Valuing Urban Green Space: Hypothetical Alternatives and the Status Quo

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ABSTRACT Although many cities have guidelines on the quantity of green open space that should accompany residential development, there is less guidance on the type or facilities of these spaces. The study uses an approach to determine whether green space can be valued on the basis of its constituent characteristics and, if so, what characteristics are preferred. The results indicate that preferences vary depending on whether the green space in question is a small local park or a larger municipal park. However, where a base alternative of usual park destination is included in the analysis, the results are affected by collinearity and the actual availability of relevant green space attributes in these destinations. A mixed logit approach is used to tease out this effect from the underlying preference values.

Introduction

Green open spaces (parks, country parks and landscaped open space) provide an important contribution to quality of life. Such spaces act as recreational resources, peaceful retreats from the city, attractive backdrops to urban development, safe and exciting play areas for children and reserves for urban wildlife. Nevertheless, like many public goods, green space can be taken for granted. The public authorities do not receive any significant income from green space and must budget for its maintenance along with other municipal responsibilities such as education or roads. New green spaces are usually only provided when new suburbs are being planned and often without the input of a landscape architect. With regard to existing green space, local residents usually only participate in park management when issues of public safety arise, when maintenance has greatly deteriorated, or when an existing green space is threatened by built development. Forty years on from Jane Jacobs (1961) critique of planning and park design in the United States, much of the existing portfolio of green space is sustained by low maintenance regimes or persists in a form that risks becoming less relevant to modern lifestyles (see also Lynch, 1965; Cranz, 1989).

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The Current Study

The study set out to determine what aspects of urban green space people most value. Dublin was selected as a case study, although it can be argued that the findings and methodology have relevance to other locations even though underlying preferences are likely to be specific to individual cities or cultures. The impression obtained from newspaper articles and letters is that green space is highly valued by Dubliners. However, this remains only an ‘impression’ as no detailed published survey has ever been carried out.

A discrete choice model was applied to examine whether these spaces can be valued in terms of their component attributes. This method can also be used to determine whether these values can be converted into a monetary measure for the purposes of a cost benefit analysis. For the study to be manageable, the research focused on the use benefits of green space rather than on indirect benefits such as wildlife habitat, flood management or noise/pollution mitigation.

In addition, the study sought information on whether people value variety, whether they would value different types of green space to that with which they are currently familiar, and whether these values are held uniformly within the population. In fact, it revealed that people hold a strong attachment to existing open space, even though some planners have commented that much of Dublin’s green space is unstimulating (see comments by various planners quoted in Frank McDonald’s book, 2000).

To some extent this outcome is an artefact of the method and its particular application, but a status quo bias is a well-documented characteristic of much decision making (Samuelson & Zeckhauser, 1988; Masatlioglu & Ele, 2005). The paper sets out to examine these choices and to disentangle their influence from the wider analysis.

Context

Over the years the Irish Government has issued guidelines (DoE, 1987) on the amount of green space that should be provided with any new development. These guidelines do not extend to the design or character of a green space, except in so far that sufficient space is allowed for field sports.

No new guidelines have been forthcoming, even though Ireland has recently been experiencing a period of rapid economic growth that has allowed living standards to catch up with those of other EU member states. This has brought about a new social context that has included changes in expectations with regard to living standards. Demand for amenity has increased at a time when hours worked are now amongst the highest in Europe (ILO, 2003). Consequently, a greater premium has been placed on leisure time than before and many people are becoming engaged in active pursuits such as walking, cycling, jogging and water sports, in addition to the more familiar field sports.

In addition, Dublin has experienced a considerable amount of residential expansion, particularly in its outer suburbs. Although designated parks are safe from development, much privately owned green space and other undeveloped land has a considerable opportunity cost value that has attracted the attention of
developers. A more contentious issue, at least within planning circles, is the argument that government guidelines require too much open space to be set aside with any new development. The subsequent maintenance obligations then place a strain on local authority resources (Williams & Shiels, 2001). Partly as a consequence, landscaping can sometimes be unimaginative and there are rather few facilities such as toilets, cafes, quality outdoor sports facilities or, until recently, quality play areas for children. Possibly, the absence of good facilities contributes to a lack of park use. The interesting questions are, therefore, (a) how much do Dubliners value their existing open spaces relative to alternative provision? and (b) what facilities should these alternatives contain?

**Study Approach**

An issue of green space quality may apply, in which case there is the matter of how ‘quality’ is to be defined. Research in psychology suggests that people’s valuation of improved green space might attract less interest or lower values than a potential loss of green space could provoke. For example, Thaler (1980) or Kahneman & Knetsch (1992) have left their mark on environmental valuation by countering economic theory with empirical evidence that people value losses more than they value gains. In the context of this study, people were not being confronted with a potential loss of parks, but rather being asked if they would value additional features that could be regarded as providing additional quality.

The challenge was to solicit values for enhancements of green space compared with what exists already. For urban green space, most of the existing international economic research has been in the form of hedonic pricing studies that have inferred the value of green space from local property values. However, the benefits that tend to be identified in these studies are not use related, but rather ones that have a structural link with property values, namely views (Tyrvainen, 1997), neighbourhood character (Peiser & Schwann, 1993) or, most tenuous of all, protection from further development (Irwin, 2002).

Use values are difficult to pin down. Different people value parks for different reasons. In addition, the same people value parks for different reasons at different times. Context is important. People visiting a park with children will obviously have different motivations for using a park compared with occasions when they visit on their own. There are also socio-economic factors. People living in more disadvantaged parts of a town may have different preferences and needs to those living in more affluent suburbs. Indeed, parks often take on the characteristics of their surroundings, so that what could be a pleasant wooded park in an affluent part of town becomes a threatening place if located in a more marginalised neighbourhood (Coughlin & Kawashima, 1973; Crompton, 2001).

