A behavioral intervention to reduce range anxiety and increase electric vehicle uptake

Mario Herberz (✉ mario.herberz@unige.ch)
University of Geneva  https://orcid.org/0000-0001-8683-5604

Ulf Hahnel
University of Geneva  https://orcid.org/0000-0002-0595-5899

Tobias Brosch
University of Geneva  https://orcid.org/0000-0001-6883-0383

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Electric vehicles are on the rise, but are still far from reaching the global market share required to achieve climate objectives. While financial and technological adoption barriers are increasingly removed, psychological barriers remain insufficiently addressed on a large scale. Here, we show that car owners substantially underestimate the compatibility of available battery capacities with their individual mobility needs, increasing the demand of long battery ranges and reducing willingness to adopt. We test a simple behavioral intervention in two randomized online experiments in Germany and the U.S.: providing tailored compatibility information reduced range anxiety and increased willingness to pay for electric vehicles. Compatibility information more strongly increased preferences than information about privileged access to charging infrastructure, and selectively increased preferences of car owners for whom an electric vehicle would yield higher financial benefits. This scalable intervention may complement classical policy approaches in achieving a resource-conscious and global electrification of mobility.

The adoption of battery electric vehicles (BEV) is taking up speed in many countries, which is an important step towards curbing transportation-related CO\textsubscript{2} emissions [1, 2]. This success can be ascribed to a range of policies that aim to promote BEV adoption. Current policies are mainly based on providing financial incentives, creating a denser charging infrastructure, and adapting traffic regulations, for instance by providing privileged access to public transport lanes or charging infrastructure [3]. In particular, subsidies of BEV purchase prices have successfully counteracted consumer tendencies to overweight the higher BEV upfront costs and to discount future financial benefits [4]. Despite these achievements, the global share of BEV is still far from its mass market objective. In 2020, electric vehicles (including hybrid-electric vehicles) accounted for only 2.6% of global car sales [2]. Concerns have been raised that financial incentives and technological improvements may be insufficient to convince the majority of hesitant consumers [5–7]. For example, financial incentives do not always increase BEV adoption, suggesting that other, non-financial factors play a crucial role [8]. Similarly, research suggests that taxing CO\textsubscript{2} emissions will by itself not result in a large-scale uptake of BEV [9]. With respect to technological improvements, the benefits of developing a dense public charging infrastructure have also been contested [10, 11]. Consumers tend to prefer home charging [5, 7], mainly due to the still relatively long charging times [12]. Moreover, further increases in battery capacities may only result in minor usability advantages, allowing only few additional car trips with a single battery load [5].

What is more, larger batteries lead to increased CO\textsubscript{2} emissions due to their heavier weight, and require more scarce resources such as lithium and cobalt [13]. An increased demand of larger batteries may endanger the supply of these resources and exacerbate social injustice in the countries of their extraction [14]. New policy approaches may be needed to effectively increase BEV adoption while promoting sufficiency in battery sizes. Smaller sized batteries would reduce the need for challenging reuse and recycling solutions [13, 15].

Given that many financial and technological barriers are already being addressed and alleviated in many places [3], behavioral interventions targeting psychological barriers to BEV adoption may importantly complement existing policies. Many consumers are sceptical that available BEV battery ranges can meet their mobility needs. Range anxiety, the worry that one will run out of battery before reaching the destination, is one of the major barriers to BEV adoption [5, 7, 16–18] and a driver for preferences for long battery ranges [19]. Indeed, the perceived compatibility of a given BEV with individual mobility needs seems to be one of the most important predictors of BEV purchase intentions [20, 21].

Analyses of actual driving profiles, on the other hand, suggest that even BEVs with a moderate battery range already meet most consumers’ mobility needs [5]. Across Australia, China, the U.S., and European countries, research has found that more than 90% of individual mobility needs can be met with increasingly available and affordable BEV battery ranges such
as 200 km [17, 22–25]. Despite the scientific consensus on the relevance of range anxiety [17, 18], previous behaviorally informed interventions have almost exclusively focused on providing first-hand BEV experiences (i.e., test drives), resulting in both positive [26, 27] and mixed impacts on BEV preferences [28, 29]. We are not aware of any research addressing range anxiety in an effective and scalable way.

