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Applying nudging techniques to promote fuel efficient car purchases

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Summary

The aim of this 3-year project is to identify and test effective low-invasive behavioral interventions, called *Nudges*, to motivate consumers to shift their purchasing decisions towards fuel-efficient vehicles. For this purpose, the project has been divided into three phases. The first project phase was finalized by the end of 2018 and summarized in the Annual report 2018. It combined a theory-driven (top-down) and a practice-driven (bottom-up) approach, with its main results being the categorization and classification of most important nudging techniques from the literature and practice and suggestions of the nudging techniques to be tested in the following project phases. Further, the bottom-up approach revealed an increasing number of actors and support measures promoting fuel-efficient car purchases, with specific momentum dedicated to electric cars (EVs).

Building on these results, the project realized the need to gain additional insights on the consumer vehicle purchase process and mobility motives. Consequently, it decided to run two complementary studies analyzing these issues. The *consumer vehicle purchase processes analysis* revealed the complexity of the customer vehicle purchase process, composed of 5 stages and underlined by a plurality of decision-making processes. It then identified five touchpoints within the purchase process in which individual nudging techniques can be implemented to increase fuel-efficient car purchases. Online Study 1 and the field test build on these findings by analyzing to what extent bundles of EVs and charging services at the point of sale can reduce the complexity and thus nudge customers into purchasing EVs. The findings of the vehicle purchase process survey also revealed an important role of peers and social influence in general when potential customers gather information relative to a car purchase. The role of dynamic social norms was then decided to be further investigated in the Online Study 2. Results from the *consumer mobility motives analysis* revealed that motives play a crucial role in predicting consumer's purchase intentions of a variety of mobility products. Notably, environmental motives had an important impact for the purchase intentions of all efficient mobility alternatives, and this above and beyond the predictive value of other important consumer variables such as demographic variables and prior ownership. Contrarily, for the purchase intentions of a less efficient vehicle (i.e., a SUV) not environmental, but status motives played a more important role. Based on this result, Laboratory Study 1 was conducted, investigating how status maintenance and status advancement goals can be activated to interact with political ideology and thereby influence the environmental friendliness of consumer choices. The findings on the relevance of status motives were then further investigated in the Laboratory Study 1, which additionally highlighted the relevance of political ideology, which seems to interact with status motives in the context of fuel-efficient car purchases. The results of all studies will be combined and contribute to the conclusion of the project at the end of Project Phase 3.

This report summarizes the progress of the project to date, i.e. the progress and preliminary conclusions of Project Phase 2 until the end of September 2019. Additionally, it provides an outlook onto the second half of Project Phase 2 (running until mid 2020).

Zusammenfassung

Dieses 3-Jahres Projekt hat das Ziel effektive niederschwellige Verhaltensinterventionen („Nudges“) zu identifizieren, mit welchen Kaufentscheidungen von Konsumenten zugunsten von effizienteren Autos beeinflusst werden können. Das Projekt besteht aus drei Phasen, von denen die erste Phase Ende 2018 beendet und im Jahresbericht 2018 beschrieben wurde. In Phase 1 wurden theorie- (top-down) und praxisgeleitete (bottom-up) Ansätze kombiniert, um eine Kategorisierung und Klassifizierung der wichtigsten Nudging Techniken von der Literatur und der Praxis herzuleiten. Eine Auswahl dieser vielversprechenden Techniken wird nun im Rahmen der Phase 2 getestet. Ebenso konnte durch den praxisgeleiteten Ansatz der Phase 1 eine wachsende Anzahl an Akteuren und Massnahmen identifiziert werden, die zu einer Förderung effizienter Fahrzeuge beitragen können. Des Weiteren konnte gezeigt werden, dass die momentanen Chancen Elektromobilität hoch ist.

Aufbauend auf diesen Ergebnissen hat das Projektteam beschlossen zwei komplementäre Untersuchungen zu den Mobilitätsmotiven von Konsumenten und dem Autokaufprozess durchzuführen. Die *Studie zu Autokaufprozessen* verdeutlicht dessen Komplexität. Über 5 Phasen hinweg werden im Rahmen eines Autokaufs beim Kunden eine Vielzahl von Entscheidungsprozessen ausgelöst. Um den Kauf energieeffizienter Autos zu fördern, müssen Nudges auf die 5 identifizierten Kontaktpunkte mit dem Kunden abgestimmt werden. Die Online-Studie 1 und der Feld-Test bauen auf diesen Erkenntnissen auf und untersuchen, inwieweit Bundles für Ladeinfrastruktur die Komplexität für den Kunden reduzieren können und somit einen geeigneten Nudge darstellen. Die Wirkung von sozialen Normen als Nudge, welche ebenfalls als wichtiger Einflussfaktor in der Studie über den Autokaufprozess identifiziert wurde, ist Gegenstand der Online-Studie 2. Die Ergebnisse der *Studie zu Mobilitätsmotiven* zeigt, dass Motive eine entscheidende Rolle bei der Vorhersage der Kaufabsichten der Verbraucher für eine Vielzahl von Mobilitätsprodukten spielen. Insbesondere Umweltmotive hatten einen starken Einfluss auf die Kaufabsichten aller effizienten Mobilitätsalternativen, und dies über den Vorhersagewert anderer wichtiger Verbrauchervariablen wie demographischer Variablen und früherem Kaufverhalten hinaus. Im Gegensatz dazu spielten bei den Kaufabsichten eines weniger effizienten Autos (SUV) nicht Umwelt-, sondern Statusmotive eine wichtigere Rolle. Basierend auf diesem Ergebnis wurde die Laborstudie 1 durchgeführt, in der untersucht wurde, wie Statuserhaltungs- und Statusförderungsmotive aktiviert werden können, um in Interaktion mit politischer Ideologie die Umweltfreundlichkeit des Konsumentenverhalten zu beeinflussen. Die Studienergebnisse werden in der Projektphase 3 zusammengeführt, um Handlungsempfehlungen abzuleiten.

Dieser Bericht fasst unsere bisherigen Fortschritte und Schlussfolgerungen aus Phase 2 (Stand September 2019) zusammen und gibt einen Ausblick auf die zweite Hälfte der Phase 2 (Laufzeit bis Mitte 2020).

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List of abbreviations

SFOE	Swiss Federal Office of Energy
CO_2	Carbon dioxide
EV	Electric car
SUV	Sports-Utility vehicle
UNIGE	University of Geneva
UNISG	University of St.Gallen
SHEDS	Swiss Household Energy Demand Survey
CREST	Competence Center for Research in Energy, Society, and Transition

1 Introduction & Context

1.1 Background information and current situation

CO_2-emissions from the private transport sector represent one of the main contributors to Swiss greenhouse gas emissions (SFOE, 2015). In order to reach global and local environmental goals, a change of mobility behavior towards more efficient options is thus indispensable (Vuille, Favrat, & Erkman, 2015). Nevertheless, their promotion and uptake still remain very limited (EnergieSchweiz, 2019). Of particular importance are long-term, high impact decisions like car purchase decisions, because they strongly determine daily mobility behavior for a long-time frame (Fujii & Gärling, 2003). Even though it appears obvious that if one possesses a fuel-efficient car, one will necessarily emit less CO_2 during a considerable period, research of the promotion of fuel-efficient car purchases is only emerging.

As the political processes of implementing traditional approaches of behavior change (e.g. standards and legislations) can be difficult and slow, behavioral interventions that preserve consumers freedom of choice (*i.e. nudges*) can be a promising complementary tool (Reisch & Sunstein, 2016; Thaler & Sunstein, 2008). In various domains of human behavior, such as health and nutrition, nudging has been shown to be of a considerable effectiveness (Sunstein, 2015). Nevertheless, there is still a lack of systematic synthesis of evidence and analyses on the transferability of findings from one domain to another domain are needed.

1.2 Purpose of the project

In this project, we aim to fill this gap in the scientific literature by considering theoretical as well as practical evidence of the effectiveness of nudging techniques to promote fuel-efficient vehicle purchases. The conclusions of the project will result in guidance for policy and industry.

1.3 Objectives

The goals of this research project are:

1. Synthesize and classify evidence of nudging techniques relevant for the mobility sector, both in the scientific literature and current practice. To achieve this, we set out to acquire as much evidence as possible through a systematic literature search and widespread contact to practitioners and other important stakeholders in the mobility sector.
2. Understand the underlying processes (e.g. motivations, purchase processes) of why and how consumers choose a more or less efficient car.
3. Identify, adapt, or improve existing nudges and develop new promising ones. We aim at identifying a small set of nudges that are especially effective in change behavior in the transportation domain based on evidence we gain in laboratory, online, and field studies.
4. Provide precise recommendations on the implementation of nudges for policy and industry in Switzerland as well as generate publications in scientific journals.

