in the doctor-patient relationship.[30 31]

The technique is based on the premises that any good or service can be described by its characteristics (or attributes) and that the extent to which an individual values a good or service depends on the levels of these characteristics. The technique can be used to

- Show how people are willing to trade between characteristics; this is useful when deciding on the optimal way to provide a service within limited resources[16 20–22]
- Produce overall benefit scores for alternative ways of providing health care; this allows the ranking of health services against one another when setting priorities[21 22]
- Estimate the relative importance of different characteristics of a service; this allows the policymaker to observe the individual impact of each characteristic on overall benefit[15–31]
- Estimate whether an attribute is important; this may be particularly useful when assessing the outcomes of trials. Trials generally include more than one outcome measure. Without further information it is not possible to determine whether these different outcome measures are important to patients.[28 29]

### Summary points

Conjoint analysis is a rigorous method of eliciting preferences

It allows estimation of the relative importance of different aspects of care, the trade-offs between these aspects, and the total satisfaction or utility that respondents derive from healthcare services

The technique can help with decision making for some of the issues facing the NHS

Though further applications of conjoint analysis are encouraged, methodological issues need further consideration

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*A table comparing scenarios is available on the BMJ website*

## Undertaking a conjoint analysis study

**Stage 1: Identifying the characteristics**
The characteristics can be identified by various methods. If a policy question is being addressed, the characteristics will be predefined. For use alongside a randomised controlled trial, the characteristics may be defined by the different components of the arms of the trial.[28 29] Where the characteristics are not predefined, literature reviews, group discussions, and individual interviews will be necessary.[19]

**Stage 2: Assigning levels to the characteristics**

Levels assigned to the characteristics may be cardinal (for example, waiting time, where two weeks is twice as long as one week), ordinal (for example, though "severe pain" is worse than "moderate pain," we do not know by how much), or categorical (for example, where there is no natural ordering for specialist nurse, general practitioner, or consultant). Pragmatically, the levels must be plausible and actionable, thus encouraging respondents to take the exercise seriously.

**Stage 3: Choice of scenarios**

Scenarios are then drawn up that describe all possible service (or outcome) configurations given the characteristics and levels chosen. The number of scenarios increases with the number of characteristics and levels. Rarely can all the scenarios generated be included in the questionnaire, and experimental designs are used to reduce the number to a manageable level.[32 33]

**Stage 4: Establishing preferences**

Preferences for scenarios included in the questionnaire are elicited by using one of three methods: ranking, rating, or discrete choices. With ranking, respondents are asked to list the scenarios in order of preference. This method has not as yet been used in health care. The rating method requires the respondents to assign a score, of say 1 to 5, to each of the scenarios.[21 25] For the discrete choice method, respondents are presented with a number of choices and, for each, asked to choose their preferred one. Possible responses include stating that either A or B is preferred,[15–31] or responding on a five point scale where 1 equals definitely prefer A and 5 equals definitely prefer B (see figure). Given that choices more closely resemble real life decisions, the discrete choice approach has been preferred in health care.

**Stage 5: Data analysis**

Regression techniques are used to analyse responses. The appropriate method is determined by the type of data collected.[34] For discrete choice data, a benefit function is estimated, which can be specified as

$$\Delta B = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_1$$

where $\Delta B$ is the change in benefit in moving from service A to B, $X_j$ ($j = 1, 2, \ldots, n$) are the differences in the attribute levels between A and B, and $\beta j$ ($j = 1, 2, \ldots, n$) are the coefficients of the model to be estimated.

## An application to orthodontic services

This application considers the trade-offs that individuals were willing to make between location of treatment and waiting time in the provision of orthodontic services.

**Table 1** Attributes and levels included in conjoint analysis study

| Attributes | Levels | Regression coding |
|---|---|---|
| Waiting time (for first appointment) (WAIT) | 4 months, 8 months, 12 months, 16 months | 4, 8, 12, 16 |
| Location of first appointment (for diagnosis) (LOC1) | Hospital, local | 0=local, 1=hospital |
| Location of second appointment (and subsequent appointments for fixing the appliance) (LOC2) | Hospital, local | 0=local, 1=hospital |

**Subjects and methods**

A total of 160 patients attending three orthodontic clinics in the Grampian area of Scotland were asked to take part in the study.

