Landscape Valuation: Choice Experiments or Contingent Valuation?

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Abstract

Landscapes represent the dynamic interaction of natural and cultural processes acting on the environment. Increasingly human impacts are dominating the natural processes resulting in landscape change and habitat loss. Due to the public good nature of landscapes, no market price exists to indicate their economic value and consequently impacts to the landscape are excluded from decision making processes. To include landscape change within the decision making process, valuation studies have been undertaken; primarily stated preference methods.

In common with the valuation of many public goods, Choice Experiments (CE), have dominated the landscape valuation literature. However, CE makes the implicit assumption that the value of the good can be captured by the attributes of the good. In CE a landscape would be described in terms of its features i.e. trees, field boundaries.

Drawing from psychology/cognitive research, we explore whether the spatial configuration of those landscape features has an impact on preferences. The findings of two surveys indicate that spatial configuration does have an impact on landscape preferences and therefore potentially on economic values. This would indicate that unless CE can incorporate spatial configuration, they may not be an appropriate method for valuing landscapes.

Keywords Landscapes, Stated Preference methods

JEL code Q24 Q51 Q57)

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1. Introduction

Landscapes are the visual representation of the dynamic interaction of natural and cultural processes acting on the environment. While the land-form and land-cover are created by geological and biological processes, landscapes have been continually modified through the activities of humans, with different land-uses and the land's spatial structure being reorganised in response to changing societal demands (Antrop, 2005).

The importance of landscapes to human well-being and identity has been demonstrated through the provision of a sense of security and health (Appleton, 1975, Kaplan and Kaplan, 1989, Kaplan and Kaplan, 1982) with legal recognition granted through the EU Landscape Convention (ELC) of 2000 (Council of Europe, 2000). This legislation requires policy makers to introduce specific policies to protect, manage and plan landscapes. The incorporation of the perception of landscapes within the EU Convention requires an understanding of what drives preferences for landscapes.

In common with the valuation of many public goods, Choice Experiments (CE), have dominated the landscape valuation literature in recent years. However, choice experiments make the implicit assumption that the value of the good can be captured by the attributes used with the survey. While, for economists, landscapes are thought of as a physical entity, valued for its aesthetic attributes (Hanley *et al.*, 2009), landscapes have been the focus of a wide range of other disciplines in which landscape is considered to be more than a matter of scenery and aesthetics (Swanwick *et al.*, 2007). Drawing from the psychology/cognitive research this paper reports the findings of two studies into landscape perception and explores the consequences for valuation methods.

The rest of the paper is laid out as follows: section 2 explores landscapes preferences from the perspectives of economics and other disciplines and their impacts on non-market valuation; section 3 details the studies; section 4 presents the preliminary results and section 5 contains concluding remarks.

2. Economics and the landscape

Bourassa (1992) highlighted the importance of the link between economics and aesthetics, arguing that economics provides the justification for public action to maintain and enhance the aesthetic quality of the landscape. However, limited economic research has been undertaken on the impact of changes made to the landscape. In the research which has been undertaken, the emphasis has for the most part been on the impact on the visual appearance of the entire landscape or landscape features; through photographs, manipulated photographs, paintings, computer generated images (including 3D GIS e.g. Appleton and Lovett (2003)) and trips to the countryside (Tinch *et al.*, 2010).

As with many environmental goods, the landscape is often considered to be a public good due to the nature of its consumption, being both non-excludable and non-rivalrous.

Compounding the potential market failure resulting from the public good aspects of landscape is the disconnect between those deciding how land is used and potentially multiple benefactors (or those negatively impacted). In addition to the benefits accruing to the land-owners, both local residents and visitors can benefit (or be negatively impacted) by changes in land-use which affect the landscape. Landscape can be considered as a common heritage, transgressing property boundaries (Antrop, 2005).

The ownership of the land within a given landscape lies predominantly in the hands of multiple private enterprises and thus is subject to multiple decision-making processes. As highlighted by Gottfried *et al.,* (1996) producing an optimal landscape where all societal factors are taken into account is problematic when decisions over land-use are made by landowners in a decentralised,

unregulated manner. Firstly, a lack of information about the benefits accruing from landscapes prevents any potential payment of compensation in respect of the externality (what magnitude would the compensation be paid to, by whom) and secondly, the need for outside intervention to ensure equitable decisions. There is also the conflicting need to work at both the individual level and at the landscape scale. Considering individualised levels of incentives is costly and at the landscape scale, individual landowners acting independently cannot provide the social optimal mix of ecosystem services required.

Economic valuation of landscapes

As a direct consequence of the public good nature of the landscape, non-market valuation methods have been used to capture the economic values of landscape change, of which stated preference methods have dominated. Exceptions include Luttik (2000) who undertook a hedonic price study of the affects of the local environment on house prices in the Netherlands and Van Huylenbroeck *et al.,* (2006) who demonstrated different landscapes impacted on rental income from tourist accommodation.

Within stated preference methods, studies have used both the contingent valuation method e.g. Willis and Garrod (1992, 1993); O'Riordan *et al.*, (1993); Boatman *et al.*, (2010) and Hanley *et al* (2009) and choice experiments e.g. Campbell (2007), Grammatikopoulou *et al., (2011a, 2011b)*; Hanley *et al.*, (2007); Madau and Pulina (2011) and Tinch *et al.*, (2010).

