How to motivate consumers to test electric vehicles – An approach to design consumer interfaces to foster innovation adoption

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Abstract. Electric mobility is a current example of an innovative technology facing innovation resistance by consumers despite being an important strategy towards sustainable mobility. In this study the design of a consumer web interface incorporating elements from behavior change research to support overcoming resistance towards innovations, is introduced. An experimental study is conducted to test the influence of the proposed design strategies that are implemented in a rental car booking website. Results show a significantly positive effect of leveraging social influence and providing targeted information about the innovation on consumers' decision to test an innovation.

Keywords: Electric Mobility, Innovation Adoption, Sustainability, Persuasive Technology

1 Introduction

Even though people tend to be pro-innovative, many consumers resist certain innovations even if they are considered as superior to entrenched alternatives [1]. One explanation lies in the fact that adopting innovations often threatens consumers to change established routines and to put in effort to adapt their behavior to the changed situation [2]. The electric drive technology is a prominent current example of an innovation facing consumer resistance despite being an effective strategy towards more sustainable mobility [3], [4]. Being a promising approach to solve the problem of fossil fuel dependency, and to reduce exhaust and noise emissions, electric cars offer important benefits in contrast to gasoline or diesel cars. Still, resistance among consumers exist, also because most consumers have prejudices against electric cars arising from uncertainty considering their driving range or recharging infrastructure [5]. This study investigates how the perception of electric cars can be improved, and innovation trial among consumers promoted by incorporating elements from behavior change research (Choice Architecture [6], Persuasive Technology [7], Commitment and Compliance Gaining [8], etc.) in the design of a digital consumer interface. Innovation promotion, in this context, means to better highlight environmentally-friendly alternatives and motivating consumers to consider more sustainable options

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while ensuring freedom of choice. Booking an electric rental car serves as specific use case in our study.
We therefore formulate the following research question:
RQ: How can we design electric car choice settings such that the decision for innovation trial is more likely?
The remainder of the paper proceeds as follows: Section 2 introduces theoretical foundations relevant for this study. Section 3 reviews related work. In section 4, our research model and hypothesis are introduced. Section 5 describes the experimental study to test the hypothesis. Section 6 summarizes the findings of our research and section 7 and 8 close the paper with a discussion of the topic and its contribution.

2 Theoretical Background

The following chapter introduces fundamentals on innovation resistance and the role of innovation trial for adoption. As we want to positively influence consumer's behavior towards innovation trial, we additionally present, behavior change theories and research streams concentrating on the promotion of behavior change.

2.1 Resistance Towards Innovations and Innovation Trial

Innovation decision process models [9] assume consumers to follow a certain structure when deciding upon adopting an innovation. Roger's process consists of five stages from (1) knowledge, (2) persuasion, (3) decision, (4) implementation to (5) confirmation. This process is primarily influenced by adopter-specific (e.g. risk aversion, cognitive rigidity), situation-specific (e.g. budget restrictions, shopping environment) and innovation-specific factors (e.g. the adopter's perception of the innovation) [9]. Innovation resistance can occur as outcome of any stage of the adoption process. Passive innovation resistance results from a generic tendency of consumers to resist innovations and is a potential outcome of the knowledge stage, whereas active innovation resistance is a result of an unfavorable innovation evaluation and thus an outcome of the persuasion stage [10]. Passive innovation resistance is driven by adopter-specific factors such as personality traits leading to an inclination to resist changes [11] or situation-specific factors like status-quo satisfaction [10]. New technologies usually require consumers to change existing behaviors and habits, and can accordingly cause resistance [12]. The higher the degree of change or discontinuity the innovation evokes, and the more it conflicts with prior belief structures, the higher is the resistance to the innovation. Hence, new technologies, like electric cars, are associated with high discontinuity [6], [7].

Following Roger's adoption process model, trial is part of the awareness-interest-evaluation-trail-adoption sequence and therefore a common pre-stage to adoption [9]. Trialability refers to the degree to which an innovation can be tested on a limited basis [14]. Trial allows users to self-inform about the innovation performance and to experience benefits while using it [15]. Trial can increase the perceived ease of use of an innovation, which relates to the extent to which someone believes that the usage of

a system is free of effort [16], and can accordingly positively influence the intention to adopt the innovation [17].

