Evidence-based Research in Environmental Choice Experiments

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Abstract

Results of choice experiment studies are widely claimed to provide valuable inputs into more efficient environmental policy development. The implicit price estimates for the attributes included in the choice experiment give policy makers an indication of the non-market values of environmental goods and services. There are, however, few standardised approaches to guide the choice of the environmental attributes. Although recent publications (Boyd and Krupnick, 2009; Johnston and Russell, 2011) stress the need to base the definition of non-market environmental attributes in ecological theory, choice experiment studies often give minimal evidence to support the choice of attributes.

This paper reviews ten years' worth of choice experiment studies in leading environmental economics journals. The aim of this study is to investigate on what basis the attributes and units used in the valuation studies were chosen, and how the survey development process is reported. The review shows that only very few published papers report the evidence sources on which the choice of attributes and their levels was based. The disjoint between evidence-based research method and the reporting of protocols in choice experiment valuation studies undermines the credibility of nonmarket value estimates to people outside the profession. There is a need for greater attention to transparent, evidence-based survey development to support more robust welfare estimates and withstand criticism.

Keywords: Attribute selection, Choice experiments, Environmental attributes, Evidence-based methods

JEL Classifications: Q51, Q57

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1. Introduction

Since the late 1990s, there has been an increasing focus on using evidence in developing environmental policies (Banks, 2009; European Commission, 2012). Evidence based environmental management advocates a more rational, rigorous, and systematic approach to research (Sutcliffe and Court, 2005). It follows from the focus on evidence-based decisions that studies that aim to inform policy making need to provide high quality research evidence (Davies, 2004).

A line of research that is frequently claimed to provide useful inputs into decision making processes is nonmarket environmental valuation (e.g. Bennett, 2005; Hanley et al., 2006; TEEB, 2009). While nonmarket studies indeed provide valuable inputs for policy development, the methods used have been subject to much criticism. In this paper, I argue that for nonmarket valuation studies to provide credible information, and to support improved policy making, measures of environmental changes need to be developed based on sound and documented evidence.

One of the challenges in designing surveys for environmental valuation is how to characterise the condition and changes in the ecosystem under consideration, and the related impacts on valued goods and services (Johnston et al., 2011a; Keeler et al., 2012). On the one hand, the information about the environmental change must be readily understood by respondents; on the other hand, the indicators used to communicate environmental change must provide an accurate representation of the change being valued (Bennett and Blamey, 2001; Hanley and Barbier, 2009).

The discussion that follows will focus on the choice experiment approach to nonmarket environmental valuation. In a choice experiment, environmental changes are expressed in terms of impacts on various attributes, which have different levels in different policy scenarios. Textbooks on choice experiments don't typically elaborate on the approach to survey development and attribute choice. While it is widely acknowledged that attributes included in the choice set should be policy relevant and understandable to respondents (Bennett and Birol, 2010; Kanninen, 2006), there is little guidance as to how to choose the most appropriate attributes, the most appropriate levels, and the best way to describe those to respondents. A recent publication on the definition of attributes and levels stresses the importance of focus groups to ensure that the attributes are relevant and credible, but provides no guidance on what scientific evidence could be used to support attribute choice (Carlsson, 2011). As a result, indicators used in much existing valuation work lack documented reference to empirical findings regarding ways in which natural systems respond to changes or stresses, and often have limited grounding in prior ecological research (Johnston et al., 2011a).

There is an emerging literature addressing the development of indicators in environmental valuation studies. For example, (Johnston et al., 2011a) claim that indicators of ecological changes in stated preference surveys rarely correspond to formal indicators presented in published ecological literature; and often use ecologically ambiguous descriptors. (Keeler et al., 2012) discuss the challenges (and shortcomings) in describing water quality related ecosystem services in valuation studies. Finally, (Boyd and Krupnick, 2009) formulate a set of principles to guide the choice of non-

market environmental attributes based on "ecological production theory". The authors describe how 'ecological endpoints' can provide meaningful attributes for valuation studies.

In this paper, I assess whether the indicators used in choice experiment valuation studies are soundly based in environmental evidence. What is the scientific basis for attributes to be included in valuation studies? How are attribute level changes predicted? Does the information about the attribute selection process provide sufficient evidence to communicate the quality of the research to meet an evidence-based policy agenda?

The section that follows describes the method used to answer the questions posed above, followed by a presentation of research findings in Section 3. In Section4, I discuss the results and make recommendations for future choice experiment work. Section 5 concludes.