2 Procedures and methodology

The project is composed of three project phases. The outcomes of Project Phase 1 are summarized in the Annual Report 2018 (see Table 1 for graphical illustration of individual Project Phases). The outcome of Phase 1 was a thorough classification of promising nudging techniques to be tested in Phase 2. Furthermore, we identified the need to conduct two complementary studies to guide scientific inquiry in the further project phases, namely the vehicle purchase process analysis and the analysis of motives in the transportation domain. Building on the classification of nudges and the results of the two complementary studies, two online studies and one laboratory study have been already conducted as part of the Project Phase 2. Specifically, an experimental study on the relevance of status effects in the context of a car purchase (Laboratory Study 1), an online experiment testing the role of product bundling to increase the convenience of EV purchases (Online Study 1) have been completed. Data collection of Online Study 2 testing the role of social norms to increase EV purchase willingness has been recently completed. Finally, a Laboratory Study 2 on the influence of information presentation (e.g., fuel consumption) on car purchases and a Field Study building on the results of the Online Experiment 1 testing the role of bundling nudge in a real-life setting are currently being set-up and data collection will be completed until the end of Phase 2. This section presents the methodology and set-up of the conducted and planned studies together with the complete or preliminary results, where available. Please note that more detailed information on the conducted and planned studies are provided in the next section.

Table 1: Detailed project plan including the three main project phases.

Time plan

		1st year				2nd year				3rd year			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 1	Bottom-up approach (UniSG)												
	Top-down approach (UniGE)												
	Integration (UniSG/GE)												
Phase 2	Laboratory studies (UniGE)												
	Set-up studies												
	Data coll./analysis												
	Online studies (UniSG)												
	Set-up studies												
	Data coll./analysis												
	Field study (UniSG)												
	Set-up study												
	Data coll./analysis												
Phase 3	Suggestions practice (UniSG/GE)												
	Contributions theory (UniSG/GE)												
Phases 1-3	**Publications**												

3 Activities and results

3.1 Complementary steps Phase 1

3.1.1 Complementary step 1: Vehicle purchase process analysis

Bottom-up analysis in Phase 1 of the project indicated the need to analyze the customer vehicle purchase process in more detail. Understanding the purchase process in more depth allows to identify touchpoints, the episodes of interaction between customers and the product (Baxendale, Macdonald, & Wilson, 2015; Stein & Ramaseshan, 2016), in which to implement individual nudging techniques in order to most effectively promote fuel-efficient car sales.

To this end, an online survey was conducted in December 2018 with a total sample of 553 Swiss car owners. The requirements to participate in the survey were to be more than 18 years old; the household had to have an experience with a car purchase. The sample was representative of the Swiss adult population in terms of age, sex, language regions (the survey was run in German and French, thus covering the large majority of the Swiss population) and education. Moreover, respondents also mirrored the Swiss average in terms of cars owned and their propulsion technologies (Plananska, 2019).

The survey was composed of eight parts, including among others sections on respondents' car ownership, information sources consulted in relation to the car purchase, the role of external influences (namely energy label for cars, car dealers and peers), reasons for or against EV purchase and EV consideration. To measure individual responses, a plurality of question types was applied, namely Likert-scale type, single- and multiple-choice response questions.

Vehicle purchase process analysis: Results

Four main results were generated by the study. Firstly, a novel, comprehensive model of the customer vehicle purchase process was developed by combining knowledge from the behavioural and marketing literature with insights from the conducted survey. The model shows that the customer vehicle purchase process is very complex, consisting of 5 stages that are underlined by a plurality of decision-making strategies. Five touchpoints within the model were identified, in which individual nudging techniques can be implemented to promote fuel-efficient car and EV purchases. The developed model is illustrated in Figure 1 below. Secondly, car dealers were concluded to represent the most important external influence on vehicle purchases. 73% of vehicles of the sample were purchased through this channel; car dealers are also the second most important source of information for potential customers. At the same time, they pose an important barrier to EV sales. Namely, only 5.3% of respondents who visited a car dealer in relation to their last car purchase indicated that a car dealer offered them an EV during that visit. Thirdly, consumers who consider purchasing an EV see a plurality of information sources as significantly more important than respondents who do not consider an EV, concretely the website of the car brand, energy efficiency labels and online car configurators.

Policy makers aiming to promote fuel-efficient car purchases have to be firstly aware of the complexity of the vehicle purchase process when developing and delivering the support measures. They have to be aware which vehicle purchase process stage they want to target, what they want to achieve and which target group they want to address. Furthermore, building

on the findings of the survey, recommendations to policy makers incorporating nudging techniques to more effectively promote fuel-efficient car purchases have been proposed. Specifically, policy makers should foster consultation of a plurality of information channels for potential customers (e.g. by launching interactive promotional campaigns) and launch obligatory training programs for car dealers to get familiarized with EVs. These interventions would be most effective at Touchpoints 2 and 3, in the search and evaluation stages, respectively.

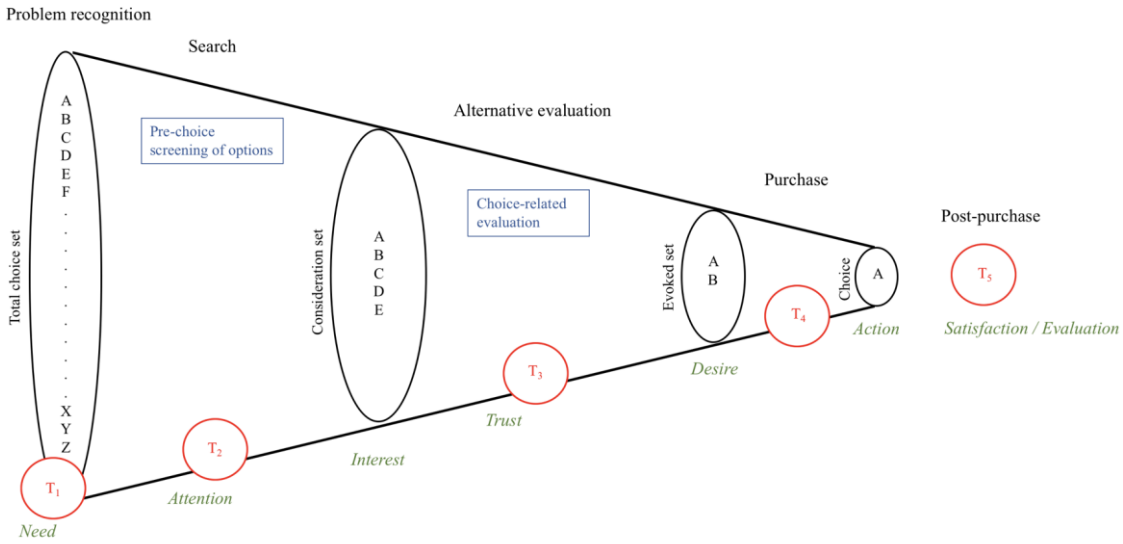

Figure 1: A comprehensive model of the customer vehicle purchase process, depicting the diverse touchpoints allowing to implement nudging techniques.

3.1.2 Complementary step 2: Motive analysis

In order to understand the underlying motives why consumers intend to buy different types of mobility means, we conducted a survey on mobility motives based on previous literature (Hahnel, Gölz, & Spada, 2014; Steg, 2005). The sample of this survey consisted of 503 participants with a driver's license currently living in Switzerland (only German part). As a first step of our analysis, we conducted a confirmatory factor analysis on our measurement of consumers' global mobility motives. The second step consisted in predicting purchase intentions of a battery-electric vehicle, a hybrid-electric vehicle, a fuel-efficient car, an electric bike, a public transport ticket (Generalabonnement, GA) and a SUV with environmental, status, financial, independence, safety, and hedonic mobility motives. Please refer to Appendix 9.1 for short descriptions of the mobility products provided to the participants. Purchase intention options were not designed to be exclusive, which means that a purchase intention of a "Tesla X" would lead to the report of purchase intentions for a battery-electric vehicle and a SUV. The impact of motives on purchase intentions was first evaluated across the different mobility means. Then, the impact of motives was compared within each mobility mean by comparing it with the impact of other important predictors of purchase intentions, like demographic and prior ownership variables.

Motive analysis: Results

The confirmatory factor analysis validated that the adapted items from prior research on mobility motives and purchase intentions were reliable measurements of the respective psychological constructs. The raw distributions of the variables for the entire sample of consumers gives interesting insights into the self-reported mobility motives of Swiss consumers and their purchase intentions (see Figure 2).

