Behavioral trends in EV adoption & charging: Evidence from southern California

Ahmed Abdulla

Assistant Professor, Mechanical & Aerospace Engineering

Carleton University

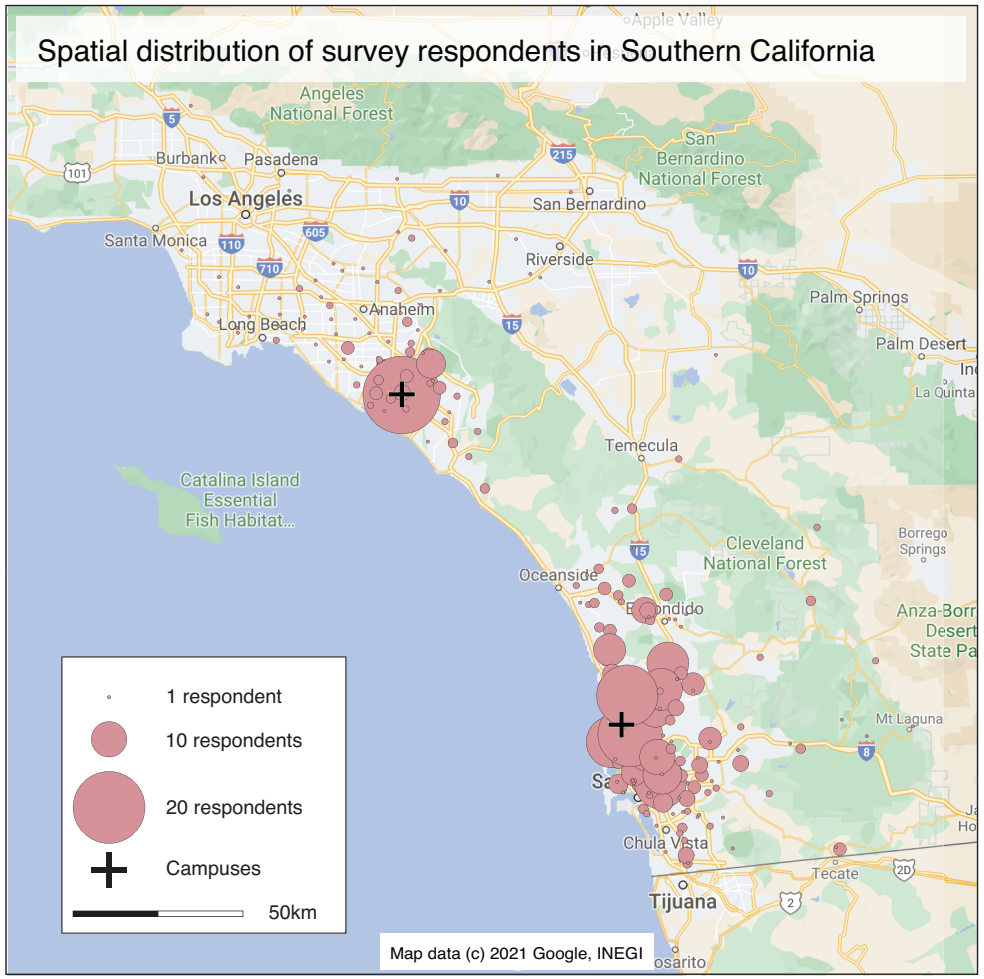
NASEM EV Workshop

28 August 2021

Carleton University | Mechanical & Aerospace Engineering

carleton.ca/APEX

We conducted a survey of EV owners in southern California



Why California?