While the majority of the valuation studies have focused the visual appearance of the entire landscape or landscape features; a few notable exceptions exist. Hanley *et al.,* (2009) demonstrated that preferences and values for landscapes in the Lake District in North West England and the Trossachs in Scotland were affected by both how special respondents thought the landscape was and how long they thought that people had lived and worked in landscape. Tinch *et al.*, (2010) in addition to using photographs, took respondents to the landscape they were valuing. They demonstrated that experience and memory affected the welfare estimates obtained from the experiment, with the memory effects leading to a slight reduction in mean willingness to pay in the short term and a further reduction in the longer term for several of the landscape attributes.

Landscape Research – the perspective from other disciplines

While economic research has tended to focus on the visual impacts of landscape, reflecting the common usage of the term 'landscape' as referring to "inland natural scenery or its representation within a picture" (Oxford English Dictionary, 2011) with similar terms being used to reflect sea and urban areas i.e. seascapes and cityscapes respectively. As Daniel (2001) highlights, these definitions emphasise a limited area of land surface and views/scenes of the land surface. However, landscapes have been the focus of a wide range of other disciplines. As Howard (in Jones *et al.*, 2007) highlights, the disciplines of geography, archaeology, architecture, ecology, planning and philosophy and landscape architecture are all involved in landscape management; each of which has developed their own concept of landscape; in some cases the concept of 'landscape' is continuing to evolve.

In particular, an extensive literature exists on how landscapes are perceived; covering both objective approaches in which aesthetic quality is seen as being inherent within the physical characteristics of the landscape, where landscape quality is determined by experts and the application of formal design parameters and subjective approaches in which aesthetic quality is subjective, dependent on the individual relationship to the landscape.

One of the subjective theories of landscape preferences is the evolutionary perspective, whereby perception of scenic quality is rooted in survival; people prefer landscapes which are survival enhancing (Lothian, 1999). Kaplan and Kaplan (1989) developed the Landscape Preference Model

which proposes that landscape quality is determined by people's need to 'make sense' and be 'involved' with their environment. It is not only about processing information (comprehension) it is about the landscape yielding information about further possibilities that exist within the landscape (stimulate). The ability to make sense relates to the perceived structure of the environment, - is it easy to map, characterise, summarise; while involvement relates to the possibilities that exist within a landscape - the potential to be challenged. There are two scales of analysis – firstly the two-dimensional level in which the respondent can immediately understand and secondly the three-dimensional level which includes spatial aspects and involves the respondent making inferences to understand the landscape. In this model, landscape preferences are influenced by the perceived presence of four concepts:

1) Complexity – is defined as the number of different visual elements within a landscape - its richness. It relates to the ease with which the information can be organised, issues at the two-dimensional level of analysis rather than requiring depth clues (three-dimensional);

2) Coherence - this concept is at the two-dimensional level and refers to factors which make the landscape easier to organise, to structure. It is enhanced by anything that helps to organise the patterns/objects within a landscape into a manageable number of objects/areas for example with repeated elements, uniformity of textures, readily identifiable component;

3) Legibility – this concept is at the spatial scale of analysis, involving a well-structured space with distinctive elements, enabling respondents to visualise their way within the scene and back to the starting point. It entails a promise or prediction of the capacity to understand and function within the landscape;

4) Mystery - the landscape promises the potential to learn more, something that is not immediately apparent from the original vantage point, through a bend in the path, an area partially obstructed by foreground vegetation. However, the character of the new information must be implied by the existing landscape, a continuation not a surprise i.e. what is beyond a closed door, with the rate of exposure being at the discretion of the viewer.

In this Landscape Preference Model, preferences are affected by the spatial arrangement of the landscape features; it is not just the presence of a landscape feature *per se*. Preferences are derived from both the woodland and the inferred presence of the concepts of complexity, mystery, legibility and coherence it offers. For example, a woodland which offers a degree of mystery with a visible footpath leading into the trees may be preferred over woodland with no footpath.

These concepts have been demonstrated to have an impact through extensive testing e.g. by Kaplan and Kaplan (1989) and others e.g. Herzog *et al.*, (2000). As many of these studies have involved the use of students, it may be unsurprising that a 'consensus' of preferences has been reached, as a direct consequence of the homogeneity of the sample used e.g. Herzog and Leverich (2003) and Kaplan and Kaplan (1989). Furthermore, many of the same experiments selected a large number of landscapes which were deemed to fit the cognitive concept in question *a priori* and then assessed the preferences of the homogenous sample for these photographs. Indeed, it took Herzog & Leverich (2003) judicious selection of scenes to separate the coherence and legibility category.

Linking economics and psychology research into the Landscape

In common with the valuation of many public goods, Choice Experiments (CE), have dominated the landscape valuation literature in recent years. This is due in part to the biases that have been identified within the contingent valuation method, e.g. embedding (Kahneman and Knetch, 1992)

and partly due to the potential for choice experiments to obtain more information about the preferences for a public good, relative to contingent valuation for the same resources (Day *et al.*, 2009).

The premise of choice experiments is that the good in question can be described and therefore valued in terms of its attributes and levels and specifically that these values can then be aggregated up to derive the value of entire good. Choice experiments make the implicit assumption that the value of the good can be captured by the attributes used with the survey. While, for economists, landscapes are thought of as a physical entity, valued for its aesthetic attributes (Hanley *et al.*, 2009), landscapes have been the focus of a wide range of other disciplines in which landscape is considered to be more than a matter of scenery and aesthetics (Swanwick *et al.*, 2007). Can the cultural meanings that humans attach to landscapes which are dependent on their cultural, socio-economic or historic context aspect be captured when describing a landscape in terms of its attributes?