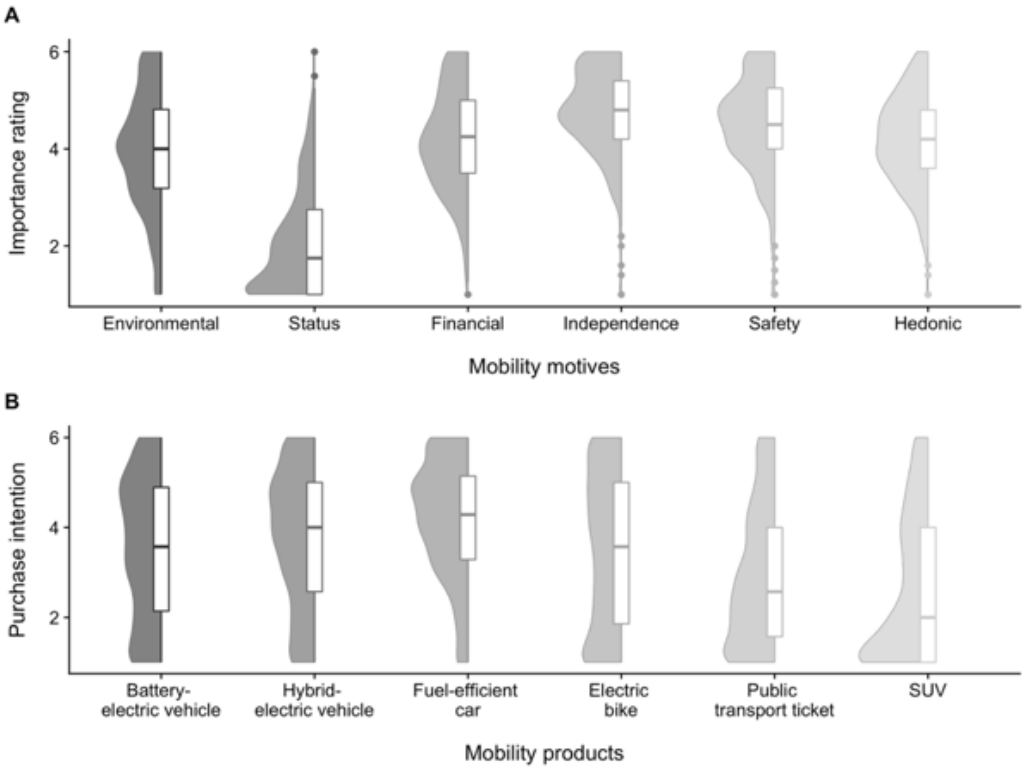

Figure 2: A: Participant's importance ratings of the respective mobility motives on a scale from 1 - "strongly disagree" to 6 - "strongly agree". B: Participant's intentions to purchase the respective mobility product on a scale from 1 - "strongly disagree" to 6 - "strongly agree". Probability distributions including boxplot with median.

When predicting purchase intentions by mobility motives, environmental motives appeared to be the most important driver for the purchase of most mobility means. Higher environmental motives led to higher reported purchase intentions for all sustainable mobility means and to lower reported purchase intentions of the only unsustainable mobility mean, the SUV. Higher status motives led to higher reported purchase intentions of a SUV. Higher financial motives led to lower purchase intentions of most sustainable mobility means. Higher independence motives led to higher purchase intentions of a fuel-efficient car and to lower purchase intentions of a public transport season ticket (GA). Higher safety motives only led to higher purchase intentions of a public transport season ticket (GA). Hedonic motives did not seem to predict any of the purchase intentions. See Figure 3 for a summary of these results.

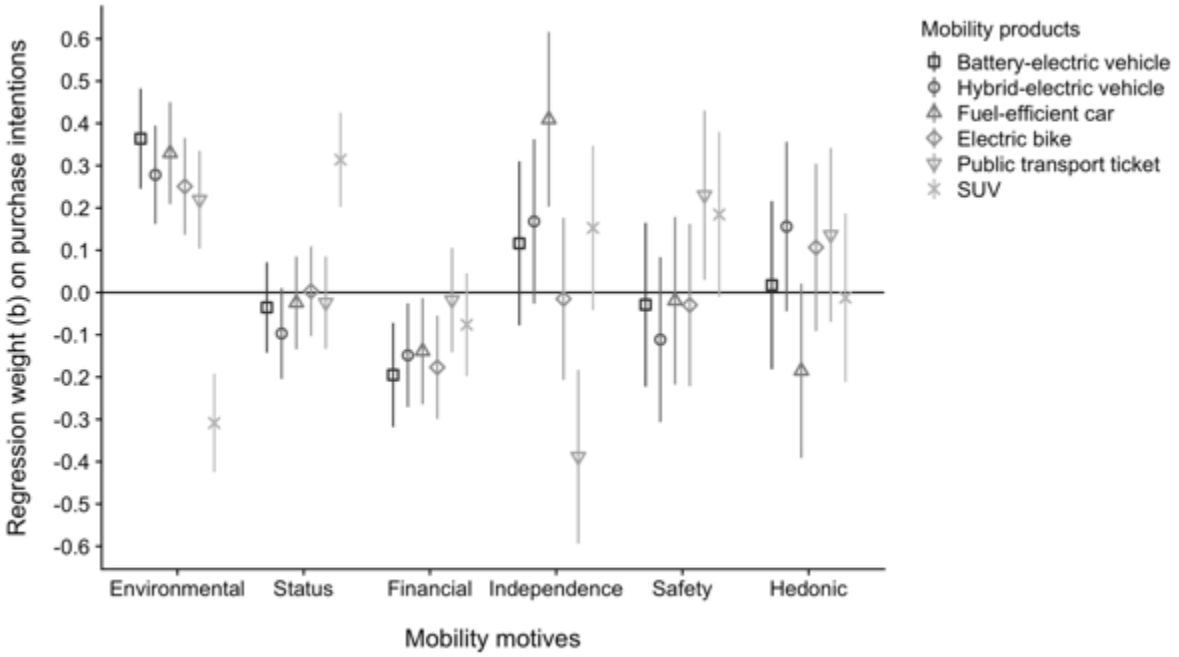

Figure 3: Mobility motive unstandardized regression weights predicting all purchase intentions.

Lastly, the inspection of absolute variance explained by mobility motives and other important demographic and prior ownership variables revealed that the influence of motives, especially relative to prior ownership varied substantially between mobility means (see Figure 4 for the results).

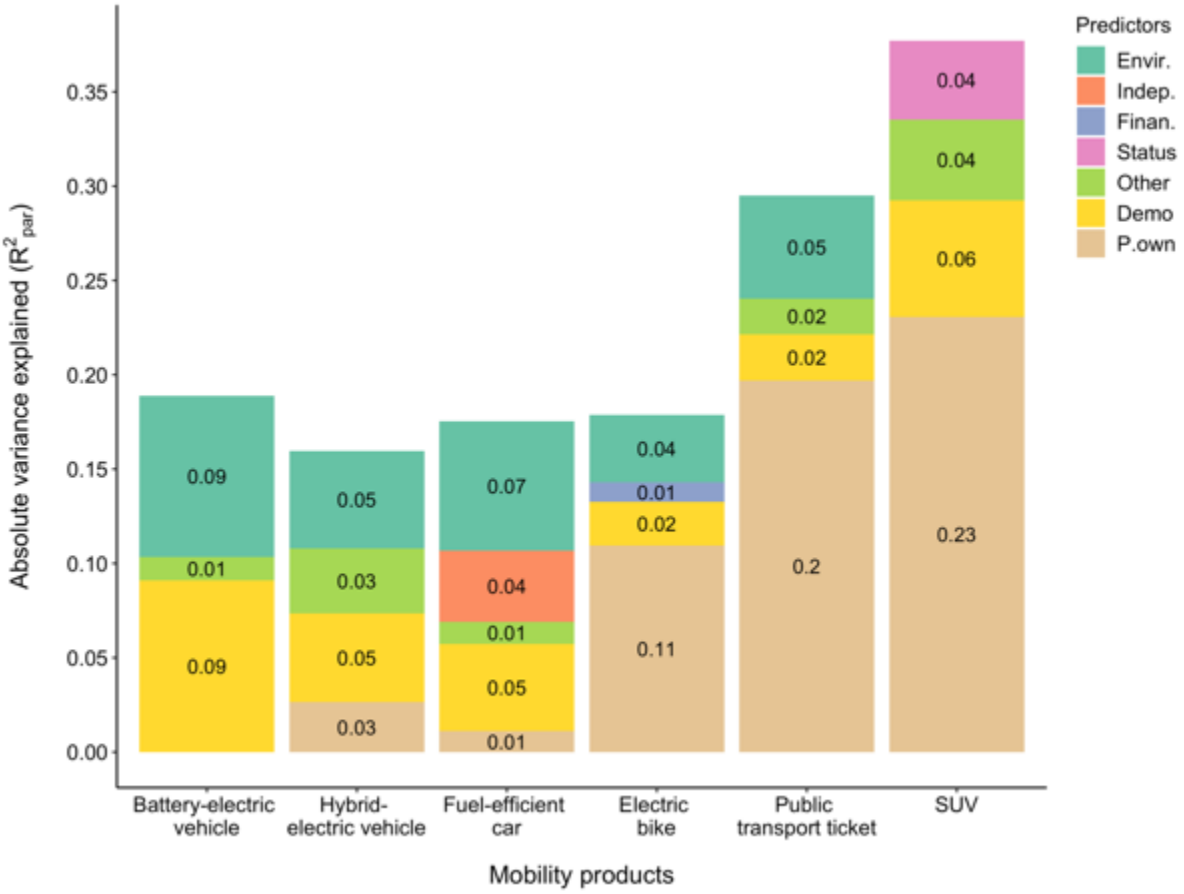

Figure 4: Absolute importance of predictors for mobility product purchase intentions, rounded to two decimals. Envir. = Environmental motive, Indep. = Independence motive, Finan. = Financial motive, Other = Aggregated variance explained by motive predictors < 1%, Demo = Aggregated variance explained by age, gender, education and gross household income, P.own = Prior ownership of the respective mobility product.