The principal methodology selected for the study was the use of choice modelling. The method provides a considerable amount of data in that respondents are provided with a series of choice sets. This supplies more information than would typically be available to a researcher who is using hedonic pricing or is applying a travel cost approach to a single or handful of sites. The method also has an advantage over the main alternative stated preference approach of contingent valuation because the risk of strategic or hypothetical bias, while not eliminated, is
reduced (Bristow & Wardman, 2004). Arguably, there is also less risk of the respondent giving obsessive attention to the one consideration of price in that this is but one of several attributes in the format.

This method relies on a stated preference questionnaire in which people are confronted with alternative products that are described by their respective characteristics or attributes. They are then requested to choose a single alternative by mentally trading off the set of attributes. These implicit trade-offs provide a measure of the marginal substitution of one attribute in terms of another. As each alternative’s constituent attributes are varied substantially on the basis of an orthogonal statistical design, this allows the subsequent estimation of marginal values to be free of the collinearity between attributes that can occur in reality. Collectively, questionnaire responses supply an indication of the odds of selecting a composite alternative based on a particular attribute level.

In principle, attributes can be packaged into recognisable products, for example, to provide a value for different types of parks. It is also possible to investigate the interactions that exist between attributes and between type of user and type of park. In this way, choice models can be used to explore some of the values and motivations of different subsets of people.

Despite the versatility of choice models, it is an open question as to whether people can disaggregate the value they attach to environmental goods to the level of their component attributes. It might be true of recreation scenarios where choice models have previously been used (Adamowicz et al., 1994; Hauber & Parsons, 2000). Therefore, there is value in determining whether people value green space in this fashion. Certainly, users of green space will have certain expectations as to the presence of attributes such as play facilities, paths or seating. On the other hand, green space may be valued in its entirety, perhaps because a user likes the overall landscape setting or has not consciously attributed this value to any particular combination of attributes. Green space could also be valued for subtle reasons that cannot be easily captured by attributes. For example, it might be valued due to personal recollections and memories, or in relation to vicarious values associated with the needs of the wider community.

Nevertheless, choice models do have the merit of replicating many real-life situations in which people can only choose to consume one product or another. Trade-offs are an inevitable fact of life. The relative value of attributes that emerges from these trade-offs supplies practical information on preferences for use by park managers and administrators faced with managing specific elements within a limited budget. Arguably, this information is of more value than a single willingness-to-pay in that decision makers are interested in knowing what works best, i.e. what are the most valued features of different parks allowing for their various contexts. The relative values of individual attributes can also be converted into marginal prices if the coefficient on each individual attribute is divided by that of a monetary attribute included in the choice model. This is a major strength of choice modelling in that it provides data for a cost-benefit analysis through which decision makers can decide how to allocate resources. A further advantage is that the scenarios presented in a questionnaire, as represented by alternatives in the choice model, do not need to be restricted to the current environment, but can also be used to assess public reactions to green spaces that are not currently available.
In the current study, other approaches were used to complement the choice methodology and to provide additional data through which to interpret the results. Four focus groups were used at the outset of the survey to collect qualitative data in relation to the values people hold for parks and for the purpose of refining the attribute definitions to be used in the choice model. A factor analysis of 100 responses from a postal survey of park users was also used both for attribute selection based on an examination of the perceived benefits of a much wider range of attributes than could feasibly be included in choice model. These 58 green space attributes include characteristics such as ‘park keeper’, ‘litter regularly removed’ and ‘over-looked by apartments’. Correlation matrices and factor rotation (e.g. Varimax and Direct Oblimin) revealed that three main components accounted for most of the correlation, namely ‘peaceful, safe, community amenity’, ‘naturalness’ and ‘a facility for active recreation’. While the first construct is difficult to describe in words, the constituent attributes together present an image of the classic neighbourhood park.

Previous Relevant Applications of Choice Models

There are no examples of choice models having been applied to urban green space, except for those conducted within the EU GREENSPACE Project1 that was responsible for the funding of the current study. However, there are now numerous examples of choice models having been applied to recreation (e.g. Adamowicz et al., 1994; Hanley et al., 2001a) and to environmental policy choices (Hanley et al., 1998, Campbell et al., 2007). Within the spatial sciences, choice models have been applied to planning issues such as housing and retailing (Oppewal et al., 1996). Recently, researchers have also been experimenting with a combination of choice based approaches and hedonic pricing (e.g. Earnhart, 2001) or travel cost (Fleischer & Tsur, 2003).

A common challenge that has emerged in these situations has been that of the large number of potential attributes that must be considered. Some researchers (e.g. Timmermans, 1988; Kroes & Sheldon, 1988; Haider et al., 1994; Oppewal et al., 1996) have attempted to accommodate these by means of hierarchical experiments based on common bridging attributes. However, this approach has had only mixed success, in part because of the effect of context dependence on each sub-experiment (Oppewal et al., 1996). The effect is difficult to isolate, but Oppewal & Timmermans (1991) and Timmermans & van Noortwijk (1995) have explored its influence through the analysis of cross-effects. Stemerding (1996) has identified both structural and circumstantial context effects in the case of an application of choice models to amusement parks. Typically, these studies report much variation in the effect of context on user type, as, for example, between regular and irregular users (Moeltner & Englin, 2001).

Methodology

An assumption of continuity of preferences is fundamental to choice analysis. Substitutability is assumed whereby consumers are able to make trade-offs between goods (Freeman, 1993). Utility is associated with the characteristics of a good and each attribute is assumed to have an associated part utility. However, as noted
above, it is an open question as to whether green space is valued in this manner. In one respect, green space is a discrete good in that an individual can only visit one park at a time. However, the decision context may be more continuous in response to the variety of parks available and the needs of the user on any one occasion. There is also a degree of continuous substitution in terms of how long to stay and which attributes to use or visit.

