

Justifying toll payment with biased travel time estimates: Behavioral findings and route choice modeling

Einat Tenenboim^{a*}, Nira Munichor^b, Yoram Shiftan^a

Road pricing is enjoying widespread support as a tool for managing congestion, yet its effects on travelers' experience, perceptions and travel-related decisions are not sufficiently known. Research shows that travelers respond differently to toll versus non-toll routes. For example, Tenenboim & Shiftan (2016) identified toll-route choice as one of the factors accountable for the discrepancy between subjective and objective travel times: Drivers estimated toll trips as shorter than non-toll trips, even when objective times were controlled for. The present study was aimed at examining the hypothesis that toll paying leads drivers to form false expectations of travel time savings, and identifying the underlying psychological mechanisms. This study was also aimed at investigating the contribution of subjective time to demand modeling, given prior evidence highlighting its potential in improving estimation accuracy. In a field experiment, experimenters approached people departing a local shopping mall to its parking lot, asking them for their destination, and whether they intended to drive via the Carmel tunnels, a local toll-road located in proximity to the mall. We recruited only drivers for whom the toll-road was a feasible alternative. We paid participants 10 NIS (about 2.5 Euros), a payment which we randomly presented in one of two ways: Participants in the toll-paid group were told this payment was to cover the cost of the toll, whereas participants in the control group were told it was simply a participation fee. In other words, all participants received the same incentive, yet only half of them were led to believe it offered them a free ride via the tunnels. As a result, some participants in the toll-paid group did not initially intend to drive via the tunnels but they had done so following the experimenter's request. Nevertheless, participants' initial intention to drive or not via the tunnels was registered. Participants then indicated their chosen route, alternative route, and estimated travel times for both. Participants' intentions to drive via the toll-road and the payment-frame manipulation formed a 2*2 experimental design, enabling us to examine several possible sources for the toll effect on estimated travel time (justification bias, price-quality relationship, and time saving expectations). Data of various complementary variables were also gathered (e.g., destination familiarity, mall familiarity, number of passengers, time urgency, frequency of toll-road driving, frequency of navigation app usage). Finally, we installed a route tracker application on participants' smartphones, which provided us with their actual routes, speed data and objective times for comparison with their subjective estimates. Data from a total of 386 drivers was collected. An initial examination of the data revealed substantial variance in actual travel times, as trips varied from 5.7 min to 100.8 min (M=27 min, SD=17.1 min), leading us to separately consider short and long trips in some of the analyses. Estimated times ranged from 4 min to 150 min (for chosen routes) and 180 min (for alternative routes). Mean deviation of

estimated time from actual time was -7.1%, indicating a general tendency to under-estimate travel times. On average, the tunnels saved drivers an actual travel time of 5 min. However, while those who did not initially intend to drive via the tunnels had reasonable time savings expectations, those who did intend substantially exaggerated in their estimation, reporting estimated time savings of 13 min on average. This finding supports a justification bias account, as those who intended to drive via the tunnels apparently tried to justify their choice (not wanting to feel as if they wasted their money). Comparing the two toll-paid groups, we found that the group who freely decided to drive via the tunnels exaggerated their time savings more than the group who drove via the tunnels following the experimenter's request. This finding offers further support for the justification bias account. Interestingly, we also found evidence for the *zero price effect* (Shampanier et al., 2007), according to which drivers in the toll-paid group significantly exaggerated their toll time savings compared to the control group. Apparently, driving via the tunnels for free was experienced as a 'win', consequently leading them to overemphasize its benefits. Another interesting finding concerned the time ratio (estimated/actual time) for home destinations, which was found to be significantly lower (.90) than the time ratio for other destinations (.97), suggesting that drivers underestimated travel time when returning home but not when driving elsewhere, a finding that is consistent with the *return trip effect* (Ven et al., 2011). Linear and non-linear regression models were estimated for the prediction of drivers' time estimates based on actual times and various related variables. Regression models were also estimated for predicting drivers' estimated travel time savings. These models highlighted the role of drivers' initial intention to drive or not via the toll-road and the payment-frame manipulation, alongside several other variables. Furthermore, drivers' (toll) route choice was modeled using multinomial logit models based on estimated and actual travel times. As expected, the estimated time model yielded a better fit for the data compared to the actual time model. In an integrated model incorporating both estimated and actual times, we found a significant contribution for estimated time, yet a negligible contribution for actual time. Examining the contribution of other factors to drivers' route choice, we identified two main components: high familiarity with the tunnels and/or the shopping mall, and a high degree of pressure for time. As a whole, this study contributes to the understanding of the key factors affecting toll-route choice, an understanding that is essential for effective implementation of road pricing and better design of toll-related policies. Moreover, this study demonstrates the insights that can be gained from incorporating psychological constructs within travel behavior research.

References

Shampanier, K., Mazar, N., & Ariely, D., 2007. Zero as a special price: The true value of free products. *Marketing Science* 26(6), pp. 742–757.

Tenenboim, E., Shiftan, Y., 2016. Accuracy and bias of subjective travel time estimates. *Transportation*, in press.

Ven, N., Rijswijk, L., Roy, M., 2011. The return trip effect: why the return trip often seems to take less time. *Psychological Bulletin Review*, 18(5), 827–832.

^a Faculty of Civil and Environmental Engineering, Technion, Israel

^b School of Business Administration, Bar-Ilan University, Israel

* Presenting author. Contact e-mail: einatrei@technion.ac.il

Keywords

Travel time estimates, Toll road, Travel behavior modeling