Of particular interest are the concepts developed by the Landscape Preference Theory of Kaplan and Kaplan (1989) highlighting the need for humans to 'make sense' and be involved' with their environment which is linked to landscape structure. Within this theory, it is the spatial configuration of the landscape features within the landscape rather that the landscape features themselves which drive preferences. Therefore, the Landscape Preference Theory of Kaplan and Kaplan (1989) conflicts with the basic premise of choice experiments, namely that landscape preferences are affected by the spatial configuration of the landscape attributes – something that is not usually included within a landscape based choice experiment. An attribute could be an increase in the amount of trees in a given area, not where the extra trees are located (singularly, or in clumps). This theory could potentially call into question the validity of some of the economic values of landscapes derived from the aggregation of the implicit prices of the landscape attributes obtained from choice experiments if spatial configuration has an impact on preferences.

As previously stated, while the concepts developed by Kaplan and Kaplan (1989) have undergone extensive testing many of these studies have involved the use of students and the careful selection of landscapes by the experimenters *a priori*. This paper reports the findings of two studies of landscape preferences based on the general population of Northern Ireland. In the first, three policy-derived landscape images were used: preferences and the individual's respondent's assessment of the complexity, legibility and mystery of each landscape was obtained. This enabled an assessment of whether landscape preferences are affected by these concepts. In the second study, six images were developed in which the quantities of landscape features (trees, field boundaries, colour of fields, road/paths) were kept constant and their location varied to reflect the concepts of complexity, coherence legibility and mystery[1] If, as assumed by choice experiments, landscape preferences are driven by landscape features alone, then the respondents would be indifferent between these images. These two studies enable an assessment regarding the validity of the concepts and the implications of the Landscape Theory of Kaplan and Kaplan (1989) for non-market valuation of landscapes.

3. The Study

Recognising that preferences for landscapes are complex, dependent on the characteristics of the landscapes and of the individual observer, this paper reports the findings of two studies examining the preferences for rural landscapes in Northern Ireland, assessing whether the structure of the landscape influences those preferences.

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[1] Individual respondent's assessments of these concepts were also obtained.

Within both studies, a common methodology was applied in developing the landscape images and the means with which to obtain the preferences.

The Landscapes

In representing these proposed landscapes, we selected one landscape, with a view-shed with a short depth of field to enable a variety of changes to be made and not too large so that it comprised too much detail and people would not be able to determine the changes. For each study, one photo of the landscape was computer manipulated to represent the landscapes.

All the images contained some degree of manipulation, so that no one image appeared to be an original image which might influence preferences of the respondents. Using one landscape in combination with computer manipulation, we were able to separate the influence of land-form and land-cover on people's preferences. It has been shown that both land-form and land-cover can influence landscape preferences (Hammitta *et al.*, 1994).

In the first study, the landscape images were driven by policy (baseline, agri-environment management and abandonment), no regard was paid to the concepts of Kaplan and Kaplan (1989), In developing the landscapes, consultation took place with ecologists within AFBI, NGOs and policy makers to ensure that the results were believable and representative of the policy-based scenarios. The landscapes used within study 1 are shown in Figure 3.1.

In study 2 the quantity and quality of landscape features are held constant while their spatial configuration changes. The concepts of Kaplan and Kaplan (1989), namely coherence, complexity, legibility and mystery were used as a basis for the changes, in particular coherence and complexity with alternative field boundaries and tree distributions. To link into the mystery concept, a road and path changed location within the image to imply a promise of something beyond the 2-dimensional landscape features and a number of buildings were made brighter to make them more distinctive and so tap into the legibility concept. The landscapes used within this study are shown in Figure 3.2. and the landscapes and spatial distribution of the features are shown in Table 3.1.

Table 3.1. Summary of the spatial configurations of the landscape features of each landscape.

	Fields A (rectangular)	Fields B (radiating)	
		No Mystery & leg	Mystery & leg
Trees 1-(Scattered)	**Landscape W**	**Landscape F**	**Landscape T**
Trees 2 (clumps)	**Landscape M**	**Landscape J**	**Landscape O**