The observed discrepancy between perceived and actual compatibility of electric vehicle range with consumer needs raises the question to what extent consumer perceptions may be ill-informed or influenced by heuristic decision processes [30, 31]. For instance, judgments and decisions are more strongly influenced by easily computable and comparable product attributes such as absolute battery range than by difficult-to-compare attributes such as actual compatibility [32, 33]. Thus, BEVs may be evaluated based on the comparison of their battery range with the (superior) range of petrol cars instead of the comparison of BEV battery range with one’s actual needs. Moreover, decision makers have been found to be frequently and unconsciously influenced by the anchoring heuristic, whereby judgments tend to align with an initially provided reference value which serves as anchor, even if the anchor is irrelevant to the judgment at hand [34, 35]. When evaluating a BEV battery range, the relatively high numerical value of the range in comparison to most daily trips may act as an anchor and increase the salience of long car trips in memory (e.g., vacation trips). The resulting salience of exceptionally long car trips may additionally contribute to a systematic underestimation of compatibility.

Systematic compatibility underestimations may increase the minimum battery range consumers deem necessary when considering a BEV and reduce consumers’ overall willingness to adopt a BEV. Correcting this underestimation may therefore be a promising and presently untapped avenue to promote BEVs while avoiding the over-sizing of batteries. In the present work, we (i) estimate the compatibility bias (i.e., the discrepancy between perceived and actual compatibility with mobility needs), (ii) determine the effect of the compatibility bias on BEV preferences and battery range requirements, (iii) develop and test a behavioral intervention to counteract this bias, (iv) identify reductions in range anxiety as underlying mechanism of the effectiveness of the intervention, (v) assess the effectiveness of the intervention as a function of individual car operating costs, and (vi) compare the compatibility intervention to a conventional intervention providing access to charging infrastructure.

**Car owners underestimate the compatibility of BEV with their mobility needs**

Participants from two representative samples of car owners in Germany (N = 438) and the United States (N = 421) estimated which proportion of their annual car trips they could complete with a given BEV battery range (i.e., perceived compatibility).

Eight battery range levels were selected to reflect most available battery ranges from 80 to 400 km in the German sample and 50 to 240 miles in the U.S. sample. Participants moreover reported their driving behavior during the previous year (2019) by indicating how often they completed car trips of different distances, regrouped in 15 bins ranging from "less than 0.5 miles" to "more than 240 miles" (see Methods for details). The actual compatibility of BEV battery ranges with consumer needs was computed as the ratio of the number of car trips that could have been completed with a given battery range (i.e., trip distance < battery range) divided by the total of reported car trips (see Methods and Supplementary Note 1). Finally, participants reported whether they intended to buy a BEV within the next 10 years and indicated which battery range they would require to consider a BEV as an alternative to their current combustion engine car. We predicted that car owners systematically underestimate the compatibility of BEV with their mobility needs and that the size of this bias predicts lower buying intentions and higher battery range requirements.

Figure 1 shows perceived and actual compatibility of BEV battery ranges with car owners’ mobility needs. A paired sample t-test confirmed that car owners systematically underestimated compatibility across both samples. As expected, the size of the bias was statistically greater than zero in both the German (b_D = 29.62%, 95%CI[28.47, 30.78], P < .001) and the U.S. sample (b_US = 32.28%, 95%CI[30.9, 33.67], P < .001). As shown in Table 1, linear regression analysis revealed that the size of the bias was negatively associated with consumer intentions to adopt a BEV, both in the German (b_D = -0.39 ± 0.09 s.e., P < .001) and the U.S. sample (b_US = -0.46 ± 0.10 s.e., P < .001), when accounting for age, gender, household income, annual mileage and access to public transport as covariates. Similarly, the size of the bias was positively associated with battery range requirements in Germany (b_D = 32.97 ± 10.91 s.e., P = .003) and the U.S. (b_US = 23.78 ± 10.43 s.e., P = .023; for regression results including perceived and actual compatibility as separate predictors see Supplementary Note 2 and Supplementary Table 3).
Providing tailored compatibility information increases willingness to pay for BEV

