The Journal of Choice Modelling 14 (2015) 48–58

Contents lists available at ScienceDirect

The Journal of Choice Modelling

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

Response time patterns in a stated choice experiment

Maria Börjesson [a,*], Mogens Fosgerau [a,b]

[a] Centre for Transport Studies, KTH Royal Institute of Technology, 100 44 Stockholm, Sweden
[b] Technical University of Denmark, Denmark

ARTICLE INFO

Article history:
Received 22 May 2014
Received in revised form
6 February 2015
Accepted 8 February 2015
Available online 5 March 2015

Keywords:
Response times
Stated choice
Data collection
Value of time
Reference-dependence

ABSTRACT

This paper studies how response times vary between unlabelled binary choice occasions in a stated choice (SC) experiment, with alternatives differing with respect to in-vehicle travel time and travel cost. The pattern of response times is interpreted as an indicator of the cognitive processes employed by the respondents when making their choices. We find clear signs of reference-dependence in response times in the form of a strong gain–loss asymmetry. Moreover, different patterns of response times for travel time and travel cost indicate that these attributes are processed in different ways by respondents. This may be of particular relevance for choice experiments in the transportation field, where the travel time attribute is central.

1. Introduction

This paper studies how response times vary between choice occasions in a stated choice (SC) experiment. A general property of brain processes is the focus on gains and losses in relation to a reference point (Palmer, 1999; Kahneman, 2003). Prospect theory (Tversky and Kahneman, 1991) holds that losses matter more than equal sized gains – this effect is called loss aversion. Moreover, Tom et al. (2007) show that different parts of the brain are involved in evaluating monetary gains and losses. Many parts of the brain show increasing activity as potential gains increase, whereas losses result in decreased activity in the same parts of the brain. Thus gains and losses are processed differently. The difference in the processing of gains and losses may lead to differences in processing times.

The stated choice experiment that we use comprised unlabelled binary choice situations differing with respect to in-vehicle travel time and travel cost. The choice situations were framed as variations around a reference time and cost of a recently made trip, resulting in choices between gains and losses in travel time and travel cost. Respondents were instructed to have in mind the specific situation of their reference trip and they were specifically instructed to take into account the time constraints they faced. Each respondent made eight choices and response times were registered for each choice except the first and the last.

This paper explores how the response time of each choice is influenced by a number of variables related to the design of the experiment using both non-parametric and parametric modelling techniques. We find that response times differ systematically depending on the size of the difference of travel times and costs from the reference trip and that gains and losses affect response times asymmetrically.

More specifically, we find that response times increase significantly with reference time and decrease with reference

* Corresponding author.
E-mail addresses: maria.borjesson@abe.kth.se (M. Börjesson), mf@transport.dtu.dk (M. Fosgerau).

http://dx.doi.org/10.1016/j.jocm.2015.02.001
1755-5345/

cost. Response times also increase with the differences in travel time between the two alternatives, primarily for the choice types involving time losses relative to the reference. The response time, on the other hand, decreases with larger difference in travel cost between the two alternatives. The effect is largest for choice types implying money losses.

Reference-dependence and gain–loss asymmetry have previously been found in models estimated on similar data where the dependent variable is the actual choice and not the response time as here (Bates and Whelan, 2001; Hultkrantz and Mortazavi, 2001; Cantillo et al., 2006; De Borger and Fosgerau, 2008; Daly et al., 2011; Hjorth and Fosgerau, 2011; Börjesson and Eliasson, 2014). The finding that also response times exhibit reference-dependence and gain–loss asymmetry gives further support for application of models allowing for reference-dependence against models that do not. Existence of reference-dependence in stated choice experiments implies that such experiments do not (directly) reveal long-term stable preferences. Standard welfare economic analysis is, however, based on reference-free long-term stable preferences.

This paper is the first to look for patterns related to reference-dependence in stated choice survey response times. Previous studies of response times in stated choice surveys were all based on the hypothesis that response times correlate with quality of responses and response error. Malhotra (2008) studies response times of questions in self-administered online stated choice experiments using the response time as a measure of the cognitive effort invested by respondents (as suggested by Klein and Yadav (1989)). Malhotra argues that studies of respondents' survey engagement are increasingly relevant given the fast increase in the use of online surveys and in particular when using web panels rewarded for survey tasks. Also Rose and Black (2006) start out from the hypothesis that response times reflect the cognitive effort of the respondents, which in turn then would affect the quality of their choices in SC experiments. They explore the link between response times and data quality by including interactions between response times and the mean and variance of the random parameter estimates, finding it significant in many cases. This paper does not analyse the discrete choice responses and hence the issue of data quality is not so relevant in the present context.

Because response times has been interpreted as a measure of data quality, a related branch of literature exploring response times has focused on response scale heterogeneity, and how to separate this from heterogeneity in random coefficients (Louviere et al., 2002, 1999; Louviere and Eagle, 2006; Swait and Bernardino, 2000). Hess and Rose (2012) show, however, that scale heterogeneity cannot be identified separately from random heterogeneity in preferences. Hess and Stathopoulos (2013) reject the idea of linking indicators of response effort (typically response time and qualitative statements) directly to the response scale since this may lead to endogeneity bias. Instead they estimate a model structure where the survey engagement is allowed to influence the response scale, and where the survey engagement is a latent variable influenced by both reported survey understanding and the response time. They also try to identify scale heterogeneity from heterogeneity in individual coefficients.

The paper is organized as follows. Section 2 describes the data. Section 3 describes a non-parametric regression technique used to generate plots and a parametric fixed effects model with response time as dependent variable. Section 4 presents the estimation results: we first apply non-parametric regression to residuals from a fixed effect regression in order to explore the properties of our data and then proceed to estimate fixed effect regression models. Section 5 discusses the results and Section 6 concludes.

2. Data

The data used in this study originate from a stated choice survey conducted in Sweden in 2008. The survey comprised car, long and short distance train and bus modes. For the car mode, a sample of respondents was drawn from the population register. They were contacted by letter and asked to participate using the internet questionnaire. Non-respondents were contacted by telephone and asked to participate either via the internet or in a call-back telephone interview. The latter option was available to avoid a potential selection bias and low response rate due to sole use of the internet. In the questionnaire, respondents were asked to list all car trips on a pre-specified day, from which one car trip was randomly selected. Selection probabilities were higher for long distance trips. The choice experiment was then framed around this selected trip.

For the public transport modes, respondents were recruited on board by collecting passengers' addresses and telephone numbers. They were asked to respond to the questionnaire via the internet or in a call-back telephone interview, and non-respondents were reminded by telephone. The public transport travellers' the choice experiment was framed around the observed trip.

In the telephone interviews, the time and costs levels of each stated choice question were read out by the interviewer. To help the respondents visualizing the alternatives, they were supplied with paper sheets on which stated choice questions with empty spaces for time and cost levels were pre-printed. The respondents were instructed to fill in the time and cost levels read out over the telephone before stating their choice. In the internet survey the alternatives were directly visible on the screen.

For car, a total response rate of 59 percent[1] was reached and for long distance and regional public transport the response

[1] This frequency refers both to respondents in the target population and those not in the target population. The target population consisted of those who made a car trip as driver the survey day. It is likely that those in the target population had a higher response frequency than 59%.