Figure 3.1. Landscapes used in survey

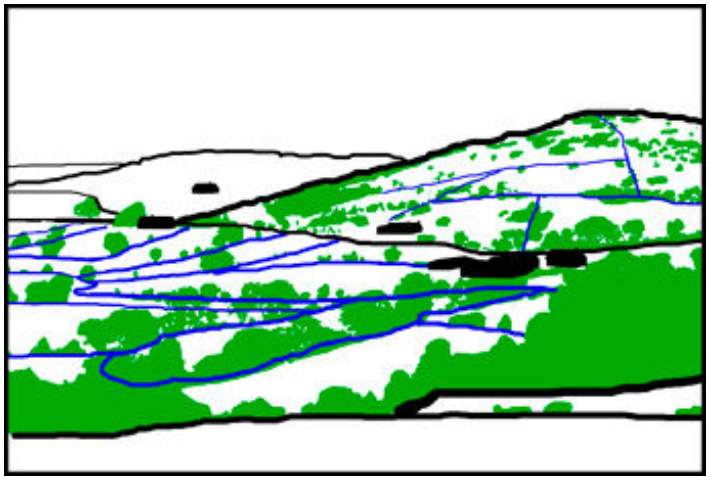
Figure 1a Baseline landscape

Figure 1b Landscape under agri-environmental management

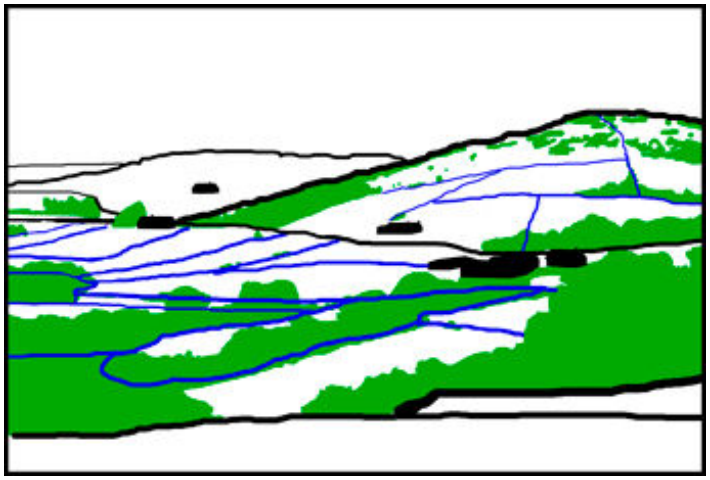
Figure 1c Landscape under abandonment

Figure 3.2. Landscape images used in study 2.

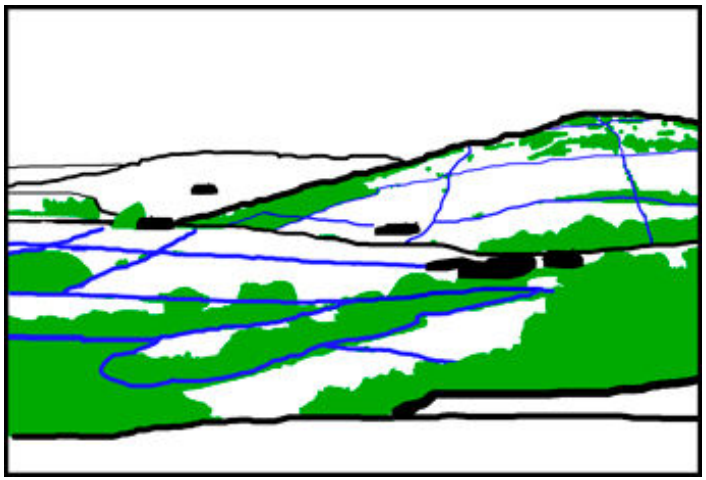
Landscape Image F: Radiating fields and scattered trees;



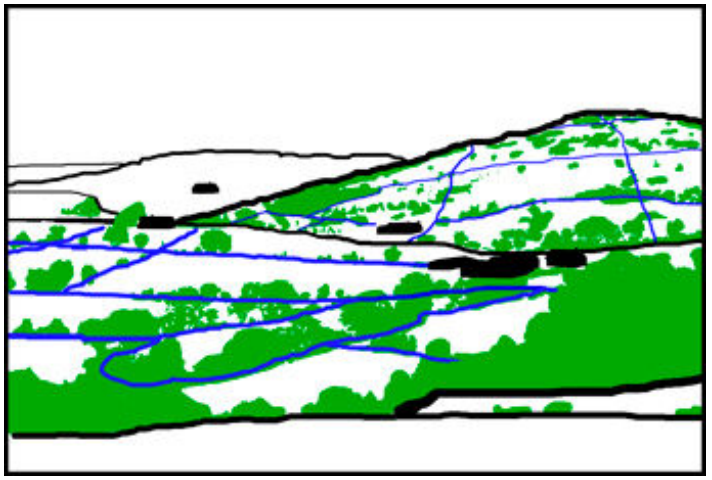
Landscape J: Radiating fields and clumped trees;



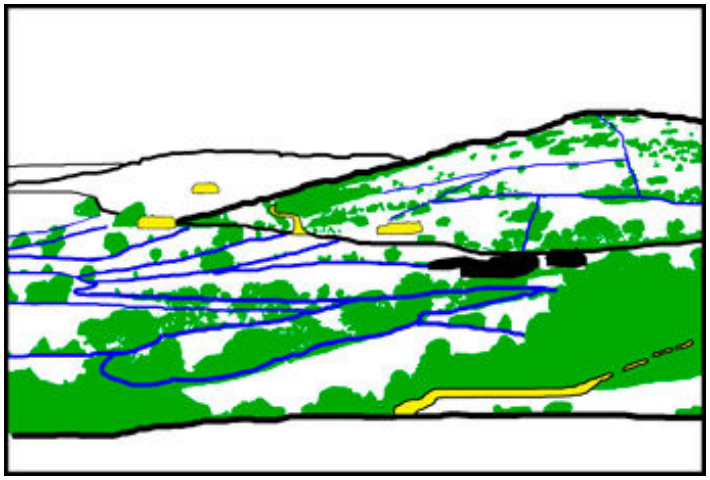
Landscape M:– Rectangular fields and clumped trees