On the basis of a change in the level sought of any one attribute, it can be assumed that an individual can switch from visiting one green space to another. This decision can be represented by a value of 1 or 0 depending on whether an individual selects a park or not. This single discrete choice requires that the indirect utility provided by one park is believed to exceed that of another, namely

$$V_i(x_i, y - p_jx_i) > V_j(x_j, y - p_jx_j) \quad \forall_{i \neq j}$$

where $x_i$ represents a single alternative park represented by a profile $i$ of attributes that are either associated with this one alternative, i.e. are alternative specific, or are common to all alternatives, i.e. generic. The vector of alternative parks is represented by $x_j$, while $p_j$ is the price associated with each complete profile. A fuller presentation of the algebra behind the choice decision can be found in Alpizar et al. (2002), amongst others.

The equation forms the basis for the calculation of economic welfare estimates. To become a predictive model, an allowance must be made for random utility. Stated preferences can still differ from those that are made in reality, depending, for example, on the mix of objective attributes, but also perceptual attributes. Other opportunities for random error to creep into the model include heterogeneity of preferences, measurement error, specification error and unobservable factors such as relevant attributes that have not been included in the choice model. The analyst cannot control for all of these factors, so utility is taken to be a random function comprised of a deterministic part and a stochastic part which can be represented by:

$$U_i = V_i + e_i$$

The equation presents utility as consisting of one part that is common to all individuals and another that is individual specific. This facilitates a workable model which can combine the probability of an outcome with a function that relates the utility of each alternative to the attributes of which it is comprised (Louviere et al., 2000). This framework for linking the deterministic model with a statistical model of behaviour is provided by the random utility model:

$$P(i) = P\{V_i(x_i) + e_i > V_j(x_j) + e_j\} \quad \forall_{i \neq j}$$

The model estimates choice on the basis that the probability ($P$) of the utility of profile $i$ exceeding that of profile $j$. It assumes that the observed difference in the associated random error $e_i$ and $e_j$ is less than the utility associated with the deterministic component $[V_i(x_i) - V_j(x_j)]$.

Multinomial logit (MNL) is typically applied to estimate the probability. However, this approach does rely on restrictive assumptions, namely that the
random elements of each alternative are independently and identically distributed (IID). This assumption of constant error variance has the further implication that it leads directly to the property of independence of irrelevant alternatives (IIA) which requires that the odds of choosing between any two alternatives are unaffected by the presence of any third alternative not in the choice set.

**Study Design**

To examine the application of choice models to the use of green space, a sample was taken of people living in Dublin south of the River Liffey. The sample area includes a broad range of suburban parks and green spaces. It also contains a wide mix of socio-economic and household types. A total of 500 people were interviewed face-to-face by a professional survey company. Random sampling was used, stratified by key characteristics such as gender, age, social class and household status. The sample was intended to closely match that of the general population as revealed by Census data and achieved this aim for most criteria. Tables 1a and 1b provide some of the descriptive statistics for the study. The use of in-person interviews ensured that all choice combinations were answered and that any bias from the exclusion of particular profiles was avoided.

The selection of attributes and the decision of how many attributes and choice sets to include in the survey is a compromise between the relevance of each attribute, the complexity of the choice models for respondents and overall design complexity. In the event, each respondent was presented with eight separate choice sets that had been preceded with information and photographs on park attributes and park types. Respondents were asked about parks as most of the accessible green space in Dublin is represented by public parks.

The research interest in attribute interactions restricted the design to eight park attributes represented at between two and four levels of provision. To accommodate more attributes, some researchers use just two attribute levels to capture the extremes of the utility distribution. However, in the context of green space, it was felt that to restrict the experiment to just two attribute levels would have misled respondents by failing to describe the range of attributes typically found in parks. It would also have provided insufficient information for park managers as well as making it more difficult to identify interactions. Eventually the experiment was restricted to the following attributes and levels (in parentheses) which the preceding focus groups and factor analysis had indicated to have most influence on park use. Each attribute was described in detail in advance of the choice exercise.

- **Size (2)** = small local park, large park
- **Maintain (2)** = moderate maintenance, high maintenance
- **Trees (3)** = few trees, mixture of open areas and trees, more wooded areas
- **Water (3)** = shallow pond with paved banks, natural-looking ponds/lakes, riverside
- **Play Facilities (3)** = no playground, small modern playground, adventure play park
- **Paths/Seating (3)** = few benches, paths and seating, ample seating and paths, plenty of seating, paths, trails and cycle paths
Table 1a. Selected sample characteristics

| Principal economic status* | Socio-economic class* | Age | Housing status |
|----------------------------|-----------------------|-----|----------------|
|                            | Sample (%) | Census (%) | Sample (%) | Census (%) | Sample (%) | Census (%) | Sample (%) | Census (%) |
| Home duties                | 22.7       | 12.9      | AB 22.9    | 39.3        | 15 – 24     | 20.5        | 16.5        | Small semi- | 62.1       | 51.4 |
| School/college             | 10.8       | 11.2      | C1 36.9    | 22.5        | 25 – 34     | 19.9        | 16.1        | Large semi- | 7.3        | 13.2 |
| Unemploy                   | 2.6        | 4.4       | C2 21.9    | 22.0        | 35 – 49     | 29.2        | 23.4        | Terrace     | 9.6        | 28.5 |
| Retired                    | 11.2       | 6.8       | D 14.6     | 11.7        | 50 – 64     | 18.2        | 14.6        | Apartment   | 10.4       | 10.4 |
| Employ full-time           | 43.9       | 44.0      | E 3.6      | 4.5         | 65+         | 11.8        | 9.5         |             |            |     |
| Employ part-time           | 8.8        | 14.1      |             |             |             |             |             |             |            |     |

Note: *Approx. by definition for South Dublin.
Congestion (3) = typically few people around, mix of quiet and busy areas, tends to be quite busy.

