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Findings

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TRANSPORT FINDINGS

A Review of the Customer Experience at Public Charging Stations and its Effects on Electric Vehicle Purchase and Use

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Findings

The electric vehicle (EV) market in the U.S. has grown rapidly. However, poor public charging reliability could challenge achieving widespread adoption. We reviewed peer-reviewed articles and market research reports to understand how the public charging experience affects the willingness to purchase EVs among first-time buyers and current owners. Ample literature identifies the measures of the public charging experiences, characterizes the current public charging experience, and identifies the effect of infrastructure availability on EV purchase decisions. However, there is no causal evidence linking the customer experience at public chargers to purchase decisions or intentions for current EV owners or prospective buyers.

1. QUESTIONS

Poor reliability at public chargers has garnered attention on the automotive and popular press (Dvorak 2023; MotorTrend 2023; Wolfe 2022). Karanam and Tal (2023) found that unreliable charging—during long-distance travel, in corridors of low charger density, or when users do not have access to home charging—leaves EV owners stranded. These issues could hinder a rapid and durable transition to EVs.

While the notion that a robust public charging infrastructure is necessary to support vehicle electrification seems obvious, the public and policymakers do not have ready access to information about the magnitude of the effects of a poor public charging experience on EV adoption and use. This paper answers the question: What does the literature tell us about the effect of public charging reliability on EV purchase and re-purchase decisions?

2. METHODS

We reviewed 23 peer-reviewed articles to understand how the public charging experience affects the willingness to purchase EVs among first-time buyers and current owners. These articles were found searching TRID and Google Scholar, using keywords such as "EV charging experience", "EV public charging", "EV owner satisfaction", "EV charging reliability".

Given the highly applied and rapidly evolving nature of this topic, we hypothesized that key data might be in industry research that was neither published nor intended for publication. Consequently, we augmented our

review with market research reports. Working with the Charging Experience Consortium Working Group 1, we solicited input from all 37 organizations, including vehicle manufacturers, charging network operators, public utilities, and charging app providers. This effort yielded 18 additional market research reports for review. In the 10 cases where companies did not have publicly available data, we conducted interviews to discuss their findings.

3. FINDINGS

Our review revealed that the primary focus of the literature and market research is on detailing how the customer experience is measured and identifying the current customer experience. Although existing research offers some insights into the relationship between charging experience and EV re-purchase decisions, effectively answering our question requires a causal analysis. We found this to be a gap in the existing literature.

Measures of the Customer Experience at Public Charging Stations

Our interviews revealed that while charging network operators are actively evaluating the charging experience, their findings and even their metrics for evaluation are viewed as proprietary. This makes the data difficult to access, explaining the lack of research in this space. This lack of clarity and consensus on what constitutes a measure of reliability in the charging experience motivated Working Group 1 to develop standard key performance indicators (Quinn et al. 2024). Table 1 shows the different measures of the charging experience found in nine studies and organized into the categories developed by Quinn et al. (2024).

The Current Customer Experience of Public Charging

The public charging experience as measured across the preceding categories is poor for many current EV owners. A 2022 audit in the San Francisco Bay Area found that nearly 28% of public fast charge stations were unusable (Rempel et al. 2022). Furthermore, J.D. Power (2022) highlighted "operability and maintenance" as key issues, with 20% of respondents unable to charge due to station malfunctions or being out of service. This increased to 21% in 2023 (Tucker 2023). Keith and Womack (2023) concluded that network operators have limited interest in maintenance investment, likely due to the challenging economics of public fast-charging stations when utilization is low.

Consumer satisfaction with public fast charging networks declined sharply in the last year (*J.D. Power* 2023, 202; Plug In America 2023). Figure 1 from Plug In America (2023) demonstrates a notable decrease in satisfaction with public direct current fast charging (DCFC) between 2022 and 2023.