3.2 Completed studies Phase 2

3.2.1 Study set-up 1: Laboratory study 1 (Status effects)

We conducted an experiment to investigate the relationship between status aspirations, political ideology, and environmentally relevant consumer choices of car configurations. In the literature, status aspirations have been identified to both promote environmental (Griskevicius, Tybur, & Van den Bergh, 2010) and luxurious (Kim, Park, & Dubois, 2018) car choices. While the promotion of environmental choices has been successfully promoted with a general status goal activation, this study aimed to analyze whether the interaction of political ideology and the differentiation between status advancement and status maintenance goals found for luxurious choices (Kim et al., 2018) also applies in the context of environmental choices. Specifically, we manipulated via a priming task the activation of status maintenance and status advancement goals (vs. control group) and measured how this influenced participant's choice of environmental (vs. more luxurious) versions of car components in a hypothetical car purchase situation.

As a preceding step to this experiment, we examined data from the Swiss Household Energy Demand Survey (SHEDS, $N = 5413$, disregarding missing data; activity of the Competence Center for Research on Energy, Society, and Transition, CREST) that served as the foundation of the subsequent laboratory experiment.

In the SHEDS survey participants were asked the following questions:

- Many people use the terms "left" and "right" to distinguish between political orientations. Below, you see a scale that goes from left to right. When you think about your own political opinions, where on this scale would you place yourself? Scale options: 1 – extremely left to 8 – extremely right)
- How strongly do the following statements apply to you? Scale options: 1– does not apply at all 7 – applies very strongly):

  Status maintenance goal

  - "I make an effort to maintain my current social standing"
  - "It is not important for me to maintain my current social standing.

  Status improvement goal

  - "I strive to improve my current social standing"
  - "I never think about how to improve my current social standing"

  Social stability preference

  - "I don't like when the social order changes too rapidly around me"
  - "Seeing too many changes in society tends to make me worry"
  - "Too many changes and reforms to the current social structure makes me feel uneasy"

In addition to the above-listed questions, we computed a measure of participants' socio-economic status from their levels of education and their gross household income (see Kim et al., 2018 for this approach) and asked participants to report how much fuel their current car consumes in liters per 100 km.

In the main study, we first asked participants to rate on a scale from 1 – not at all to 7 – absolutely how environmentally friendly, luxurious, attractive, new, exciting, and expensive they considered a set of car components. The car components were tires, lights, seats, painting, GPS navigation, cladding, windows, sensors, driving mode, and type of engine. All components were separately presented in a more ecologic version and a more luxurious version that both were briefly described in maximum two lines (see Appendix 9.2 for exact wordings). Participants were then presented with three different texts that encompassed (i) the experimental manipulation status maintenance, (ii) the experimental manipulation status improvement as well as (iii) the control condition. After being allocated to one of the three aforementioned conditions participants were asked how much they felt that the texts activated their status maintenance goals, status improvement goals, general status goals, arousal, positive emotions, and negative emotions. Finally, participants had to make a choice between the ecological version and the luxurious version of three car components. These three components were individually selected based on the ratings provided by the participants at the

beginning of the experiment. Each participant had to make a choice for those three car components for which the difference between the ecological rating of the ecological version and the luxurious rating of the luxurious version was smallest. Please refer to the Appendix for the used study material.

Laboratory Study 1: Results

The results from the analysis of the SHEDS survey indicate that there is a relationship between political ideology and the reported amount of fuel consumption of the possessed car. Unfortunately, the measurement of status maintenance and status advancement goals was not recorded in a methodologically sound way[1]. We are still in the process of determining if this data can be used for our analysis. Raw correlation between the variables recorded are depicted in *Figure 5*.

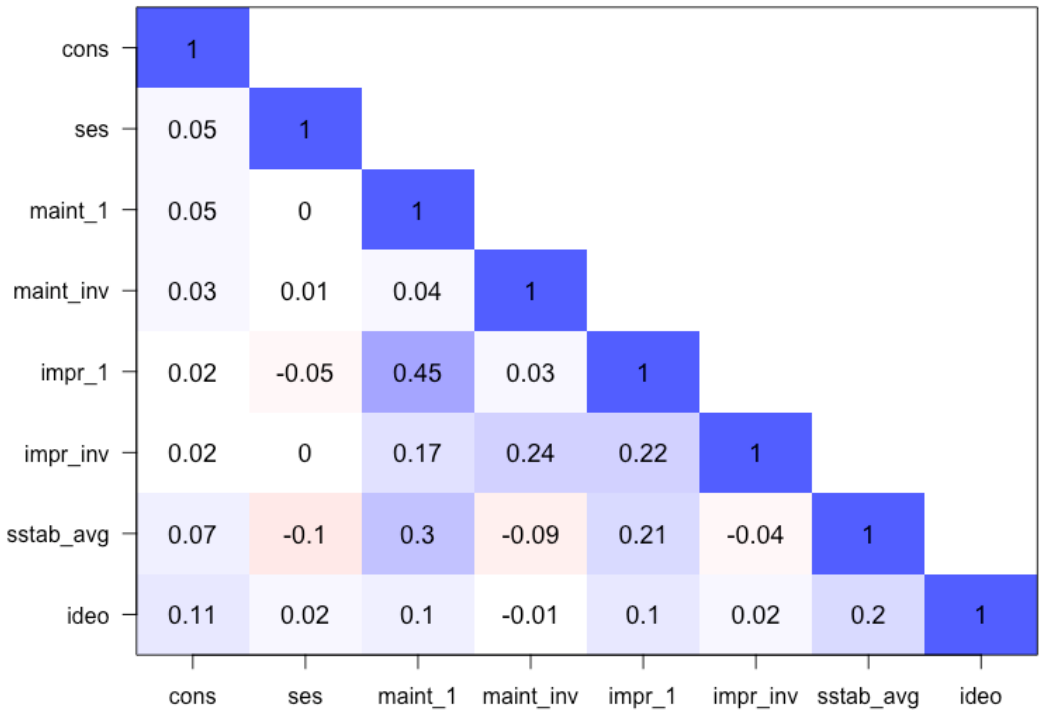

Figure 5. Raw Pearson correlation coefficients between all variables recorded in the SHEDS survey. Abbreviations: cons – fuel consumption in liters / 100 km, ses – socio-economic status, maint_1 – status maintenance item 1, maint_inv – status maintenance item 2, impr_1 – status improvement item 1, impr_inv – status improvement item 2, sstab_avg – social stability preference items averaged, ideo – political ideology.

However, a linear regression with political ideology, socio-economic status and the interaction term of both as predictors and reported fuel consumption as dependent variable was conducted with all available complete cases ($N = 2782$). The results indicate that political ideology significantly predicts fuel consumption, $t(2778) = 5.61$, $p < .001$ in that stronger political conservatism is associated with the possession of a more fuel consuming car.

[1] We measured status maintenance and status advancement goals with two items each, one of them inversed. Correlation of the item-pairs measuring both goals were equal to r = .04 for status maintenance and r = .27 for status advancement. This indicates that the items did not measure the same psychological construct, which is why we decided to not use this data for our analysis.

The hypothesized interaction of political ideology and socio-economic status was not significant, $t(2778) = 1.61$, $p = .107$. However, the correct calculation of socio-economic status is still in process. Descriptively, the relationship of politically ideology and fuel consumption was stronger for participants with a higher socio-economic status than for participants with a lower socio-economic status, albeit statistically non-significant. The results thereby partly confirm the results of Kim et al. (2018).

The results from the laboratory experiment showed that more environmental car-configurations (e.g. LED lights) were evaluated as more environmentally friendly than luxurious car-configurations (e.g. Xenon lights). Conversely, more luxurious configurations (e.g. Xenon lights) were evaluated more luxurious than environmental configurations (e.g. LED lights). Only double-paned windows were not rated more environmentally friendly than luxurious (see Table 3 for an overview of the results).

Additionally, our manipulation that was intended to activate status maintenance goals led to the hypothesized activation. That is, after the experimental activation of status maintenance goals, participants reported to have stronger status maintenance goals as compared to the others conditions. The manipulation that was supposed to active status advancement goals, however, did not result in differential activations of status maintenance and status advancement goals. The results are depicted in Table 2.

The analysis of the choice tasks that constituted the last part of the experiment is still in process. The results will provide important insights into the effectiveness of status activation as a nudge in order to promote more fuel-efficient car purchases. The findings can be translated into nudging interventions in practice, for instance conveyed by advertisement.

Table 2. Reported activations after the experimental manipulation of status maintenance and status improvement goals and control condition

Exp. condition	act_main	act_enh	act_sta	arousal	emopos	emoneg	pol.ideo
Control	1.61	1.61	1.67	1.76	3.28	1.62	5.60
Maintenance	4.49	3.78	4.49	2.46	3.98	2.36	5.64
Improvement	3.44	3.70	4.10	1.94	2.84	2.86	5.50
t-test contrast Main&Impr	< .001	.80	.13	.056	.001	.155	.70

Note. T-tests were computed with experimental condition as independent variable and the following dependent variables: act_main - status maintenance activation, act_enh – status improvement activation, act_sta – general status activation, emopos – positive emotion activation, emoneg – negative emotion activation, pol.ideo – political ideology.

