

Laypeople's Perspectives on Electromobility: A Focus Group Study

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Abstract. Although many electric cars are readily available on the market and the charging infrastructure is expanded, the majority of people is still reluctant to buy and use an electric car. It is assumed that underlying motives and mental models play decisive roles for the acceptance. To gain insights into laypeople's concepts concerning electromobility, three focus group studies on perceived benefits and barriers with a total of 24 participants were conducted in which the participants discussed their perceived benefits and barriers of electric mobility. It was found that while participants' perceived benefits referred almost exclusively to environmental issues, the barriers concerned multiple thematic areas such as costs, infrastructure, security of the technology, and practicability. Overall, it has become obvious that many misconceptions and prejudices against electromobility and electric cars still exist which can only be overcome by adequate information and communication concepts.

Keywords: Electromobility · Technology acceptance · User-centered design · Urban systems · Focus group study

1 Introduction

More and more people will live in cities, bringing with them cars for individual motorized transport. This leads to increased traffic which, in turn, negatively affects the city climate. Already today, many cities regularly exceed the limits for fine particle concentration. Electric cars provide a solution to this problem without limiting the users in their access to individual motorized transport. Moreover, they are able to run on environmentally friendly, sustainable sources of energy instead of fossil fuels like traditional cars with combustion engines.

Despite these advantages over traditional cars, the market adoption of electric cars is slow: In Germany, only 6,000 of all cars newly registered in 2013 were electric cars, which equals a share of 0.2 % [1]. It is therefore essential to understand usage motives and barriers of potential users to be able to develop adequate communication and information strategies which ultimately can foster acceptance for electric cars.

Current acceptance research on electric mobility covers a wide range of methods and thematic areas. General acceptance studies include field studies on the relation between driven distance and attitude towards electric mobility [2], studies on the social

influence on perception and preference for electric vehicles [3], stereotypes on electric mobility [4], and studies on the influence of user factors on acceptance and preferences for electric cars [5, 6]. Other research focuses on special aspects of electromobility, investigating, e.g., psychological barriers of range [7].

While most of the studies used a quantitative approach, only few studies can be found that report the results of qualitative approaches although these are especially useful for new, not yet established technologies for which the acceptance-relevant parameters are not yet known. One of the few examples is Hoffmann et al. [8] who selected focus groups according to profiles of future users to discuss particular use cases of electromobility.

We applied a two-step research approach to gain a better understanding of user requirements and perceived barriers of electromobility. First, exploratory focus group studies were conducted which will be presented in this paper. Based on the results, a quantitative user study using an online survey was conducted [9, 10].

2 Focus Group Study

Three focus group studies were conducted in 2012. Participants were recruited among acquaintances and fellow students. The focus groups lasted around 2.5 h and were carried out on university campus. Two students who had received prior training moderated each focus group. Data were collected via audio-recording and note-taking by assistants who were not involved in the discussion.

2.1 Participants

The three focus groups were different with regard to the user characteristics of the participants. While group 1 contained mainly female students in their mid-twenties, groups 2 and 3 were more mixed regarding age, gender distribution, and job status.

2.2 Results

Although the groups were mixed in terms of participants, very similar concerns regarding electromobility were raised.

In the first group (7 participants), which consisted mainly of female students, different *areas of application* for electromobility were discussed. Although none of the participants could imagine buying an electric car themselves, they suggested that electric cars would be useful for courier services such as mail delivery. They also thought that taxis could be electric as well, as they are parked, often for longer periods of time, while waiting for customers, and they could use this time for recharging. This group had mixed opinions about using electromobility in public transport. On the one hand, they feared an increase of ticket prices as a result of the expensive e-busses (“It’s clear who will have to pay the extra price”). On the other hand, one participant raised the idea that public transport could become cheaper by using electric busses, as they

would not have to rely on expensive gasoline anymore. Overall, however, e-mobility in public transport was seen as more feasible than in private, individual transport.