The policy question identified the characteristics to be included in the conjoint analysis study. These and their levels are shown in table 1, together with their coding for the regression analysis. Sixteen scenarios were possible. Fifteen discrete choices were constructed by comparing the current service to all alternatives. Each respondent was presented with the 15 choices and asked, for each, which they preferred (see figure).

A check for internal consistency was included and dominant preferences (respondents not willing to trade a reduction in one attribute for an improvement in another) were identified. Respondents who were inconsistent or had dominant preferences were dropped from further analysis.

The following benefit equation was estimated for consistent traders:

$$\Delta B = \beta_1 LOC1 + \beta_2 LOC2 + \beta_3 WAIT$$

where $\Delta B$ is the change in benefit in moving from the current service to an alternative and the explanatory variables are the difference in the attributes of the two clinics, as defined in table 1. Given the nature of the dependent variable, the random effects ordered probit model was used to analyse the data.[34 35]

Coefficients $\beta_1$ to $\beta_3$ show the relative importance of the different attributes, with the associated P statistic indicating whether the attribute has a statistically significant effect on choices. When interpreting these coefficients, it is important to be aware of the unit of measurement: $\beta_1$and $\beta_2$ show the change in benefit for a unit change in location from central to local, and $\beta_3$ for a week's change in waiting time. $\beta_1/\beta_3$ indicates how much waiting time individuals are willing to give up to have their first appointment at a local clinic, and $\beta_2/\beta_3$ shows how much waiting time an individual would be willing to give up to have the second (and all subsequent appointments) at the local clinic. Benefit scores were estimated for different ways of providing orthodontic services.

| | (a) Current | | | | (b) Alternative | | | Which option would you choose? (please tick one box for each choice) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First appointment | Second appointment | Waiting time | | First appointment | Second appointment | Waiting time | Definitely (a) current | Probably (a) current | No preference | Probably (b) alternative | Definitely (b) alternative |
| Choice 1 | Hospital | Hospital | 8 months | OR | Local | Local | 12 months | | | | | |
| Choice 2 | Hospital | Hospital | 8 months | OR | Hospital | Hospital | 16 months | | | | | |
| Choice 3 | Hospital | Hospital | 8 months | OR | Local | Local | 16 months | | | | | |

Example of conjoint analysis question

**Table 2** Results from regression analysis (1081 observations in 73 individuals)

| Variable | Coefficient | P value |
|---|---|---|
| Waiting time* | −0.59 | <0.001 |
| Location of first appointment (0=local, 1=central) | −0.77 | <0.001 |
| Location of second appointment (0=local, 1=central) | −0.91 | <0.001 |
| Log likelihood | −1220 | |
| $\chi^2$ | 319.49 | |
| McFadden $R^2$ | 0.12 | |

*Extra months willing to wait for a local first appointment=1.3; extra months willing to wait for a local second appointment=1.54.

### Results

In all, 157 questionnaires were completed. Dropping inconsistent responders, those with dominant preferences, and missing values left 73 individuals and 1081 observations in the sample.

Table 2 presents the regression results for this group. The positive and significant signs on both location coefficients show that respondents prefer a local clinic to a hospital. Moving from a hospital clinic to a local clinic will increase benefit by 0.77 for the first appointment and 0.91 for the second appointment. The negative and significant sign of waiting time indicates that the higher the waiting time, the lower the benefit. The negative coefficient of 0.59 means that a unit increase in waiting time (for instance, from four months to five months) will reduce the benefit score by 0.59. Individuals are willing to wait an extra 1.3 months (0.77/0.59) to have a local clinic for their first appointment and an extra 1.5 months (0.91/0.59) to have a local clinic for their second appointment. From the equation used in the study, the benefit in moving from the current situation to having local first and second appointments and waiting 12 months was estimated to be −2.28. (Benefit scores were estimated for all the choice situations presented to individuals in the questionnaire; more detailed results are available on the *BMJ* website.) Generally, positive benefit values indicate an improvement over the current service and negative values indicate that patients would be less satisfied with that service configuration. Attempts should be made to reach the best configuration within available resources.