2. Method

To answer the questions posed above, I reviewed nonmarket valuation studies published in peer-reviewed journals between January 2002 and April 2013. A search for relevant publications was conducted using the databases of eight leading journals in environmental economics: the American Journal of Agricultural Economics, the Australian Journal of Agricultural and Resource Economics, Ecological Economics, Environmental and Resource Economics, the European Review of Agricultural Economics, the Journal of Agricultural Economics, the Journal of Environmental Economics and Management, and Land Economics. Combinations of the following search terms were used to search the databases: "choice experiment", "choice modelling", and "discrete choice".

No attempt was made to conduct a fully comprehensive systematic review of the peer-reviewed and grey literature. Nevertheless, the results reported in this paper will give a reasonable indication of publication standards in the field, and the extent to which researchers report their evidence-base in developing choice experiment surveys.

The initial search yielded 323 articles, which were subsequently screened on the subject matter and valuation technique used. A distinction was made between studies that target resource use and non-use. For an article captured by the search to be relevant for the review, only articles that use choice experiments to evaluate non-use value impacts of management on environmental resources (e.g. natural assets, ecosystems, biodiversity) were retained. Valuation studies on recreation, food products, travel choice, or health issues were not assessed. All the studies that met the above inclusion criteria were further screened to ensure that only original DCE applications were included in the analysis, so that benefit transfer studies or meta-analyses were removed from the sample. This process resulted in 65 papers that were identified as relevant after examination of their full text. For each of these papers, the following were recorded: the natural resource management issue considered; the environmental attributes included in the choice experiment; the data sources that were used to choose attributes and attribute levels; and whether references were provided with further detail about the survey development process. All journal articles that were included in the detailed review are reported in Appendix A to this paper.

3. Results

Most of the reviewed papers dealt with water resources management (Table 1) [1], such as protecting river or coastal water quality, riparian vegetation, or aquatic flora and fauna. Other NRM issues included forest management, agricultural land use, or protection of native vegetation.

Although it is difficult to directly compare the attributes used in different studies[2], the types of attributes used in various choice experiments are summarised in Appendix B. About one-quarter of the studies presented some attribute representing landscape appearance, such as 'character of surrounding land' (Newell and Swallow, 2013) or 'visual appearance of stonewalls' (Campbell, 2007). Also often included were attributes aiming to capture the protection of rare native species, such as 'endangered wildlife' (Domínguez-Torreiro and Soliño, 2011) or 'rare native animals and plants' (Kragt, 2013). Other attributes that are commonly used include 'access for recreation', 'healthy riverside vegetation', 'fish populations', or 'area under management contract' (Appendix B).

Table 1. Environmental / Natural Resource Management issues considered in reviewed papers

Issue considered	Number of papers*
Agricultural / Rural land use	13
Afforestation / Forest conservation	10
Coral reef degradation	3
Native vegetation protection	9
Water resources management (rivers, lakes, coastal water)	16
Wetland management	6
Other	14

* The total number is >64 because some papers considered multiple NRM issues.

The particular focus of this paper is the evidence base for attribute selection. The description of the attribute selection process was compared for all 65 papers. Attention was paid to the reporting of the data sources used to guide attribute selection and the choice of attribute levels. The various reported data sources are summarised in Table 2. Following common practice in choice experiment survey design, most papers reported to have used focus group discussions with members of the public, and/or in interviews with expert scientists to guide attribute selection. Surprisingly, only a few papers report the criteria that the select attributes had to meet. For example, (Meyer, 2013) state that attributes need to be 'credible', and (Blamey et al., 2002) stress that attributes should be demand-relevant, policy-relevant, and measurable. Lists of initially considered possible attributes were missing in all papers, although a few papers refer to research reports in which additional detail is provided. None of the reviewed papers discuss their full focus group protocols, such as approach to inviting focus group participants, discussion questions.

[1] Note that this paper does not aim to present a representative sample of commonly studied NRM issues in valuation surveys.

[2] The use of 'papers' refers to the actual number of journal articles reviewed. When 'studies' is used, I am referring to different choice experiment studies – which may be described in more than one paper.

Only eight studies reported to have collaborated closely with scientists (e.g. ecologists or hydrologists; Johnston et al., 2011b; MacDonald et al., 2011) in the survey development, and suggested varying levels of communication with experts. 'Expert interviews' may be interpreted as speaking to scientists prior to drawing up a list of possible attributes, or as consulting with scientists to check whether the attributes included in the survey are plausible *after* those attributes are chosen by the CE researchers. 'Collaboration with experts' is likely to involve more interdisciplinary consultation during the survey development, where expert scientists participate at multiple stages of the attribute selection process. Collaborative survey development is likely to provide a greater evidence base for attribute selection than consultation alone. It is important to note that only three studies explicitly report what kind of expert scientists were expert feedback, and that none of the studies report the number of experts involved. It is thus completely unclear whether 'experts' involved a phone call to a couple of colleagues, or multiple rounds of workshops with scientists from different backgrounds and institutions.

