Transportation Research Part D 51 (2017) 290–303

Contents lists available at ScienceDirect

Transportation Research Part D

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

Electric vehicles adoption: Environmental enthusiast bias in discrete choice models

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ARTICLE INFO

Article history:

ABSTRACT

A Stated Choice (SC) survey, employing a Best-Worst choice design, was administered to 440 households in Perth, Australia as part of a major investigation into consumer preferences and attitudes towards electric vehicles. It was noted that 48 (10.9%) respondents chose EV as their best/most preferred option across all six choice replications. We hypothesise that for most of these respondents their choices reflected their desire to present themselves in a favourable light, with social desirability biasness manifested in non-trading behaviour. There were also 24 (5.5%) respondents who chose EV as their worst/least preferred option. We hypothesise that for these respondents lack of interest or confidence in the new technology and inertia may have driven their decisions. The paper offers demographic and psychographic profiles of non-traders facilitated by additional items being included in the experiment. While there was little difference between the demographic profiles, the attitudinal scores of the non-traders were significantly higher than for traders, which may indicate social desirability. Non-traders (Best) scored significantly higher on environmental concerns and subjective norms and were more likely to rate their intention to purchase and use an EV higher. Conversely, non-traders (Worst) had the lowest environmental concerns and subjective norms. From a choice modelling perspective, keeping non-traders in the estimation biases the taste parameters and therefore the willingness-to-pay (WTP) measures. However, when incorporating the worst alternatives into the choice models, the 'social desirability' non-traders do appear to be making decisions based on the attributes, which is consistent with the rest of the sample.

1. Introduction

The recent revival of electric vehicle (EV) technology is in its early days and in markets like Australia the number of EV's on the road is very small. With limited real market data available, stated choice (SC) experiments have emerged as a popular tool to study the factors influencing the uptake of EVs. Typically, this involves participants being presented with a set of vehicle and fuel alternatives (including the EV) and choosing their preferred alternative by trading-off key attributes such as purchase price, running costs, environmental performance, safety, range, and refuelling/recharging considerations (Kurani et al., 1996; Dagsvik et al., 2002; Hess et al., 2006; Lieven et al., 2011; Ziegler, 2012; Bühler et al., 2014). This information can in

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http://dx.doi.org/10.1016/j.trd.2017.01.008
1361-9209/

turn be used to identify the relative importance of each attribute both across the sample and by socio-demographics and market segment.

While SC experiments can yield rich information on consumer preferences, they are prone to a number of issues impacting their validity. First, because they are based on hypothetical choices, there may be a distinct gap between stated intention and actual purchase behaviour, what has been coined, *hypothetical bias* (Hensher, 2010). Second, there is a continuing tension between capturing the complexities of choice decisions without over-burdening participants (Caussade et al., 2005). Third, as hybrid choice models – models that incorporate latent variables and constructs into the choice model – become more the norm rather than the exception, SC experiments are also surveys of attitudes and perceptions. As such, they are subject to a number of response biases – including demand characteristics and social desirability (Nichols and Maner, 2008; Lusk and Norwood, 2011). Fourth, SC requires participants to *trade-off* choices based on varying the levels of attributes. If this non-trading is significant, it is: (i) important to try to assess whether this is genuine or non-genuine, (ii) if genuine, what the reasons, and (iii) assess the impact of this non-trading on the preference parameters and conclusions drawn from the choice modelling results.

In the case of EVs, which may present a highly polarising choice, levels of non-trading may be non-trivial. This could reflect the desire of respondents to present themselves as environmentally friendly to others. In this case, responses are subject to so-called 'social desirability' bias. Another possibility is that respondents are attempting to understand the purpose of the experiment and subconsciously change their behaviour (Orne, 1962). One way in which respondents alter their behaviour is to comply with their understanding of the researcher's aims. This is known as the 'good subject' effect (Nichols and Maner, 2008). However, often this issue is overlooked and/or not accounted for in the subsequent choice modelling.

With this in mind, the current paper presents analyses of non-trading behaviour observed during a SC experiment conducted as part of the Western Australian Electric Vehicle Trial (WAEVT), with a sample of 463 households. The experiment employed a Best-Worst (B-W) design. B-W is an adaptation of SC in which participants selected their most preferred (best) and least preferred (worst) option among four vehicle types, namely EV, Plug-in Hybrid, Diesel, and Petrol. This was repeated over six choice tasks. Initial analysis of the results suggested significant levels of non-trading with 48 (10.9%) of respondents always choosing the EV as their best alternative, and 24 (5.5%) always choosing EV as their worst alternative. The study presented here did not anticipate the extent of non-trading responses and as such no additional attempt was made to identify the respondents on a social desirability scale (e.g., Crowne and Marlowe, 1960). However, a number of attitudinal measurements based on the theory of planned behaviour (Azjen, 1991) and the technology acceptance model (Davis, 1989) augmented the experiment. The paper explores the responses to the attitudinal items to uncover possible reasons for the non-trading behaviour in the stated choices, before assessing the impact of the inclusion of non-traders in choice models on taste parameters and therefore willingness-to-pay (WTP).

The paper is organised as follows. The literature review briefly considers the key factors behind EV uptake before focusing on how SC experiments have been used and refined to elicit preferences with specific consideration of non-trading and bias. Following this, is a description of the conceptual approach and survey instrument before details of the fieldwork are provided. We then present a demographic and psychographic profile of non-traders, facilitated by the additional attitudinal variables to uncover plausible reasons for the non-trading. The paper investigates the impacts of this non-trading on model parameter estimates and whether the respondent's indicated Worst choice provides information on their preferences, even if they are not trading when responding to their Best alternative. Finally, conclusions are drawn as to the importance, reasons for, and impacts of non-trading on inferences drawn with regards to EV preferences.

2. Literature review

The review of the literature is organised as follows. First, we consider recent evidence on EV uptake and the key factors behind this uptake (Section 2.1). Section 2.2 outlines the rationale for and evidence obtained from SC approaches in the context of EVs (2.2.2), before specific consideration is given to the Best-Worst (B-W) approach. B-W offers certain advantages over traditional SC experiments, described in Section 2.2.3. Finally, we consider the reasons for and problems caused by non-trading behaviour in choice experiments with specific consideration of factors that could be causes of (genuine) non-trading in EV scenarios (2.3).

2.1. Electric vehicle uptake

The concept of an electric vehicle is by no means new and in fact pre-dates internal combustion engine (ICE) vehicle technology. However, following decades of relative obscurity, with only niche applications employing EV technology (e.g., forklifts, golf carts), there has been a slow but assured resurgence recently, as many of the technological/practical barriers have been lowered, particularly in parts of Europe and to a lesser extent the U.S. and Japan. Norway and the Netherlands have seen their EV market share rise to over 5% of new car sales since 2013,[1] a reflection of assertive government policy responses to growing fuel security and environmental concerns designed to make EVs more appealing both financially and pragmatically to consumers (Figenbaum et al., 2014). By contrast, Australia, where the current study was undertaken, is a relative laggard,

[1] http://www.abb-conversations.com/2014/03/electric-vehicle-market-share-in-19-countries/. Accessed 25/11/15.