Table 1. Customer experience measures at public chargers identified in nine studies

Elements of the Customer Experience	Measure of Charging Experience Identified in Review	Source
Finding a charger	Reviews and feedback from ChargeHub customers	1
	Price	2, 3, 8
	Price transparency	2
	Ease of finding the charger	3, 4, 7, 8
	Availability	2, 3, 7, 8
	Number of ports	1
	Diverse payment options	5
Accessing a charger	Charger accessibility (clear pathways, weather protection, manageable cables, etc.)	6
Starting a charge	Hardware issues	5, 6
	Charging issues	6
	Payment (initiation, options, ease)	3, 4, 5, 7, 8, 9
	Ease of use	2, 3, 8
Completing a charge	Functionality	2, 3
	Charging efficiency	3, 5, 7, 8
	Uptime	4
	Failure rate (number of failed charge cycles)	4
	Utilization (number of sessions per month, charging hours per month, plug-in time, etc.)	4, 6
	Mean time between failure	4
	Vehicle failure rate (vehicle fails when equipment is okay)	4
Getting help	Mean time to repair	4
Feeling safe and comfortable	Comfort	2, 8
	Location (convenience, things to do at the charger, etc.)	3, 5, 7, 8

Sources:

1. Mogile Technologies, Inc. 2021
2. Fabianek and Madlener 2023
3. *J.D. Power* 2023
4. Alexander et al. 2023
5. Okoma 2023
6. Mogile Technologies, Inc 2022
7. Plug In America 2023
8. Consumer Reports 2022
9. Li et al. 2024

Although the baseline satisfaction was much better for Tesla Superchargers than for other charging networks, satisfaction also decreased for the Tesla network from 2022 to 2023 (Figure 2, Plug In America 2023).

The reduced satisfaction across all measures in Figures 1 and 2 could be attributed to a shift toward less forgiving customers (Kurani and Ogunmayin 2023) or to a customer-base with a greater reliance on public charging (Lee, Hardman, and Tal 2019). Either way, these changes in satisfaction will likely only accelerate as EVs push further into the middle of the market.