General comments that were made about electric cars for private use concerned, e.g., the driving experience itself, which one participant expected to be like a normal car. Another participant was not sure if “they drive like normal cars,” which expressed a general lack of knowledge about electromobility. Also, participants wished for bigger e-cars with more storage space and seats, probably because they had small 2-seaters like the Renault Twizy in mind when thinking about e-cars. Furthermore, they criticized that most e-cars they knew looked ugly, “like some cars out of the future,” and wished for a more conventional design.

A lot of comments referred to **security issues** and it became clear that especially the battery of an e-car was a reason for concern. Participants feared, for example, leakages and the danger of explosion and thus concluded that accidents with electric cars would be more dangerous for the driver. They also had the impression that electric cars were less robust and would therefore “lose” in a crash with a traditional car. The missing engine noise was also discussed controversially as blind and old people with hearing disabilities could not rely on the sound anymore to recognize a car approaching them.

Much of the discussion also evolved around the topics of **range and charging**. Participants agreed that the range should be extended to at least 200 km and that flexibility would decrease if they had to “calculate how far (they) will be able to drive.” They suggested using hybrid cars or range extenders so they would not “get stuck somewhere” once the battery was dead. One participant voiced that she would not be willing to drive more slowly just to go easy on the battery: “It’s embarrassing and I would need twice as much time.” Concerning the charging process, participants agreed that it took too long to recharge the e-car. They suggested that charging stations at home and at the workplace would be useful so that the car could recharge overnight and during working hours.

Environmental aspects were also discussed with regard to the source of electricity for the e-cars. The focus group members had the opinion that e-cars are not necessarily environmentally friendly as long as electricity is generated from fossil fuels or nuclear power plants.

In the second group (9 participants), which was mixed regarding age, gender, and job status, the arguments of the discussion were similar although more emphasis was placed on the general immaturity of electric mobility. For **fields of application**, participants, like those of group 1, also suggested that electric cars would be handy for companies with a lot of short-range deliveries such as pizza delivery, taxis, but also car sharing companies. In addition, they suggested that persons with prestige who drive a lot could function as role models, e.g., city majors. They did not dismiss the idea of an electric car for private, individual transport entirely but found that electric cars would be suitable as “second cars,” in addition to a traditional car that could be used for long-distance trips. They were concerned that electric busses in public transport could not take as many people on board as a traditional bus, because of the lower power of the battery compared to a combustion engine.

General aspects discussed included, also like in group 1, the look of the electric cars. Participants agreed that most e-cars looked ugly and that they should not look different from traditional cars. When showing them pictures of e-cars resembling

traditional cars, they commented that we had “selected good looking ones” which shows that the mental models of electric cars and actual e-cars diverged. Our group 2 participants stated that a requirement would be that the e-car is comfortable. The high costs of electric cars in comparison to traditional cars were also discussed.

Interestingly, the *security aspects* were also very similar to those discussed in group 1. In group 2, the danger when it comes to accidents such as leakage of battery acid, static charge, electric shocks, and short-circuits were mentioned. These thoughts were raised almost exclusively by a female participant, which mirrored the concerns of the all-female group 1. Additionally, danger from lightning was discussed although one expert dismissed this concern. Like in group 1, e-cars were associated with “plastic cars” and thus not considered as secure and robust as traditional cars. A further concern already raised in group 1 was that the reduced noise level could lead to e-cars being overlooked because people are used to listening for cars, but the participants of group 2 also recognized the benefit of reduced noise stress.

Arguments concerning the *range and the charging process* were also exchanged. Similar to group 1, participants of the second group found it “stressful” to plan the recharging. They had diverging opinions about which range was already possible today but mentioned a range extender to overcome the problem. Although they wished for an extended range, they were aware that the existing range is probably sufficient for most people, even if they commute to work each day. The laypeople in the group were also concerned about “memory-effects” of the battery, meaning that with more and more charging processes, the battery’s maximum capacity would decrease. The expert in the round, however, denied this worry. Participants also discussed a trade-off between battery size and storage capacity of the car. They thought that with increased battery size, the range would also increase but at the same time, the storage space in the car would decrease. In contrast to this, a small battery would probably allow less range but also increase the storage capacity in the car, e.g., for passengers, bags, etc.