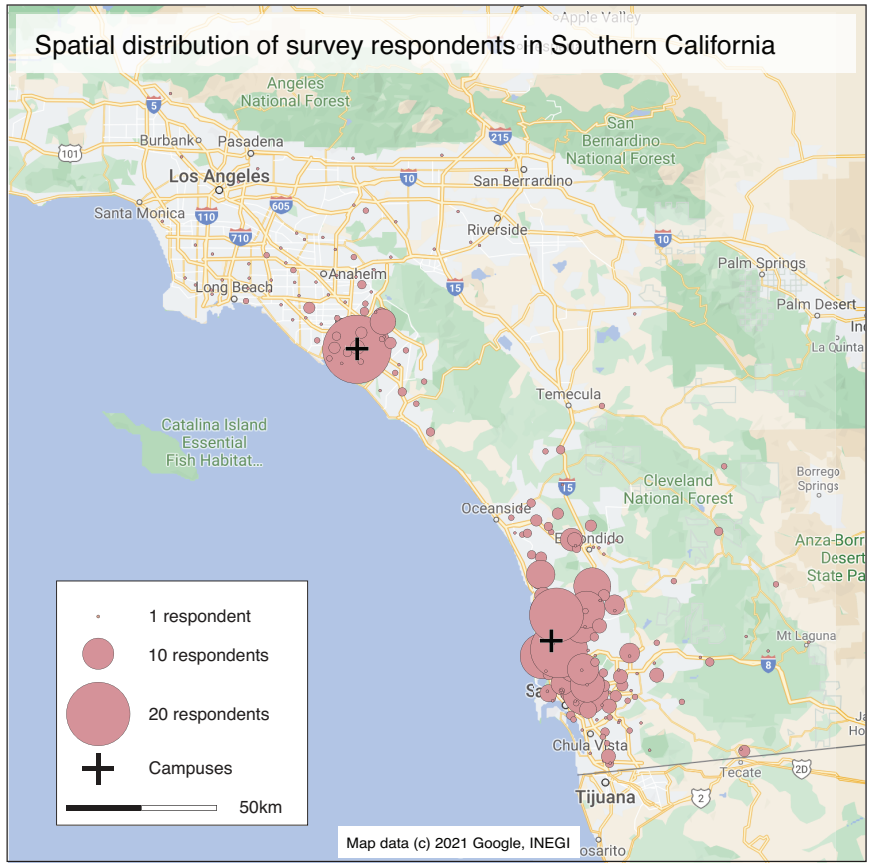
- Early adopter of regulatory standards:
  - Has influence in establishing trends.
- 10% of new vehicle sales and 50% of EV sales in U.S.
- Making investments to encourage EV adoption.
- UC campuses rank among ChargePoint's top 10 university customers by amount of energy delivered.

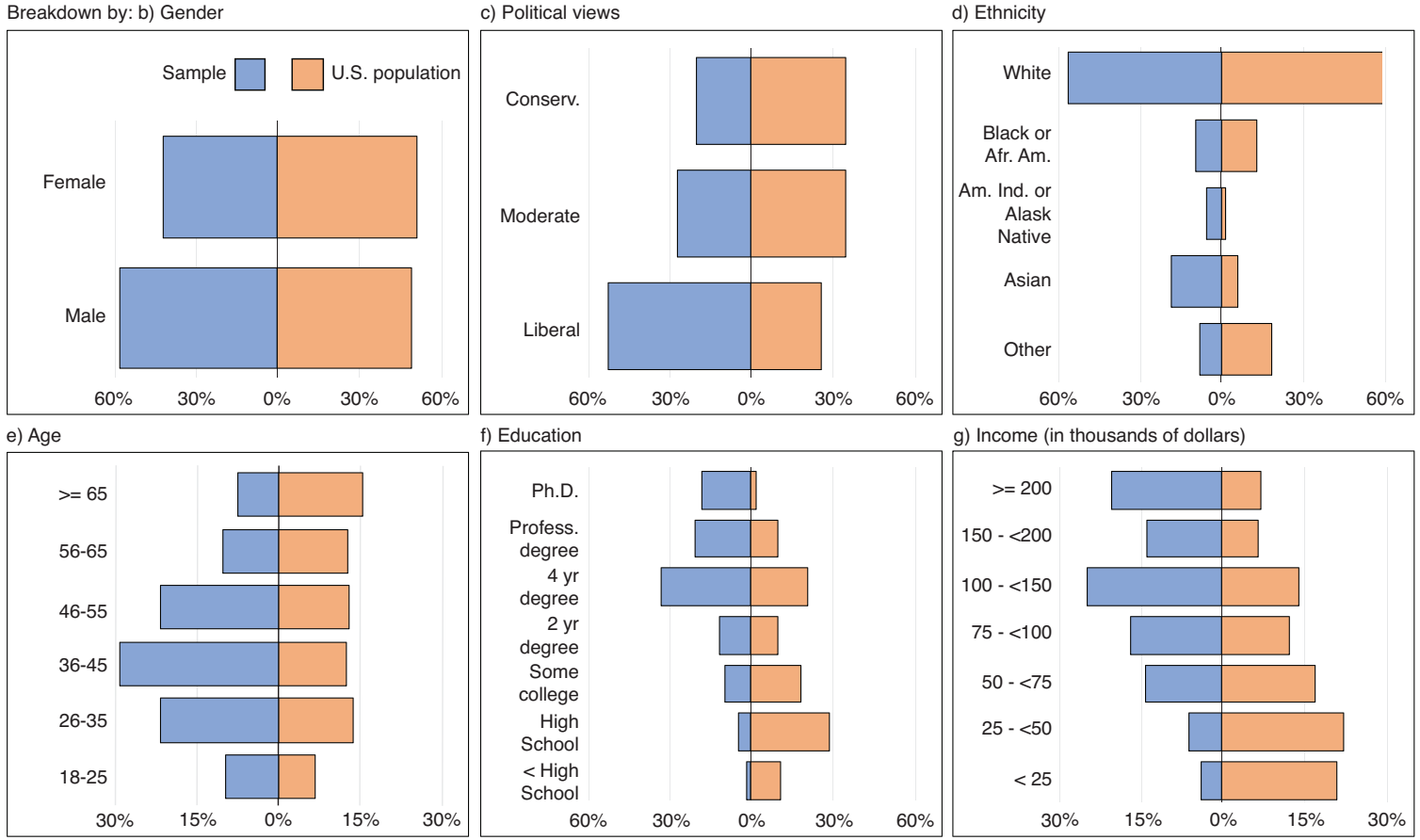
What research questions are we investigating?

