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Preferences for the supply of emergency contraception: Dealing with non-demanders in a DCE experiment

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INTRODUCTION

Discrete Choice Experiments (DCEs) are now a widely used method in health economics. However, few studies take into account respondents who do not demand healthcare services or innovations. It is essential that DCEs deal with respondents who choose not to demand services or interventions, as failure to do so is likely to result in inaccurate estimation of benefits. This paper reports use of an approach to allow for non-demanders in a DCE to determine preferences for the supply of emergency contraception. Preliminary results from the study will be reported, along with issues relating to the appropriate modelling techniques for this type of data.

Non-demanders in discrete choice experiments

Discrete choice stated preference experiments have been widely used within healthcare to evaluate preferences for a range of services and interventions.[1] Although stated preference methods are designed to be hypothetical, is important that the decision-making context is as close an approximation of real-life choices as possible. The majority of DCEs conducted to date have used a binary choice format, whereby respondents are asked to make a choice between two options. A small number of studies have employed a multinomial format, offering respondents the choice between three or more options.[2, 3] Binary formats may be appropriate for certain preference elicitation contexts, for example where a respondent is facing surgery and has a choice between two different surgical interventions.

However, there are a number of situations where individuals may choose not to use a health service or intervention that is offered to them. These respondents have been called 'non-demanders'.[4] Individuals may choose not to demand a healthcare service or intervention for reasons relating to the attributes of the service on offer, for example, they may choose to demand only if the service is free, or if they can be seen at a particular time. Alternatively, they may choose not to demand the service because of factors relating to their personal circumstances or experience. For example, if someone believes they are not at personal risk of getting a particular disease, they may decide not to accept screening for that disease if it is offered to them.

A DCE that does not present respondents with an 'opt-out' option may result in respondents feeling forced into making a choice.[4] Alternatively, they may make a protest choice. Forcing respondents to make a choice may also affect the quality of the data gathered, as welfare estimates may be overstated. The benefits of including an opt-out option are therefore that it reflects real-life decision-making,

that it allows for accurate estimation of welfare benefits and the results may have more validity for health policy-makers.

There are disadvantages to including an opt-out option, as respondents may choose this option to avoid making difficult decisions between choices. It is important that the levels for any 'opt-out' option are specified clearly in the DCE, so that respondents are aware what they the 'opt-out' option means. For some studies, the attribute levels for an opt-out / neither option will be zero (e.g. if no service is offered). For others, the levels need to be specified in the questionnaire.

Examples of studies that have incorporated an 'opt-out' option include studies of preferences for cervical screening, genetic screening, breast cancer screening, and varicella (chickenpox) vaccination. [4-7]

A DCE that allows for non-demanders cannot be analysed by the traditional random effects probit model commonly utilised by binary choice DCEs.[8] The appropriate econometric models for analysing data will be discussed in the subsequent section.

ANALYSING NON-DEMANDERS

The multinomial nature of data from a DCE that allows for non-demanders means that alternative econometric models must be considered. Binary choice discrete choice models such as random effects probit are not appropriate. In essence, the decision-making process can be seen to involve two simultaneous decisions, whether to participate/visit a particular service and if so, which alternative to choose. Joint decisions such as this can be modelled in either a multinomial / conditional logit or a nested logit framework. The choice of model for multinomial data will depend on the extent of substitution between alternatives within a choice set, as expressed in the independence of irrelevant alternatives assumption.[8]

Multinomial / Conditional logit models

In the few DCE studies that have allowed for non-demanders, multinomial or conditional logit models have commonly been used.[4;5;6] The key differences between multinomial (MNL) and conditional (CL) logit models will be considered, in addition to the appropriateness of the conditional logit for this particular type of data.