Table 3. Activation ratings of all car components in both versions: ecologic and luxurious

	ecological tires	luxurious tires	ecological lights	luxurious lights	ecological seats	luxurious seats	ecological varnish	luxurious varnish	ecological GPS	luxurious GPS
Ecologic	5.53	1.91	5.69	3.41	5.33	2.28	5.53	2.61	5.09	3.47
Luxurious	3.31*	4.85*	3.98*	4.23*	4.35*	5.30*	3.81*	4.69*	3.21*	4.02*
Attractive	5.08	2.77	5.40	3.69	4.93	3.81	4.95	3.73	4.75	3.96
New	4.69	2.84	5.21	3.49	4.44	2.62	4.75	2.74	4.29	2.99
Excitement	3.55	3.11	4.19	3.45	3.91	3.31	4.00	3.49	3.75	3.39
Expensive	4.63	5.76	5.09	4.99	5.29	5.59	4.95	5.07	3.60	4.35

	ecological cladding	luxurious cladding	ecological windows	luxurious windows	ecological sensors	luxurious sensors	Eco-drive mode	Sports- drive mode	Electric engine	Sports engine
Ecologic	5.27	2.79	4.93	2.91	5.31	3.51	5.47	1.81	5.29	1.72
Luxurious	3.69*	4.99*	4.66	4.36*	3.34*	5.03*	3.56*	4.31*	3.99*	4.56*
Attractive	4.33	3.62	4.61	3.54	4.64	4.77	4.79	3.15	4.71	2.86
New	4.29	3.45	4.75	2.34	2.94	3.19	3.94	2.57	4.02	2.31
Excitement	3.55	3.46	3.74	3.13	3.29	4.08	3.86	3.27	3.92	3.17
Expensive	4.56	5.27	5.30	4.55	4.02	5.09	4.15	4.78	5.35	5.51

Note. Average ratings on a scale from 1 – “not at all” to 7 – “absolutely". Significant difference between ecologic and luxurious rating pairs are signaled with an asterisk ($p < .001$ *). Please refer to the Appendix for complete descriptions of the car components.

3.2.2 Study set-up 2: Online study 1 (Bundling of EVs and additional services)

The vehicle purchase process survey conducted as a complementary step of this project generated a broad range of insights. One key finding was that the complexity of charging represents one of the major barriers to EV sales. To illustrate, it was selected by 32.6% of respondents, making it the third most important reason against a potential EV purchase (after the high price of the vehicle (72.7%) and not a sufficient range of EVs (40.1%), a reason related to the perception of the lacking charging opportunities for EVs) (for the most important reasons against car purchase, see Figure 6) (Plananska, 2019).

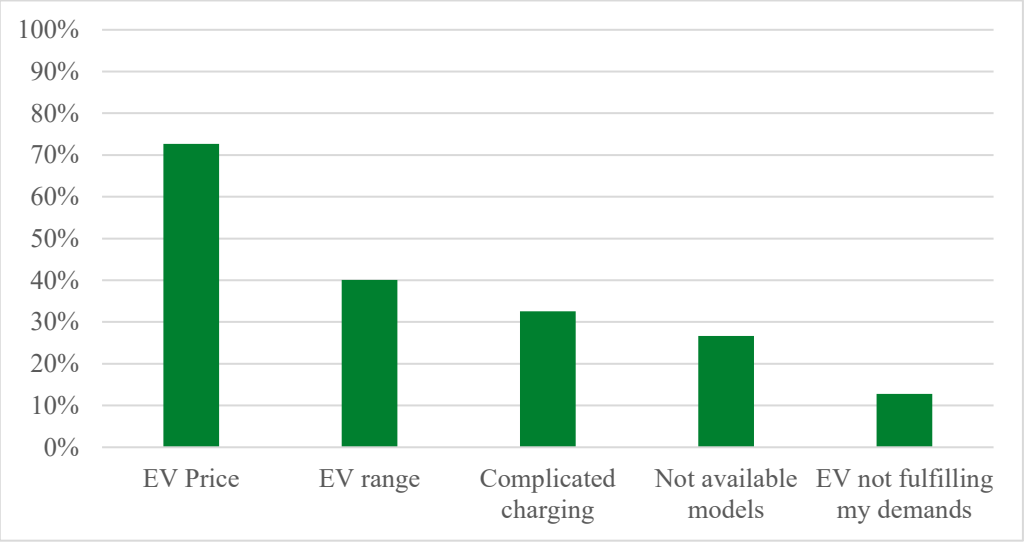

Figure 6. Most important reasons against the EV purchase, survey (Plananska, 2019).

The complexity of pro-environmental behavior has been identified as one of the major barriers to more sustainable consumer decisions (Heinzle & Wüstenhagen, 2012; Hjelmar, 2011). A plurality of strategies has been suggested to tackle it, one of them being the bundling of different products and services. Bundling is a very common marketing strategy in many fields, ranging from food options, sports and entertainment to IT products (Johnson, Herrmann, & Bauer, 1999; Sharpe & Staelin, 2010) and it has been increasingly discussed in view of EV purchases (Aggeri, Elmquist, & Pohl, 2009; Bernhart, Zhang, & Wagenleitner, 2010). The main idea of this study was to combine EVs with a plurality of services at the point of sale, most importantly charging. The aim is to overcome the complexity for customers that otherwise have to organize the operation of the EV on their own (i.e. to search for information on charging, potentially set-up a private charger or get access to a public charging network etc.).

Our online experiment tested the role of bundling on EV interest and EV purchase willingness. Concretely, it consisted of a between-subject online experiment, with one control group and two experimental groups. In the Experimental Condition 1 participants were presented with individual components needed to operate an EV, highlighting that they are delivered by a plurality of individual providers separately. These were namely a private charging station with an app, an installation of the private charging station, access to the public charging network and a green electricity certificate (see Figure 7, left figure) shows these individual components. In the Experimental Condition 2 participants were presented with a bundle combining all these individual components in one convenient package (see

Figure 7, right figure). In an additional control group, participants did not see any of the two options (single components or bundle). After exposure to either experimental condition or none (for the control group), respondents answered a variety of questions (interest in EV and EV purchase willingness, both measured on a seven-point Likert scale from 1 - not at all (interested) to 7 – very much (interested)). Additionally, a choice-based conjoint (CBC) analysis was conducted to determine the values attached by potential customers to individual components of the bundle.

The experiment was conducted in August and September 2019. Data collection finished mid-September 2019. The total sample was 313 participants, representative of the Swiss average in terms of age, sex and linguistic regions (the survey was run in German and French). The condition to participate was to be older than 18 years old and to possess a driver's license.

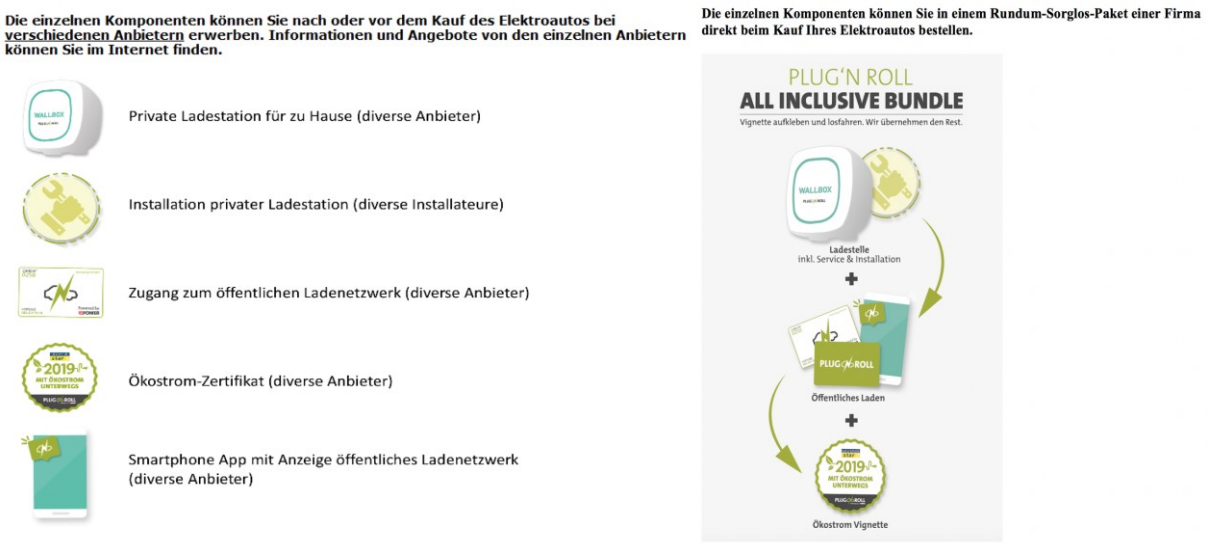

Figure 7: Online study 1: Experimental condition 1: Individual components (left); Experimental condition 2: Bundle (right)

Online Study 1: Results

Since the data collection finished mid-September 2019, the analysis is still ongoing. Yet, the preliminary results already show that highlighting the complexity of EV operation decreases EV purchase willingness whereas the provision of a bundle increases it. While the interest in EV in general increased for both experimental conditions compared to the control (M=4.87 for the control group, M= 4.96 for the Experimental Group 1 that was exposed to individual components and M=5.03 for the Experimental Group 2 exposed to the bundle), the EV purchase willingness decreased for the Experimental Group 1 compared to the control group (M=5.08 for the control group and M=4.93 for Experimental Group 1). As expected, the EV purchase willingness increased for the Experimental Group 2 (M=5.17). See Figure 8 for graphical illustration of the recorded scores.