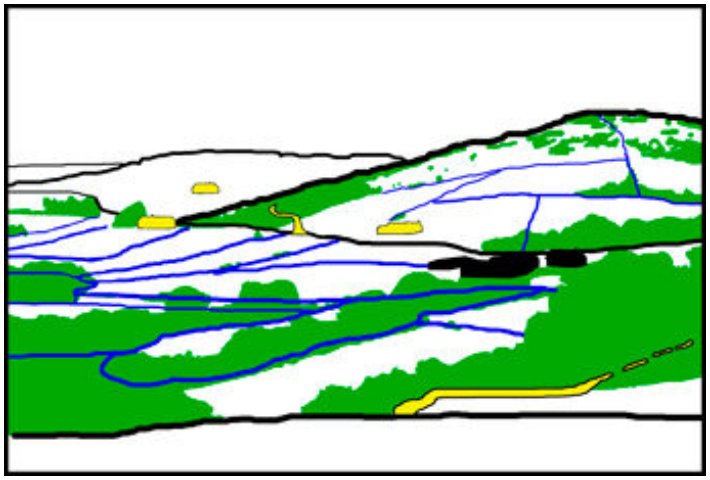
Landscape W: Rectangular fields and scattered trees;



Landscape T: Radiating fields, scattered trees and mystery/legibility (Sample A);



Landscape O: Radiating fields, clumped trees and mystery/legibility (Sample B).



Methodology

Within both these studies the choice-based method of paired comparisons was used to determine each individual respondent's preferences for the landscapes in question. The method involves all possible pairs of landscapes being offered to the respondents who state which of the landscapes they prefer for each pair (David, 1988, Edwards, 1957). This enables the transitivity of the preferences for landscapes to be tested and a scale produced showing the relative strength of the aggregate preferences for each landscape. From the data, it is possible to examine preferences between each pair of landscapes and for the overall ranking of the landscapes.

In these studies, rather than being asked directly which of the pair of landscapes was preferred, respondents were asked to state the intensity of their preference, from Strong, Moderate or slight. Importantly, respondents were given the option of stating "Same Preference" if they felt that they liked both landscapes the same. In the latter study, the analysis of the "same choices" enabled an assessment of whether respondents were indifferent between the landscapes – as assumed by choice experiments. For landscape preferences to be indifferent to the spatial configuration, respondents would state "same preferences" for choices between two landscapes with the same landscape features but different structure.

Analysing transitivity tests whether people are able to make choices over alternative landscapes (a fundamental assumption in both the methods of Contingent Valuation and Choice Experiments). Respondents are transitive in their choices when given three objects A, B, C, if object A is preferred to object B and object B is preferred to C, then object A MUST be preferred to object C, i.e. A > B > C < A. Intransitivity will occur when one preference is reversed, which results in the preferences becoming circular i.e. A > B > C > A. Kendall and Smith (1940)defined this occurrence of intransitivity as a 'circular triad.' Intransitivity is not restricted to the preferences for three goods, i.e. the circular tetrad A > B > C >D >A, however all circular n-ads will contain circular triads. Therefore, an assessment of these elementary inconsistencies will enable an assessment of the transitivity of each respondent. Our paired comparisons experiment could be considered a simple Choice experiment. If people are unable to do this, which would be reflected in a high level of intransitivity, then it would be highly unlikely the addition of monetary values would improve people's ability to choose.

Following extensive focus group work and piloting of the survey instrument prior to the first survey, respondents were first asked to look at all the photos "*…..and imagine that you are standing in each of these landscapes*". They were then shown the landscapes in pairs and asked "*For each pair of landscapes, I would like you to tell me which of the two landscapes you most like*."

In presenting the landscapes to the respondents, both the order in which they were presented to the respondents initially and within the pairs was randomised. No inference was made as to which landscape was the baseline, as previous studies have shown that the knowledge of the status quo landscape affects preferences (van den Berg and Vlek, 1998). For the administration of the survey, it was necessary to label the landscapes, however randomly drawn letters were used to avoid any inference of order on the landscapes.

Study 1.

This study examines the preferences for rural landscapes in Northern Ireland, assessing whether the inherent characteristics of individuals and their cultural background influence those preferences, including an assessment of the impacts of the concepts of complexity, legibility and mystery[2].

Sample 1

The survey involved in-person interviews was undertaken in March 2008. A two stage sampling method was used, with an initial random selection of 35 electoral wards across Northern Ireland. A sample of 515 respondents was then drawn at the ward level was based on quota controls (age, sex and socio-economic grouping), to ensure the overall quota is representative of the Northern Ireland adult population.

Study 2

This study sets out to explore whether landscape configuration has an impact on landscape preferences using six landscape images developed to explore the impacts of landscape structure on preferences (see Table 3.1).

Sample 2

Within this study, an experimental approach was undertaken as the aim was not to derive preferences of a representative sample of the population. However, rather than drawing a sample of students, a sample of 400 members of the general public during the autumn of 2011 was obtained using a well-established database of organisations who participate in AFBI Taste Panels. While this would not be a statistically representative sample of the general population, care was taken to ensure that participants reflect a wide range of socio-economic groups who have been shown to have an impact on landscape preferences – rural, urban, ages, sex, use of the countryside.

A split sample was used in which 200 respondents made choices over Landscapes F, W, J, M and O and 200 respondents made choices over Landscapes F, W, J, M and T.

3. Results

Study 1.