In order to correct the compatibility bias and reduce range anxiety, we designed an intervention that provided car owners from Germany (N = 279) and the U.S. (N = 999) with tailored information about the actual compatibility of BEV battery ranges with their individual mobility needs. The compatibility information was computed based on respondents’ self-reported driving behavior using the same measures as in Study 1a and 1b. Participants were then presented with a number of BEVs with battery ranges between 100 and 400 kilometers and were asked to indicate their willingness to pay for each BEV (for an example of the task see Supplementary Figure 4). In the control condition, participants received information about battery range only, provided either in km (Germany) or miles (U.S.). In the compatibility condition, participants were additionally provided with tailored information about the percentage of their annual car trips which they could complete with each BEV without charging stops. In order to compare our intervention with previous policies aiming to increase BEV adoption, in the experiment conducted in the U.S. a third group of participants was moreover presented with information about a more conventional infrastructure intervention. Specifically, in addition to battery range these participants were informed that the presented BEV would grant them privileged access to reserved parking with charging possibilities in inner cities (see Methods). Access to charging infrastructure can also be expected to increase consumer preference by reducing range anxiety [3, 36]. However, we predicted that compatibility information more strongly increases willingness to pay than infrastructure information, since it more precisely targets consumers’ misperception of compatibility, which we suspect to strongly provoke range anxiety.

Mixed-effects models confirmed that car owners reported higher willingness to pay when provided with tailored compatibility information as compared to the control group receiving information about battery range only, both in the German sample (b = 829.4, 95%CI[24.8, 1634.0], P = .045, one-sided test) and the U.S. sample (b = 2237.4, 95%CI[1476.6, 2998.2], P <
TABLE 1: Linear regression results of buying intentions and battery range requirements on the compatibility bias and demographic characteristics in the German (Study 1a) and U.S. sample (Study 1b).

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Study 1a</th>
<th>Study 1b</th>
<th>Study 1a</th>
<th>Study 1b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buying intentions</td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.16***</td>
<td>3.49***</td>
<td>3.48***</td>
<td>3.25***</td>
</tr>
<tr>
<td>Compatibility bias</td>
<td>−0.51***</td>
<td>−0.39***</td>
<td>−0.55***</td>
<td>−0.46***</td>
</tr>
<tr>
<td>Age</td>
<td>−0.57***</td>
<td>−0.60***</td>
<td>34.78**</td>
<td>43.99***</td>
</tr>
<tr>
<td>Gender</td>
<td>0.47*</td>
<td>0.17</td>
<td>29.50</td>
<td>−9.5</td>
</tr>
<tr>
<td>Household income</td>
<td>0.40***</td>
<td>0.28**</td>
<td>19.27</td>
<td>28.12**</td>
</tr>
<tr>
<td>Annual mileage</td>
<td>−0.08</td>
<td>−0.07</td>
<td>41.56***</td>
<td>24.8*</td>
</tr>
<tr>
<td>Access to public transport</td>
<td>0.23*</td>
<td>−0.16</td>
<td>−6.03</td>
<td>7.52</td>
</tr>
</tbody>
</table>

Note. Biased perception of the compatibility of an electric vehicle with one’s mobility needs predicted lower intentions to buy an electric vehicle (left half of the table) and higher battery range requirements (right half of the table) in Germany (Study 1a) and the U.S. (Study 1b). The dependent variable intention to adopt an electric vehicle within the upcoming 10 years was measured on a scale from 1 "Not at all" to 7 "Absolutely Yes", while battery range required of an electric vehicle to present an alternative to your current combustion engine car was reported in km/miles (see Methods). The Compatibility bias was averaged across battery ranges within participants. All continuous predictors were z-standardized. ***P < .001, **P < .01, *P < .05.