The CL model is an extension of the multinomial logit model. It fits a fixed effects logit for panel data and also fits McFadden's choice model (1974).[9] A CL model is appropriate for models of choice behaviour, where the explanatory variables include attributes of the choice alternatives (for example cost) as well as characteristics of the individuals making the choices (e.g. income).[10]

Both MNL and CL models are used to analyse the choice of a respondent among a set of alternatives, but the central difference between the two models is that the MNL uses the individual as the unit of analysis and uses the individual's characteristics as explanatory variables. In contrast, the CL model focuses on the set of alternatives for each individual and uses the characteristics of the alternatives as the explanatory variables. MNL models are appropriate for providing information on which individuals make which choices, while CL models can provide information regarding why choices are made. Individual characteristics can easily be accommodated within a CL model. Both models share a common likelihood function.[8]

The statistical specification for the MNL and CL models is based on the assumption that the error terms in the equations follow an extreme value distribution and are independent across alternatives. This assumption is called the independence of irrelevant alternatives (IIA) property and is one of the key weakness of MNL and CL models. Concerns that the IIA property will be violated have prompted the use of nested logit models to analyse multinomial data.

The IIA property assumes that the ratio of two choice probabilities is independent of the other alternatives in the choice set. The implication is that a change in an attribute of one alternative will have same proportional impact on the probability of each of the other alternatives being chosen.[8]

In an example where respondents have a choice between three contraceptive methods, the oral contraceptive pill, condoms and intra-uterine devices, a MNL or CL model would assume that the odds of choosing an IUD would be the same whether or not condoms were available. However, respondents may perceive that the oral contraceptive pill and condoms are more similar than IUDs and condoms. Thus, if condoms were not available, potential contraceptive users might choose to use the pill rather than an IUD. In this case, the IIA assumption would be violated. Therefore, if a pair of methods is perceived as more similar than another method then the MNL or CL model would result in overestimates of the joint probabilities for similar methods.[11]

A number of statistical tests exist to test whether the IIA property is violated. One of the most commonly used is the Hausman test.[8] The test involves the comparison of a model estimated with a full set of choice alternatives with a model estimated using a restricted set of choice alternatives. The theory underpinning the Hausman test is that if the IIA property is valid, the parameters of the restricted set model should be 'approximately the same' as those of the full choice set model.

A MNL or CL model is therefore appropriate for a DCE where the alternatives within a choice-set are close substitutes for each other. In this type of model, respondents would consider all of the options simultaneously. However, if the alternatives available are not considered to be close substitutes and the IIA property is violated, MNL and CL models are not appropriate. In these circumstances, a nested logit model is more appropriate.

Nested logit model

The nested logit model (NLM) can be considered as a generalisation of the MNL or CL model. In a NLM the researcher partitions the alternatives into groups or nests, which can be further grouped into subnests.[8] The notion underlying the nested logit specification is that Jn alternatives are partitioned into subsets of alternatives, such that the ratio of probabilities for any two alternatives that are in the same subset is independent of the existence of other alternatives.

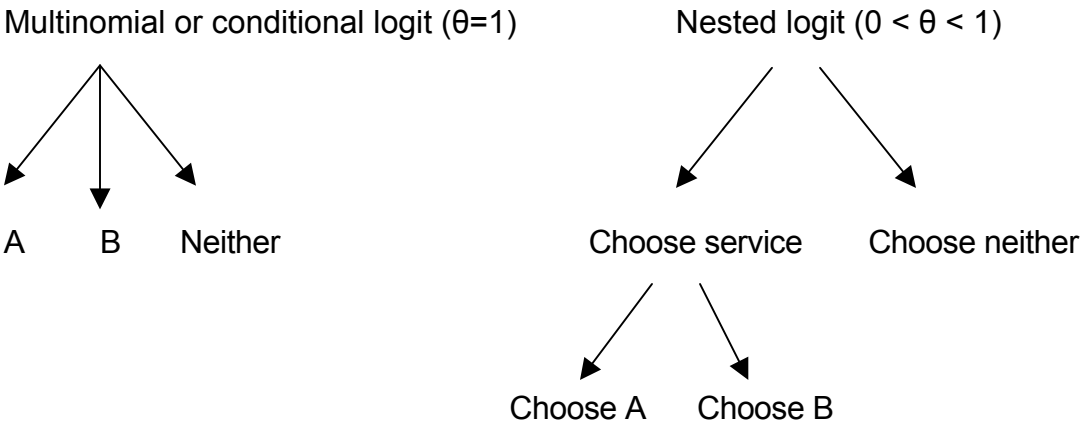
The advantage of the NLM over the MNL or CL model is that it can allow for differential degrees of similarity between subsets of alternatives in a choice set. An NLM is particularly recommended when the intention is to model the decision whether to visit a service and the choice of service simultaneously.[8] The argument underpinning this is that the IIA assumption may not be appropriate when one of the alternatives is non-participation. It is recommend that the decision to participate and the choice of service should modelled as a two stage nested decision that does not impose IIA a priori across all pairs of alternatives. In a two-level nested logit, the first level represents the decision of whether or not to visit a service. Where a choice is made, the second level relates to which of the services is chosen.

