POLICY BRIEF

EVAdopt: De-biasing Electric Vehicle Adoption with Personalized Nudging

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Executive Summary

- While global adoption of battery electric vehicles (BEVs) is increasing slowly, BEV shares in the total vehicle stock remain low; on average BEV represent only 1.5% of all passenger cars in Europe (EU 27 including Switzerland, Norway and UK)
- Economic, financial, technological, and psychological barriers might be responsible for the low adoption rate of BEV.
- Among the psychological barriers to BEV adoption, we identify three main biases on the compatibility between perceived needs and actual use on: 1) Charging times, 2) Range of the battery, and 3) Total Cost of Ownership.

- This project aims to:
1. Quantify the proportions of perception biases for BEV adoption.
2. Evaluate the impact of possible measures addressing these biases in increasing BEV adoption rates.

- To reach these objectives, we implemented a randomized controlled trial (RCT) where participants were assigned to different treatments, received personalized information addressing the biases mentioned above, and were then asked to choose between combustion engine and electric vehicles.

- Our results show striking perceptual biases of car owners across three categories:
  ◊ **Range:** overestimation of range needs.
  ◊ **Charging:** overestimation of charging needs.
  ◊ **Total Cost of Ownership (TCO):** underestimation of the cost advantages of BEVs.

- Results from the RCT reveal that providing personalized information to car owners regarding these three categories significantly increased the intention to purchase BEVs.
- We identify three effective treatments to increase adoption of BEV that can be used by car manufacturers, dealerships, or policymakers

Outline

The widespread adoption of battery electric vehicles (BEVs) is increasing but remains below the necessary levels to significantly reduce transportation-related CO2 emissions by 2030.

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For example, BEV represented only 3.3% of all passenger cars in Switzerland in 2023. Regarding new registrations, 29.3 percent were plug-in vehicles in 2023, while the goal of the Roadmap electromobility is to achieve a share of 50% by 2025. Similarly, in Europe (EU 27 including Switzerland, Norway and UK) the BEV share was only 1.5% in 2022.

Economic, financial, technological, and psychological barriers might be responsible for the low adoption rate of BEVs. Among the psychological barriers to BEV adoption are perception biases 1) Charging compatibility, 2) Range compatibility, and 3) Total Cost of Ownership compatibility.

Many car owners are skeptical that BEVs meet their mobility needs and lifestyle. Tailored communication could help reduce such concerns by addressing psychological biases and be more effective in increasing BEV adoption than broad, untargeted information campaigns.

The present study aims to assess the extent of perception biases linked to BEV adoption through a detailed survey and address them with personalized information treatments to increase the adoption of BEVs among owners of internal combustion engine vehicles.

To this end, we organized a survey with 3,181 UK car owners. In the first part of the questionnaire, we collected information on the extent of perception biases of the individuals in the following categories:

1. **Range compatibility:** the share of car trips within a year that could be completed with a given battery range.
2. **Charging compatibility**: number of charges needed per week for an electric car with a given battery range.
3. **TCO compatibility:** to estimate the total cost of owning and using a compact gasoline car (for example a VW Golf) and a compact electric car (for example a VW ID.3) over a period of four years.

In the second part of the questionnaire, we conducted a randomized controlled trial (RCT) in which participants were asked to hypothetically choose between combustion engines and electric vehicles. The participants were presented with different personalized treatments that targeted three perception biases. The personalized treatments were customized based on the biases identified in the initial questionnaire.

Psychological barriers for BEV adoption

To understand the perception of BEV compatibility with their own behavior and expected costs, respondents were asked to estimate in random order the perceived range compatibility, perceived charging compatibility, and perceived total cost of ownership. Subsequently, to identify respondents actual behavior, they were asked to fill out detailed driving and parking diaries based on their behavior in the year 2022. We used this information to determine actual BEV compatibility with respect to range, charging, and total cost of ownership. Comparing annual mileage from our survey to UK averages, we find that our survey represents driving behavior adequately.

