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Speed reductions and judgments of travel time loss: Biases and debiasing

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ABSTRACT

Priority decisions concerning maintenance or reconstruction of roads are made with the aim of road improvements with as little traffic disturbance and time loss as possible. However, it cannot be avoided that speed will be reduced and travel time increased during the time of construction. The present study shows how intuitive judgments of travel time losses are biased in a way similar to the times saving bias (Svenson, 2008), but not perfectly corresponding to that bias. This means that when speed is decreased from a slow speed <50 km/h, the time loss is underestimated and when speed is decreased from a high speed >80 km/h it is overestimated. Also, drivers, politicians and policy makers who do not make exact calculations are likely victims of the time loss bias. The time loss bias was weakened but not eliminated by a debiasing instruction including mathematical computations of travel times. When driving speed restrictions are implemented, in particular on fast motorways, it is necessary to consider and counteract the time loss bias and inform the public. This can be done, for example, in communications about travel time facts, by information in driver training and by mounting temporary road signs informing about the average travel time prolongation due to a road work.

1. Introduction

Priority decisions concerning maintenance or reconstruction of roads are made with the aim of improving a road with a boundary condition that the traffic should be disturbed as little as possible during the reconstruction, even if the speed limits have to be changed during the time of maintenance. Most decisions concerning which road stretches will be maintained and reconstructed are backed up by engineering and economic analyses. However, drivers and the public will use intuitive judgments to evaluate the decisions and their consequences in terms of travel time increases. Unfortunately, intuitive judgments are often biased (Tversky & Kahneman, 1974) and this applies also to speed and travel time judgments (Svenson, 2008).

The present study investigates how information about how a lower mean speed during reconstruction of a road affects intuitive time loss during a period of reconstruction and how possibly biased judgments about time loss after speed change can be ameliorated. To elaborate, a questionnaire technique will be used to describe two alternative equally long road reconstructions, A and B and the mean speed on each of them before any construction work has started, e.g., A = 55 km/h and B = 110 km/h. We then give the expected lower mean speed during reconstruction for one of the alternatives, e.g., A = 35 km/h and ask participants to estimate the lower speed of B that would give the same time loss as alternative A. Hence,

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the estimated lower speed of B gives the same perceived time loss and accessibility for both construction alternatives (other factors constant). These estimates make will be used to evaluate how differences in speeds can affect conceptions of time-savings.

The present research is about time loss and it is already known that judgments of time-savings after speed increases are biased (Peer, 2010a; Peer & Gamliel, 2013; Svenson, 1970, 1971, 2008, 2009). People overestimate the time saved when speed is increased from a high speed and underestimate the time saved when speed is increased from a low speed. The biased judgments of time-savings are the result of the *time-saving bias* (Svenson, 1970, 2008). Extrapolating from the finding that people overestimate time saved when increasing speed from a high speed, it is possible to hypothesize that when speed is decreased from a high speed, the time lost will be overestimated. Correspondingly, the time lost when decreasing from a slow speed will be underestimated. Fuller et al. (2009) performed the only study specially focused on time loss that the present authors are aware of and their results are in accordance with these hypotheses. Judgments of mean speed over a given distance showed that the effect on actual mean speed of a temporary slowdown of speed on part of a trip was underestimated (Svenson & Salo, 2010) lends further support to the hypotheses.

Perceived time-savings or loss from driving faster or slower may provide motivation for exceeding a speed limit in order to save time (Navon & Kasten, 2015). It is known that the time-saving bias can influence and predict driver's speed choices (Eriksson, Svenson, & Eriksson, 2013; Peer, 2010a, 2011) and that speed is an important factor in traffic accidents (Aarts & Van Schagen, 2006; Nilsson, 2004; World Health Organization, 2015). Correspondingly, a time loss bias when speed is decreased can influence route choice and lead to incorrect choices for a travel between two locations or an effect on traffic flow that was not anticipated. It is not self evident that a time loss is perceived and judged in exactly the same way as a time-saving, for example, prospect theory predicts that losses loom larger than gains (Kahneman & Tversky, 1979). We want to explore the hypothesized time loss bias, search for the heuristic function that may produce the bias and explore a possibility to reduce the bias. The time-saving bias will first be presented and then a possible time loss bias.

1.1. The time-saving bias

Svenson (1970) asked drivers to estimate how much time they would save if they increased the mean speed over a trip from, for example, 30–50 km/h. He found that intuitive judgments of time-savings were biased and that they deviated in a regular way from correct time-savings. There were two main reasons for the deviations. The first was related to the distance factor. The second reason was that participants used a simplifying and incorrect rule when they estimated the component related to the speeds. The correct formula for computing time gains following a speed increase is:

$$time - saving = cD(1/V_1 - 1/V_2), \tag{1}$$

or expressed differently

$$time - saving = cD(V_2 - V_1)/(V_1 * V_2) \tag{2}$$

The symbol c is a constant and depends on the units chosen, D is distance driven and V_1 the original average speed and V_2 the higher average speed.

When judging time-savings, most people seemed to use the proportion of speed increase and to adjust it with the distance driven. The intuitive judgments were described by the following equation:

$$time - saving = cD^{\beta}(V_2 - V_1)/V_2 \tag{3}$$

In Eq. (3), D denotes distance, V_1 the original average speed, V_2 the higher average speed and c and β are constants. The distance component, which will not be considered further here, made the time-saving judgments successively shorter relative to real time-saving when the distance was increased.

The velocity component can be interpreted to mean that drivers estimate the difference in speeds as a ratio or a percentage of the faster speed. The differences between Eqs. (2) and (3) describe the bias of intuitive judgments in relation to actual time-savings.

In the following of this paper, we will only treat problems in which the distance driven is constant. The time-saving bias is caused by the application of a heuristic described by Eq. (3), and is a simplifying rule to solve a problem (Simon, 1955; Tversky & Kahneman, 1974). In general, the use of a heuristic means that less mental effort is needed to solve a problem, but also that less accuracy is achieved compared with the correct solution in Eq. (2) (Payne, Bettman, & Johnson, 1993). With driving distance constant for high and low speeds, one of the factors in the denominator of Eq. (2), V_1, is ignored by the judgment heuristic.

Empirical studies have revealed that also other cognitive simplifications of Eq. (2) than Eq. (3) could describe the heuristic giving the time-saving bias (Svenson, 1970). If V_2 is replaced by V_1 in the denominator of Eq. (3) this means that the speed increase is treated as a proportion of the lower speed, V_1, which was found in analyses by Peer and Gamliel (2012, 2013) and in some analyses by Svenson (1970). In choices between time-saving alternatives some decision makers seem to ignore the denominator completely and base their decisions on a function of the difference between the speeds when asked to save as much time as possible.