In general, participants of group 2 discussed many aspects related to the perceived *immaturity of the technology*. They had the impression, for example, that the grid is not ready yet to provide the extra amount of electricity to recharge e-cars. Also, it could be a problem that garages are not fit to deal with electric cars in case of problems. Participants also criticized the lack of charging infrastructure. Concerning the battery, they found that the weight-performance ratio was negative and thus research on lighter and more efficient batteries is needed.

Environmental aspects were discussed more controversially than in group 1. Not only was it mentioned, like in group 1, that the e-car is only as environmentally friendly as its source of electricity but the battery was also seen as a source for concern. After all, it has to be disposed of somewhere. In contrast to group 1, group 2 recognized the benefit of electric cars for the city climate and discussed the possible reduction of fine particles in the city. One participant seriously considered buying an e-car because of its environmental advantages that would give him a “clear conscience.”

The third group (8 participants), like the second, was also mixed with regard to age, gender, and job status. Concerning the *fields of application*, electromobility was thought to function well in public transport. The participants elaborated on the idea of inductive charging, so that busses could recharge while waiting at bus stops. They were aware that research on this topic is already going on.

The group exchanged opinions on the *range and the charging process*, and it became clear that they were unsure how far an electric car was actually able to drive nowadays. They, like the other groups, criticized long recharging times. Innovative ideas for charging stations included supermarket parking spaces and street lights which function as charging stations.

They found, like group 2, that the battery is a potential *environmental* hazard because of its production and disposal processes.

Overall, they also criticized that information on electromobility was scarce.

3 Discussion and Outlook

The results show that electromobility still faces many prejudices and that several misconceptions exist about the functionality, security, and actual range. It has to be taken into account, however, that these data are highly culturally specific and that, especially in Germany which is a car-loving nation and has a long tradition of car industry, people hesitate to give up their beloved cars. From our results, it is reasonable to assume that user factors also play a role for acceptance, e.g., gender, as we found that especially the women were concerned about security issues. As we only had a very limited, not representative sample, future research should include a quantitative approach to statistically validate the influence of gender on security as a barrier.

Meanwhile, more “normal looking” electric cars are available for customers e.g. Tesla Model S, BMW i3, VW E-up!, so one major point of criticism of our participants was also recognized by the automobile industry. Interestingly, the visions of the participants that electric cars could be used for short-distance services has been put into practice by, e.g., the city council of Aachen (Germany) where some city cleaning teams use the e-car Renault Twizy as a means of transportation.

The possible range of electric cars was considered a major drawback. Although field studies have shown that the average range of an electric car would meet the mobility demands of a large amount of people ([7, 11, 12]), the wish for an extended range still persists. This topic thus seems to be a psychological one rather than one of technical feasibility as drivers have to be able to cope with limited range and uncertainty. Franke et al. [7] therefore propose better strategies and technological support to deal with the limited range rather than expanding the range itself.

Because of the qualitative nature of the study, quantitative follow-up studies have been conducted. As results have shown that perceived usefulness of electromobility is higher for public than for private mobility, it is necessary to investigate the acceptance of electromobility in public transport, e.g., busses, separately from the acceptance of electric cars for private use. In a second step, we therefore carried out a study on acceptance of electromobility in the context of private, individual transport [9] and, additionally, in public transport [10].

Acknowledgements. This work was funded partly by the Excellence Initiative of the German State and Federal Government (Project UFO), partly by the German Ministry for Economic Affairs and Energy (Project econnect Germany, ref. no. 01 ME 12052).

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