Of concern is the relative large number of studies that did not report the approach to attribute selection. For 17 papers, it is unclear whether focus groups, literature, or experts were consulted to decide on what attributes best capture the environmental change being considered in the survey.

Table 2. Reported data sources used for attribute selection in reviewed papers

Data sources for attribute selection	Number of papers
Focus groups	38
Expert interviews	17
Policy documents	10
Scientific literature	10
Pilot study	9
Worked with scientists /ecologists	8
Not reported	17

Next to evidence to support the attributes *per se,* papers were examined for data to support the selection of attribute *levels*. There are remarkably few papers that explain how the researchers decided on the attribute levels that were included in the choice sets. More than 40% of the papers (27/65) did not describe anything related to attribute level selection process, leaving it up to the reader to guess what evidence was used to decide upon the attribute levels.

Only a handful of papers explain the process used to select attribute levels. Some studies base their attribute levels directly on policy objectives, such as (Brouwer et al., 2010), who directly present the European Water Framework Directive objectives of 'poor', 'moderate', 'good' and 'very good' river water in their choice sets. Only a few other papers provide insights into the attribute level selection process. (van Bueren and Bennett, 2004) selected attribute levels based on information gained from scientists and natural resource managers about the current status of each attribute, and how these attribute levels could change under different funding programs. (Brey et al., 2007) explain that their chosen 10% increase in forest area consistent with the Farmland

Foresting Program (EC Regulation 2080/92), and was based on suggestions made by 'forest experts'. (Colombo et al., 2007) used the Geographic Information System of the Andalusian Community (SINAMBA) to define the expected change in attribute levels due to project implementation. This approach, in combination with expert consultation, provided a more precise prediction of the expected changes with and without environmental management. (Kragt and Bennett, 2011) state that "the levels of the environmental attributes were identified based on the best available scientific knowledge through a combination of literature review, expert interviews and biophysical model predictions", and refer to a more detailed research report for more information on what literature and which models were used.

Notwithstanding these evidence-based examples, there are few papers that adequately describe their attributes- and attribute-level selection processes. Even when the process is explained in a paper, authors rarely cite their actual data sources: most papers just note that 'the scientific literature' or 'expert review' was used.

4. Discussion

Much of the current discussion in the literature about discrete choice experiments (and indeed at the International Choice Modelling Conferences) focus on the development of elaborate econometric models to account for preference or scale heterogeneity, or address other complex statistical questions. However, with regards to environmental valuation, the primary challenge lies not only in the econometric modelling of nonmarket impacts, but in the development of surveys that link management interventions to indicators that are both scientifically credible and relevant to people. A problem arises if new CE practitioners take currently published approaches to attribute selection as examples of 'best practices' (which may not necessarily be the case). New practitioners cannot rely on published literature if that literature does not provide sufficient guidance on attribute selection processes. While I am by no means questioning the analytical rigour of current research, it is plausible that—without adequate reporting of the survey development process—people outside the valuation discipline will question the reliability of our welfare estimates. In this section, the basis of 'evidence-based methods' is explored, and the implications for choice experiment survey development discussed.

Evidence-based methods

All good methodologies have a number of features in common (based on Banks, 2009): (i) they have a serious treatment of the 'counterfactual'; namely, what would happen if no action is taken? (ii) they involve, wherever possible, quantification of impacts; (iii) they are designed to avoid errors that could occur through self-selection or other sources of bias; and (iv) they have the ability to be tested and, ideally, replicated by third parties.

Choice experiments implicitly quantify the impacts of management changes by presenting respondents with multiple attributes that vary in levels. Given the above methodological requirements, evidence-based choice experiment surveys will further need to:

(i) Describe the impacts on the environmental resource (and attributes) in the absence of any new management. Choice sets typically include a 'status quo' option that describes this counterfactual. However, it is not always evident how the attribute levels of such a

counterfactual were chosen. It is advised that future choice experiment studies clearly report the way in which attributes and levels of the status quo option were determined.

(ii) Be developed and administered in ways that avoid bias. While survey respondents are typically drawn from random population samples, it is not clear whether the stakeholders and focus group participants are an unbiased sample of the relevant population. To avoid issues related to the objectivity of the evidence and its sources, it is important to question (and avoid) any possible bias in the data sources (be they experts, focus groups, or literature) used to support survey development (Shaxson, 2005).

