Journal of Choice Modelling 22 (2017) 39–50

Contents lists available at ScienceDirect

Journal of Choice Modelling

journal homepage: www.elsevier.com/locate/jocm

Discrete choice experiment validation: A resource project case study

Sisi Que[a,b], Kwame Awuah-Offei[c], Nathan Weidner[d], Yumin Wang[e,*]

[a] Key Laboratory of Hydraulic and Waterway Engineering of the Ministry of Education, Chongqing Jiaotong University, China
[b] School of River and Ocean Engineering, Chongqing Jiaotong University, Chongqing, China
[c] Mining & Nuclear Engineering Department, Missouri University of Science & Technology, Rolla, MO, USA
[d] Department of Psychological Science, Missouri University of Science & Technology, Rolla, MO, USA
[e] School of Economics and Management, Chongqing Jiaotong University, Chongqing, China

ARTICLE INFO

Keywords:
Design validation
Discrete choice experiment design
Online surveys
Stakeholder analysis

ABSTRACT

It is necessary to validate discrete choice experiments to ensure they will lead to reasonable responses and, consequently, to valid modeling results. While some researchers have started to consider the validity of their discrete choice experiments, the approaches used for such validation are not widely reported in the literature. This paper addresses the validation process, which is crucial to the integrity of discrete choice experiments. In particular, this study addresses the selection of attributes and levels, as well as the cognitive load imposed on respondents.

This paper presents an approach for discrete choice experimental design and validation for experiments conducted via the Internet. The work covers design, evaluation, and revision to facilitate valid experiments. A focus group study and statistical analysis were used to test the clarity of instructions and difficulty of choices. We show that, in some cases, using respondents' rate of completion, a criterion that is easy to obtain in online surveys, we can confirm self-reported difficulty ratings and improve survey design. Further, we take advantage of other online tools to enhance the clarity of the instructions. These appear to improve clarity and reduce the difficulty of making a choice.

1. Introduction

In discrete choice experiments (DCEs), hypothetical alternatives are generated with a set of attributes, which are set to different levels. Discrete choice experimental design involves selecting the particular attributes and levels to use in generating alternatives for choice sets (Caussade et al., 2005; Hoyos, 2010). Other aspects of DCE design include the number of choice sets, how many attributes to include in a choice set (in situations where there are too many attributes), and the number of respondents required to ensure inferences are statistically significant (de Bekker-Grob et al., 2015). In addition, the whole DCE needs to be straightforward and to not ask more of the respondents than they are cognitively able to handle.

Recent research has highlighted the importance of rigorous DCE design (Abiiro et al., 2014; Greiner et al., 2014; Kløjgaard et al., 2012). DCE design is important because DCE results cannot be valid if the design produces flawed instruments that do not elicit respondents' true preferences. There have been many calls for more detailed reporting on the design process so that readers can verify the validity of choice models based on these experiments (Ashcroft et al., 2006; Mortimer and Segal, 2008). These calls underscore a belief that the designs of some DCEs are limited and the "black box" nature of the design process hides these

* Corresponding author at: School of Economics and Management, Chongqing Jiaotong University, China.
E-mail addresses: sq3g3@mst.edu (S. Que), kwamea@mst.edu (K. Awuah-Offei), WeidnerN@mst.edu (N. Weidner), 410298174@qq.com (Y. Wang).

http://dx.doi.org/10.1016/j.jocm.2017.01.006
Received 1 August 2015; Received in revised form 30 October 2016; Accepted 25 January 2017

limitations. Addressing limitations of DCE design will, therefore, enhance the usefulness of discrete choice experiments to acquire data for discrete choice modeling.

Details of how to conduct a DCE and the associated theoretical issues have been well covered in previous literature (Bliemer MCJ, 2006; Caussade et al., 2005; DeShazo and Fermo, 2002; Greiner et al., 2014; Hensher et al., 2005; Kløjgaard et al., 2012; Kuhfeld, 2010; Louviere, 2006; Louviere et al., 2008, 2003; Rose et al., 2008; Rose and Bliemer, 2008; Ryan and Gerard, 2003). For example, Louviere (2006) identified a number of key methodological issues that are critical for DCE design and analysis. Also, Lancsar and Louviere (Lancsar and Louviere, 2008; Louviere and Lancsar, 2009) developed a checklist and other considerations for DCE design, which offer insights into key issues, knowledge gaps and further research needs. Hensher, Rose, and Greene (2005) proposed a general discrete choice experimental design process involving eight steps (refine the problem, refine stimuli, consider experimental design issues, generate experimental design, allocate attributes to design columns, generate choice sets, randomize choice sets, and construct survey instrument), which we used in our DCE design.

