Increasing—and decreasing—fuel economy using feedback: a behavioral theory inspired ecodriving experiment

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ABSTRACT

This paper presents results of a year-long study of driver feedback, attitudes, and adoption of ecodriving behaviors. Broadly defined, ecodriving includes behaviors a vehicle driver can use to minimize energy use once a trip has begun. In general, *ecodriving behaviors are moderating acceleration, top speed, and braking*. Ecodriving has long been recognized as a potential source of reductions in transportation energy use, though estimates range widely from less than 5% to over 20% depending on context. Although many studies have tested unique feedback designs, little research has been has been conducted into the cognitive precursors to driver behavior change that may underlie the adoption or rejection of ecodriving practices, and therefore underlie the effectiveness of feedback design. This study examines both precursor cognitive factors and driver behavior changes with the *introduction of energy feedback using a framework that hypothesizes attitudes, social norms, perceived control, and goals influence behavior and behavior change*. The study finds that the introduction of *feedback can modify those cognitive precursors and result in behavior change*. Using a latent group statistical approach, the study finds three groups respond differently to energy feedback. In the presence of energy feedback, *Savers achieve large increases* in fuel economy, *Speedsters fuel economy is relatively unchanged*, but *Techies decrease* their fuel economy. Statistically significant relationships are found between cognitive change and behavior change – supporting the theoretical framework.

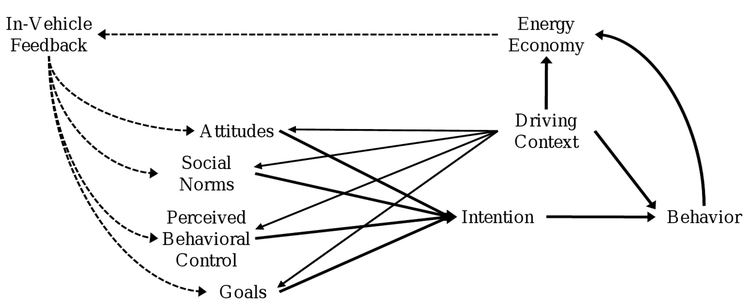


FIGURE 1: Theoretical Cognitive Framework Showing Feedback. Solid lines show the relationships hypothesized by TPB and the EMGDB adapted to the driving context; dashed lines show the additional effect of feedback as hypothesized in this experiment.

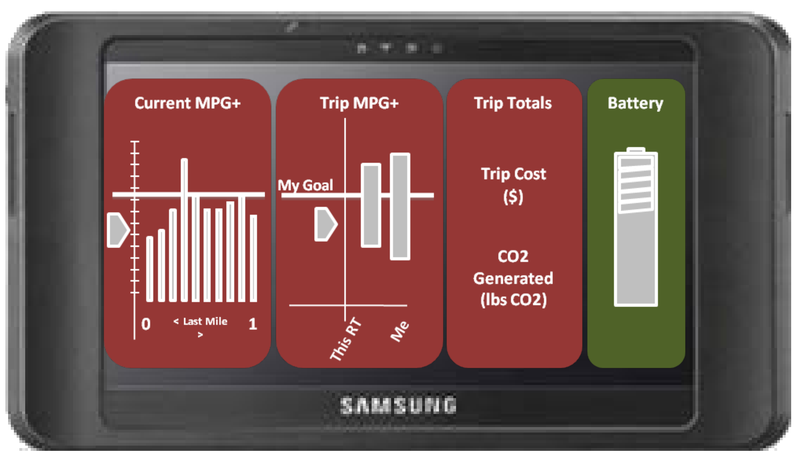


FIGURE 2: Energy feedback device schematic.

