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for model performance. The APCA (also called the success rate) is defined as the mean of the fitted probabilities for the observed class. For example, if $p=(0.6,0.4)$ and the observed class is 2, then this observation contributes to the success rate by 0.4. The APCA is also used for selecting an optimal split to construct learning and testing datasets. The APCA is defined as follows:

$$APCA = p = (p_1 + p_2) / N_T$$

where $p_k = \sum_{i=1}^{N_T} P(\hat{y}_{ik} = k | X_i, y_{ik} = k)$; y_{ik} is the actual categorical outcome and p_k is the sum of the probabilities of correct assessment of class k , and the subscript T denotes restriction to the test dataset T. **Takeaway:** Several machine learning approaches have been relatively successfully applied to predict travel mode. In particular, neural nets have shown good performance due its capability to mimic any non-linear function. Of course, no machine learning method is the best overall. It depends for instance, on data complexity, size of dataset and the case study. To the best of our knowledge, very few papers give insights on theoretical proof of model performance. The common practice is a quantitative comparison among several methods. The issue of deciding on the best machine learning methods is very complex and needs further investigations.

Keywords: *mode choice prediction, machine learning, artificial neural networks, data split, validation.*

Paper Title:	Drivers' perception and learning in route choice
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Abstract:	Transportation researchers increasingly recognize that some of the common assumptions on travel choice behaviour used in transport modelling, and derived from standard economics, perhaps insufficiently reflect the true choice behaviour of travellers. More realistic seems the perspective on choice decisions known as bounded rationality or satisficing behaviour as first introduced by Herbert Simon in the 1950's. This perspective acknowledges that people do not behave perfectly rational due to constrained cognitive abilities and imperfect knowledge, leading to prejudiced reasoning. For example, they make choices that are satisfactory rather than optimal or only adapt their choice if the associated benefit exceeds a certain threshold. Interestingly, multiple studies from the field of cognitive psychology, social sciences and behavioural economics suggest that these 'irrational' behaviours are neither random nor

senseless; they are systematic, consistent, repetitive, and therefore predictable. Although since a few decennia more and more transportation modellers have been incorporating boundedly rational mechanisms into their models, not much empirical research has been undertaken to fully understand and prove these mechanisms in a travel choice behaviour context. Looking at route choice, there is evidence that drivers do not necessarily choose the shortest time route and that their perceptions are biased. Even in cases with non-trivial travel time differences between routes in the range of 2-5 minutes or 8-20% of the average travel time, such as shown in several GPS surveys that are reported in literature. Many other attributes were found to be important in route choice, including directness, road hierarchy, number of intersections and turns, reliability of travel time, distance and maximum speed, information and weather, and the moment of congestion. However, due to the formation of habit, as a result of making the same choice over and over again, drivers become less attentive to changes in the route attributes and continue using the specific route even though it may not be the best one anymore. Considering errors in perception it is interesting to learn more about these perceptions, what drives them and how they evolve. The main motivation of this research is that the error in drivers' perception of route alternatives is presumably a good indicator to quantify boundedly rational mechanisms and satisficing behaviour in particular. In this research we combine interviews among drivers and measurements of actual travel times to study the empirical relationship between perception of travel time, actual travel time and route choice. The survey was held in the medium-sized city Enschede in the Netherlands, which has about 160.000 inhabitants. Respondents for the interviews were randomly recruited at parking areas on the university campus on two different days (Nday1=232, Nday2=141). The interview consisted of 2 route choice situations with the university as the origin (located in the north-west of Enschede), a business park in the south-east of Enschede as the destination. The choice set consisted of 2 orbital and 2 centre routes. On each of the two days the choice sets were different (see Figure 1). To study the effect of road hierarchy, respondents on day 1 had to choose between orbital routes in situation 1 and between centre routes in situation 2. On the 2nd day the choice was between an orbital and a centre route in both route choice situations. For each of the routes the respondents had to indicate their level of familiarity (very familiar, moderately familiar, used 1-2 times, and used never). Note that also people with absolutely no knowledge of the proposed routes (e.g. they live elsewhere in the region or were just visiting the university) were asked to complete the whole interview as good as they could. The reason for this design was to evaluate the credibility of perception interviews in general and to determine the evolution of perception through learning. For the next question the respondents had to choose one of the two routes assuming that they had to make a trip during the morning peak period to arrive at a business meeting. Besides they had to estimate the expected travel time for both routes. To elicit the switching propensity of the respondents they were also asked to indicate the strength of their preference (high, medium, low, none) and whether they would choose the same route outside the peak hour. Finally, the respondents were asked to make a top-3 out of 7 route choice factors which best reflected their deliberations while making a choice. Actual travel times were derived from a vehicle re-identification system that uses vehicle