Assessment of Transitivity

In making their choices between the pairs of landscapes, respondents were given the option of stating that they were unable to choose between the landscapes. In total, 23 respondents (4.5%) were unable to make a choice between one, or more of the pairs. For the purpose of this initial analysis of preliminary findings these respondents were excluded from the sample.

The findings for this survey show that respondents exhibited a high level of transitivity, with 83% of respondents being transitive. This demonstrates, therefore, that the vast majority of the sample can make rational choices over these landscapes.

[2] Within the focus group and pilot testing, the respondents were struggling with the concept of "coherence" therefore this was excluded from the main study.

Table 4.1. Findings from comparisons between the baseline, abandoned and agri-environmental heavy landscapes

Sample size	515
Respondents able to chose between ALL pairs	492
Transitive respondents (number)	410
Transitive respondents (%)	83

Influence of the Kaplan and Kaplan concepts

We examined the preferences for landscapes with respect to a number of socio-economic and cultural factors. The results of the statistical tests are reported in the following tables. If the test statistic is significant, this indicates that a relationship exists between the explanatory variable and the landscape choice in question.

The results shown in Table 4.2 demonstrated that:

- Respondents who thought the agri-environment (baseline/abandoned) landscape was the most Mysterious were significantly and positively related to the choices involving the agri-environment (baseline/abandoned) landscape.
- Respondents who thought the baseline (abandoned) landscape was the most complex were significantly and positively related to the choices involving the baseline (abandoned) landscape.
- Respondents who thought the abandoned landscape was the most legible were significantly and positively related to the choices involving the abandoned landscape.

Table4.2: Influence of respondent self-reported mystery, complexity legibility on landscape preferences compared to the rest of the sample

	Most Mysterious landscape……			Most Complex landscape……			Most legible landscape……		
Choices (total sample preference choices in parenthesis)	**Agri-environ**	**Baseline**	**Abandoned**	**Agri-environ**	**Baseline**	**Abandoned**	**Agri-environ**	**Baseline**	**Abandoned**
Agri-Environ. (63%) vs Baseline (37%)	***	***	n/a	ns	***	n/a	ns	ns	n/a
	70% Agri. Environ. 30% Baseline	40% Agri. Environ. 60% Baseline			48% Agri. Environ. 52% Baseline				
Agri-Environ. (62%) vs Abandoned (38%)	***	n/a	***	ns	n/a	ns	***	n/a	ns
	77% Agri. Environ. 23% Abandoned		52% Agri. Environ 48% Abandoned				69% Agri. Environ 31% Abandoned		
Baseline (66%) vs Abandoned (34%)	n/a	***	***	n/a	***	**	n/a	ns	ns
		85% Baseline 15% Abandoned	52% Baseline. 48% Abandoned		75% Baseline 25% Abandoned	57% Baseline. 43% Abandoned			

Note: * denotes significant at the 10% level, ** denotes significant at the 5% level and NS denotes not significant.

Study 2

The key test within this study was the number of "same preference" choices and where these choices were located. As can be seen in Table 4.3, of the 3857 choices made by respondents within this study, only 649 (17%) were for the option 'same preference'. Respondents who stated an equal preference for the pairs of landscapes ranged from 11% for the choice between Landscape F and Landscape M to 28% in the choice between Landscape F and Landscape T. Therefore, it can be seen that for each of the pairs of landscapes in this study, the majority of respondents were able to state a positive preference for one or other of the landscapes.

A formal statistical test was conducted for each of the pairs of landscapes, comparing respondents who made a choice (for either landscape) Vs 'same preference' using the non-parametric chi-squared test. This showed a statistically significant difference between these respondents at the 99% level for all pairs of landscapes. Consequently, the hypothesis that respondents would state 'same preference' between these landscapes can be rejected.

Assessing the occurrence of 'same preference' choices across the landscape pairs, it can be seen from Table 4.3 that while the overall occurrences of 'same preference' is low for all pairs of landscapes, the actual levels varied considerably. Focusing initially on the landscapes F, J, M and W, for which choices were undertaken by all respondents, the percentage of 'same preference' choices made between Landscape F and Landscape W (26%) and Landscape J and Landscape M (22%) are considerably higher than the average and higher than reported for all the other choices. Referring back to Table 3.1, it can be seen that these landscapes which report higher levels of 'same preference' have a change in their field boundaries (rectangular and radiating) while the tree configuration is held constant. When the trees distribution is changed (field boundaries held constant) the levels of 'same preference' are lower - Landscape M and Landscape –W 13%; landscape F and Landscape J, 16%.

The pair of landscapes in which the lowest level of 'same preference' was observed, was the choice between Landscape F and Landscape M (11%). Again referring to the table 3.1, it can be seen that in this choice both the potential changes to the spatial configuration have occurred. Landscape F has radiating fields and scattered trees while Landscape M has rectangular fields and clumps of trees.

Therefore, from this analysis of the 'same preference' choices, it can be seen that not only are there low levels of 'same preferences' reported between landscapes varying only in spatial configuration; as the number of changes made to the spatial configuration increases, the reported level of "same preference" falls. In addition, there appears to be an impact of the type of change, whereby a change in field pattern (holding trees constant) resulted in a higher level of 'same preference' choices than the corresponding change in tree pattern.