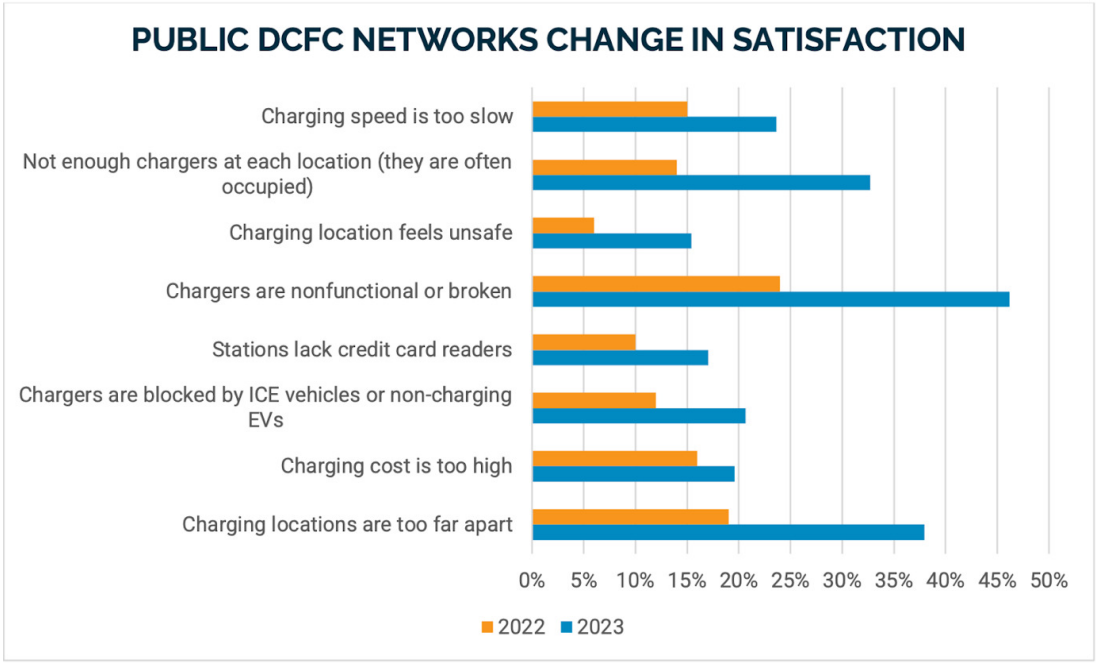

Figure 15: Public DCFC Networks Change in Satisfaction

Figure 1. Public DCFC networks change in satisfaction (Plug In America 2023)

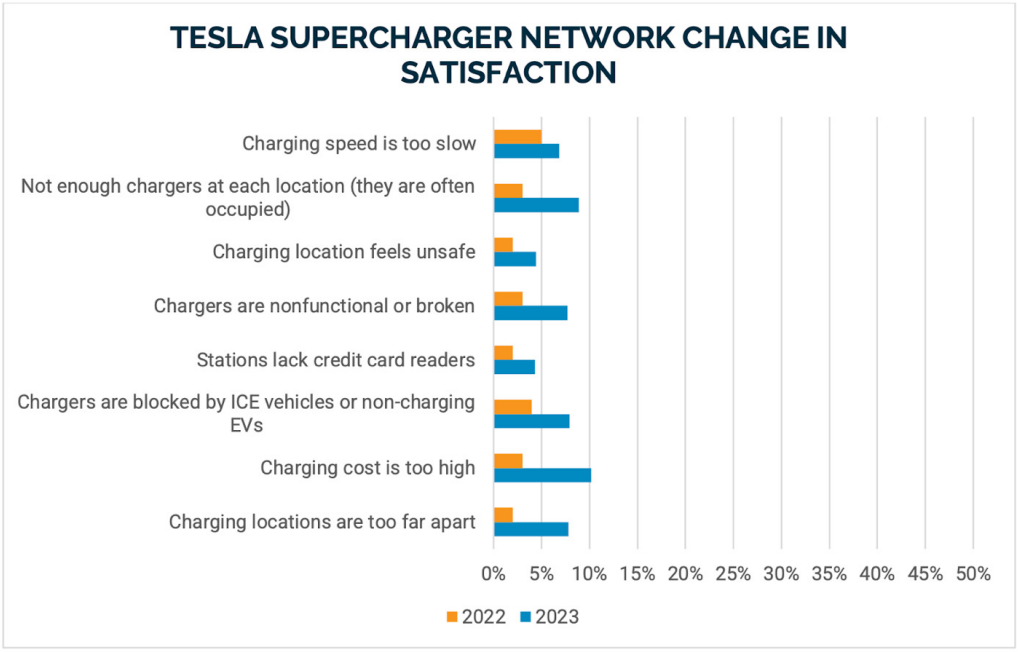

Figure 16: Tesla Supercharger Network Change in Satisfaction

Figure 2. Tesla Supercharger network change in satisfaction (Plug In America 2023)

How Poor Public Charging Affects Willingness to Purchase

Limited access to public charging stations is a major barrier to consumers' willingness to purchase their first electric vehicle (*Cox Automotive* 2023). Multiple studies have identified a substantial positive correlation between charging infrastructure and EV-adoption rates at various scales, including the national level (Sierzchula et al. 2014), regional or state level (Mersky et al.