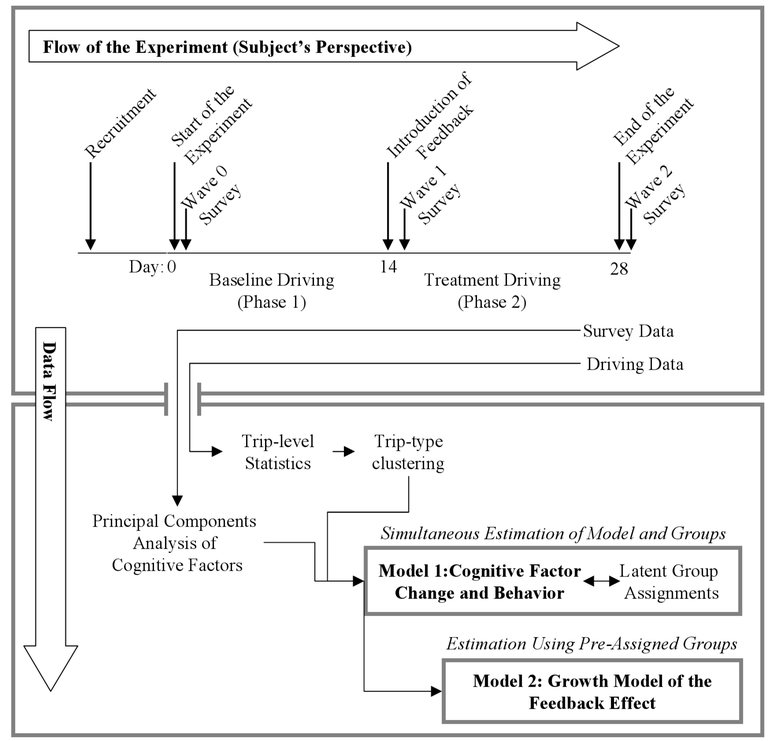
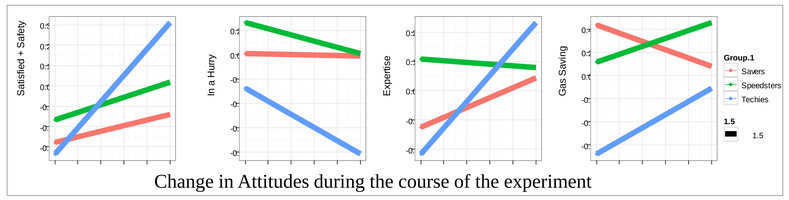
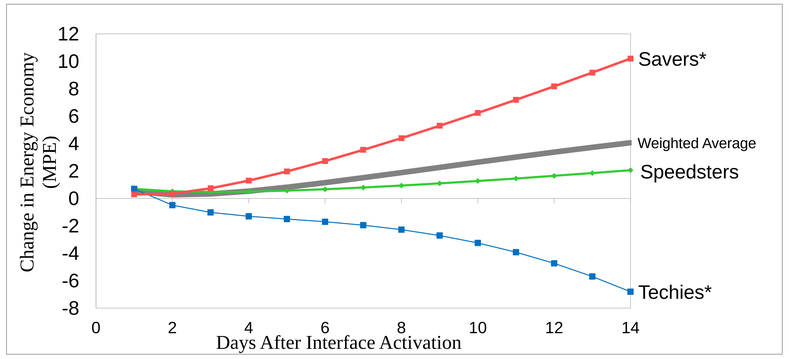


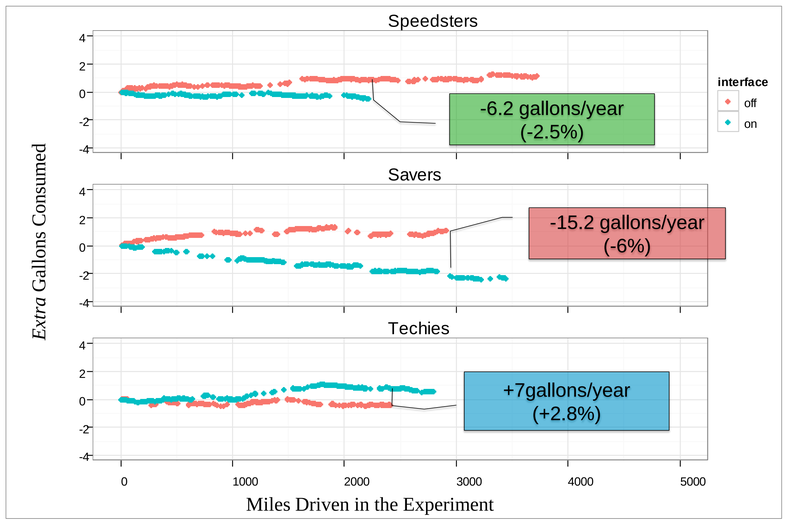
FIGURE 3: Flow of the Experiment and Data Analysis Process. The timeline is approximate and varied according to participant availability. Also, questionnaires not used in the analysis are omitted.

FIGURE 4: Principle component analysis and interpretations from the attitudinal survey.



Change in Attitudes during the course of the experiment





CONCLUSIONS

- There are multiple types of drivers who can be differentiated by their cognitive factors and who have substantially different responses to the same feedback information and medium;
- The majority of participants increased their MPGe for the two-week duration of their exposure to the feedback compared to their two-week period without feedback and fuel economy increased on average for the participants as a whole;
- But as suggested by the first result, there are identifiable groups who increase or decrease their achieved on-road energy economy in response to feedback;
- Cognitive factors are shown to change based on exposure to the feedback – an indication that driver attitudes, perceived control, goals, and even reported personality indicators are flexible constructs that are influenced by feedback; and
- Reductions in satisfaction and perceptions of time pressure and increases in both an interest in saving gas and money or increased vehicle expertise are all associated with increased fuel economy facilitated by energy feedback device.

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