Journey Time (4) = 5 minute walk/2 minutes by car, 15 minute walk/10 minutes by car, 45 minute walk/20 minute by car, 1 hour by car.

As noted above, a challenge with all environmental valuation is to find a price attribute through which the coefficients on other attributes can potentially be transformed into monetary values. In this case, no meaningful price attribute exists because parks are generally funded as an unattributed part of central government grants to local authorities. Instead, journey time was used for this purpose as previous local authority surveys have shown that this factor exerts most influence on visitation.2

Time has an opportunity cost that must be traded-off in relation to the utility that is provided by the park attributes. Income has been used as an indicator of the opportunity cost of time but, for green space, visits are determined by the opportunity cost of leisure time rather than working time. A separate contingent rating exercise was used to determine the value of journey time in comparison with on-site time and journey cost using an approach similar to that employed by Mackenzie (1992) and Alvarez-Farizo et al. (2001). An individual exercise is illustrated by Figure 1. However, as this process was quite demanding to include

| Frequency park visits | When visit usual park | Motivation | Primary | Secondary |
|-----------------------|-----------------------|------------|---------|-----------|
| V. frequency          | During the week       | 35% Family trip | 28%     | 7%        |
| Quite frequently      | Occasionally during the week | 11% Exercise | 27%     | 33%       |
| Rarely                | Most weekends         | 18% Sport   | 5%      | 12%       |
| Quite infrequently    | Some weekends         | 25% Relaxation | 18%    | 28%       |
|                       |                       | Walking the dog | 15%    | 6%        |
|                       |                       | Passing through | 2%     | 3%        |

Table 1b. Park use

Figure 1. Example of contingent rating exercise for value of leisure time.
along with the choice modelling in the survey, respondents were asked if instead they were prepared to complete a short follow-up postal questionnaire.3

In the choice model, journey time, together with the other attributes, was given a reference baseline level. This has the advantage of linking parameter estimates to a meaningful base level for the purpose of estimating utility. Parameter coefficients represent the odds of choosing one attribute level over the base level, but also indicate the relative utility provided by each attribute level.

The focus groups had suggested that the attribute ‘size’ provided a clue as to the type of facilities likely to be found in a park. Therefore, while the attributes were generic, separate designs were selected for the two pairs of choice sets which presented a choice between two small local parks, and two further pairs presenting a choice between large parks. In addition, a third design was prepared for four choice sets representing a mixture of both local and large parks (mixed dataset).

In order to free subsequent parameter estimates of interactions, a large proportion of the full factorial set of potential attribute combinations was selected. The complete set of possible profiles was reduced by strategies that included eliminating aliases and the use of Latin Squares. Latin Squares provide an alternative design preparation where profiles need to be blocked, in this case by the park size and maintenance attributes, and require an equal number of treatments in each block. The design resulted in 978 unique individual profiles in the case of small and large parks, and 1296 profiles in the case of the mixed combination.4 Attribute levels were designed to be independent of one another with the exception of ‘size’ and ‘journey time’ where an interaction naturally exists in that large parks are typically located at greater distance from most users.

Two questions were asked after each of the eight choice sets as illustrated by Figure 2. The first of these (Choice model Question 1) asked respondents to choose between the two hypothetical parks and a base of ‘not go/do something else’. The second question (Choice model Question 2) asked respondents to rank the hypothetical alternatives in relation to their usual park destination (i.e. the status quo).

The attribute mix of each respondent’s usual park had been defined through an earlier question in which respondents had been asked to describe their usual park in terms of the same attributes used in the choice model. That respondents should be asked to describe the existing alternative in terms of their perception is an approach that has been recommended by Hoehn & Randall (1987). For both questions, it was emphasised to respondents that they should consider that all non-represented attributes are the same as those for their usual park.

All respondents received the same version of the questionnaire, but 100 respondents were asked to rank their preference for the hypothetical scenarios in comparison with their nearest park as the baseline alternative (rather than usual park). Other sample subsets emerged from the data analysis.

Results

The 500 responses provided for up to 4000 choice responses, except 90 omissions where the first choice question (CM Question 1) was not answered, 353 omissions for the choice element of the rank question (CM Question 2) and 410 omissions of
complete rankings. Only 10% of householders declined to be interviewed, but these were replaced up to the target number.

Common trends are apparent through each analysis of the local park, large park and mixed size datasets. In each of these, the levels representing provision of children’s play facilities attract high significant coefficients, whereas journey time has a negative coefficient of varying size. Effects coding was used for the attribute levels, a characteristic of which is that one level less than the total number of levels appears for each attribute in the tables. The absent base level can be calculated as the negative sum of the reported coefficients for each attribute.

**Choice Question (CM Question 1)**

The first two pairs of choice sets (Table 2, column 1) provided a comparison between small local parks and the option of ‘not go/do something else’. The attribute level ‘modern play facilities’ attract the strongest positive coefficients while ‘wooded areas’ and ‘natural-looking pond’ have negative coefficients. By comparison, for large parks (column 2), ‘adventure play facilities’ and ‘ample seating, surfaced paths and trails’ attract higher coefficients than was the case in the local park experiment. In addition, ‘wooded areas’ and ‘natural-looking lakes’ attract positive coefficients whereas these attribute levels had a negative coefficient for local parks. ‘Journey time’ assumes a smaller negative coefficient. Model fit is described by the log likelihood ratio $\rho^2$.

In interpreting these values, it is possible to imagine a situation in which facilities such as adventure play facilities and trails would be more familiar constituents of larger parks. More surprising is that ‘natural-looking pond’ has a negative
coefficient, although such a facility in a local park could imply a potential danger to unsupervised children compared with a shallow pond with paved surroundings (38% of the sample had dependent children). In addition, it would appear that where the choice is between one large park and another, users are less discouraged by journey time than they might be for a local park. Perhaps they accept that a journey to a large park is a dedicated expedition that might usually be performed at weekends, whereas local parks are expected to be conveniently nearby.