Table 4.3 Respondent Preferences for each of the pairs of Landscapes (F, J, M, W, T and O)

Landscape Choice (Landscape A V Landscape B)	Strong Preference (Landscape A)	Moderate Preference (Landscape A)	Slight preference (Landscape A)	Same Preference	Slight preference (landscape B)	Moderate Preference (Landscape B)	Strong Preference (Landscape B)
Landscape F v Landscape J (N=386)	46 (12%)	75 (19%)	52 (13%)	**60 (16%)**	55 (14%)	65 (17%)	33 (9%)
Landscape F v Landscape M (N=386)	50 (13%)	74 (19%)	50 (13%)	**44 (11%)**	57 (15%)	66 (17%)	45 (12%)
Landscape F v Landscape W (N=386)	22 (6%)	61 (16%)	51 (13%)	**102 (26%)**	61 (16%)	61 (16%)	28 (7%)
Landscape J v Landscape M (N=390)	27 (7%)	65 (17%)	59 (15%)	**85 (22%)**	65 (17%)	64 (16%)	25 (6%)
Landscape J v Landscape W (N=388)	39 (10%)	70 (18%)	60 (15%)	**56 (14%)**	59 (15%)	70 (18%)	34 (9%)
Landscape M v Landscape W (N=385)	45 (12%)	74 (19%)	55 (14%)	**50 (13%)**	51 (13%)	73 (19%)	37 (10%)
Sample A (Landscape T)							
Landscape F v Landscape T (N=194)	10 (5%)	32 (16%)	29 (15%)	**55 (28%)**	29 (15%)	27 (14%)	12 (6%)
Landscape J v Landscape T (N=195)	17 (9%)	31 (16%)	26 (13%)	**26 (13%)**	26 (13%)	51 (26%)	18 (9%)
Landscape M v Landscape T (N=198)	26 (13%)	38 (19%)	28 (14%)	**17 (9%)**	21 (11%)	45 (23%)	23 (12%)
Landscape W v Landscape T (N=181)	20 (11%)	31 (17%)	34 (19%)	**22 (12%)**	30 (17%)	44 (24%)	13 (7%)
Sample B (Landscape O)							
Landscape F v Landscape O (N=191)	15 (8%)	31 (16%)	30 (16%)	**24 (13%)**	30 (16%)	42 (22%)	19 (10%)
Landscape J v Landscape O (N=192)	8 (4%)	27 (14%)	32 (17%)	**49 (26%)**	23 (12%)	36 (19%)	17 (9%)
Landscape M v Landscape O (N=192)	19 (10%)	36 (19%)	36 (19%)	**34 (18%)**	28 (15%)	26 (14%)	13 (7%)
Landscape W v Landscape O (N=193)	19 (10%)	36 (19%)	34 (18%)	**25 (13%)**	32 (17%)	30 (16%)	17 (9%)

When the extra landscapes (T and O) are included, the pattern is repeated. In essence, Landscape T is Landscape F, while Landscape O is Landscape J, both with an additional change made to the roads and paths and a change in the brightness of some of the buildings. This individual change in the spatial configuration designed to relate to the Kaplan and Kaplan (1989) concepts of mystery and legibility, resulted in an increase in the level of 'same preference' choices, with 28% reported for the choice between Landscape F and Landscape T and 26% being reported between Landscapes J and Landscape O.

In both the sub-samples, low levels of no 'same preference' were reported when all three spatial configurations of the landscape features were varied within the landscape pairs, i.e. Landscape M (rectangular fields, clumpy trees, no mystery) and Landscape T (radiating fields, scattered trees, plus mystery); and Landscape W (rectangular fields, scattered trees, no mystery) and Landscape O (radiating fields, clumped trees, plus mystery); with 9% and 13% respectively.

In this survey, as shown by Table 4.4 below, only 2% of the sample stated 'same preference' for each of the pairs of landscapes, with 90% of the sample making 5 or more positive choices. In particular, 41% of the sample were able to state which of the two landscapes they preferred for all the pairs of landscapes and a further 18% and 10% only stated 'same preference' for one and two choices respectively. Therefore, it would appear that nearly 70% of the respondents were able to make positive choices over eight of the choices.

Table 4.4 Number of choices in which respondents stated "Same preference"

Number of 'same preference' choices	Respondents	Sample A	Sample B
0	164 (41%)	89 (44%)	75 (38%)
1	71 (18%)	31 (15%)	40 (20%)
2	39 (10%)	21 (10%)	18 (9%)
3	24 (6%)	11 (5%)	13 (7%)
4	19 (5%)	9 (4%)	10 (5%)
5	11 (3%)	4 (2%)	7 (5%)
6	8 (2%)	7 (3%)	1 (0.5%)
7	7 (2%)	3 (1%)	4 (2%)
8	3 (1%)	1 (0.5%)	2 (1%)
9	1 (0.25%)	0 (0%)	1 (0.5%)
10	9 (2%)	3 (1%)	6 (3%)

Transitivity testing

To test the level of transitivity of respondents, it is first necessary to identify only those respondents who have made a positive choice for all the pairs of landscapes. As highlighted in the former section, levels of no preference ranged from 9% to 28% for each choice and with 164 respondents stated a positive choice for all ten pairs of landscapes.

For five objects, the maximum number of circular triads is 5, for four objects, there is a potential for a maximum of two circular triads and for three objects, only one circular triad can exist. These formulas were applied to the preferences of the 164 respondents (Sample A = 89 and Sample B =75) and the results can be shown in Tables 4.5.

Table 4.5 Levels of transitivity (number of circular triads) for the landscapes F, J, M, W , T and O (164 respondents able to make choices over all 10 pairs of landscapes).