The NLM is based on a full information maximum likelihood model (FIML), where the entire model is estimated in a single phase. The goodness-of-fit of a nested logit model can be assessed by the likelihood ratio test, in which a restricted version of the model is tested against a full version of the model.

The decision of which model to use to analyse multinomial data can be assessed by measuring the inclusive value (IV) parameter (θ). This can be estimated in a NLM. Ryan & Skatun (2004)[4] recommend that this be calculated within the NLM first to determine which model to use. The IV parameter represents the extent of substitution between alternatives. Its parameter is 1 minus the correlation between the error terms of the grouped set. The value lies between 0 and 1. If

hypothesis that this parameter is equal to one cannot be rejected, the nesting structure is not appropriate and the model will collapse to a MNL or CL. In this situation, the decision whether to visit a service is determined both by the anticipated utility of visiting the service and individual characteristics. If the inclusive value is significantly different from zero and one, this provides a validation for using a nested logit model. See fig 1. for a representation of the two models. (adapted from Ryan & Skatun, 2004)

Fig.1. Representation of the multinomial and nested logit models



Two forms of NMNL derivations appear in the literature. The first is known as normalised nested logit. A problem with the dissimilarity parameters of the NLOGIT model means that this model is not consistent with random utility maximisation theory. A newer derivation, NLOGITRUM has been developed, which is consistent with RUM.[12] For the purposes of this paper, results from a normalised nested logit will be reported. The data will be analysed at future date using the NLOGITRUM derivation.

Having discussed some of the appropriate models for analysing data of this nature, the following section will apply these methods to a DCE study to determine womens' preferences for the supply of emergency contraception.

DISCRETE CHOICE EXPERIMENT

Aims and objectives

The aim of this study was to determine the preferences of women for the supply of emergency contraception (EC) The objectives of the study were to:

1. Identify important attributes of EC services
2. Determine the relative importance of different attributes of EC services
3. Determine the impact of respondents personal characteristics on the decision-making process

Background to the study

Emergency contraception (EC) is tablet that can be taken up to 72 hours after unprotected sex or contraceptive failure to prevent pregnancy. [13] The use of EC has been identified as a cost-effective means of preventing unwanted pregnancies.[14] In England and Wales, EC is available free of charge from a range of service providers, including GP surgeries, family planning clinics, specialist youth clinics, genitor-urinary medicine clinics, accident & emergency departments and National Health Service (NHS) Walk-in centres. Access to EC has been expanded in recent years and is now available for women to buy in community pharmacies at a cost of approximately £25. It is also available free-of-charge in pharmacies in some areas of England under local health authority schemes. [15]

There is evidence that knowledge of EC, one of the prerequisites for effective use, has been rising over the past decade, with a majority of women now aware that EC can prevent an unwanted pregnancy and aware of the time limits for use.[16] However, there is still evidence that women do not always use EC, even if they are aware they are at risk of an unwanted pregnancy and they have sufficient knowledge to use it.[17] This suggests that some women may be non-

demanders of EC and that an opt-out option would be appropriate in a DCE to examine preferences for the supply of EC.

Questionnaire development

The DCE questionnaire was designed using a review of the literature and qualitative interviews (n=8) with a sample of users and non-users of EC. Six attributes were identified through this process and levels were assigned to the attributes, based on information from the interviews and literature review. Five of the attributes were assigned two levels and the cost attribute, was assigned four levels. The attributes and levels are shown in table 1.