- Is adopter profile changing? Revolution still unfolding and so incentives still matter: are people satisfied with them?
- Is workplace charging behavior changing? How, and what are the implications of that evolution?
- Here, EV = BEV + PHEV.

Survey data: descriptive statistics

643 respondents; April to July 2019.
Recruited from UC San Diego, UC Irvine, and EV Club of San Diego.





1) How satisfied are owners with the **incentives** they receive?

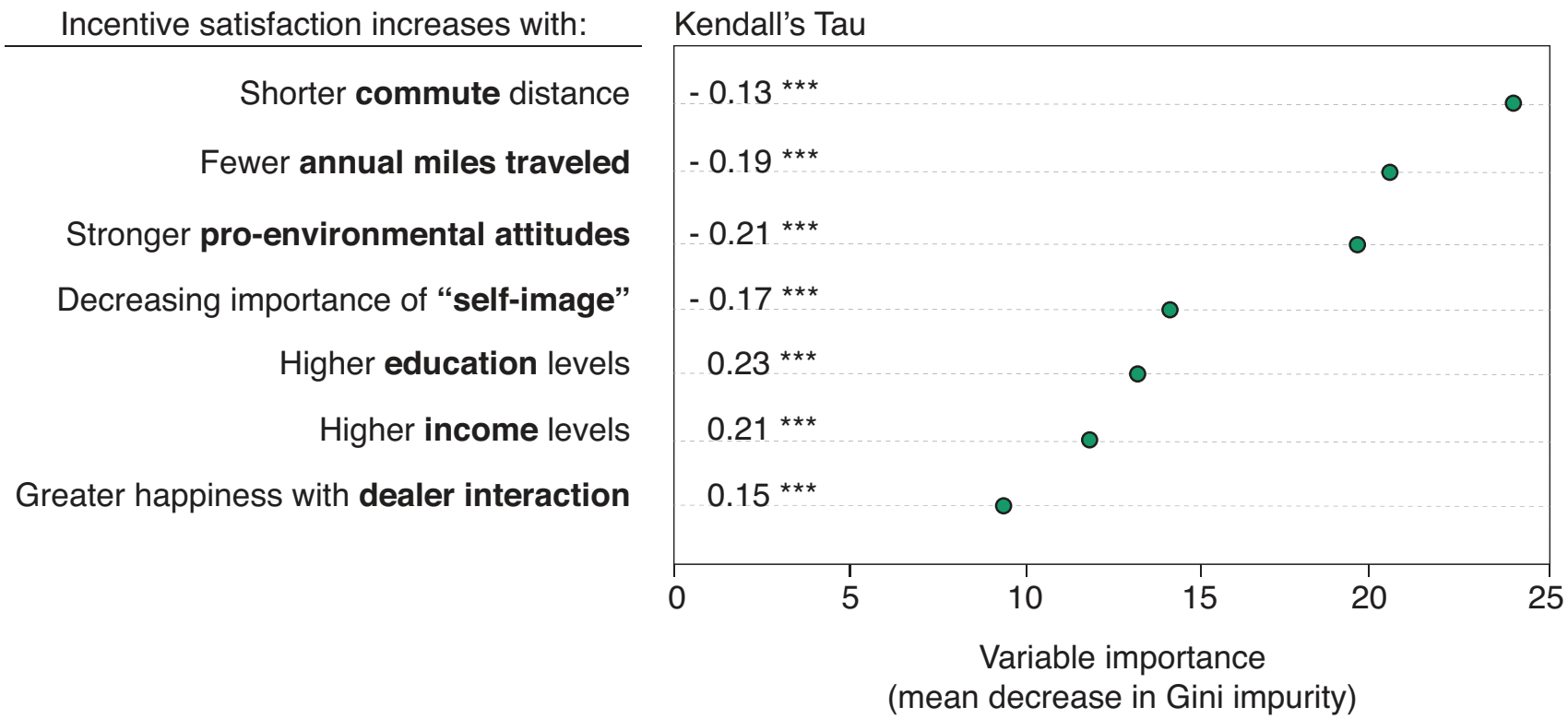
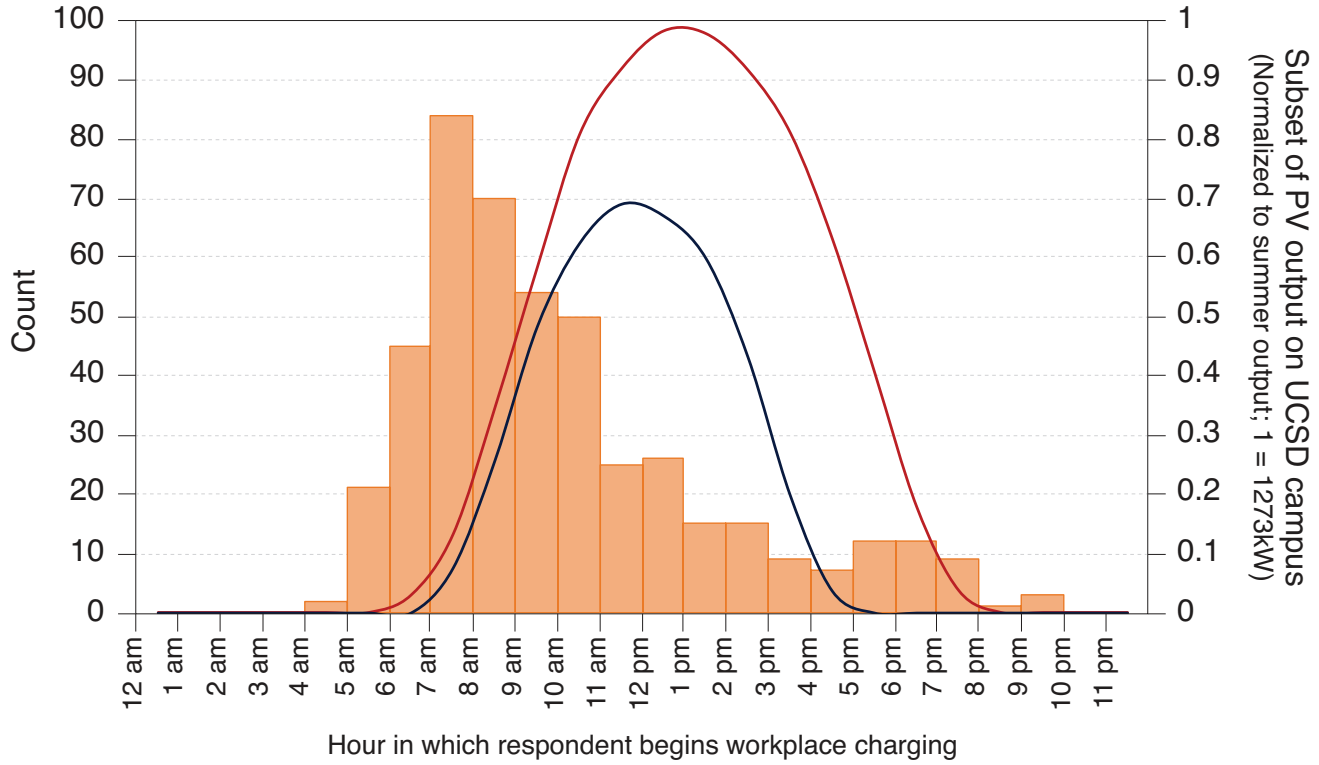