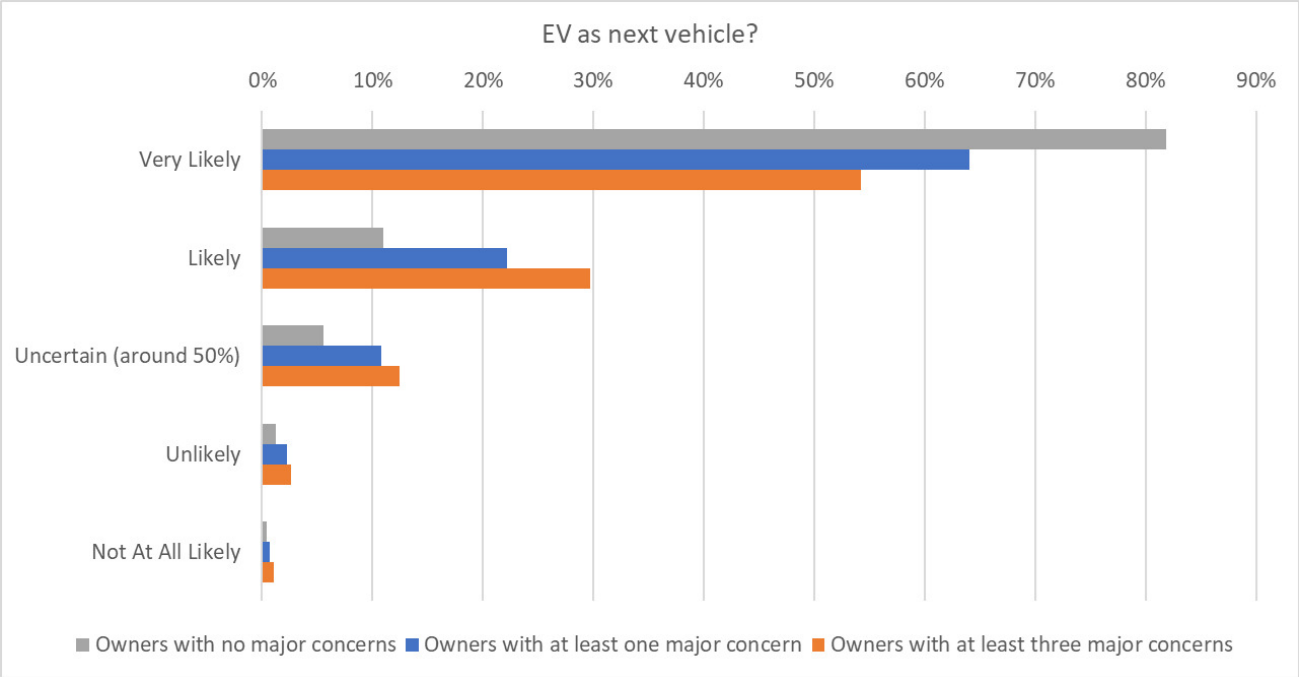

Figure 3. Likelihood of EV purchase based on number of concerns about public charging (Plug In America, custom analysis)

2016; Okoma 2023), and the municipal level (Egnér and Trosvik 2018). An increased number of public chargers offers practical improvements to the utility of driving an EV and also signals a change in social norms that makes purchasing an EV more acceptable to prospective buyers (White et al. 2022).

Although access to public charging is necessary, access to an unreliable public charging station is unlikely to sustain growing market adoption. In response to a request for this study, staff at Plug In America ran a custom analysis of their survey data to explore how their data on owner satisfaction with charging networks influenced their willingness to purchase another EV. They measured satisfaction as the number of concerns respondents selected about public DCFC networks (shown in Figures 1 and 2) and willingness to purchase another EV as respondents' stated likelihood of choosing an EV as their next vehicle. Their analysis revealed that the EV owners with at least one major concern about public charging networks (n = 1,365) were almost twice as likely as those with no major concerns (n = 1,151) to indicate that their next car would not be electric (Figure 3). While this is a large relative effect, Figure 3 highlights that this represents a small share of users overall. Still, a similar effect was also identified in Hardman & Tal's (2021) study which found that dissatisfaction with the convenience of charging was highly correlated with discontinued EV use for EV owners (n = 1,672). This effect was stronger than that for any other factor, including those relating to concerns about recharging costs, reliability, or range.

These studies highlight the relationship between the charging experience and EV repurchase intentions for existing EV owners. However, further analysis is needed to identify a causal link and to determine this relationship for non-EV owners.

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