Providing tailored compatibility information decreases range anxiety

To elucidate the psychological mechanisms underlying the impact of the compatibility intervention on willingness to pay for BEV, in Study 2b we additionally assessed range anxiety and its impact on willingness to pay. Range anxiety was assessed as car owners’ worry to run out of battery before reaching their destination when driving BEV with different battery ranges. We predicted that range anxiety mediates the effect of compatibility information on willingness to pay (for the mediation model see Supplementary Figure 3).

As expected, respondents reported lower range anxiety when provided with tailored compatibility information (see Panel B of Figure 2; b = 0.51, 95%CI[0.273, 0.753], P < .001, one-sided test) or with infrastructure information, as compared to battery range only: (b = 0.42, 95%CI[0.176, 0.654], P < .001, one-sided test). Respondents receiving compatibility information were less sensitive to decreases in battery range as compared to respondents in the control (b = −0.18, 95%CI[−0.129, −0.235], P < .001) and the infrastructure conditions (b = −0.19, 95%CI[−0.137, −0.243], P < .001; see Supplementary Note 3 for ANOVA results and Supplementary Table 4 for model specifications). Mediation analyses supported the role of range anxiety as a potential mediator of the effect of the compatibility intervention on willingness to pay (indirect effect = 0.062, 95%CI[0.023, 0.101], P = .002), 10,000 bootstrap samples. In contrast, range anxiety did not mediate the effect of the infrastructure intervention on willingness to pay (indirect effect = 0.015, 95%CI[−0.02, 0.05], P = .422), 10,000 bootstrap samples; see Supplementary Figure 3).
Intervention effects are most pronounced for car owners who would most benefit from adopting a BEV

Behavioral interventions targeting cognitive biases have raised concerns of patronizingly nudging [37] people towards a behavior that is beneficial for society or the environment while ignoring their personal preferences or potential costs[38, 39]. To address this concern, we investigated to what extent the effect of the compatibility intervention on BEV preferences aligned with individual financial costs and benefits of BEV adoption. Following past work, we approximated car owners’ total cost of owning their current combustion engine car (TCO) based on their fuel costs (i.e., mileage x fuel consumption), depreciation costs (i.e., purchase price x b(car age); see [40]), repair, tax and insurance costs (see Methods and Supplementary Note 4 for
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details). High TCO mainly reflects high fuel costs, for which BEV efficiency advantages would yield the greatest individual savings. It moreover reflects high depreciation costs of car owners who recently purchased a new car. Car owners with high depreciation costs may be able to more easily afford the high depreciation costs of a BEV, which continue to be mostly available on the new car market. An intervention that increases BEV preferences for car owners with high TCO would thus align individual financial and environmental benefits, while increasing BEV preference of car owners with low TCO, for whom individual benefits are smaller, would be ethically questionable.

As illustrated in Figure 2 (Panel C), compatibility information more strongly increased WTP for car owners with high TCO compared to those with low TCO, both in the German ($b = 1389.28$, $95\%CI[384.23, 2394.33]$, $P = .007$) and the U.S. sample ($b = 2089.8$, $95\%CI[1159.78, 3019.86]$, $P < .001$). The effectiveness of the infrastructure intervention did not vary in function of TCO ($b = -38.99$, $95\%CI[-906.53, 828.55]$, $P = .93$; see Supplementary Note 5 for ANOVA results, and Note 6 for regression results including individual TCO components instead of TCO as predictors). In sum, the compatibility intervention presented here seems to precisely target consumers who would benefit most from owning a BEV.

Discussion

The present research demonstrates that providing car owners with tailored compatibility information based on their individual driving behavior seems to be a viable means to reduce range anxiety, increase preferences for BEV, and align financial and environmental benefits. These findings appear robust with German and U.S. car owners, despite important variations in geography and transportation energy requirements between both countries [41]. Providing compatibility information seems to counteract car owners’ systematically biased underestimations of the extent to which BEVs can meet their individual driving needs. Correcting for this bias boosted BEV preferences and may help facilitate BEV adoption while avoiding resource-intensive over-sizing of batteries.