2.2 Guiding Decision Makers' Behavior

Behavior is defined as a person's observable response to internal or external events [10-11]. The way behaviors are formed, changed and predicted is subject of several psychologic theories. Theories explaining the determinants of behavior and seeing attitude as a predictor of future behavior are proposed by Fishbein and Ajzen [20] (Theory of Reasoned Action), Ajzen [21] (Theory of Planned Behavior), and Bandura [22] (Social Cognitive Theory), amongst others. The opposite research stream, which is explaining how the performance of certain behaviors can change related attitudes, is represented by the Cognitive Dissonance Model [23] and the Self-Perception Theory [24], for example. Behavior change theories are complemented by the Transtheoretical Model [25], which explains the stages that an individual passes when changing or forming a behavior. Considering the way information receivers process persuasion messages, dual process models, comprising the Elaboration Likelihood Model [26] and the Heuristic Systematic Model [27], distinguish between two ways of information processing. The central route of information processing is chosen, when systematically focusing on the content of an information, whereas the choice for the peripheral route refers to making decisions based on available heuristics or cues.

Strategies to non-coercively change human behavior are presented in several research areas. Choice Architecture–a concept in the field of behavioral economics–reflects the idea that people's choices are influenced by the design of a decision situation [6]. Compliance gaining techniques [8], [28], [29]–rooted in social psychology and adapted in marketing–aim to change behavior by eliciting cognitive dissonance [30]. With concepts like Gamification [31], [32], Persuasive Technology [7] and Human Behavior Change Systems [33]–emerging from Information Systems research–we can observe a growing interest in digital approaches to induce behavior change.

3 Related Work

Behavior change strategies are applied and tested in various context with a particular focus on health-related behavior [34-36] and sustainability promotion [37-39]. In the domain of innovation resistance, Kuester et al. [40] demonstrate the effectiveness of defaults in helping to overcome innovation resistance. With regard to overcoming resistance towards electric mobility, Wolf et al. [4] propose an agent-based model simulating the effects of policy interventions and social influence on transport mode preferences. A gamification based approach visualizing their individual benefits to users is introduced by [41]. Stryja et al. [42] demonstrate the effects of applying choice architecture tools to the case of electric car selection. Related work is limited in the fact that only simulations are applied and that they rely on the willingness of consumers to proactively inform themselves about the benefits of electric vehicles. Our study contributes by proposing the design of a consumer web interface based on integrated

knowledge from behavior change research, and evaluating its effect on innovation trial decisions. We consequently design and model a concrete decision situation in which consumers need to decide upon testing an innovation.

4 Research Model

This study aims to apply theoretical knowledge on innovation resistance and behavior change to the design of a consumer web interface that non-coercively motivates consumers to overcome their passive innovation resistance. The interface is implemented in such a manner, that decision makers are encouraged to consider and select innovative options instead of directly rejecting them. Accordingly, the dependent variable in our research model is the decision to select or reject the innovation in a trial situation. For the purpose of this study, we draw upon tools from Choice Architecture, Persuasive Technology and Compliance Gaining Theory, as this specific combination of tools from decision-situation design, IT-based persuasion, and marketing adequately reflects our use case of booking rental cars. In particular, we propose the implementation of four behavior change design strategies, *Salience, Commitment with Labeling*, *Social Influence* and *Information Provision* in a rental car booking website aiming to encourage users to choose electric cars over conventional ones. Their theoretical derivation is explained in the following.

Salience. Salience refers to the *"translation of choice-related information into a format that is manageable by a cognitive system with limited capacity for information processing and representation"* [43]. Cognitive effort of decision-making is associated with the identification of best options and underlying tradeoffs, as well as with the decision for one specific option [43], [44]. When cognitive resources and attention are restricted, humans mainly focus on the most salient cues for deciding upon their behavior. Choice Architecture proposes mechanisms like setting defaults or structuring complex choices that aim to make desired options more salient and consequently keep the effort that is associated with decision-making low [46]. Studies on the effects of minimizing conscious effort demonstrate positive effects on behavior change [43], [45]. We therefore expect that:
Hypothesis 1 (H1): Designing the consumer web interface in a way that the innovation is more salient will positively affect the decision for innovation trial.