Table 1: Attributes and levels for inclusion in DCE

Service characteristic	Levels and descriptions
How many hours a day the service is open (OPEN)	2, 8
Medical staff you see (STAFF)	Doctor or nurse, Pharmacist
Cost to you (COST)	£0, £10, £25, £50
How quickly you can be seen within (hours) (WAIT)	24, 48
Will you be seen in private? (PRIVACY)	Yes - you cannot be seen or overheard by others, No - it is possible you could be seen or overheard by others
Attitude of staff towards you (ATTITUDE)	Good – staff are sympathetic and not judgmental towards you, Bad – staff are not sympathetic and are judgmental towards you

The attribute opening hours was included in the DCE because limited opening hours of contraceptive services were identified as a problem by interview participants and have also been cited in the literature.[16] The medical staff

attribute was included to address concerns that potential users may not regard pharmacists as a suitable health professional to deal with a request for EC. A question has been included in the questionnaire to identify respondents who prefer to see a doctor or a nurse, and this will be used at a later stage of the analysis to identify differences between pharmacists and doctors and pharmacists and nurses.

Cost was included in the DCE as there have been concerns that the cost of buying EC over-the-counter (£25) may act a deterrent to young women or those on low incomes.[18] The use of cost as an attribute in stated preference techniques has been questioned, and it has been argued that respondents are not used to judging costs in publicly-funded healthcare systems, where they do not pay for care.[19] However, respondents may be familiar with buying drugs over-the-counter in pharmacies and some forms of contraception, for example, condoms, are available to buy in a variety of outlets.

The wait attribute was included as participants in the interviews reported delays in accessing EC. This is important because there is a strong body of evidence to suggest that EC is most effective if it is taken within 24 hours of unprotected intercourse or contraceptive failure.[13] The privacy attribute was included as lack of privacy was problematic for women who had visited a community pharmacy to request EC.[18] Finally, participants in the interviews and reports from women who had visited pharmacies to request EC indicated that positive and negative staff attitudes could influence their decision whether to visit a service.

In this study, the number of attributes and levels, 2^5 x $4^{1,}$ gave rise to 128 possible scenarios for inclusion in the DCE. If all the possible scenarios were included in DCE this would result in a large number of pair-wise choices and a lengthy research instrument. There is also evidence from the literature to suggest that respondents can only deal with between 9 and 16 pair-wise comparisons before becoming bored.[20] In order to reduce the number of scenarios to a more

manageable level, a fractional factorial design was employed, by inputting the attributes and levels identified into the software package SPEED v 2.1 (Stated Preference Experiment Editor and Designer).

SPEED reduced the number of scenarios from 128 to 16 and these were paired into 8 pair-wise choices, avoiding the dominant scenarios identified by SPEED. Correlation coefficients were calculated for the computed 'difference' variables for each pair-wise choice using Pearson's Correlations coefficients and Spearman's Rho coefficients to check for multicollinearity. No significant coefficients were identified.

The questionnaire

The eight choice sets were presented to the respondents in a self-completion questionnaire. Two additional choice sets were included, one acted a test of consistency and one choice set was repeated as a test of reliability test. The consistency test contained one alternative in which all the 'best' levels of the attributes were presented. If respondents understood the nature of the DCE exercise it was anticipated that they would choose this option.

Respondents were asked to make a choice between two services, A and B, based on the attribute levels specified in the choice-set. Respondents were also given the option of 'choosing neither service'. They were advised that if they did so, they would not be able to visit another service to get EC.

Personal and socio-demographic data was also collected, including age, relationship status, previous use of EC, contraceptive method used and attitude towards pregnancy. A question on income was planned for inclusion but the local research ethics committee would not permit this to be asked. The questionnaire was piloted with 30 women for face validity and minor amendments were made to the wording of the questions. An example of one of the DCE questions is shown in Fig. 2.

Fig. 2. Example of question in DCE questionnaire

Service characteristics	**Service A**	**Service B**	
How many hours a day service is open	Eight hours	Two hours	
Medical staff you see	Doctor or nurse	Pharmacist	
Cost to you	£0	£50	
How quickly you can be seen	Within 24 hours	Within 48 hours	
Will you be seen in private?	Yes	No	
Attitude of staff towards you	Good	Bad	
I would choose to visit…. Tick <u>one</u> box only	**Service A** ☑	**Service B** ☐	**Neither Service** ☐

