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Is there a systematic relationship between random parameters and process heuristics?

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1. Introduction

Traditional discrete choice studies have typically imposed very strong behavioural assumptions on how attributes offered in choice experiments (as well as in real markets) are processed in order to reveal knowledge of preferences. The common assumption is that attributes are traded linearly in the parameters and additive in the attributes (LPAA) (often with interactions of linear attributes), ignoring other possibilities on the way specific individuals might be reaching a decision. A growing literature, referred to as process heuristics (Hess et al., 2012; Leong and Hensher, 2012; Hensher, 2014; Balbontin et al., 2017), has promoted other ways in which individuals process information, in revealing actual or preferred hypothetical choices. One heuristic that is particularly interesting is Value Learning (VL), which hypothesises that preferences are not stable and might change when an individual is faced with sequential choices (McNair et al., 2012). VL is part of the family of heterogeneous process rules in which one or more rules might be invoked by individuals in making a choice, and hence is a candidate decision-making process.

As the literature on process heuristics grows in interest within a discrete choice setting, and especially where preference heterogeneity is increasingly accommodated by a random parameter specification, the question arises of whether there is a systematic relationship between random parameters as a representation of preference heterogeneity and one or more process heuristics. That is, is there a relationship between preference heterogeneity and process heterogeneity such that process heterogeneity, as represented by specific heuristics, conditions the distribution of preferences in a sampled population in such a way that it adds a systematic (in contrast to random) explanation of preference heterogeneity?

More specifically, we recognise that the parameters defined under LPAA may be conditioned by a process strategy, such as VL. This conditioning may offer a more meaningful way of 'locating' each respondent on the preference parameter distribution, which is important for deriving willingness to pay estimates (since we draw off of the distribution of parameter estimates for the numerator and denominator, if in utility space). Moreover, it may also change the parameters' distribution (notably the standard deviation). If true, this suggests that we may have found a way of improving our understanding of preference heterogeneity, which in the absence of a recognition of process heterogeneity (similar to invoking other sources of potential systematic variation) often creates greater variance than is behaviourally likely, largely due to the nature of arbitrary analytical distributions used in specifying the shape of the random parameter distribution. The process heterogeneity

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inclusion takes on a similar appeal as that of constrained distributions for random parameters, in that it reduces the incidence of coefficients that have behaviourally implausible signs, but has the added advantage of a behaviourally appealing hypothesis. Indeed, this is analogous to the earlier work on attribute non-attendance (see Chapter 21 in Hensher et al., 2015) which tended to reduce or eliminate, under an unconstrained distribution, the incidence of a sign change for WTP estimates that have an expected single sign (e.g., positive for value of travel time savings). The objective of this paper is to investigate, in an empirical setting, the relationship between the mean and standard deviation of random parameters defined typically under LPAA and candidate sources of systematic variation in such random parameters that can be attributable to process heuristics. The model form proposed includes LPAA as the main heuristic, and it estimates the mean and standard deviation parameters as a function of the VL heuristic. This study compares the WTP distributions associated with random parameters in the presence and absence of process heuristic heterogeneity specified within the utility expression.

The following sections are organised as follows. We begin with an overview of the data setting, which is followed by a synthesis of the adopted process strategy, a discussion on the relationship with random parameters, and the model structure within which to empirically investigate the conditioning of the mean and standard deviation parameters of a random parameter distribution on VL. The model results are then presented with a focus on how VL conditions the two moments (i.e., mean and standard deviation) of the distribution. WTP estimates are also derived and discussed. We conclude with a summary of the main findings.

2. Data setting

The dataset used in this study was collected to evaluate a proposal to build a new Metro rail system for Sydney (Hensher et al., 2011). The survey included four alternatives: bus, metro, train and car. Each of them was described by access, main mode and egress attributes. The travel times for the car and bus, road-based modes, are described by three attributes: slowest trip time, quickest trip time and travel time on average which are not applicable to train-based modes. Fig. 1 shows an example of a choice set shown to the respondents. Full details of the design of the survey and the choice experiment are provided in Hensher et al. (2011).

Respondents were first asked to describe the characteristics of their most recent trip, referred to as the 'status quo' situation or the revealed preference choice (RP). The levels shown in the experiment were pivoted, based on each individual's 'status quo'. The costs associated with car travel were defined by the fuel cost, toll cost and parking cost. The costs for the public transport modes were described by the fare, together with service attributes for the number of transfers, service headway and level of crowding. The levels for crowding were described by seating and standing density.

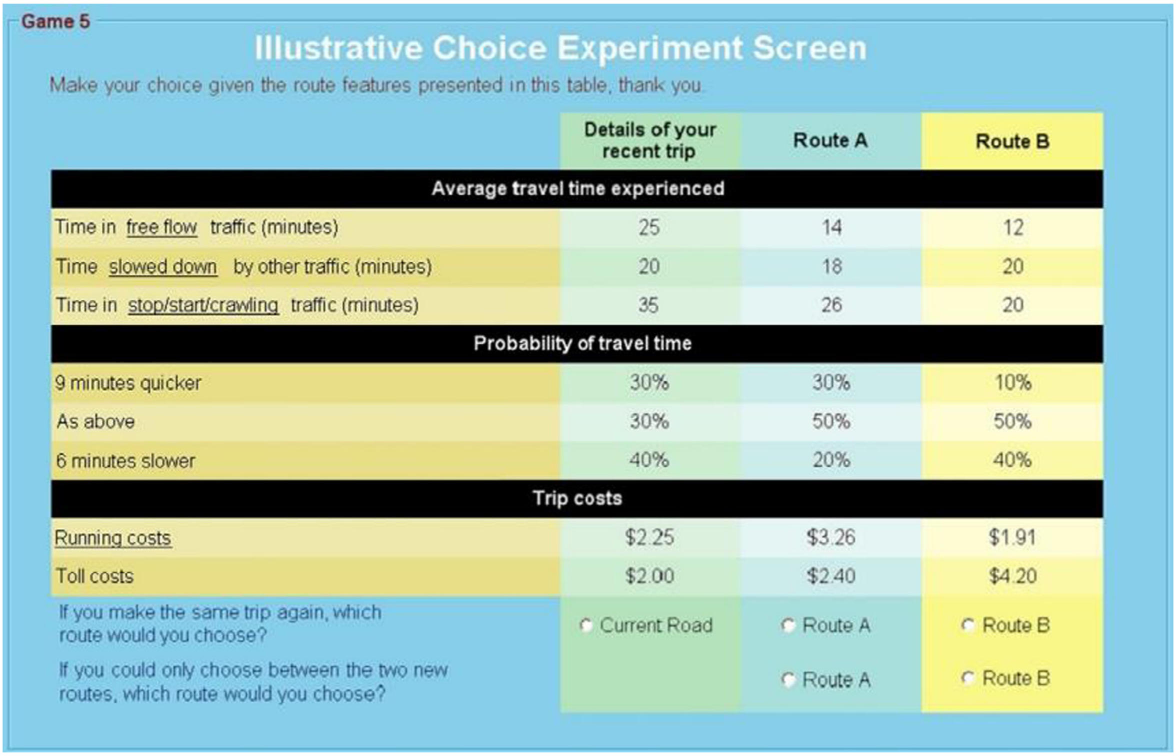

Fig. 1. Example of a choice scenario.