The effectiveness of the compatibility intervention developed here illustrates the potential of psychologically informed interventions to ensure a successful transition to electric mobility on a large scale. Correcting the compatibility bias may complement conventional policy approaches such as financial incentives, the development of charging infrastructure, and traffic regulations [3]. Despite their uncontested importance, conventional policies tend to be costly and seem to be insufficient to ensure a fast and large-scale adoption of BEV [5, 6]. Consequently, addressing major psychological barriers such as range anxiety may become decisive.

Our findings contribute to the debate on whether battery range limitations should be understood as a technical [19, 42] or a psychological barrier [17, 18]. In line with transportation research estimating that most mobility needs can already be met with moderate battery ranges [5, 17, 22–25], our results provide further evidence that limited battery range might to a large extent be a psychological barrier to BEV adoption.

Correcting the compatibility bias may help guide consumers towards adequately sized batteries as BEV adoption will increase. The depletion of increasingly scarce resources needed to build BEV batteries [13] may be mitigated by consumer demand based on more accurate compatibility perceptions. The compatibility intervention was particularly effective for car owners with high total costs of their current combustion engine car. More specifically, car owners for whom the switch toward BEV would yield the lowest additional costs of depreciation and the highest savings of fuel costs seem to be most receptive to the provision of compatibility information. This responds to ethical concerns raised with regard to behavioral interventions [38, 39] and illustrates that the approach presented here has the potential to align private and public benefits in the combat of climate change [1, 43].

One limitation of the present research is its reliance on self-reported driving data. Specifically, our calculations of the actual compatibility of battery ranges with consumer driving behavior may deviate from the true values. Additionally, we do not account for trip velocity profiles and ambient temperature that can have an important impact on battery range [5]. Reassuringly, however, our calculations largely align with research based on more reliable GPS-based tracking data (e.g., [44]; see Supplementary Note 1 for a detailed discussion). Another limitation is that our research elicited car owners’ stated preferences in a hypothetical purchase scenario. Differences in willingness to pay should thus be interpreted as relative differences between experimental conditions rather than absolute values consumers would be willing to invest.

Future research should rely on more precise measurements and revealed preferences to validate our findings. Research in more applied contexts should moreover investigate to what extent compatibility information succeeds in the competition for consumers’ attention [45]. One advantage of the self-report approach used here is that the procedures can be easily integrated into existing online tools. For instance, car manufacturers, retailers and car sharing providers, whose markets increasingly move online [46, 47], could easily provide compatibility information in exchange for minimal digital input by consumers. Analysing click rates of BEV car models or search patterns could provide important insights into the impact
of compatibility information on consumer preference. Targeting the compatibility bias jointly with car owners’ biased perception of the financial costs of cars [40], may help to guide consumers towards decisions that best fit their needs and benefit the environment at the same time.

Methods

The sample sizes for Study 1a, 1b, and 2a were determined based on similar previous research on consumer misperceptions of the energy consumption of foods and household appliances [48]. The sample size for Study 2b was determined to be at least twice the sample size as for Study 2a per condition in order to allow for a sufficiently powered replication and extension. All data collection took place online and was completed between July 13th, 2020 and January 15th, 2021. We used multiple linear regression for all analyses of single measure outcomes and mixed-effects linear models for the analyses of the repeated willingness to pay and range anxiety outcomes in Stud 2a and 2b. Significance tests were computed one-sided to test directional hypotheses and two-sided to test non-directional hypotheses using an alpha level of 0.05. The random effects structures of the mixed-effects models were selected based on the best global model fit as indicated by the Bayesian and Akaike’s Information Criterion (see Supplementary Table 4). We included attention checks that reminded participants to pay attention, to convert “satisficing participants into diligent participants” [49] and thus minimizing exclusion rates. We conservatively used all available data for our analyses whenever possible and if not indicated differently.

Study 1a and 1b.