An alternative model is available for the second group of four choice sets. In the ‘mixed’ dataset (column 3), respondents were forced to choose between the two types of parks by being asked to compare both local and large parks. While the trade-offs are vulnerable to the different contexts in which actual visits may be made to large or to local parks respectively, the model does contain a good number of significant parameters. The presence of both levels of play facilities appears to be influential to the choice. Small negative coefficients apply to the attribute levels ‘park can be quite busy’ and to ‘wooded areas’. ‘Large size’ also attracts a negative value due to the association between large park and greater journey time. This latter effect could not be removed by including a specific

Table 2. Choice question (CM Question 1) with ‘not go/do something else’ as third alternative

| Parameter                              | Local parks |                      | Large parks |                      | Mixed size |                      |
|----------------------------------------|-------------|----------------------|-------------|----------------------|------------|----------------------|
|                                        | Coeff.      | Signif               | Coeff.      | Signif               | Coeff.     | Signif               |
| Large size                             |             |                      |             |                      | –0.234**  | 0.0015               |
| High maintenance                       | 0.089       | 0.5142               | 0.116**     | 0.0245               | 0.151**    | 0.0000               |
| More wooded areas                      | –0.225      | 0.4350               | 0.050       | 0.7134               | –0.005     | 0.9315               |
| Mix open areas and trees               | 0.114       | 0.8569               | 0.143       | 0.8120               | 0.188**    | 0.0000               |
| Riversides                             | 0.020       | 0.5520               | –0.054      | 0.5812               | 0.117      | 0.0153               |
| Natural-looking pond/lake               | –0.092**    | 0.0035               | 0.143**     | 0.0375               | –0.297     | 0.0000               |
| Adventure play park                    |             |                      | 0.379**     | 0.0000               | 0.218**    | 0.0000               |
| Small modern playground                | 0.257**     | 0.0000               | 0.017       | 0.1235               | 0.210**    | 0.0000               |
| Paths, seating, trails, cycle          | 0.065       | 0.1534               | 0.134**     | 0.0452               | 0.022**    | 0.6870               |
| Paths and seating                      | 0.117**     | 0.0346               | 0.052       | 0.1325               | 0.098**    | 0.0287               |
| Park can be quite busy                 | –0.034      | 0.6138               | –0.025      | 0.6873               | –0.044**   | 0.3694               |
| Mix of quiet and busy areas            | 0.125**     | 0.0036               | 0.020       | 0.7774               | 0.106**    | 0.0095               |
| Journey time                           | –0.210**    | 0.0000               | –0.022**    | 0.0000               | –0.616**   | 0.0000               |
| Size journey time interaction          |             |                      |             |                      | –0.135**   | 0.0000               |
| Observations                           | 999         |                      | 1003        |                      | 2006       |                      |
| Log-likelihood (1)                     | –997.22     |                      | 972.32      |                      | –1885.46   |                      |
| Log-likelihood (0)                     | –1095.45    |                      | –1101.91    |                      | –2203.82   |                      |
| $\rho^2$ (adjusted)                    | 0.095       | 0.118                | 0.141       |                      |            |                      |

Notes: **Significant 5%; *Significant 10%.
size/journey time interaction, although the effects coding of the four levels of journey time demonstrates the influence of this variable with journey times in excess of 15 minutes attracting increasingly negative coefficients.

**Rank/choice Question (CM Question 2)**

The second choice model question asked respondents to rank the two hypothetical parks compared with their usual park. On the one hand, this is a more meaningful alternative than that of ‘not go/do something else’ (which was selected by few respondents in the CM Question 1). On the other hand, this third alternative is not comprised orthogonal attribute combinations. Consequently, there is a degree of collinearity in the existence of some attributes within particular park types. For example, large parks may contain a mix of higher quality facilities for a larger catchment population. There is also a problem of restricted attribute availability in that desirable park facilities are often not present in smaller parks even though such a park may be the respondent’s usual destination.

The question can be analysed both as a first choice or rank response. The latter involves the transformation of ranks into sequential choice data for analysis by MNL. Using the exploded rank method introduced by Chapman & Staelin (1982), the preferred alternative was excluded each time and the rankings structured as a product of logit formulas so as to be equivalent to independent choices. However, as comparisons are needed with the baseline alternative, lower ranks need to be discarded once this alternative has been chosen (Louviere et al., 2000).

In the case of the rank/choice question, model fit is much improved for local, large and mixed local/large parks. Significant positive coefficients apply to the attribute levels of ‘large size’, ‘mixture of quiet and busy areas’ and ‘adventure play park’. However, a challenge for the analysis is that a majority of respondents (60%) preferred their usual park destination to the hypothetical alternatives. The influence of the usual park choice can be captured through the inclusion of an alternative specific constant. This reveals a preference for the status quo choice and also provides a small improvement to model fit. However, the parameter does have the effect of including other sources of unexplained variation.

**Valuation of Green Space Attributes**

Using the best fitting model for the full population, it is possible to provide relative values for each attribute level by dividing the respective coefficient values with that for journey time representing the price variable. For this calculation, the effects coding of journey time is replaced by levels represented by the time in minutes given in each attribute description. The assumption of an additive utility function does have its limitations, as does the use of journey time given that the sample used to quantify the value of time was only part of the full sample. However, the coefficients for journey time are similar for all population subsets, while being slightly higher for those working full-time and those not in work. Although, at first, this appears contradictory, the observation seems to arise from the inconvenience of journeys for both full-time workers and for many unemployed people or spouses without a car, particularly those with children.
Monetary values for each attribute begin at just 12 cents per visit. They become more meaningful when combined into a compensating variation welfare estimate, although this is only a partial value in that green space would possess more attributes than just those included in the study (see Hanley et al., 2001b). Taking respondents’ overall preferences, visits to a park with these attributes would be worth a compensating improvement of €1.27 per visit compared with a typical Dublin park, or €6.82 per visit compared with a park containing only the baseline attribute levels. Parks containing mostly natural elements as defined by the respective attributes appear to represent a utility gain of only €2.66 over the baseline, but the inclusion of an adventure play park increases this to a welfare improvement of €5.03 per visit. If frequent users are examined separately, the preferred attributes result in a welfare gain of €105 per person per year based on an average of 23 visits. For irregular users visiting an average of 15 times per year, the gain is less at €65 although the utility per visit is similar at just over €4. Taking the population of the sample area (230 000), this suggests an aggregate benefit of €20 million, an amount that is well in excess of the municipal authorities’ parks budgets.

