

Editorial: Recent Developments in Prospect Theory-based Travel Behaviour Research

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Prospect theory, a descriptive approach of modelling individual choice making which has been applied in a range of contexts, has recently attracted the interest of transport academics and professionals and is seen by many as a promising framework for travel behaviour modelling. This special issue follows a seminar on prospect theory and its applications to transport held in Delft at October 2009. It features a selection of carefully reviewed papers that were presented at the seminar. This special issue aims to expose the reader to the recent developments in this field and to some particularly relevant theoretical discussions, potential applications and critical views of prospect theory and its potential applications in the study of travel behaviour.

Keywords: Prospect theory; loss aversion; travel behaviour

Introduction

Thirty years ago Kahneman and Tversky (1979) published their seminal paper on prospect theory. Through a series of experiments, they found strong evidence of systematic deviations from normative models of risky choice making, like the Expected Utility-maximization model. This has led them to the development of a descriptive model of choice making, which captured the observed behaviour of individuals in settings that involve risky choices. For this work, and its further extension, known as cumulative prospect theory (Tversky & Kahneman, 1992), and more generally for "having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty" (The Royal Swedish Academy of Sciences, 2002), Daniel Kahneman was awarded the 2002 Nobel Memorial Prize in Economics.

In the last three decades prospect theory and its elements have been applied to explain behaviours in a range of contexts, such as finance, economics, consumer choice, and political sciences. As many of the behavioural assumptions and paradigms applied in transportation research have emerged from classical microeconomic theory, which largely assumes unbounded

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rationality³, it was only natural for transport researchers to revisit these assumptions and explore the potential of prospect theory in providing alternative explanation and better prediction of travel choices. The result is a growing body of recent studies that apply Prospect Theory (or related theoretical notions such as loss aversion) to model a variety of travel choice-dimensions such as route choices (e.g. Avineri, 2006), departure time choices (Jou et al., 2008) and choices whether or not to perform a given trip (Schwanen & Ettema, 2009).

The seminar

At October 8, 2009, TRAIL (The Netherlands Research School for Transport, Infrastructure and Logistics), together with Delft University of Technology, and in collaboration with RWS-DVS⁴ have hosted in Delft an international seminar on "**Prospect Theory and Heterogeneity in Choice Behaviour Strategies**". Seven leading academics in the area of prospect theory and its applications in transport were invited to present their recent work in the seminar. At the seminar recent advances in the study of prospect theory, mostly in describing and analysing travel choice, were presented; also presented were applications of prospect theory to operational driver behaviour models (Mahmassani) and to the design of behavioural change measures (Avineri).

Among those who attended the seminar were academic staff and research students from the Netherlands and other countries, consultants, and representatives of The Dutch Ministry of Transport, including RWS-DVS and other Dutch government agencies; although being a rather mixed audience, all shared strong academic and professional interest in the state-of-art and potential applications of prospect theory in transport contexts. The nine invited presentations were followed by a lively discussion and the event was concluded by the chair, Bert Van Wee (whose reflections on the seminar are reported in the last paper of this special issue).

This special issue of EJTIR is devoted to prospect theory and its applications to travel behaviour and includes a carefully reviewed selection of the papers presented at the seminar as well as another paper that was submitted to EJTIR and reviewed through the 'regular' process and included in this special issue due to its relevant scope).

The contributions to this special issue

This special issue brings a selection of some of the recent works in the area of transport that have applied or have been inspired by prospect theory. The main aim of this special issue is to expose the reader to the recent developments in this field and to stimulate discussions of a critical nature on theoretical aspects and potential applications of prospect theory in transport contexts.

As mentioned above, reasonably-large amount of emerging evidence of prospect theory in a range of transport-related behaviours has been reported in the literature. More and more academics and professionals are becoming interested in further research and application of prospect theory and its elements in transport contexts. These might be seen as indications that the research community has already reached a certain stage in exploring this field. After a recent surge in empirical papers on prospect theory (mainly in the modelling of travel choice) and a 'critical mass' of technical work it seems to be the natural time for some reflection, (critical) review and conceptualization of prospect theory and its elements – which is largely offered by

³ See Bates et al. (2001), Denant-Boèmont & Petiot (2003), Sun et al. (2005), Ettema et al. (2005), de Palma & Picard (2005), Batley (2007) and Chorus et al. (2009) for a sample of Expected Utility-maximization based travel choice studies published in the last decade.

⁴ RWS-DVS aims to supply knowledge to the Ministry of Transport, to help enable smooth mobility in The Netherlands.

this special issue. Therefore most of the papers that are featured in this special issue are of conceptual or theoretical, rather than empirical nature.

In addition to their obvious relevance to researchers and modellers, some of the empirical findings and theoretical concepts presented in the papers of this special issue might be relevant to policy context, such as reducing biases in the design of stated preferences surveys, pricing of user costs for transport infrastructure, and in incorporating some features of prospect theory in the design of behavioural change measures.