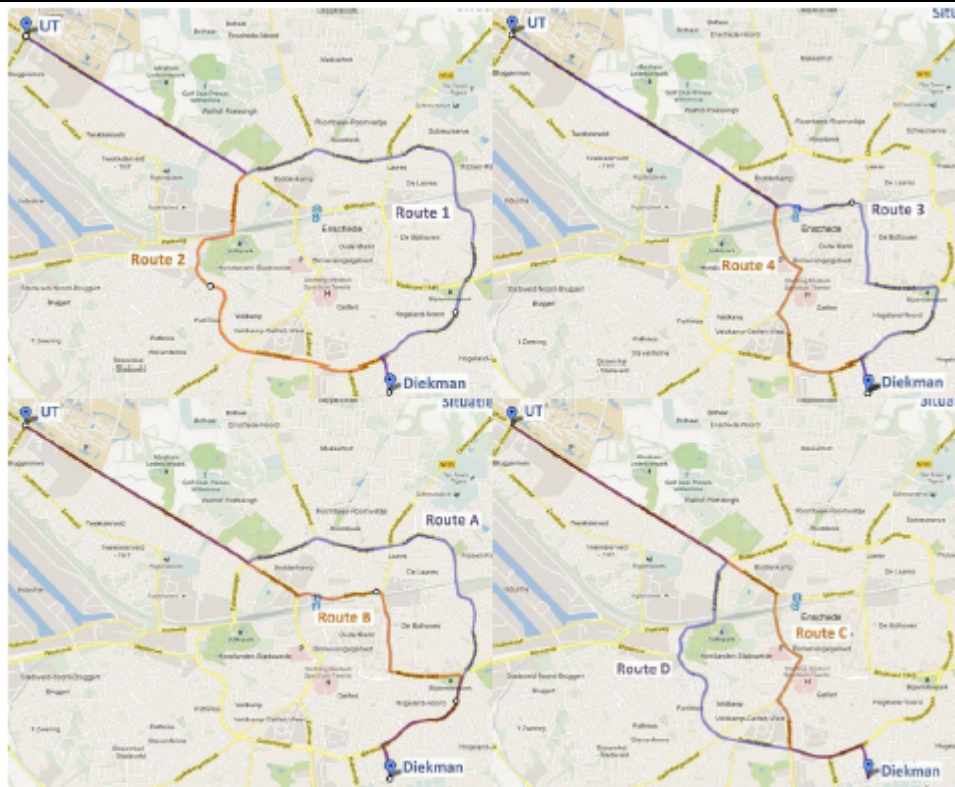


Figure 1: choice situation of day 1 (above) and day 2 (below)

travel time perceptions of chosen routes were fairly accurate. However, non-chosen routes were perceived as being far worse than they actually are, confirming the choice supportive bias. Also non-chosen routes were perceived as being worse than chosen routes, which shows that respondents intentionally selected the route which they perceived as being shortest. Unfortunately, no statistically significant findings could be derived on the effect of road hierarchy. The data does not confirm an a priori preference for orbital routes over centre routes as was suggested by earlier research of the authors. However, the results did indicate that the respondents preferred the route that approached the destination in the most direct manner. This is in line with literature. In terms of the process of learning, the results reveal some interesting findings. On average, there is a positive linear relation between familiarity and perceived

profiles from magnetic loop detectors at traffic light controlled intersections. This system provided average travel times and the variation in travel time from intersection to intersection for periods of 5 minutes.

The study results provide evidence in favour of the choice-supportive bias, which is a well-known phenomenon in cognitive science. That is, people are more likely to attach positive feeling to options they choose and attribute negative features to options they reject. In terms of route choice this suggests that driver have different perceptions of routes they frequently use than routes they hardly use. Therefore a distinction was made between perceived travel times of chosen and non-chosen routes. Results show that on average, travel times were overestimated by roughly 3 minutes, but there is no statistical evidence that supports that chosen routes were perceived as being better than they actually are. In fact,

travel times, with highest travel time estimates belonging to very familiar drivers and lowest travel time estimated belonging to the least familiar drivers. Since travel times were generally overestimated this also suggests that the travel time estimates of the least familiar drivers were among the most accurate. Considering the process of learning these findings seem to imply that drivers initially are fairly positive about new routes, but that over time actual usage of these routes makes them increasingly pessimistic, or perhaps realistic. This might be explained due to bad experiences that inevitably occur and make drivers cautious not to rely on average travel times alone but also on the travel time reliability. Similar notions have been reported in literature before, mostly related to prospect theory and the asymmetry of losses versus gains in particular. Finally, the respondents indicated that travel time is by far the most important route choice factors for them, closely followed by traffic density. Of lesser importance were travel time reliability, distance and average speed. Directness and road type were hardly considered relevant. To derive vast conclusions and quantitative values for perception errors from these findings and to make inferences on satisficing behavior thresholds is not trivial and at best should be regarded indicative rather than conclusive. The results presented here differed per choice situation and respondent characteristics, therefore confirm the situation-specific nature of boundedly rational and satisficing mechanisms. However, looking at the averages some trends could be derived that can serve as a reference and outline the magnitude. In day-to-day dynamics, results from studies like these can only partially predict drivers' ability to detect changes in travel time and the propensity of resulting route switching. It will require more empirical research to prove whether or not it is feasible to derive also probabilistic formulations from observed differences in perceived travel times. In this way this research may contribute to the improvement of route switching and learning models.

Keywords: ----

Paper Title: Incorporating Scenario Uncertainty in Stated Choice Experiments: A Mixed-Logit Panel Effects Model of the Latent Choice of Electric Cars with Special Reference to Mixture of Social Influences

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Abstract: **Problem and research questions:** The uncertainty in scenarios (market conditions) is not included in commonly used choice models in travel behavior research. In this project, we suggest an approach to include uncertainty in market scenarios in the design of complex stated choice experiments. The domain of application concerns the choice of electric car. Scenario uncertainty is related to the share of people in one's social network already in possession of an electric car, differentiating between relatives, friends, co-workers and peers. Main underlying research questions are: (i) How can we systematically include scenario uncertainty in stated choice experiments? (ii) How can we specify the specific influence of social networks on the choice of electric cars? (iii) What is the relative effect of social