The Effect of the Usual Park Alternative

The inclusion of a status quo choice is often recommended in that it provides a more meaningful choice comparison in that most real decisions have a status quo alternative. However, there are problems of collinearity arising from the large proportion of people who ranked the status quo alternative first. Respondents had been asked to only consider the attributes of their usual park that appeared in the hypothetical alternatives. Despite this request, there does appear to be an influence from attributes that are present in the usual park destination, but which are not represented in the other alternatives.

The status quo choice could be due to some respondents treating the usual park option differently from the hypothetical alternatives, possibly due to a labelling effect whereby respondents failed to treat non-represented attributes as being the same as those of their usual park destination. They could also have simply found it less demanding to select usual park in response to awkward questions. On the other hand, a genuine bias for the status quo could arise due to an endowment effect (Thaler, 1980).

The issue of status quo preferences has arisen in other applications of choice models (Salkeld et al., 2000; Meyerhoff & Liebe, 2006). One consequence is an element of over-specification in the analysis of the rank question and its choice element in that low variability in the data means that $\rho^2$ is misleadingly good. As an alternative, it is interesting to examine the nature of respondents who were prepared to choose the hypothetical alternatives A or B. Regular users were more likely to choose the status quo, but an interaction between these variables is not significant and there are no distinct differences in parameter coefficients. People from more affluent social classes, younger people and those with dependant children were also more likely to select one of the hypothetical alternatives. Model fit is also good for the small subset who were asked about their nearest parks (rather than their usual park), despite the small sample size. Here again, respondents were more likely to choose one of the hypothetical alternatives.

Alternatively, a model was produced for those respondents who chose one of the two hypothetical alternatives in at least six of the eight choice sets, i.e. those
respondents who were more prepared to consider alternatives. In these models $\rho^2$ remains reasonable despite the much smaller sample size. The third column of Table 3 shows that these respondents attach higher values for both levels of play facilities, for ‘natural-looking ponds/lakes’ and for ‘riversides’. It seems that these features have an influence on those individuals who are more open to the consideration of new alternatives. The nature of the sample reduces the influence of status quo attributes, although if a constant is reintroduced this does have the effect of reducing attribute significance.

**Mixed Logit Analysis**

A weakness of analysis based on MNL is its dependence on the assumption of IIA and that results only indicate average preferences. Of the latter, Bergland (2001) in his valuation study of agricultural landscapes, finds that heterogeneous preferences

| Parameter                          | Coeff. | Signif | Coeff. | Signif | Coeff. | Signif |
|-----------------------------------|--------|--------|--------|--------|--------|--------|
| **Rank Choice analysis**          |        |        |        |        |        |        |
| Large size                        | 0.925**| 0.0026 | 0.934  | 0.0000 | 0.884**| 0.0000 |
| High maintenance                  | 0.121**| 0.0000 | 0.096**| 0.0239 | -0.121**| 0.0237 |
| More wooded areas                 | -0.074 | 0.1661 | -0.073 | 0.3136 | 0.125  | 0.1671 |
| Mix open areas                    | 0.094**| 0.0160 | 0.136**| 0.0449 | 0.196**| 0.0076 |
| Riversides                        | 0.048  | 0.9682 | 0.074**| 0.1750 | 0.144**| 0.0609 |
| Natural-looking pond/lake         | 0.032**| 0.0004 | 0.004  | 0.9585 | 0.260**| 0.0026 |
| Adventure play park               | 0.229**| 0.0000 | 0.279**| 0.0000 | 0.309**| 0.0005 |
| Small modern playground           | 0.092  | 0.4760 | 0.069  | 0.2246 | 0.191**| 0.0076 |
| Paths, seating, trails, cycle     | 0.029  | 0.5051 | -0.026 | 0.7138 | -0.054 | 0.5677 |
| Paths and seating                 | 0.040**| 0.0050 | 0.138**| 0.0124 | 0.039  | 0.5921 |
| Park can be quite busy            | 0.034  | 0.6165 | 0.053  | 0.3670 | 0.078  | 0.3467 |
| Mix of quiet and busy areas       | 0.227**| 0.0000 | 0.229**| 0.0000 | 0.092  | 0.1793 |
| Journey time                      | -0.554**| 0.0000 | -0.579**| 0.0000 | -0.601**| 0.0000 |
| Size journey time interaction     | -0.386 | 0.432  | -0.432 | 0.418**| 0.0000 |
| Usual park                        | 1.212**| 0.0000 | 1.072**| 0.0000 |        |        |
| Observations                      | 1796   | 1822  | 769    |        |        |        |
| Log-likelihood (1)                | -1591.26 | -1452.27 | -709.41 |        |        |        |
| Log-likelihood (0)                | -1973.11 | -2001.67 | -844.83 |        |        |        |
| $\rho^2$ (adjusted)               | 0.200  | 0.271  | 0.154  |        |        |        |

**Notes:** **Significant 5%; *Significant 10%.
are rather large and dominate other factors. Indeed, it can be expected that green space preferences, and therefore choices, would differ substantially across the sampled population. Any failure to describe this variation would mean that the model would be providing a poor explanation of behaviour. Only by examining interactions and differences between population subsets, as above, can variations in preferences be observed using MNL. However, interactions only indicate the nature of the influence and not relative coefficients, while the use of subsets reduces the size of the dataset and requires that any differences can be correctly identified from population characteristics.