Comparing perceived and actual EV compatibility allows us to identify perception biases. The results of this first part of the survey indicate that:

- Participants tend to overestimate concerns about range compatibility, as shown in Figure 1. Across battery ranges from 70 to 420 miles, they believe the range would be insufficient to cover most of their trips. For instance, with a 220-mile battery range, participants thought they could cover only 75.1% of their yearly trips on average, yet the analysis of their driving behavior indicated they could cover on average 99.99% of all trips.
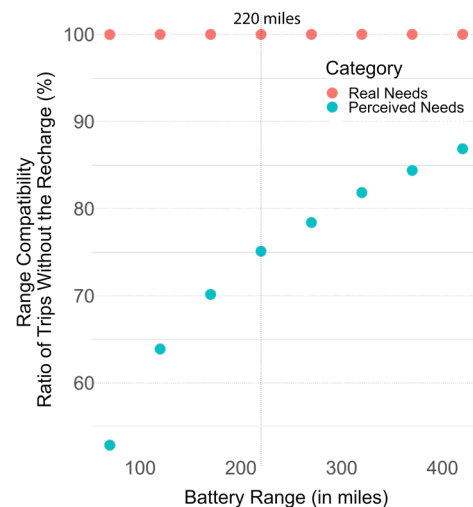

Figure 1: Psychological barriers for real and perceived range compatibility. Participants tend to also underestimate charging compatibility, as depicted in Figure 2. Across the same battery ranges, they anticipate needing to recharge more frequently than necessary. For a 220-mile battery range, participants reported an average need to charge twice per week, while their driving behavior suggests an actual need for only 0.72 charges per week.

Figure 2: Psychological barriers for real and perceived charging compatibility.
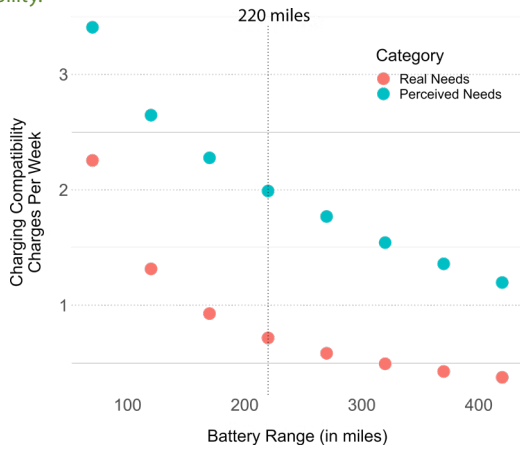
- In general, respondents strongly underestimate the total cost of ownership of both BEVs and combustion engine cars. Additionally, they often underestimate BEVs› total cost of ownership (TCO) advantages, as highlighted in Figure 3. On average, respondents think BEVs are 372£ cheaper than combustion engine vehicles. However, the analysis of their driving behavior shows a TCO advantage of 2307£ for the specific BEV.

Figure 3: Psychological barriers for real and perceived TCO compatibility.
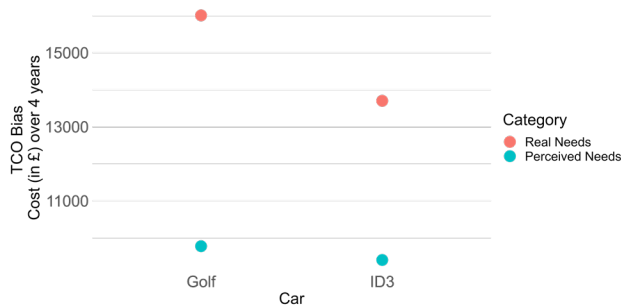
Role of personalized treatments for BEV adoption

In the second part of the survey, we organized a randomized controlled trial to analyze the impact of three personalized messages on EV adoption. The 3181 car owners were randomly assigned to 4 groups: one control and three treatments groups. Next, we illustrate the personalized information provided to participants in a) the control group, b) the range compatibility treatment group, c) the charging compatibility treatment group, and d) the total cost of ownership treatment group.