(iii) Be documented in such a way that the survey development approach can be assessed by external parties. One important finding from the review in this paper is the lack of comprehensive reporting of the survey development process. Clear presentation of a systematic approach to data collection and analysis is likely to increase the (perceived) analytical rigour of choice experiment studies.

What counts as evidence?

The development of any research methodology cannot be neutral or value-free. Collecting evidence to support the development of choice experiment surveys will always involve a selection and interpretation of facts (Tacconi, 1998). These are inherently guided by the analysts' values and interest. Evidence thus is a fundamentally ambiguous term (Sutcliffe and Court, 2005). The UK Government defined evidence to include: "expert knowledge; published research; existing research; stakeholder consultations; previous policy evaluations; the Internet; outcomes from consultations; costings of policy options; output from economic and statistical modelling" (Blair and Cunningham, 1999). In non-market valuation studies, we typically use a variety of these types of evidence. Choice modellers need to ensure that the information has been collected through a systematic research process. This may include any systematic critical investigation and evaluation, theory building, data collection, analysis and codification, as well as self-reflection by analysts about the objectivity of their practice (Sutcliffe and Court, 2005).

Even though evidence can be collected through a range of sources, not all forms of evidence share equal importance, relevance or weighting (Sutcliffe and Court, 2005). Researchers and policy makers often make hierarchical judgements about evidence. For example, (Banks, 2009) questions the use of focus groups – on of the most important data sources for choice experiment surveys!

Biophysical scientists may favour 'hard evidence' (quantitative data collected through experiments or trials) over 'soft evidence' (qualitative data collected through interviews and discussion groups). It is worth noting here, that this hierarchy tends to complicate collaboration with biophysical scientists because they often find it difficult (if not impossible) to nominate attributes that are understandable to survey respondents without quantitative observations about environmental conditions and processes. Given that choice experiments are often developed in an environment of incomplete information and hypothetical futures, biophysical scientists may be reluctant to select indicators that are suitable as attributes in the survey (Kragt et al., 2011).

The different perceptions about what constitutes evidence further creates the risk that surveys developed based on tacit forms of stakeholder knowledge are not regarded as evidence based methods. We can improve the credibility of our evidence base by collecting the information through a systematic process that is open to scrutiny (Banks, 2009). Current reporting of choice experiment survey development appears to be rather opaque. For nonmarket valuation to be truly

evidence-based, we need to be transparent about our data sources, assumptions and methodologies, such that the analysis could be replicated.

Editorial policies?

An argument that may arise when examining evidence reporting in the published literature is the fact that the background information about attribute selection is often the first to be cut out of a paper when authors aim to reduce a paper's length. That means that, even though the systematic assessments have been done, they are not being reported. An approach that could circumvent this issue includes referencing technical reports written about the survey development that include more detail. Another approach would be for editorial boards to require additional validation of the survey development process in manuscripts that are submitted for publication. Finally, we may need to make more use of opportunities for posting supplementary material on journals' websites. With online publication of Supplemental Information becoming increasingly common in biophysical sciences and modelling, there is no reason why choice modellers would not publish details of the attribute selection process (such as types of experts consulted, focus group protocol or demographics, initially considered attributes) in online repositories.

5. Conclusion

This paper reviewed a number environmental valuation studies that used choice experiments to estimate nonmarket values. The review focussed on the reporting of evidence used to support the selection of attributes and attribute levels. Results show that few studies provide details on the survey development protocol, the way in which attribute level changes were predicted, or what experts and stakeholders were consulted during the survey development process. Similar to (Boyd and Krupnick, 2009), I find little information about the attribute selection and whether predictions were driven by clear economic or biophysical principles.

Transparency and rigorous reporting are essential to provide an evidence-base for choice experiment valuation estimates. To maintain the credibility of nonmarket environmental valuation research, it is vital that we report our information sources and survey development protocols. I hope that this paper will contribute to more debate, and indeed more concerted efforts, to use and report systematic protocols for evidence-based choice experiment survey development and application.

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Appendix B – Types of environmental attributes included in the reviewed choice experiments

Attribute	Number of times included	Attribute	Number of times included
Aesthetics / scenic landscapes / visual appearance (e.g. of river or farmland)	20	Endangered species / native flora and fauna populations	15
Recreational facilities / recreational access	14	Riverside vegetation	13
Fish abundance / native fish stock / fish species	10	Area under management / size of protected area	9
Wildlife habitat	8	Native vegetation protection (e.g. woodlands, heathlands)	8
Wetland area	7	Forest area	6
Cultural heritage	6	Native birds / waterbirds	6
Water quality (e.g. suitable for bathing, clarity)	6	Social impacts / impacts on jobs	5
Reliable water supply / river flows	4	Coral cover	4