Commitment with Labeling. The effect of commitment and compliance-gaining strategies–especially on environmentally friendly and sustainable behavior–has been demonstrated in several studies [29], [47-49]. Commitment is considered as strategy leading to an enduring change in behavior, as people committing to a certain behavior are likely to adhere to their decision [29]. Labeling–working in the way that people are being labeled as the kind of person who normally performs the target behavior–can be used as strategy to stimulate commitment [51]. Pallak [50] furthermore shows a strong effect on commitment-making when people are labeled as public-spirited, fuel-conserving citizens. We therefore expect that:

Hypothesis 2 (H2): Labeling decision makers as the kind of person that performs the target behavior will positively affect the decision for innovation trial.

Social Influence. Social influence is a psychologic phenomenon occurring in response to social forces [28]. Social influence is defined as change in an individual's attitudes, behaviors or beliefs due to external pressure. People tend to look for social proof and rely on their environment for cues on how to act, think and feel [52]. Social norms are considered as underlying concepts for behavior changes under influence of other people [28]. Normative influence and peer pressure make it more likely for a person to adopt a target behavior [53]. Previous studies also demonstrate the effect of social influence on the promotion of sustainable behavior [52], [53]. We therefore expect that: *Hypothesis 3 (H3): Designing the consumer web interface to leverage social influence, will positively affect the decision for trial decision.*

Information Provision. Next to personal characteristics or social system variables, a consumer's decision to adopt an innovation is influenced by the perceived characteristics of the innovation [9]. Providing decision-makers with targeted information that allow them to adequately evaluate the advantages of an innovation at the time of the decision can influence their decision behavior [43]. With the provision of information, the direct route of persuasion [26] is chosen, which aims to persuade users by appealing to intelligence and reason. On condition that users have the potential to evaluate the content of the persuasive message, direct persuasion is shown to lead to more enduring behavior change than indirect persuasion [53]. We therefore expect that: *Hypothesis 4 (H4): Providing targeted information about the innovation at the point of decision will positively affect the decision for innovation trial.*

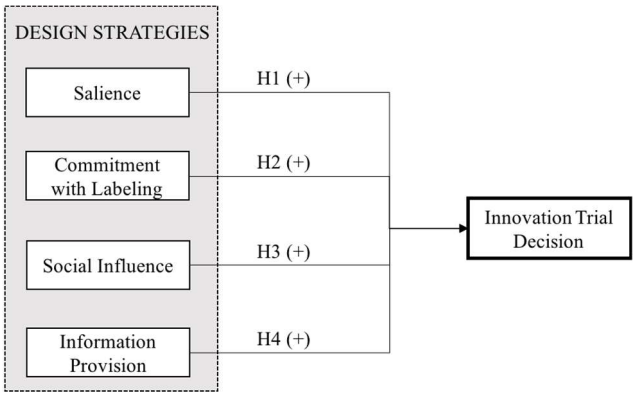

Figure 1: Research Model

In summary, we propose the design of a consumer web interface based on the behavior change design strategies *Salience*, *Commitment with Labeling*, *Social Influence* and *Information Provision.* The research model is tested in an experimental study which will be described in the following section. Figure 1 depicts the hypotheses and the research model addressed by our research design.

5 Experimental Study

5.1 Procedure and Treatment

The research model is tested in a laboratory experiment with a within-subject design to control for individual preferences and experiences with electric vehicles. Treatment variables are *Salience, Commitment with Labeling*, *Social Influence* and *Information Provision*. To minimize carry-over effects, the sequence of treatments is set in such a manner that treatments, which only rely on situational cues are presented first (*Salience*, *Commitment with Labeling*). Treatments that provide information, which could later be memorized by participants, are presented afterwards (*Social Influence*, *Information Provision*).

Within the experimental procedure, participants are presented five different scenarios describing non-private travel set-ups. Each scenario describes a route starting and ending in a German city with a two-day stay in another city in at most 82km distance from the starting and ending one. By limiting the travel distance and setting the stay at the destination to at least 24 hours, it is ensured that all scenarios are feasible with electric as well as conventional cars. Dates, cities, as well as the number of passengers are varied to a certain extent to keep up participants' attention during the experiment. Within the scenario description, participants are informed about their task to decide for a specific car, a hotel category as well as a food category. Hotel and food categories (high and low class) and according prices are given before the decision for a rental car is made to ensure that participants are fully aware of all costs and options when choosing a rental car. Participants are given a fixed budget forcing them to make trade-offs between car, hotel and food.