The relevance of including personal and social characteristics in this DCE is that there is evidence to suggest that previous experience can influence preferences.21 Indeed, Salkeld argues that respondents make their decisions under a '*veil of experience.*'[22] In a DCE study exploring preferences for cervical screening, previous experience of screening influenced the decision whether or not to choose screening.[4]

Sample selection and size

The sample chosen for the administration of the questionnaire was women using health services for contraceptive and sexual health advice in a primary care trust in the northwest of England. The target group for the sample was women aged between 16 and 50 years old who were at risk of pregnancy, that is, were currently sexually active or were likely to be so in the future. Women were had been sterilised, were infertile or had had a hysterectomy were excluded from the

study. The specific services recruited to take part in the study were family planning clinics, one specialist youth service and one NHS Walk-in centre. It could be argued that this group was biased towards women using contraception. However, not all women who use sexual health services are users of contraception and the clinics participating in the study provided a range of services, including pregnancy testing, referral for terminations of pregnancy, sexually transmitted infection testing and cervical screening. It was not possible to recruit any GP practices to take part in the study. This may have been due to research fatigue in this particular PCT, as the practices were already involved in a number of other studies involving data collection techniques. This is a limitation that should be borne in mind when considering the results of this study.

The proposed sample size for this study was 200 women. The appropriate sample size for DCE has not yet been established and sample sizes of between 50 and 1000 plus have used to establish sufficiently robust models [7,23] In order for regression techniques to be carried out, it is suggested that a minimum of 20 observations are required per attribute. Therefore, if a DC study has six attributes, the minimum acceptable sample size would be 120. If subgroup analysis is to be performed, it is recommended that a minimum of 30 respondents per subgroup be recruited.

A sample of 200 women was felt to be adequate, given the number of attributes (six) and possible subgroups, for example, age, use of emergency contraception, pregnancy intentions, which were mainly dichotomous.

Distribution of the questionnaire

Seven family planning clinics, one specialist youth clinic and one NHS Walk-in centre distributed questionnaires for a period of up to three months. In the family planning and youth clinics, they questionnaire was displayed in the waiting area for respondents to complete, either while they were waiting for their appointment

or in their own time. In the walk-in centre, reception staff distributed the questionnaire to women requesting EC.

Handling of datasets

The data collected from the questionnaires were inputted into SPSS and then transferred into STATA version 8.2. for analysis. The data were presented in a long format, with one observation for each case for each alternative on the dependent variable. The dependent variable 'choice' was coded as a 0/1 dummy variable, which was coded 1 if the respondent chose that alternative. Additional variables to identify the data included 'option', a three-category variable identifying the possibly alternatives (0, 1, 2). The variable 'id' indexed each case and the variable 'indid' was a unique identifier for each observation. Some of the independent variables, such as age, relationship status, did not vary across alternatives, whereas others, such as the attribute levels, did. The attribute levels of the 'neither' option were set at zero,

RESULTS

Data was collected in the relevant clinics over a three-month period in 2004. A total of 285 questionnaires were returned. Fifteen questionnaires were subsequently excluded as none of the choice questions had been completed. One questionnaire was excluded as it had been completed by a man. This left 269 usable questionnaires. At present, it is not possible to report a response rate for this part of the study, as data is currently being collected by the various clinics on the number of consultations during the data collection period. Once this data is available, it should be possible to calculate a crude response rate.

Fifty-two of the respondents (19%) failed the consistency test and were excluded from the analysis, resulting in a usable sample of 217. This gave rise to 4674 observations, of which 1135 provided a 'choose neither service' response. Characteristics of the sample are provided in table 2.

Table 2: Characteristics of respondents

Characteristics	N=217
Age (mean, (±SD)	23.83 (±8.636)
Relationship status (% who were single)	40
Currently using contraception (%)	88
Previously used EC(%)	65
Attitude to pregnancy (% who don't want child now or at any time in the future)	29

Nested logit model

A nested logit model was run to determine the factors influencing respondents' decision-making processes. In addition to the six service attributes, five personal characteristics; age, relationship status, previous use of EHC, whether respondent uses contraception and attitudes towards a pregnancy were included in the model. It was posited these characteristics might influence respondents' choices. Women who expressed a strong preference for not wanting a child might be expected to have different preferences to women who expressed a preference for having a child. See table 3 for details of characteristics included in the model.