In the paper "**Prospect Theory and Choice Behaviour Strategies: Review and Synthesis of Concepts from Social and Transport sciences**", Evert Jan van de Kaa, through a process of systematic comparison and synthesis, provides a review of utility theory and prospect theory assumptions and empirical findings about individual choice behaviour. Van de Kaa introduces an extension of prospect theory which includes assumptions about the valuation of attributes and the employment of decision rules to describe most of the reviewed empirical findings to a larger extent than utility theory. Much of the recent works in this field tends to focus on the technical aspects of prospect theory, and lacks strong theoretical background, therefore this paper could make an excellent starting point for those who are on their early stage of research methodology and design, as it addresses many of the gaps in theoretical understanding of prospect theory and its application to (travel) choice making.

One of the most notable concepts related to prospect theory and other descriptive models of choice and decision making is the concept of reference-dependent preferences. How an individual assesses the outcome of a choice is often determined in large part by its contrast with a 'reference point', as by intrinsic taste for the outcome itself (Kahneman & Tversky, 1979; Koszegi and Rabin, 2006). Reference points have been much discussed in the context of loss aversion: It was generally observed that in the evaluation of choices people tend to feel and respond differently to outcomes that are perceived as gains or losses, against a reference point (Kahneman & Tversky, 1979; Thaler et al., 1997). This observed behaviour, called loss aversion, refers to the fact that people tend to be more sensitive to decreases in their wealth than to increases. Recent studies provide evidence that travellers exhibit aversion to loss and have a strong tendency to avoid choices associated with losses (See for example Avineri & Prashker, 2004; Senbil & Kitamura, 2004; and a review by van de Kaa, 2008).

Individual preferences of alternative choices are commonly captured by the individual's willingness to pay (WTP) or her willingness to accept (WTA) of the choice. However, it has been observed that WTP results are systematically found greater than WTA - a findings that can be explained by loss aversion, as further explored by John M. Rose and Lorenzo Masiero in their paper "**A comparison of the impacts of aspects of prospect theory on WTP/WTA estimated in preference and WTP/WTA space**", who examine, through an empirical study and econometric analysis, the effect of reference dependence, loss aversion and diminishing sensitivities - all of them basic features of prospect theory - on WTP/WTA discrepancies.

Evert Jan van de Kaa's paper, "**Sign-dependent value of time in stated preference: Judgment bias or exposure of genuine preference?**", is also concerned with the effects of reference-dependent framing and loss-averse valuation of attributes on the evaluation of travel time saving. Through a systematic review of the evidence, including national travel surveys from the Netherlands and the UK, he shows that prospect theory can shed more light on some puzzling outcomes from these surveys, such as differences in monetary valuation between travel time gains and losses.

As outcomes from empirical studies on prospect theory are emerging, in both general and transport contexts, its shortcoming and limitations are also increasingly being identified. Most features of prospect theory, such as reference dependency and gain/loss asymmetry, have been exhibited in a range of behaviours tested mainly in static ('one-shot') settings, with limited

feedback or incentives. However, some recent studies have questioned this paradigm, mainly in dynamic settings (repeated choice) that feature feedback (see for example Ert & Erev, 2008; Avineri & Prashker, 2003). In his paper "**On the (ir)relevance of Prospect Theory in modelling uncertainty in travel decisions**" Harry Timmermans provides a critical review of theoretical and applied aspects of prospect theory in transport research. He revisits the original purpose and context of prospect theory and through a review of transport research literature he reviews and further develops arguments about the shortcomings of prospect theory in describing behaviour in travel contexts. This paper might be considered an essential reference for those who have strong interests in exploring prospect theory in the applied context of travel behaviour – as it challenges the researcher and the modeller with some intellectual and practical aspects that should be considered in a rather early stage of the research.

This special issue ends with "**Prospect Theory and travel behaviour :A personal reflection based on a seminar**" by Bert Van Wee, who chaired the seminar, and was invited by the editors of this special issue to provide his reflection on prospect theory. His paper is largely based on the discussions held during the seminar. He concludes that prospect theory, specifically the concepts of reference dependency and loss aversion, contributes to our understanding of travel behaviour, and to the valuations of several transport policy options.

Additional contributions to the seminar (not included in this special issue)

In addition to the papers described above, five other papers were also presented at the seminar. These works, although they were relevant to the scope of the special issue, and could potentially provide a contribution to the academic state-of-the-art regarding prospect theory, were not included in this special issue for different reasons (some will be published elsewhere in the near future).

Among the invited speakers who presented works at the seminar which are not published in this special issue were John Polak (Imperial College, London, UK) who presented his study on reference dependent choice, and empirical evidence based on two case studies; Erel Avineri (UWE, Bristol, UK) who presented how prospect theory and hedonic framing can be applied to the design of information context, and incorporated in behavioural change measures; Caspar Chorus (TU-Delft, the Netherlands) who discussed the role of loss aversion and regret in travel choice making and demonstrated it using a case study; Tim Schwanen (Oxford, UK) who tested, using data about responses to travel time variability, how to specify cumulative prospect theory's value and weighting function; and Hani S. Mahmassani (Northwestern, US), whose work on risk perception in highway driving incorporated insights from prospect theory in operational driver behaviour models.

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