In addition to heterogeneous preferences, error can also arise due to factors that have only been partially observed by the researcher, or which have been subject to measurement error or functional misrepresentation (Manski & Lerman, 1977). In turn, this can be reinforced through poor mental accounting, habit formation or motivational effects (Hensher et al., 1998).

A random parameters, or mixed logit, formulation is an alternative approach that can be used to account for varying tastes amongst respondents, including attitudes of the status quo. Mixed logit adopts an extreme value distribution which relaxes IIA, effectively disengaging IIA from the IID distribution (Louviere et al., 2000). Examples are provided by Revelt & Train (1998) and Brownstone et al. (2000).

Formally, a description of the mixed logit model can begin with the familiar utility function below for individual n and alternatives j:

\[ U_{nj} = \beta_n x_{nj} + e_{nj} \]

The parameter \( \beta \) represents the tastes of each individual and cannot be observed. Instead, it varies across the sampled population on the basis of a probability density function \( f(\beta_n|\varphi) \) where \( \varphi \) represents the parameters of the distribution which have to be estimated. The true error that remains is IID extreme value and independent of both \( \beta \) and \( x \).

Conditional on \( \beta \), the probability that individual \( n \) chooses alternative \( i \) is standard logit:

\[ L_{ni} = e^{\beta_n x_{ni}} / \sum_j e^{\beta_n x_{nj}} \]

However, the unconditional probability is the integral of the conditional probability, i.e. the logit formula \( L_{ni} \), estimated for the various values of \( \beta_n \) (Revelt & Train, 1998). This is weighted by the parameters of \( \varphi \), namely the mean and covariance, i.e.

\[ P_{ni} = \int L_{ni}(\beta_n) f(\beta_n|\varphi) d\beta_n \]

where utility is of the form:

\[ P_{ni} = \int \left( e^{\beta_n x_{ni}} / \sum_j e^{\beta_n x_{nj}} \right) f(\beta_n) d\beta_n \]
The two relevant sets of parameters are the varying tastes of the population, $\beta$, and those that describe the density of this distribution, $\varphi$. The ‘mixed’ element of the function derives from the combination of the logit estimates for selected levels of $\beta$ with the mixing distribution provided by $(\beta|\varphi)$.

Among unobserved parameters will be those which are choice invariant due to characteristics of respondents. These elements can be identified by the mixed logit in that they are correlated within the choice sets completed by individual respondents.

Practical use of mixed logit necessitates simulation which is used to approximate the probability by estimating the simulated log likelihood function for repeated draws of $\beta$ on the basis of selected values of $\varphi$. These simulated probabilities are then inserted into the likelihood function:

$$\text{Sum LL} = \sum_{n=1}^{N} \sum_{j=1}^{J} d_{nj} \ln P_{nj}$$

Application of Mixed Logit to the Survey Data

A mixed logit analysis of the choice element of the rank question (CM Question 2) provides evidence of heterogeneity of preferences in relation to several variables including, as might be expected, an influence for family composition on the preference for play facilities. Separate simulations based on respondent characteristics reveal some interesting patterns. For example, for people with dependent children, a strong positive coefficient and standard deviation for play facilities indicates that superior play facilities do have an influence on the frequency of visits to parks. Gender also has an influence on the coefficient associated with ‘more wooded areas’ such that the attribute level has a lower negative coefficient once this factor has been identified. This pattern probably arises from considerations of personal safety.

Using mixed logit to introduce variables representing occasion of journey (i.e. week/weekends) and mode of travel has the effect of reducing the significance of journey time which had been a highly significant variable in all previous models. In particular, access to a car appears to have an impact on the utility of the journey. Heterogeneity might also have been expected in relation to other attributes, for example, those suggesting naturalness. However, this is not the case, probably because interest in naturalness is not restricted to any one socio-demographic variable.

In addition, mixed logit offers a useful mechanism to reduce the undue influence that usual park choices have on attribute values. Table 4 shows the effect of introducing new variables to account for conservative preferences. The variable ‘status quo choice’ identifies each occasion when the status quo was selected, while ‘number status quo’ represents the number of times each respondent chose the usual park alternative. The introduction of both variables to identify which attributes influence choices of the status quo, leads to a significant improvement in parameter significance and model fit. The Table shows that these variables reduce the influence of collinearity due to the choice of usual park. Negative relationships between status quo choices and the presence of water and congestion now emerge. So too does a negative relationship with play facilities. The interpretation of these results is unclear.
in that it could suggest that parents are more variety seeking in terms of their green space destinations or that people’s usual park destinations simply do not have good play facilities or water features. A step-by-step examination of various variables also reveals the consistent positive influence of ‘more wooded areas’ and ‘more intensive levels of maintenance’ and the negative influence for ‘journey time’ and ‘large size’ although the attributes are entered as nonstochastic because a distributional form cannot be identified. This suggests that while wooded areas, smaller park size and proximity are all benign or positive features within the preferred context of usual park choices, they have a more distinct or negative influence when presented within