Participants. Two online samples of car owners were recruited in Germany (N = 512) and the U.S. (N=512) via market research institutes. Both samples were representative for the respective car owner population with regards to age, gender and household income (see Supplementary Table 1 and 2). Quotas were ensured by the market research institutes. German participants’ age ranged from 19 to 85 with a mean of 49.01 (SD = 16.7), U.S. participants’ age ranged from 18 to 92 years with a mean of 48.14 (SD = 17.3). Among participants 48.4% (Germany) and 49.8% (U.S.) were female. The median yearly gross household income reported by participants was 30,000€ to 42,000€ in the German sample and $50,000 to $74,999 in the U.S. sample (see Supplementary Table 2 for the ethnic composition).

Procedure. After providing demographic information, participants were asked to estimate which percentage of their car trips in 2019 would have been feasible with a BEV without having to stop for recharging (i.e., perceived compatibility). Participants were asked to consider all one-way car trips for their estimation (i.e., outward and return trips separately) and were provided with the information that a BEV is exclusively powered by its built-in battery. Participants completed their estimations for BEV with battery ranges of 50, 60, 90, 120, 150, 210 and 240 miles in Study 1b, and 80, 100, 150, 200, 250, 300, 350, and 400 km in Study 1a on a scale from 0% (none of the car trips feasible) to 100% (all of the car trips feasible). Next, participants reported their intention to buy a BEV within the next 10 years, indicated the range they would require of a BEV to consider it an alternative to their current combustion engine car, and completed an attention check. Buying intentions were elicited for a relatively long time horizon to provide participants with some room for consideration, since average car age in Germany in 2020 was 9.8 years [50]. Then, participants were asked to report the frequencies with which they had travelled the following distances with their car throughout the year 2019: shorter than 0.5 miles, 0.5 < 1 mile, 1 < 2 miles, 2 < 5 miles, 5 < 10 miles, 10 < 20 miles, 20 < 30 miles, 30 < 60 miles, 60 < 90 miles, 90 < 120 miles, 120 < 150 miles, 150 < 180 miles, 180 < 210 miles, 210 < 240 miles and 240 miles and longer (shorter than 0.5 km to 400 km and longer in Study 1a). They were asked to carefully answer the questions while considering shorter, daily car trips as well as longer, less frequent trips such as vacation trips. Additionally, in order to facilitate estimations participants were reminded that one year consists of 52 weeks with 5 working days each and of all federal public holidays. Finally, participants were asked to count outward and return trips separately, and were provided with an example answer of a person commuting 15 miles to work on 5 days a week over one year (see the Supplementary Methods for the exact stimuli). Participants were thanked and compensated with about 2$ for their participation.

Analysis. Participants who reported not having completed any car trips in 2019 or estimated the amount of their 2019 car trips that could be completed with a BEV to be 0% across all battery ranges were excluded from the analysis (N = 74 in Study 1a and N = 91 in Study 1b). We dummy-coded exclusion to probe if exclusion was related to any of the measured demographic variables, which would have reduced the representative nature of our data. General linear regressions revealed that none of
the demographic variables age, gender, and income (plus ethnic group in the U.S. sample), significantly predicted exclusion
from the analysis (all ps > .05, see Supplementary Table 1 and 2).

For the remaining participants from Germany (N = 438) and the U.S. (N = 421), we computed the actual compatibility of
BEV as the proportion of car trips reported by participants that could be completed without charging (see Supplementary
Note 1). For example, the actual compatibility of a BEV with a battery range of 60 miles was computed by dividing the sum
of all reported trip frequencies for distances shorter than 60 miles by the total sum of trip frequencies. Next, we computed
each participant’s compatibility bias by subtracting the actual compatibility from the perceived compatibility for each battery
range. Finally, we introduced the mean bias of each participant as predictor of intention to buy an electric vehicle and battery
range requirements in a linear regression, while controlling for age, gender, income, yearly mileage and the connection of
participants’ homes to public transport services (see Table 1).

Study 2a.

Participants. An online sample of car owners from Germany was recruited via a market research institute (N = 280).
Participant’s age ranged from 18 to 80 years with a mean of 44.9 (SD = 15.1) and 52.1 % were female.