		No of circular triads					
Sample	**Landscapes**	**0**	**1**	**2**	**3**	**4**	**5**
A	**FJMWT (89)**	36 (40%)	19 (21%)	15 (17%)	11 (12%)	7 (8%)	1 (1%)
B	**FJMWO (75)**	27 (36%)	19 (25%)	14 (19%)	8 (11%)	6 (8%)	1 (1%)
A&B	**FJMW (164)**	102 (62%)	37 (23%)	25 (15%)	-	-	-
A&B	**JMW (164)**	143 (87%)	21 (13%)	-	-	-	-
A&B	**FWM (164)**	144 (88%)	20 (12%)	-	-	-	-
A&B	**JMF (164)**	137 (84%)	27 (16%)	-	-	-	-
A&B	**FWJ (164)**	145 (88%)	19 (12%)	-	-	-	-
A	**JFT (89)**	81 (91%)	8 (9%)	-	-	-	-
A	**TMF (89)**	81 (91%)	8 (9%)	-	-	-	-
A	**WFT (89)**	70 (79%)	19 (21%)	-	-	-	-
A	**JMT (89)**	77 (87%)	12 (13%)	-	-	-	-
A	**TWJ (89)**	80 (90%)	9 (10%)	-	-	-	-
A	**TWM (89)**	79 (89%)	10 (11%)	-	-	-	-
B	**JFO (75)**	67 (89%)	8 (11%)	-	-	-	-
B	**OMF (75)**	67 (89%)	8 (11%)	-	-	-	-
B	**FWO (75)**	58 (77%)	17 (23%)	-	-	-	-
B	**JMO (75)**	63 (84%)	12 (16%)	-	-	-	-
B	**OWJ (75)**	65 (87%)	10 (13%)	-	-	-	-
B	**OWM (75)**	68 (91%)	7 (9%)	-	-	-	-

An initial assessment of the transitivity of the landscape preferences was undertaken at the triad level. Assessing transitivity at this level, i.e. each of the possible combination of three landscapes, revealed high levels of transitivity for each of the triads, ranging from 77% to 91%. Given that the respondents had the option of stating 'same preference' rather than having to make a choice, the potential for intransitive choices was reduced. The finding of high levels of transitivity therefore indicates that a linear relationship does exist between the landscapes for those who were able to make choices. This compared favourably to the landscape survey undertaken within AFBI – Economics in which respondents exhibited levels of transitivity of 83% in the study reported earlier.

As the number of landscapes and therefore choices also increase, as does the potential to make intransitive preferences. The percentage of respondents who are transitive reduces to 60% for the tetrad F, J, M and W and to approximately 40% in the pentads (as a split sample was used within this study, the transitivity test was based at the split sample level for the pentads).

4. Conclusions

This paper reports the findings of two studies undertaken to explore the impact of landscape structure on landscape preferences using the Landscape Preference Theory of Kaplan and Kaplan (1989). It assessed the question of whether choice experiments, which make an implicit assumption that preferences are indifferent to landscape structure; an appropriate method with which to value landscapes?

Two generic landscapes were derived, which were manipulated to produce a number of alternative landscapes in which land form was kept constant. In the first, the landscape features were varied to reflect alternative policy based scenarios and in the second, the quality and quantity of landscape features were kept constant while the spatial configuration varied.

In both studies, the concepts of the Landscape Preference Theory (Kaplan and Kaplan, 1989) were shown to influence preferences, however those impacts were not consistent across all the concepts, within the first study the 'mystery' concept had a more significant impact than the other two concepts across all landscape choices. In the second study, changing the trees and field boundaries had the largest impact. While these images were developed to reflect the concepts of coherence and complexity we have yet to assess how the individual respondents rated these images with respect to the concepts and how their ratings affect their preferences.

The stated preference method of paired comparisons was used; where respondents were offered pairs of landscape images and they stated which of the two landscapes they preferred or whether they had the *same preference* for the two landscapes under consideration. This enabled a test to be made of the impact of spatial configuration of the landscape featured on landscape preferences and therefore whether choice experiments would be an appropriate method with which to value landscapes.

The studies demonstrated that respondents in both studies were able to express preferences for landscapes. In particular, the second study showed that changing the arrangements of the trees, field boundaries and road/path simultaneously resulted in a lower level of 'same preference' choices than any of the changes in isolation, indicating that increasing the number of changes made to the spatial configuration makes it easier for respondents to choose between the landscapes. Respondents who stated "same preference" only once were more likely to select this option for pairs of landscapes which involved a change in either field boundaries or road/paths, indicating that these respondents, who were able to choose between all the other landscapes, found that landscapes involving these spatial changes were difficult to discriminate between.

The findings of the studies indicate that landscape preferences are affected by landscape structure. Consequently, to obtain robust estimates of the economic benefits deriving from landscapes, valuation methods must incorporate the issue of spatial configuration. Additionally, the study has demonstrated that the impact of changing spatial configuration is not consistent, with changing field boundaries or roads/paths having a different effect on preferences compared to changing the distribution of trees.

As choice experiments currently value only the landscape features rather than the landscape structure, they are currently not appropriate for landscape valuation. In order to incorporate the impact of alternative spatial arrangements of the landscapes into choice experiments, the landscape features would have to be offered to respondents in alternative arrangements within a complete landscape; in essence this amounts to a contingent valuation study.

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