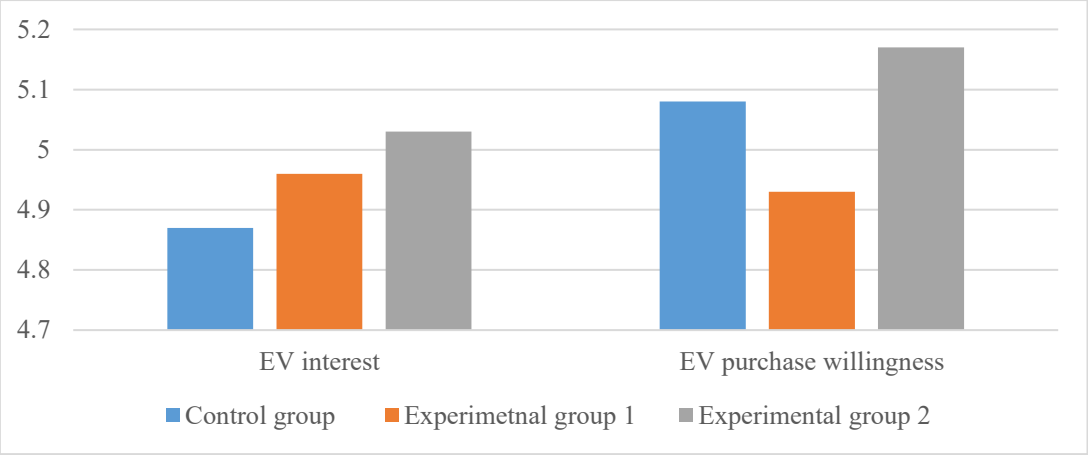

Figure 8: EV interest and EV purchase willingness of 2 experimental and control group. Experimental Group 1 was exposed to the different components individually, Experimental Group 2 to them in the form of a bundle.

Furthermore, a choice-based conjoint analysis (CBC) was run to determine the subjective utilities of bundle components. Besides the components tested in the experimental conditions, an app to operate the private charging station, battery-assistance and an insurance of the EV were included in the CBC. The first results show that the insurance is overall the most important component for potential customers, followed by including installation of a private charging station and a green electricity certificate. On the contrary, the aspects that were valued by the potential customers the least were the app for a private charging station, battery-assistance and access to a public charging network. Nevertheless, what has to be pointed out is that the scores were all very close to each other, especially for access to public charging network, price, green electricity certificate and installation, that all ranked between 14.11% and 15.82% of importance, respectively. These results are especially important for the field-test that is currently under preparation. By showing the most important components of the bundle for potential customers, the results indicate which aspects might be included in the bundle tested in the field study and which not.

The data analysis is ongoing, including regression analyses with the aforementioned individual stimuli and the dependent purchase intention and interest variables as well as the willingness to pay for individual components of the bundle (these analyses are planned to be studied first). The results of the final data analysis – which will be the basis for the field-test – are expected by the end of October/beginning of November 2019.

3.2.1 Study set-up 3: Online study 2 (Social norms)

The first phase of the project together with the results of the vehicle purchase process survey also revealed the important role of peers and social norms on fuel-efficient car purchases. To illustrate, family and friends were the four most important information source for the respondents of the vehicle purchase process survey when they were searching information in relation to their last purchased car (after test drives, personal discussions with car dealers and website of the car brand; (Plananska, 2019). Secondly, the research on the role of social norms on EV purchases likewise points to the important role of social norms on EV

purchases. With the literature still emerging, two notable contributions to mention here are the studies of EV adoption processes in Germany (Barth, Jugert, & Fritsche, 2016) and Sweden (Jansson, Nordlund, & Westin, 2017). None of the contributions to date has however looked into the ways how the role of peers and social norms can be exploited to develop effective social norms based on nudging techniques to promote fuel-efficient and EV sales.

To fill this gap in research, this online experiment aims to study the role of social norms on the willingness to purchase EVs. Concretely, descriptive dynamic social norms were tested in the present study. While the role of descriptive static social norms has received more attention in literature in the past, descriptive dynamic social norms have been proven to be more effective to promote pro-environmental behavior (Sparkman & Walton, 2017). Moreover, since the pro-environmental behavior of adoption an EV is only emerging, it does not constitute a norm in the society. Consequently, focusing on the current (i.e. static) norm is not effective in motivating more people to uptake this new behavior. In contrast, descriptive dynamic social norms have the power to motivate an adoption of EVs since these norms highlight the currently changing behavior and potential future standard in the society for which people might be motivated to strive (Sparkman & Walton, 2017). The norms tested in this study were related to the Roadmap Elektromobilität (UVEK, BFE, & ASTRA, 2018) highlighting either the target of 15% of newly registered cars in Switzerland by 2022 to be electric (Experimental Condition 1, see Figure 9, left part) or the expected important growth of charging infrastructure (Experimental Condition 2, Figure 9, right part). It has been decided to focus on these aspects due to the ongoing discussion in the literature and practice, questioning whether it is more effective to focus EV support measures on EVs or the charging infrastructure (Flammer, 2019; Langbroek, Franklin, & Susilo, 2016; Stadt St.Gallen, 2019). Consequently, such a study would deliver important contributions to both academia and practice. The investigation of the relevance of descriptive dynamic social norms could be extended by adding (dynamic) injunctive social norms that indicate future goals that are defined, for instance, by governmental authorities.

Online Studies 1 and 2 were conducted together. As a result, the conditions for participation were identical, resulting into the shared sample of 313 Swiss respondents representative of the Swiss adult population in terms of age, sex and linguistic regions.

Figure 9: Online study 2: Experimental condition 1 - Focus on EVs (left), Experimental condition 2 - Focus on charging infrastructure (right)

Online Study 2: Results

Data collection finished mid-September 2019. The researchers decided to firstly analyze the data of the Online Study 1, also since the final set-up of the field-test will depend on them. Consequently, at the point of the writing this report, the data of the Online Study 2 has been prepared for analysis, yet they await deeper analysis. The results are expected to confirm the hypothesis of the research, namely a positive impact of social norms on EV purchase willingness.

3.3 Planned studies Phase 2

3.3.1 Study set-up 4: Field study (Bundling of EVs and additional services)

A field study to test selected nudges in a real-life setting and thus to give them further external validity has been planned since the beginning of the project. Building on the results of the Online Study 1, a field study with Repower as project partner has been in preparation.

The Online Study 1 has tested the role of the bundle of EV and charging services (i.e. private charging station and its installation, access to the public charging network and a green electricity certificate) on EV interest and EV purchase willingness. Secondly, by the means of CBC analysis, it also assessed the utility and the willingness to pay for individual components of the existing bundle and additional components, namely an app to operate the private charging station, an insurance as well as a battery assistance on the battery of the EV.

Based on the final results of the online study, the currently offered bundle (that was tested in the online study) will be revised by the company. Such a revised bundle will then become the basis for the field-test.

The discussion between UNISG team and the project partner Repower on the set-up and timing of the field-test are currently ongoing. The field-test is preliminarily planned to start in winter 2019 - 2020, yet changes in the schedule depending on the availabilities of project partners and further progress of the project might happen. So far, it has been planned to be run as a 2-3-month field trial, including UNISG, the Repower team and 2-3 selected car dealers that would be offering the bundle of an EV and charging services. The identification of potential car dealers to collaborate with is ongoing. The project is planned to be kicked-off by an open day at the car dealers with all project partners on board. However, the concrete set-up of the field-test, including timing and content, will be finalized when all project partners, including car dealers have finally agreed to take part in the field trial.

3.3.2 Study set-up 5: Laboratory study 2 (Unit effect)

Building on the results obtained as a first test of a nudge, reported in the annual project report in 2018 (section 4.6.1 Transition to phase 2: A first test of a nudge), we aim to extend this line of research and thereby test further nudges on information presentation in the context of fuel-efficient car purchases. A broad field of literature has investigated how the presentation of environmentally relevant product information (such as fuel consumption or CO_2 emissions of cars) can influence consumer choices (Haq & Weiss, 2016). But although policy makers agree that the revelation of such information is crucial so that consumers can make informed decisions, there is an ongoing discussion about how much or how little information can still

be integrated by the consumer (Cheng, Ouyang, & Liu, 2019; Ungemach, Camilleri, Johnson, Larrick, & Weber, 2017). In the extension of our investigation if the fuel consumption of EVs is more easily understood when presented in terms of fuel equivalence / 100 km compared to the more common kWh / 100 km, we want to investigate if the familiarity with a given unit of measurement can be an useful guideline to make the choice of which information to display on energy labels. We aim to test this hypothesis in a set of experiments that aim to contrast how easily consumers integrate the same information presented in different forms (e.g. grams CO_2 emissions, CO_2 ratings).