Procedure. After reporting their age and gender, participants provided information about their current car. Participants were
asked to report the age, original purchase price, and fuel consumption of their current car. In case they were unsure about
some of the required information they were instructed to consult their documents or another member of their household to
obtain the information. Participants then completed an attention check [49] and, applying the same procedure as in Study 1,
reported the frequencies of their car trips in 2019. Next, participants were introduced to the WTP task. They were asked
to imagine that they had decided to replace their current car with a BEV which was available with different battery ranges.
Participants were then randomly assigned to either the control or the compatibility condition. Accordingly, they reported
their WTP either based on information about battery range only (n = 141), or based on tailored compatibility information
in addition to battery range (n = 138; see Supplementary Figure 4). The compatibility information consisted in the %
of individual annual car trips that could be completed with a given battery range without charging stop. To familiarize
participants with the task, they were presented with an example of a basic model with a battery range of 80 kilometers and a
purchase price of 20,000€. Participants reported their maximum buying price on a slider ranging from 20,000€ to 40,000€.
They completed a total of 7 trials with battery ranges of 100 km, 150 km, 200 km, 250 km, 300 km, 350 km, and 400 km,
which were presented on separate pages. Finally, participants were thanked and compensated with about 2.5€.

Analysis. One participant who reported not having completed any car trips in 2019 had to be excluded from the analysis,
leaving a final sample of N = 279. The main analysis consisted of a linear mixed-effects model including a random intercept
for subjects and a random slope for battery range, and fixed effects for experimental condition and battery range (see
Supplementary Table 4). We computed the total cost of ownership (TCO) of the current car of each participant as potential
moderator of the intervention effect. To this end, we computed the running costs by multiplying the total annual driving
distance of participants with the fuel consumption of their car and current fuel prices. Depreciation costs were calculated
by taking into account the original purchase price and the age of participants’ cars [40]. Finally, we approximated tax,
insurance and maintenance costs (see Supplementary Note 4 for details on the computation of TCO and the approximations
applied). We then added TCO and the interaction of TCO and experimental condition as fixed effects into the analysis (see
Supplementary Note 5 for the model specifications and results including covariates). To decompose the overall interaction
of TCO and condition, we additionally reran the analyses, replacing TCO with its components as predictors of willingness
to pay (see Supplementary Note 6).

Study 2b.

Participants. An online sample of car owners from the U.S. was recruited via Prolific Academic (N = 1000). Participant’s
age ranged from 18 to 84 years with a mean of 37.5 (SD = 12.8) and 52.2 % were female.

Procedure. The procedure was similar to Study 2a. We adapted language and units to the U.S. context, added the in-
frastucture condition, and additionally measured range anxiety as a potential mediator of the effect of the compatibility
intervention on WTP. In the infrastructure condition participants reported their WTP while being informed that they would
have privileged access to reserved parking in inner cities with the presented BEVs, in addition to battery range (see the
Supplementary Methods for the used stimuli). Participants were randomly assigned to either the battery range only (n =
the compatibility ($n = 310$) or the infrastructure condition ($n = 347$). In all conditions, range anxiety (i.e., worry to run out of battery before reaching one’s goal) was measured on a scale from 1 "not worried at all" to 7 "very much worried" after each WTP trial. Finally, belief in the accuracy of the battery range information was measured on a scale from 1 "not accurate at all" to 7 "absolutely accurate" at the very end of the experiment.

**Analysis.** One participant who reported not having completed any car trips in 2019 had to be excluded from the analysis, leaving a final sample of $N = 999$. All analyses were identical to Study 2a, with the exception of the analyses of range anxiety as potential mediator of the compatibility intervention. Range anxiety was introduced as a level 1 mediator of the effect of the compatibility and the infrastructure intervention on willingness to pay, using the mediation package [51] for R (see Supplementary Figure 3 for details on the analysis).

**Ethics statement**

Masked for double-blind peer review.

**Reporting Summary**

Further information on research design is available in the Nature Research Reporting Summary linked to this article.

**Data and code availability**

All data and code used to generate results and figures of the present work are available for review and will be made publicly available upon publication.

**References**


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**Author contributions**

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**Competing interests**

The authors declare no competing interests.
Additional information

Supplementary information is attached to this submission.
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