After each scenario description, the participants are directed to an instance of a rental car booking website. The first rental car booking website does not contain any treatment, thus the choices made in the first cycle can be used as control group results. The treatment variables *Salience*, *Commitment with Labeling*, *Social Influence* and *Information Provision* are implemented into the rental car booking website in cycle two to five. After a welcome page–where dates, and pick-up and return stations should be entered–a list containing 15 cars, independent of the treatment, is shown to the participants. To control for individual tendencies towards a vehicle category (small car, medium-sized car, limousine etc.), each category contains at least one electric, gasoline and diesel powered vehicle. All vehicles within one category are the same price to ensure that prices do not influence the engine choice. Furthermore, car colors are kept neutral in white or silver.

Treatment 1, *Salience*, is implemented into the rental car booking web application by highlighting one electric car model as suggestion on top position. In treatment 2, *Commitment with Labeling,* participants are shown a slogan next to the electric car models which labels people choosing these alternatives as eco-friendly drivers. *Social Influence* is integrated in the form of other clients' statements on their electric drive experience. Treatment 4, *Information Provision,* lists important information on available electric car models (e.g. driving range) and provides a charge station search algorithm.

Following the vehicle choice, preferences in hotels and food categories are inquired. After the selection tasks, the participants are guided to a questionnaire which collects demographic data, experience with and attitude towards electric car usage, and the innovation resistance.

5.2 Measurement of Variables

The experiment is implemented using Brownie, a Java-based software for NeuroIS experiments [56]. We therefore measure the dichotomous dependent variable–the innovation trial choice–by tracking the booking choices from the logging files. Within the questionnaire, attitude towards electric cars and innovation resistance are measured with seven items based on Wixom and Todd (2005) and Ram (1989) on a 7-point scale.

5.3 Sample

The experiment is conducted at a behavioral laboratory in Germany. 66 students from a large German public university are invited to participate in the pretest. Participants are neither informed about the content nor the goal of the experiment. The experiment is conducted within four sessions, three of them with 20 participants and one with six participants. Each participant receives a compensation of 10 EUR at the end of the experiment session. Additionally, a coupon with the value of 50 EUR valid for exactly one of the chosen car models is raffled to incentivize participants to reveal their true preferences. This is communicated to the participants within the task description at the beginning of the experiment. Participants are between 18 and 39 with an average of 23.25 years (SD = 3.912). 60.6% are male. 83% of the participants do not own a car. Car sharing and rental car services are used by 44% and 37% of the participants, respectively. The mean attitude towards the usage of electric cars within the total sample is 5.626 (SD=1.020) (scale from 1 to 7 with 1 indicating a very negative attitude towards usage) and mean innovation resistance is 2.782 (SD=0.928) (scale from 1 to 7 with 7 indicating very high resistance towards innovations) with a standard deviation of 0.928.

6 Results

Prior to the evaluation, we conduct a logic check to examine if participants had chosen within their given budget. One data point is excluded from analysis because of budget overrun. We furthermore check, whether participants have paid attention to the information provided to them in treatment 4. We therefore determine the subset of participants ($T4_{adjusted}$; n=34) that have spent more than 10 seconds concentrating on the treatment. The shares of electric and conventional cars chosen under the influence of the four treatments is indicated in Table 1. When no treatment was applied, 54% of the participants selected the electric car. Most electric cars were chosen in the treatment *Social Influence* with a share of 75.38%.

Table 1: Share of Electric and Conventional Cars Chosen with Respect to Treatment

	No treatment	*Salience (T1)*	*Commitment w. Labeling (T2)*	*Social Influence (T3)*	*Information Provision (T4)*	*Information Provision ($T4_{adjusted}$)*
Electric vehicles chosen	53.85%	64.62%	69.23%	75.38%	63.08%	73.53%
Conventional vehicles chosen	46.15%	35.38%	30.77%	24.62%	36.92%	26.47%

We calculate a chi-squared test of independence to test for a statistically significant association between the treatments and the innovation trial decision. The chi-squared test of independence shows significant p-values for *Social Influence* ($p<0.05$) and *Expertise Demonstration* in the subsample ($T4_{adjusted}$) ($p<0.05$). The Phi-coeffients of *Social Influence* (0.225) and *Expertise Demonstration* (0.239) indicate a moderately positive association between the choice of electric cars and the application of treatments.