It is of particular interest how different extents of familiarity with the forms of presenting the efficiency of cars impacts consumer evaluations. Following general evaluability theory (Hsee & Zhang, 2010), stronger knowledge about the distribution of a given attribute (e.g. the fuel consumption of a car in liters / 100 km) should lead consumers to be more sensitive to value differences. This means that consumers perceive equivalent numerical differences as larger if they are more familiar with an attribute presentation (e.g. liters / 100 km) and as smaller if they are less familiar with a given attribute presentation (e.g. kWh / 100 km). We hypothesize that this finding does not only hold for the comparison of fuel consumption in liters or kWh, but also extends to other common forms of presenting efficiency or fuel costs of cars. For example, it can be argued that CO_2 emissions presented in terms of grams / 100 km are relatively useless to present the environmental impact of a car, because consumers are completely unfamiliar with this unit of measurement. In contrast, consumers are more familiar with annual fuel costs and the consumption of fuel in liters, which might enable them to evaluate energy efficiency of a car more easily and accurately. Consumers are also quite familiar with energy-efficiency ratings (A-F), which are also used for other product categories. However, research has shown that this information is biased (Hille et al., 2016), which is why we will as a start focus on the other information present on many car energy labels. A sketch of the experimental design set-up that will be used for this investigation in *Figure 10*.

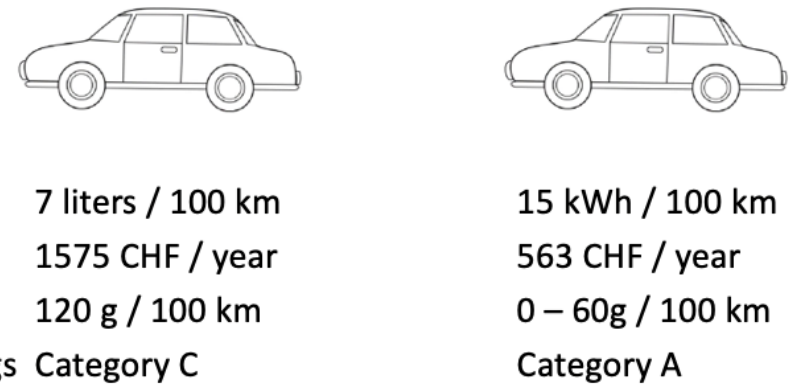

Figure 10. Sketch with example values of how the experimental set-up of laboratory study 2 will look like.

4 Evaluation of the results to date

The results of the current progress of Project Phase 2 are very promising. They deliver important insights into the effectiveness of specific nudging techniques for the transportation domain and thus can inform theory and practice. Further, the current findings provide important input for further analyses and conclusions that will be inferred in Project Phase 3.

The results of the *vehicle purchase process analysis* show the complexity of the vehicle purchase process that has to be considered by policy makes when implementing their interventions to promote fuel-efficient car sales. Namely, policy makers have to navigate within individual touchpoints that have been identified in the process analysis. Policy makers always have to be aware what they want to achieve and which group of potential customers they want to target by individual interventions. Furthermore, the survey revealed a critical role of car dealers on car purchases and a plurality of information sources on EV consideration. On the contrary, car dealers have been shown to still remain one of the major barriers to EV sales. Building on these results, policy recommendations incorporating nudging techniques have been suggested. Specifically, fostering of the consultation of a plurality of information sources in the search phase (Touchpoint 2) and EV car dealer training programs in the alternative evaluation phase (Touchpoint 3) were recommended for implementation.

The results of the complementary *mobility motive analysis* provide important insights for the development of effective nudging interventions to promote fuel-efficient car purchases. First, we could confirm the importance of environmental motives for purchase intentions of sustainable mobility options, encompassing multiple fuel-efficient cars, in a Swiss sample. This insight can be used to construct nudges that emphasize the environmental attributes of fuel-efficient mobility means in order to promote them. Labeling could be an effective tool to convey such environmental cues. Second, we identified status motives as important driver of purchase intentions of unsustainable mobility options, like the currently very popular but environmentally unfriendly SUVs. Since many consumers rely on the possession of a car in general, this insight is very important to understand why participants choose this less sustainable option over a more sustainable one. By constructing nudges that emphasize the status advantage of more environmental mobility means, the purchase of more fuel-efficient cars might be boosted. Advertisement can be an effective tool to convey the status advantages of energy efficient cars, given the increasing relevance of environmental issues in times of rapidly progressing climate change. Lastly, we revealed that the influence of prior ownership of a given mobility options on future purchase intentions varies substantially across mobility means. While the purchase of SUV, public transport season ticket (GA) and electric bikes seems to be influenced strongly by prior ownership, purchase intentions for fuel-efficient or alternatively powered cars were less affected by ownership. This finding should encourage policy makers to take an active part in establishing sustainable purchasing habits in consumers, notably towards fuel-efficient cars, for example through the means of nudging as an initial change in behavior can result in environmentally friendly habits across time.

The described results from *Laboratory Study 1* seem to be promising. The priming activation of status goals seems to be at least partly successful and the stimulus material that we designed seems to distinguish clearly between luxurious and environmental configurations of a set of different car components. The results of the choice tasks will reveal if the activation of different status goals (maintenance vs. advancement) as a nudge included, for example in advertisement, is a promising means to either reduce consumer's likelihood to configure their car in a luxurious way and/or to increase consumer's likelihood to configure their car in an environmental way (i.e., increasing the car's fuel efficiency).

The described results of *Online Study 1* confirmed the expected negative influence of complexity on EV purchase willingness. However, providing a solution to this complexity in the form of a bundle of EV and charging services substantially increased both, EV interest and EV purchase willingness. Secondly, the CBC analysis illustrated the importance potential customers assign to additional components of the bundle, namely the insurance, installation of a charging station and the green electricity certificate. These results are of critical importance, showing the role of cross-sectoral partnerships for better EV promotion (i.e. inclusion of services of additional actors in addition to original equipment manufacturers, OEMs). In this respect, the results are aligned with the measures and goals of the Roadmap Elektromobilität, suggesting deeper coordination of partners and thus reducing the complexity of the emerging electric vehicle sector in Switzerland (UVEK et al., 2018).

The described results of Online Study 1 are also of a critical importance for the planned *Field Study*, which will be run with the same project partner. It will build on the final results of the Online Study 1, thus giving the tested bundling nudge higher external validity and bringing more refined results to the present project.

The *Laboratory Study 2* on the relevance of provided product information has been set-up and data collection of the *Online Study 2* on the impact of dynamic social norms for fuel-efficient car purchases has been completed.

To sum it up, the project year 2019 has accounted a considerable advancement in the development and evaluation of nudging interventions for the purchase of fuel-efficient cars. Both complementary investigations of the vehicle purchase process and consumer mobility motives have been successfully completed. They have laid the foundation for the investigation of the most promising nudging interventions identified. The vehicle purchase process analysis led to the development of the Online Study 1 on the effectiveness of product bundles on EV interest and EV purchase willingness and the Online Study 2 on the role of social norms on EV purchase willingness. The data collection of these two studies was completed in mid-September 2019. Preliminary results of the Online Study 1 show the positive effect of bundles of EV and charging services on EV purchase willingness; data analysis of the Online Study 2 is ongoing. The final results of the mobility motive analysis led to the development of Laboratory Study 1 on the importance of status goal activation, for which data collection was completed in Summer 2019.

Building on these results, the project team will run two additional studies until the beginning of 2020 (Milestone April 2020). Specifically, the research team will complete data collection of Laboratory Study 2 investigating the unit effect on consumer car choices and the Field Study that will test the positive role of bundles of EVs and charging services on EV purchase willingness observed in the Online Study 1 in a real-life setting.

Besides data generated in individual Online and Laboratory Studies, the project has generated a variety of additional insights during regular exchanges between members of the project and beyond, for instance through the established network of the SCCER CREST and SCCER Mobility. Internal collaboration was ensured by frequent virtual meetings as well as an intermediate project meeting in June 2019. Moreover, attached bachelor and master theses further enriched the knowledge of the topic of the role of nudges on fuel-efficient car purchases in Switzerland. Besides the master thesis discussed in the last Annual report, a bachelor thesis on the role of dynamic social norms on acceptance of e-mobility in Switzerland was submitted in May 2019 at the University of St.Gallen. Two additional theses relative to the project are run at the University of St.Gallen, namely a bachelor thesis on the topic of injunctive social norms on EV acceptance in Switzerland and a master thesis

analyzing differentiated social media presence of individual car manufacturers in view of the share of EVs they have in their portfolio. The UniGE team offered a position for a master thesis at the University of Geneva and is currently seeking students for working on nudging-interventions leveraging the power of product information presentation in the context of purchase decisions.