Table 3: Personal characteristics included in the nested logit model

Characteristics	Variable type, coding
Age (scale)	Continuous variable
Relationship status	1/0 dummy variable, single = 1
Using contraception	1/0 dummy variable, using contraception =1
Previous use of EC	1/0 dummy variable, used EC=1
Attitudes to pregnancy	1/0 dummy variable, does not want baby =1

This is a two-level nested logit model. The first level represents the decision whether or not choose a service to access EC. The second level of the decision relates to which of the two services, A and B are chosen. The inclusive value parameter (θ) was calculated. A value of one indicates that a MNL or CL model is appropriate and would indicate that the decision whether or not to visit a service is based both upon the expected utility of visiting the service and certain personal characteristics of the respondent. If the IV is <0 and <1 this would validate the use of the nesting structure.

Table.4. Results from the nested logit model

Variable	Coefficient	Standard error	p-value
Service characteristics			
Opening hours	0.0449	0.013	0.001*
Medical staff seen	0.5567	0.085	0.000*
Cost	- 0.0418	0.003	0.000*
Wait to be seen	- 0.0141	0.003	0.000*
Privacy	0.8126	0.08	0.000*
Attitude of staff	1.5518	0.11	0.000*
Individual characteristics			
Age	0.0153	0.006	0.016*
Relationship status	- 0.5294	0.13	0.000*
Using contraception	0.0868	0.17	0.607
Previous use of EC	0.1960	0.13	0.144
Attitude to pregnancy	- 0.1027	0.04	0.008*

Number of obs	4674
Chi-squared	775.8905
Log likelihood	-1323.6927
p	0.000

*significant at the 5% level

The IV parameter of this nested logit model is equal to one. This indicates that the nesting structure is unnecessary and that the model can be collapsed to a CL

model. All the coefficients for the attributes of the service are significant and consistent with a priori hypotheses. The positive signs on the coefficients for opening hours, staff seen, privacy and attitude, indicate that respondents were more likely to choose the alternative if the service had longer opening hours, if they were seen by a doctor or nurse, if the consultation took place in private and if the staff displayed a sympathetic and non-judgemental attitude towards them. The negative signs on the attributes cost and wait indicate that respondents were less likely to choose the alternative when these levels of these attributes were higher. As the IV parameter=1, this implies that the expected utility of visiting a service does influence the decision whether to visit a service. In relation to personal characteristics, age, relationship status and attitudes to pregnancy were also found to influence individual's decisions whether or not to visit a service.

DISCUSSION

The results from this preliminary analysis of a DCE to determine the preferences for the supply of EC indicate that the decision-making process is a function of both the attributes of the service and certain personal characteristics. The value of the IV parameter suggests that a nested logit approach is not necessary in this instance and that a conditional logit can be used to model respondents' decisions. It is important to note that the work is at a preliminary stage and further personal characteristics may be introduced into the model. In addition, the data will be modelled using the nlogitrum command. The DCE described in this paper has also been completed by more than 1000 university students and the results from this sample will be modelled and compared with the health service user sample.

The inclusion of a 'neither' option in this study was designed to provide as realistic as possible approximation of the context in which individuals make real-life decisions about whether or not to visit services to get emergency contraception. Failure to include this option may have led to overstated estimates. It is difficult to determine whether the high level of 'neither service'

option responses in the study accurately reflects respondents' preferences. It could be argued that some of 'neither' responses could be the result of respondents choosing this rather than having to make a difficult decision between two alternatives.

Presenting respondents with an op-out option is methodologically challenging, as alternative econometric methods must be considered. This method used a nested logit model, but new approaches, including the use of the random parameter logit model, have been suggested.[4]

The results of this analysis may have value for contraceptive service providers, as they suggest that changing the attributes of EC services may be likely to increase the likelihood of individuals choosing to visit a service. The influence of personal characteristics indicates that potential EC users are not a homogenous group.

Discussion points

1. How can 'neither' or opt-out options best be explained to respondents?
2. Alternative methods for analysing multinomial DCE data – is the random parameter logit model a viable alternative?
3. How do we determine whether respondents are using the 'neither' option to avoid making a difficult choice or simply reflecting their preferences?

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