Table 2: Results of Chi-Squared Test of Independence

	Pearson's Chi-squared test		*Pearson's Chi-squared test with Yates' continuity correction*		*Phi-Coefficient/ Cramer's V*	*Contingency Coefficient*
	X^2	*p-value*	X^2	*p-value*		
T1:	1.560	0.211	1.146	0.284	0.110	0.109
T2:	3.250	0.0714	2.633	0.105	0.158	0.156
T3:	6.594	0.010**	5.686	0.017*	0.225	0.220
T4:	1.140	0.286	0.792	0.374	0.094	0.093
$T4_{adjusted}$:	4.446	0.035*	3.513	0.061	0.239	0.232
*p<0.05 **p<0.01 ***p<0.001						

The McNemar test supports the results of the chi-squared test of independency. Compared to the results of the no-treatment control group, the test indicates statistically significant asymmetries on the contingency table diagonal for *Social Influence* ($p<0.05$) and *Information Provision* ($p<0.05$) (Cf. Table 3).

Table 3: Results of McNemar test

	McNemar's X^2	*p-value*
Control group – T1	1.714	0.190
Control group – T2	3.375	0.066
Control group – T3	5.633	0.018*
Control group – T4	1.136	0.286
Control group – $T4_{adjusted}$	5.333	0.021*
*p<0.05 **p<0.01 ***p<0.001		

The switching rate from a conventional car in the no-treatment system to an electric car in the system with *Social Influence* or *Information Provision* is significantly higher than the reciprocal switching rate. *Commitment with Labeling* (T2) is significant at the 10% level ($p<0.05$).

7 Discussion

Our results show an increase in the number of electric cars chosen under all four treatments, compared to the control group. With 53.86%, the control system already achieves a comparatively high share of electric vehicles chosen. Leveraging social influence and providing targeted information about the innovation has significant positive effects on sustainable innovation trial decisions. We can therefore support H3 and H4. In the form of norms, social influence is an integral part of theories in Behavioral Sciences (e.g. Theory of Reasoned Action, Theory of Planned Behavior, Social Cognitive Theory), which further supports our findings. *Information provision* only shows significant effects, when the information that is provided is paid attention to. Dual process models that distinguish between two different ways of human information processing can give rough indications. These models state that only in combination with high motivation and ability to process given information, a central route information processing and attitude change may take place. Furthermore, there is a raise in the number of electric cars chosen between the control system and under the influence of the treatments *Salience* and *Commitment with Labeling* but without being statistically significant. We accordingly cannot find support for H1 and H2 in our data. It is important to consider that in the case of *Commitment with Labeling* the formulation of the label highly influences the effectiveness of the mechanism. Further testing with alternative wordings is suggested. In addition, allowing active or public commitment-making [57] might further increase its impact on behavior change.

8 Conclusion

In this study, we propose the design of a consumer web interface which motivates users to select sustainable innovations. We apply behavior change strategies synthesized from Persuasive Technology, Choice Architecture, and Commitment and Compliance Gaining research to the case of rental car booking. Results indicate that leveraging social influence and providing information about the innovation are effective strategies to positively influence innovation trial decisions. The finding corresponds with results from other studies which emphasize the power of social influence and tailored information to achieve behavior change [51- 52]. Making the innovation more salient to minimize the effort associated with deciding upon innovation trial, and labeling users as sustainable drivers led to an increasing number of electric cars chosen, but results are not statistically significant.

Our study is limited by the size of its sample (n=66). Furthermore, the study sample consisting of students, is very homogeneous and characterized by low average age and lower innovation resistance. Results can serve as indication and extending the study

sample to other user groups may lead to more comprehensive results. Besides these limitations, our study contributes to theory and practice. First, it integrates knowledge from social psychology, behavioral economics and information systems research, and combines findings in the design of supportive behavior change systems. In particular, testing design strategies for behavior change systems that promote innovation trial contributes to the body of knowledge of both, persuasion research and innovation resistance theory. Second, we shed light into possible application areas of persuasive consumer interfaces to promote the adoption of sustainable innovations.

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