5 Next steps

After the successful end of the Project Phase 1 and in light of the progress made in Project Phase 2, the project team is confident to complete Phase 2 according to all project requirements and to successfully proceed to the finalization of the project in Phase 3. In the next months, the project team will further analyze the retrieved rich data from the various described studies and will work on additional nudges for the transportation sector. In order to jointly discuss the upcoming steps of the second part of Phase 2, the project team will meet in October 2019. This event will also allow to define the final study set-ups as well as additional future dissemination strategies. Thus, the project team is positive that the current findings will be further extended and that new beneficial insights on how to promote purchases of fuel-efficient cars through nudging will be generated in the upcoming months.

6 National and international cooperation

Repower AG – electric utility with headquarters in Grabünden. Cooperation on the Online Study 1 and the Field Study. The company has developed a bundle of charging services, that was tested in the Online Study 1. The bundle enriched by the results of the Online Study 1 will feed into the Field Study, that is currently being planned between UNISG, Repower and additional partners (mainly car dealers).

Consumer Barometer of Renewable Energy (KUBA), 2020 – an annual survey of energy preferences of Swiss consumers run by the Institute for Economy and the Environment of the University of St.Gallen (IWÖ-HSG). The survey is very extensive, including more than 1000 respondents. UNISG plans a potential cooperation with the 2020 edition of the survey by adding questions of interest to the present project to the survey. Thus, additional data from a representative and comprehensive sample of Swiss consumers could be gathered.

7 Publications & communication

The project has been presented at the various scientific and practice-related conferences and events (Please see below for a detailed list of contributions). In addition, the project has been presented regularly at the REMforum, the annual conference on the Renewable Energy Management organized by the Institute for Economy and the Environment of the University of St.Gallen (IWÖ-HSG). The project was initially presented in a workshop in June 2018. This workshop, titled “Nudging consumers towards electric mobility”, mainly aimed to inform the participants about the project content and to get the first input for project phase 1. In June 2019, we conducted another workshop at REMforum, focusing on the touchpoints for e-mobility. Inviting a car manufacturer and a social media expert as speakers, the

workshop discussed what touchpoints would be the most effective to promote EV sales in Switzerland. With many different stakeholders participating in the workshop (such as representatives of Norwegian EV association, consumer representatives, media), the discussion was very interesting, centering around the role of car dealers on the purchase process. In the coming REMforum (April 2020), another workshop is planned to be organized, aiming to discuss the role of bundling on EV purchases. The workshop is still under development. Project partner (Repower) and SBB representatives are planned to be invited as workshop speakers, to talk about the bundles implemented by them (namely the bundle of EVs and charging services on which UNISG works with Repower as part of the present project and SBB Green class). The goal of this workshop will be to analyze, if and how bundling can be used as a strategy to promote EV sales in Switzerland.

List of contributions 2019 (January to September)

Herberz, M., Hahnel, U. J. J., & Brosch, T. (submitted, 27.09.2019). The importance of consumer motives for green mobility purchase intentions: An integrated view. *Journal of Consumer Behavior.*

Herberz, M., Hahnel, U. J. J., & Brosch, T. (2019, September). Increasing willingness to pay for alternative fuel cars: Consumer's sensitivity to fuel consumption framing. *Paper presented at the 16th conference of the Swiss Psychological Society, Bern, Switzerland.*

Herberz, M., Hahnel, U. J. J., & Brosch, T. (2019, September). Choice architecture in environmental car choices: Unit familiarity increases sensitivity to attribute differences. *Paper presented at the International Conference on Environmental Psychology, Plymouth, UK.*

Herberz, M., Hahnel, U. J. J., & Brosch, T. (2019, August).Choice architecture in environmental car choices: Unit familiarity increases sensitivity to attribute differences. *Paper presented at the bi-annual Subjective Probability and Utility in Decision Making Conference, Amsterdam, The Netherlands.*

Herberz, M., Hahnel, U. J. J., & Brosch, T. (2019, April). Unit familiarity leads to higher sensitivity to attribute differences: An application to attribute translation of car consumption. *Paper presented at the Tagung Experimentell Arbeitender Psychologen, London, UK.*

Plananska, J. (2019). Touchpoints for e-mobility: Understanding the vehicle purchase process to more efficiently promote electric vehicles *(submitted to the journal Energy Policy on July 24, 2019; currently under review by the editor)*.

Plananska, J. (2019). SCCER Mobility Young Talent Development Webinar Series: Customer acceptance of electric mobility: Vehicle purchase process understanding for a more efficient EV promotion in Switzerland *(presentation at the webinar of SCCER Mobility, March 14, 2019, Zurich).*

Plananska, J.; Gamma, K (2019). Touchpoints for e-mobility: Results from the vehicle purchase process study *(presentation at the workshop "Touchpoints for e-mobility", REMForum 2019; May 24, 2019, St.Gallen).*

Plananska, J. (2019). Touchpoints for e-mobility: Results from the vehicle purchase process study *(presentation at the annual meeting of the B2 Capacity Area of SCCER Mobility, June 28, 2019, Zurich).*

Plananska, J. (2019). Touchpoints for e-mobility: Understanding the vehicle purchase process to more efficiently promote electric vehicles in Switzerland *(poster presentation at the SCCER Mobility Annual Conference, September 6, 2019, Zurich).*

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9 Appendix

9.1 Consumer motives mobility product descriptions (translated from German)

Battery-electric vehicle

An electric car drives exclusively with energy from a battery that is charged with electricity. The local emissions (particulate matter, CO2, etc.) are zero in an electric car, but depending on the electricity used to charge the battery, emissions occur during the production of the electricity. With one battery charge in 2016, the average range of an electric car was 270 km, with up to 450 km possible by 2020. The electric motor enables fast, silent acceleration, but has a lower maximum speed than a combustion engine. Energy generated when braking or "letting roll out" is partially fed back to the battery.

Hybrid-electric vehicle

A hybrid electric car is equipped with both an electric and a combustion engine. The electric motor is used primarily for short distances, thus reducing fuel consumption and local emissions. If the hybrid electric car is mainly used in urban traffic, the faster acceleration and lower consumption of the electric motor are particularly noticeable. For long distances and high speeds, the hybrid electric car uses the conventional combustion engine.

Fuel efficient car

An efficient car has a lower fuel consumption than an average car due to its low weight and efficient engine (significantly less than 5.9 litres of petrol per 100 km, average CH in 2017). An efficient car is usually smaller and has less horsepower than the average car, giving it many advantages especially in urban traffic. Due to the lower fuel consumption, the fuel costs on a given route are significantly lower compared to a larger and more powerful car.

Sports-/Off-road vehicle

A sports/off-road vehicle (e.g. "SUV") is usually larger and often has more horsepower than an average car due to the availability of a four-wheel drive. Due to a high design, the driver's seat is above the level of most cars, so the driver has a good overview of the traffic. Due to a larger weight and a large engine, a sports/off-road vehicle often allows pulling larger loads and driving in rough terrain. Fuel consumption is usually higher than an average car.

Electric bike

An electric bike has a battery powered motor that drives the bike in addition to the rider. The speed of an electric bike that can be achieved without muscle power is a maximum of 30 km/h, while stronger motors can support the rider up to a speed of 45 km/h while pedalling. The average range of a battery charge is 50 - 100 km, depending on the terrain and outside temperature.

SBB yearly pass

The SBB/CFF/FFS General Abonnement (GA) is an annual ticket for which travel by public transport in Switzerland is free of charge for its holder. This means that the start of a journey can be fixed at short notice, making it suitable for a wide range of work and leisure activities. From a certain number of regular journeys, the general season ticket is also a financial advantage.

9.2 Study material Laboratory Study 1

Table A1. Short descriptions of car components in their ecologic and luxurious version.

Car component	ecologic version	luxurious version
Tires	Reduced local emissions due to low-abrasion rubber Reduced consumption due to optimised rolling resistance	Striking race design Sprint technology for rapid start up
Lights	Organic LEDs with Energy-efficiency label A+++ Produced wihtout the use of rare materials	New generation Xenon head lights Striking blue tone
Seats	Designed and produced by regional businesses Textiles from sustainable production	Extra-soft imported leather Integrated seat heating
Varnish	On the basis of robust natural colors Without toxical components	Nobel matted Extra big choice of colour
GPS	Default set-up for fuel-saving routes	Integrated voice control
Cladding	Certified according to eco-standards	Sound insolated for an optimized sound experience
Windows	Double paned, therefore insolted	Opaque tinted
Sensors	Energy saving start-stop automatic (Extinction of the motor at street lights)	Automatic parking system
Drive mode	Eco-mode Optimized for fuel-savings and emission reductions	Sport mode For fast start up and increased driving pleasure
Engine	Electric No local emissions and consumption equivalent to less than 2 liters per 100 km	Turbo diesel High-performance drive with powerful engine noise from a 200 PS 6 cylinder motor