## Other applications

The orthodontic study shows one way in which conjoint analysis can be applied, but the potential for the technique is much broader. Consider the issues faced by Dumfries and Galloway Health Board, recently highlighted in the *BMJ*.[36] This region faces problems common in the NHS. These relate to issues of new build, optimal information systems, relations between central and periphery hospitals, and patients' rising expectations. Conjoint analysis could be used to aid decision making within these areas. For example:

- Do patients want more personal and familiar local hospital care, where the level of specialisation may be lower, or more specialised, centrally located services?[22]
- On what basis should priority be given to competing new build projects?[23]

Although the technique can be applied to a wide range of policy questions within the NHS, several methodological issues remain. Some of these are outlined below within the context of the orthodontics study.

## Methodological issues

In the orthodontics study, although the attributes were defined by the policy question, defining their levels was more difficult. Variations around the status quo were chosen in this study. In the only study appraising this issue, conjoint analysis has been shown to be relatively insensitive to characteristic levels (M Ryan and S Wordsworth, International Health Economics Association conference, 1999).

Secondly, the attributes and levels gave rise to 16 possible scenarios and, from these, 120 possible choices. Obviously it would not be possible to ask individuals their preferences among 120 choices, so the current situation was compared with the remaining 15 scenarios. An alternative approach is to randomly pair the 16 scenarios into choices.[23] Work is needed to assess the sensitivity of results to the method of setting discrete choices.

Thirdly, in data analysis, there is the issue of what to do with inconsistent responders and those exhibiting dominant preferences. For simplicity, inconsistent responders and "non-traders" were dropped in the application to orthodontic services, following the procedure in previous applications of conjoint analysis in health care. Future work, however, should consider the extent to which inconsistent responders are behaving rationally (and therefore should be included in the analysis) and should explore issues related to non-traders. The bias that exclusion may create in the results also needs considering.

Fourthly, there is a question of how to model the benefit function. In the orthodontics study, a linear additive relation was assumed. Research from outside health care has shown that alternatives to the linear additive model seldom result in a significantly better fit.[37] Future work applying conjoint analysis in health care should explore this issue.

## Conclusions

This paper proposes conjoint analysis as a rigorous survey technique for eliciting the views of patients and people in the community on health care. The application presented here, which was well received by policymakers, shows the potential uses and pitfalls of the technique. Conjoint analysis has been successfully applied elsewhere in health care and has great potential as an instrument for establishing the preferences of patients and the community (as well as those of clinicians and policymakers). Though further applications of conjoint analysis are encouraged in the NHS, methodological issues arising from its use should continue to be considered.

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questionnaire and analysed the data. MR drafted the paper and SF provided comments. MR is the guarantor for the paper.

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*Modernising the NHS*

# Challenges to the health services: the professions

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This is the fourth in a series of seven articles

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"There is the challenge for the professions to strip out unnecessary demarcations, introduce more flexible training and working practices and ensure that doctors do not use time dealing with patients who could be treated safely by other health care staff." This was the third of five challenges to the health service set out by the prime minister on 22 March, followed up by the secretary of state for health on 23 March with the announcement of six modernisation action teams to focus on the challenges. This announcement expanded on the reference to more flexibility and removing demarcations by adding "in the context of major expansion of the health care workforce."

The challenge to the professions has been made. What are the most important things that would make a difference?

## Summary points

Professionals are ready to change—and have already done so

NHS organisations need to listen to their staff, who know where systems go wrong

More flexible working and training are long overdue, together with proper training for multidisciplinary working

Innovation needs to be encouraged—and entrepreneurial clinicians supported

## Preparing to act on the challenge

The first thing is for the government to recognise the extent to which members of the professions are ready to take on the challenge. The profile of the medical profession has changed radically in the past 10 years. Women now account for more than 50% of doctors leaving medical schools[1] and represent an increasing proportion of doctors under the age of 40, particularly in general practice. Younger doctors are much more