Table 4. Mixed dataset: Mixed logit of CM question 2 with status-quo as invariant variable (R = 100)

| Parameter                                      | Each status-quo choice | Number status-quo choices for each respondent |
|------------------------------------------------|-------------------------|-----------------------------------------------|
|                                                | Coefficient | Significance | Coefficient | Significance |
| Large size                                     | 1.423**     | 0.0000       | 1.038**     | 0.0000       |
| High maintenance                               | -0.526**    | 0.0000       | -0.539**    | 0.0000       |
| More wooded areas                              | -0.306**    | 0.0004       | -0.260**    | 0.0094       |
| Mix open areas and trees                       | 0.101       | 0.1232       | 0.067       | 0.2805       |
| Riversides                                     | 0.069       | 0.3472       | 0.027       | 0.6848       |
| Natural-looking pond/lake                      | 0.188**     | 0.0340       | 0.331**     | 0.0004       |
| Adventure play park                            | 0.327**     | 0.0000       | 0.455**     | 0.0000       |
| Small modern playground                        | 0.083*      | 0.0502       | 0.331*      | 0.0000       |
| Paths, seating, trails, cycle                  | -0.235**    | 0.0075       | -0.348*     | 0.0008       |
| Paths and seating                              | 0.108*      | 0.0986       | 0.111*      | 0.0755       |
| Park can be quite busy                         | 0.327**     | 0.0000       | 0.399**     | 0.0000       |
| Mix of quiet and busy areas                    | 0.157**     | 0.0105       | 0.110**     | 0.0488       |
| Journey time                                   | -0.294**    | 0.0000       | -0.417**    | 0.0000       |
| Size/journey time interact.                    | -0.666**    | 0.0000       | -0.447**    | 0.0000       |
| Usual park                                     | 0.224*      | 0.0279       | 0.712**     | 0.0174       |

**Heterogeneity:**

| Parameter                                      | Coefficient | Significance | Coefficient | Significance |
|------------------------------------------------|--------------|--------------|--------------|--------------|
| Large size                                     | -0.325**     | 0.0037       | -0.041      | 0.0219       |
| More intensive maintenance                     | 0.194**      | 0.0000       | 0.169**     | 0.0000       |
| More wooded areas                              | 0.905**      | 0.0000       | 0.074       | 0.0035       |
| Natural-looking pond lake                      | -0.832**     | 0.0000       | -0.106**    | 0.0000       |
| Adventure play park                            | -0.074**     | 0.0000       | -0.069**    | 0.0000       |
| Small modern playground                        | -0.168**     | 0.0000       | -0.124**    | 0.0000       |
| Paths, seating, trails, cycle                  | 0.801**      | 0.0000       | 0.010**     | 0.0000       |
| Park can be quite busy                         | -0.832**     | 0.0000       | -0.105      | 0.0000       |
| Journey time                                   | -1.393**     | 0.0000       | -0.079      | 0.0001       |

**Standard deviation:**

| Parameter                                      | Coefficient | Significance | Coefficient | Significance |
|------------------------------------------------|--------------|--------------|--------------|--------------|
| Large size                                     | 0.167        | 0.0000       | 0.124       | 0.0000       |
| Natural-looking pond/lake                      | 0.150        | 0.0401       | 0.089       | 0.0425       |
| Small modern playground                        | 0.080        | 0.0120       | 0.060       | 0.0169       |

| Observations | 1822          | 1822          |
| Log-likelihood (1) | -0.1452.26   | -0.1452.26   |
| Log-likelihood (0) | -0.2001.67   | -0.2001.67   |
| \( \rho^2 \) (adjusted) | 0.557        | 0.428        |

Notes: R = simulations.
**Significant 5%; *Significant 10%.
hypothesized alternatives. The use of mixed logit does not entirely remove the influence of the status quo, but the residual coefficients are closer to those of CM Question 1 and to prior expectations based on the preceding focus group discussions and factor analysis.

As a final step, the mixed logit was used to assist with a pooling of the stated preference data and the revealed preference data based on an earlier question in which people were asked for their three most frequent usual park destinations. By identifying respective sources of variability in the error term, the mixed logit moderates the scaling differences between the two types of data and permits a sharper focus on the attributes themselves (Brownstone et al., 2000). However, in the event, few parameters do pool and the retention of so many subset-specific attributes causes $\rho^2$ to rise to levels suggesting over-specification. Nevertheless, the coefficient on the attribute journey time that is specific to the usual park alternative, is high relative to that for the hypothetical choices supporting the findings from the preceding mixed logit in which this factor has a stronger disincentive on park visits in reality than in a stated preference experiment.

**Conclusion**

The results from the choice modelling indicate that for small local parks quality is enhanced by the presence of play facilities and by attributes such as ‘a mix of quiet and more busy areas’. For larger parks, an ‘adventure play park’ and ample walking and seating facilities attract the highest coefficient values. In the context of large parks, natural lakes and woodlands become positive factors, while the negative influence of journey time is reduced due to the more dedicated nature of the trip.

The analysis was extended through a rank question that invited people to rank the hypothetical parks in relation to their usual park destination. ‘Adventure play parks’ and ‘mixtures of quiet and more busy areas’ again attract positive coefficients, as too does the attribute level ‘large size’. However, while model fit appears to be improved, some coefficients are affected by collinearity or the limited availability of some facilities within actual parks. Although the effect cannot be removed due to the high proportion of respondents who selected the third alternative, it is interesting to examine the differences imposed on the model by these choices and how coefficients vary depending on whether respondents were asked about their usual or nearest park.

A mixed logit approach allows an analysis of the full sample. It is still unable to remove all the influence of status quo choices, but it does help to reveal the influence that quality play facilities, has on a willingness to select alternative parks. It also indicates that wooded areas, small park size and proximity all have benign or more positive influences on actual choices compared with hypothetical choices.

**Notes**

1 GREENSPACE was funded under the European Commission’s Framework 5 Programme. Available at www.green-space.org.
2 The payment vehicle was examined in the focus groups. The groups expressed unanimous disapproval for the use of entrance fees given that parks have always been a public good. Questions were also asked about tax as a payment vehicle, but this elicited much debate on how taxes are misused. Furthermore,
Irish local authorities do not collect domestic rates or individual taxes. Journey time was preferred and has been shown to be influential in various studies of Irish parks (e.g. Duffy, 1990; Gormley, 1980).

This was a necessary compromise and responses were received from only 24% of the sample.

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