As can be seen from Figure 4, the control group only received some general car-specific information such as model name, consumption, price, and range for choice cards between ID3 and VW Golf.
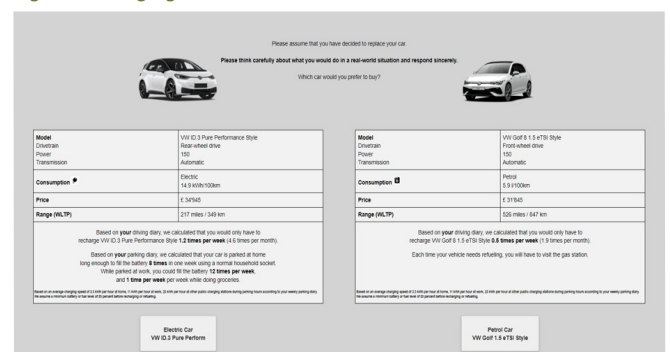
Figure 4: Control treatment choice task
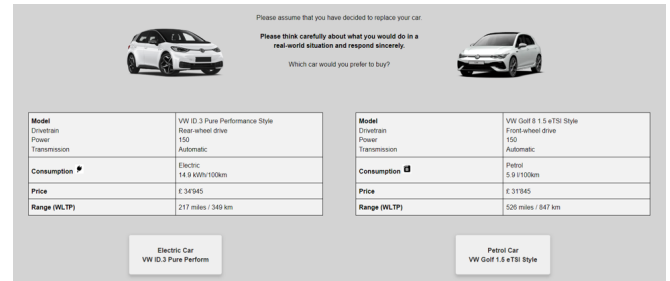
As highlighted in Figure 5, the range compatibility treatment group received information comparing the number of trips where they would have to interrupt their trip to recharge to those without stopping to recharge.

Figure 5: Range treatment choice task
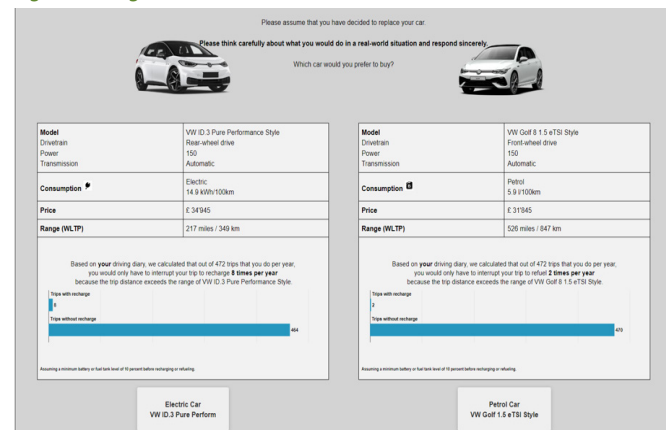
As can be seen from Figure 6, the charging compatibility treatment group received information on the number of charging instances needed per week and the number of possible charging instances at different locations where they park their car according to their parking diary.

Figure 6: Charging treatment choice task

As highlighted in Figure 7, the TCO compatibility treatment group received a comparison of the total cost of ownership for both vehicles.

Figure 7: TCO treatment choice task
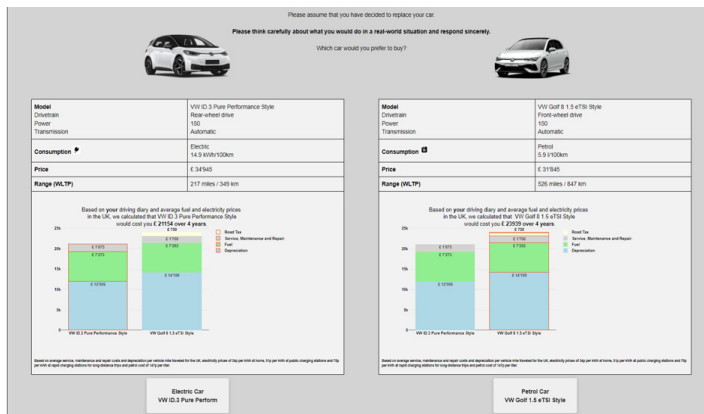
The descriptive results of the RCT experiment indicate that the share of participants that opt for the BEV is 40% in the control group, it increased to 48% for the range compatibility treatment group, 48% for the charging compatibility treatment group, and 54% for the total cost of ownership treatment group. The econometric analysis confirmed that the three treatments have a positive impact on the adoption of BEV.

Policy recommendations

We find that most car owners have misperceptions about the number of trips they would have to interrupt per year to recharge if they owned a BEV, the number of charging instances needed per week, and the cost advantages of electric cars.

Hence, addressing and correcting these psychological barriers and concerns with personalized targeting can be a scalable non-monetary intervention to increase EV adoption and complement other policy instruments.

Policymakers, car manufacturers, and dealerships could:
1. Measure individual driving and parking behavior and provide personalized informations on charging, range and total cost of ownership compatibility using digital devices.
2. Complement such targeted information campaigns with conventional policy approaches, such as financial incentives, the development of charging infrastructure, and traffic regulations.

References

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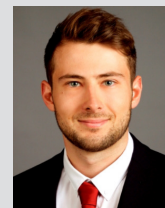
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