Driving the Scoreboard: Motivating Eco-Driving Through In-Car Gaming

Ohad Inbar
Industrial Eng. & Management
Ben-Gurion University
Beer-Sheva 84105, Israel
inbaro@bgu.ac.il

Noam Tractinsky
Information Systems Engineering
Ben-Gurion University
Beer-Sheva 84105, Israel
noamt@bgu.ac.il

Omer Tsimhoni
ATCI
General Motors
Herzlia, Israel
omer.tsimhoni@gm.com

Thomas Seder
ATC
General Motors
Detroit, USA
thomas.seder@gm.com

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Abstract
Eco-driving is one way in which car emissions can be reduced. Gamification, as a type of persuasive technology, has the potential to encourage eco-driving by making it competitive and rewarding. We suggest a research plan to construct a preliminary theoretical foundation to map the connection between information communicated to the driver and eco-driving on two dimensions: the type of reward awarded to the driver and the social and community aspects of eco-driving.

Keywords
In-car interfaces, eco-driving, gamification, persuasion

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; H.5.2 User Interfaces: User-centered design

General Terms
Design, Human Factors, Theory

Introduction
Automobile emissions account for 27% of all U.S. greenhouse gasses [11], thus the reduction of CO_2 emissions and fuel consumption from road transportation has become an increasingly important

Figure 1 – Chevrolet Volt's display

Figure 2 – Ford's EcoGuide

goal for most countries, in the attempt to fight global warming, health hazards and implement the Kyoto Protocol [5]. Reducing emissions can take many forms such the introduction of electrical vehicles (EV), technological advancements for existing solutions (e.g. improving engines' efficiency) and reducing the vehicle miles travelled [1], to name just a few.

An important (but typically overlooked) contribution to emission reduction is the modification of driving style, frequently referred to as "eco-driving". Eco-driving is a win-win proposition both for individuals, who can benefit from reduced fuel consumption of ~10%, and for society, through reduced emissions and the associated benefits thereof [1].

Communicating Eco-driving Information

While basic eco-based displays (such as a "shift up" indicator) date back many years, more recent commercial interfaces allow the drivers to see how efficient their driving style is. For example, Kia's Eco-Driving System [9] – placed in the middle of the dashboard - alternates its color between green, white and red, to indicate driving style and environmental friendliness. The Chevrolet Volt provides its driver with considerably richer information, showing the available battery charge, and also an efficiency driving style feedback meter too (right side of Figure 1). eco:Drive is a somewhat different approach co-developed by Fiat and Microsoft. It allows drivers to obtain fuel consumption and emissions data using a USB stick and then to display it on a computer's screen equipped with the eco:Drive software.

Existing studies show favorable reactions of drivers toward feedback devices in their cars ([1], [10]) and positive effects on eco-driving. An example is a heads-up-display feedback system to encourage eco-driving among school-bus drivers [11].

Games and eco-driving

Persuasive technology – "*interactive computing system designed to change people's attitudes or behaviours*" [4] – is an important means in order to achieve eco-driving. It requires fast and personalized feedback [12] in order to enhance immediate performance [2] as well as to maintain behavior over time.

Gamification - the use of game play mechanics for non-game applications in order to encourage a certain behavior (Wikipedia) – is an obvious type of persuasive technology. Building on human's psychological predisposition to engage in gaming and natural curiosity and their drive to play and master their environments, gamification can motivate people into productive behavior [12].

The desire to play is based on different needs that are fulfilled by specific games. Nine types of players are documented [7]: The Competitor, The Explorer, The Collector, The Achiever, The Joker, The Director, The Storyteller, The Performer, and The Craftsman. Most players are a combination of two or more types, often changing roles depending on the actual game being played. The rewards obtained from playing games vary, in accordance with the above categories: from bettering other players (The Competitor) to experiencing the boundaries of the play world (The Explorer).

Key to gameplay are rules, rewards and punishments resulting from changes in the game, and the presence of an environment, as well as ranking.

Games and cars
Currently, games have a relatively minor role in car interfaces. In some cases, games are entirely spontaneous and are initiated by the driver, e.g. when drivers change their driving style in order to maximize fuel efficiency and therefore are in fact engaged in some sort of an energy conservation game [8].

Other interfaces, though, are intentionally conceived in order to provide a game-like experience. Ford's EcoGuide dashboard (Figure 2) rewards eco-driving through the use of growing leaves and vines. A similar idea, suggested by [10], adds an EcoScore which can be used to compare between different trips or to compete against other drivers. Common to both interfaces is the concept of ranking, which motivates drivers to reach high scores and to compare their performance with other drivers. Steve Bishop of IDEO, responsible for the design of Ford's EcoGuide interface, explicitly suggests that: "Video games engage their users in a similar fashion with levels. In fact, when we observed hybrid drivers, we found they were going for high scores, a gaming behavior that has never existed in cars before. We designed to accommodate it." [3]

Academic research on video games suggests that competition is a key element of the entertainment provided by these games, as they allow for a continuous stream of challenging and competitive situations [14].

Future Research

The research surveyed above leads us to believe that gamification of eco-information has the potential to improve eco-driving. As we see it, future research should address two main issues: first, the type of reward that is given to the driver for excelling in eco-driving and second, the social and community aspects of eco-driving.

The relationships between these two dimensions are presented in Figure 3. Each quadrant on the Reward-Relationship grid represents a unique situation that will result in a specific driver-car-other driver interaction: when the interaction is personal and confined to the car, the driver competes with him/herself and the reward is presented as a score or message inside the car. Extending the reward to the 'real' world could, for example, award the driver the privilege of using the carpool lane for a period of time, or grant him a gift at the gas station. Interactions that are more social could see the driver compete against others with varying degrees of acquaintance - friends, people who drive the same route etc. The reward could again be confined to the car or, for example, could be broadcasted online or even on variable message signs along the road.

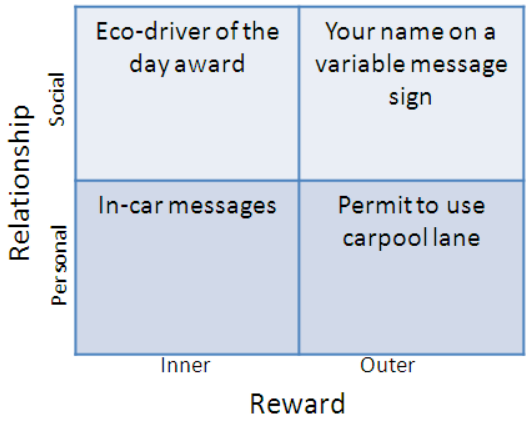

Figure 3: The Reward-Relationship grid and possible implementations.

Our research plan intends to create a preliminary theoretical foundation to map the connection between the presentation of information to the drive and eco-driving and to support it by: 1. Employing ethnographic methods to study the actual interaction of drivers with existing eco-driving interfaces. 2. Studying the effects of 'tangible' (monetary-like) rewards on drivers' attitudes. 3. Exploring the effects of social interaction and social networks on the relationship dimension explained above.

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