One of the main considerations in designing DCEs is determining how to ensure the design is clearly understood by the respondents. The discrete choice modeling result can be invalid, if the participants are confused by the design. This consideration leads to two questions that have not been well addressed in the literature. First, how do you select attributes and levels that facilitate ease of comprehension by respondents? For example, respondents may not be familiar with the terms and technical language used to describe a specific project. Defining attributes and levels, which are useful (i.e. provides data that can be used to understand stakeholder preferences in real-world decisions relating to the proposed project) for stakeholder analysis and clear to respondents, can be difficult in such situations. Second, how many attributes can a typical respondent handle (in terms of cognitive burden) in one choice set? Designing DCEs with too many attributes can result in choice sets that place too high of a cognitive burden on respondents (Caussade et al., 2005; Hoyos, 2010). Addressing how these two questions can impact the validity of a DCE is important for understanding their value for stakeholder analyses.

In this paper, we describe several approaches that we devised to address the two questions raised above. With the aim being to facilitate more effective DCE design, our study used a case study in the resource extraction sector to: (1) examine the selection of attributes and their levels that result in reasonable cognitive load; (2) examine the clarity of instructions and difficulty of the initial design with a focus group study; and (3) revise the design based on the focus group evaluation, and subsequently re-evaluate the clarity and difficulty in the actual DCE. In addition, we discuss how to be mindful of the means of administering the survey and to take advantage of the unique opportunities presented to address the challenges posed by using online surveys to deploy DCEs..

This work provides preliminary results for effective and efficient DCE design and modeling in applications with highly technical attributes. While this work uses a case study of a resource extraction project to explore the issues surrounding DCE design and validation, the methods and procedures described here are applicable to other applications of DCE as well.

2. Previous discrete choice experimental validation work

Given that DCEs rely on responses to hypothetical choices, it is crucial to investigate the validity of such responses. Recently, some discrete choice studies have reported on how they assessed the validity of their findings (Ashcroft et al., 2006; Lloyd et al., 2007; Mark and Swait, 2004; Mortimer and Segal, 2008). For example, Mark and Swait (2004), provide a detailed report on how they selected attributes and their respective levels to evaluate a doctor's prescribing decisions. They began with a set of attributes identified through the literature as the starting point. Subsequently, they used a qualitative focus group survey in which a 'think aloud' exercise was used to generate data. Lastly, they used an analytical approach, which included a series of triangulation and validation exercises, to refine the attributes and their levels respectively. Studies such as this, that report on the DCE design (particularly the development of attributes and levels), are responses to recent calls for transparent descriptions of the process for developing attributes in DCEs so that the rigor of the process can be assessed by the broader research community (Coast et al., 2012).

This study differs from the other examples in two key areas. First, the subject of the study is highly technical and unfamiliar to most respondents who are the target of the choice experiment. So unlike Mark and Swait (2004), for example, who asked doctors about prescription choices, this study is analogous to asking patients about prescription choices. Resource projects require eliciting stakeholder preferences before beginning the project in order to understand the potential risks. However, such preferences are difficult to elicit because the respondents are often unfamiliar with the terms used to define attributes and levels. Second, this study sought to deploy the DCE via the internet. To deploy DCE's via the internet, one must carefully consider the DCE design aspects that are affected by the unique opportunities and challenges of online surveys (e.g. how to ensure the respondent is paying attention). We could not find any previous study that addressed these two issues.

Consistent with previous recommendations, Coast et al. (2012), we began with a literature review to identify the initial list of attributes (Que et al., 2015). Then we used quantitative methods and a focus group study to refine the attributes and level. Also, we used the same focus group study to evaluate the questionnaire layout and clarity of instructions and questions using self-reported difficulty and clarity rankings along with measuring the time respondents took to complete the surveys. The process we used in the design and validation is shown in Fig. 1. Our DCE validation procedure includes design test, evaluation, revision and comparison components.

3. Discrete choice experiment design

In order to discuss the DCE design validation we must first discuss the design itself. The process of refining the attributes and