Figure shows variables important in distinguishing owners who were satisfied with level of incentive received from those who were not. Kendall's τ indicates the direction of the association between independent and dependent variable (*** $p \leq 0.001$).

2) How does **workplace charging** manifest itself?



On both campuses (N = 469), workplace charging begins early in the day, with a median start time of 10am and a mode of 7-8am (columns). By contrast, maximal solar output from UC San Diego's campus PV systems lies between 11am and 3pm in summer (June shown in red) and between 10am and 1pm in winter (December shown in blue).

2) Which factors explain **workplace charging** behavior?

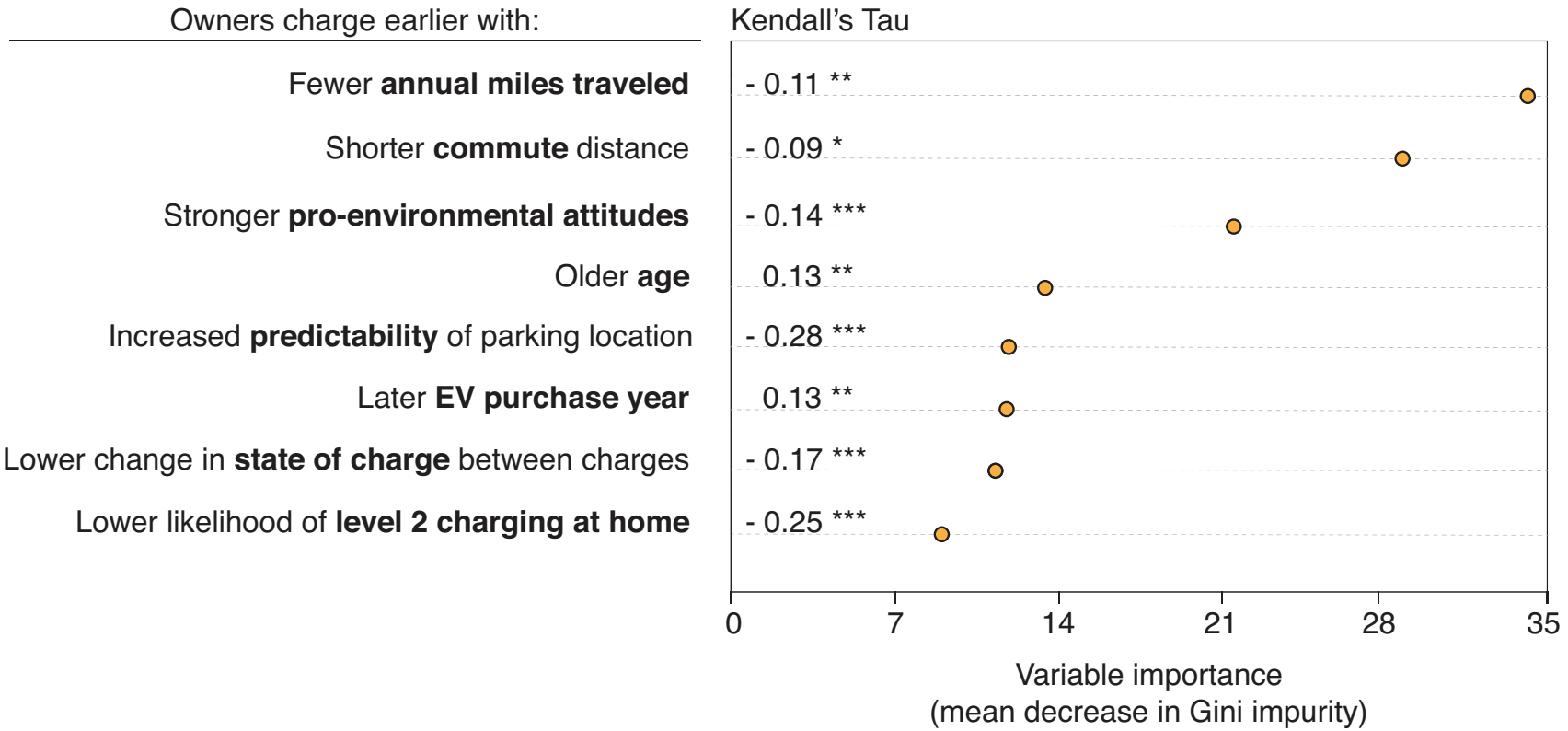
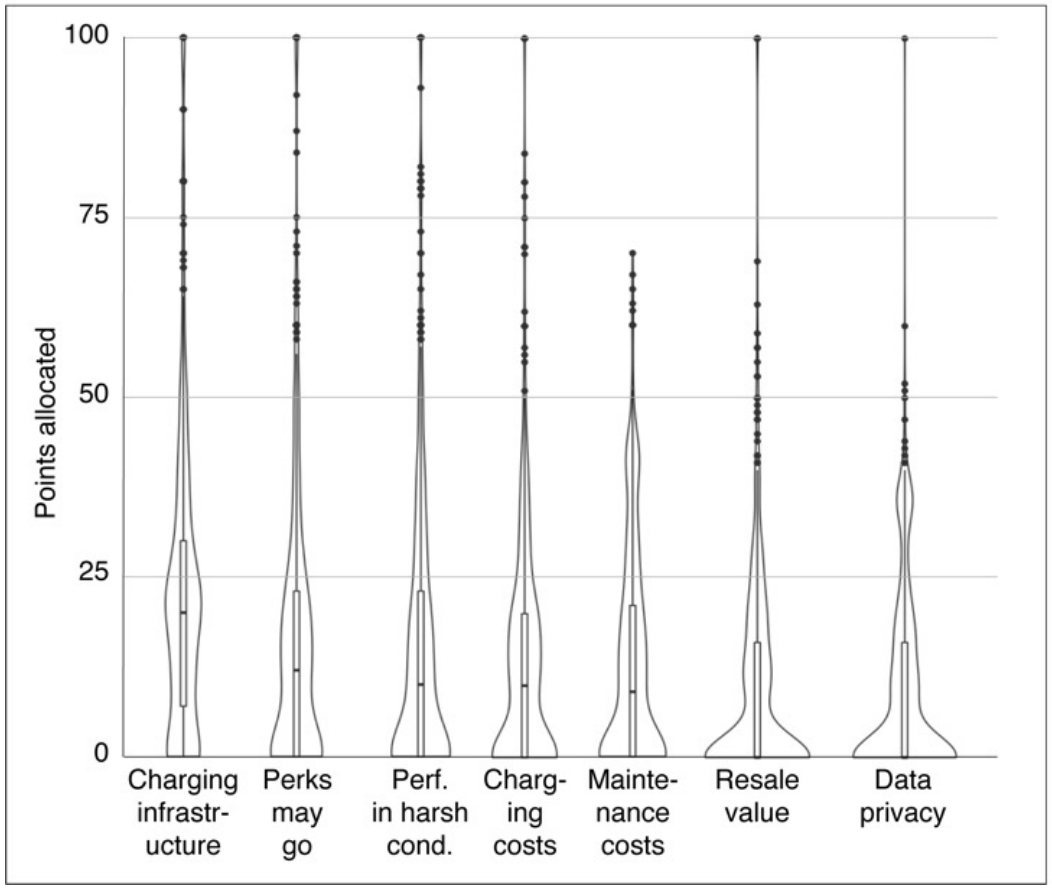


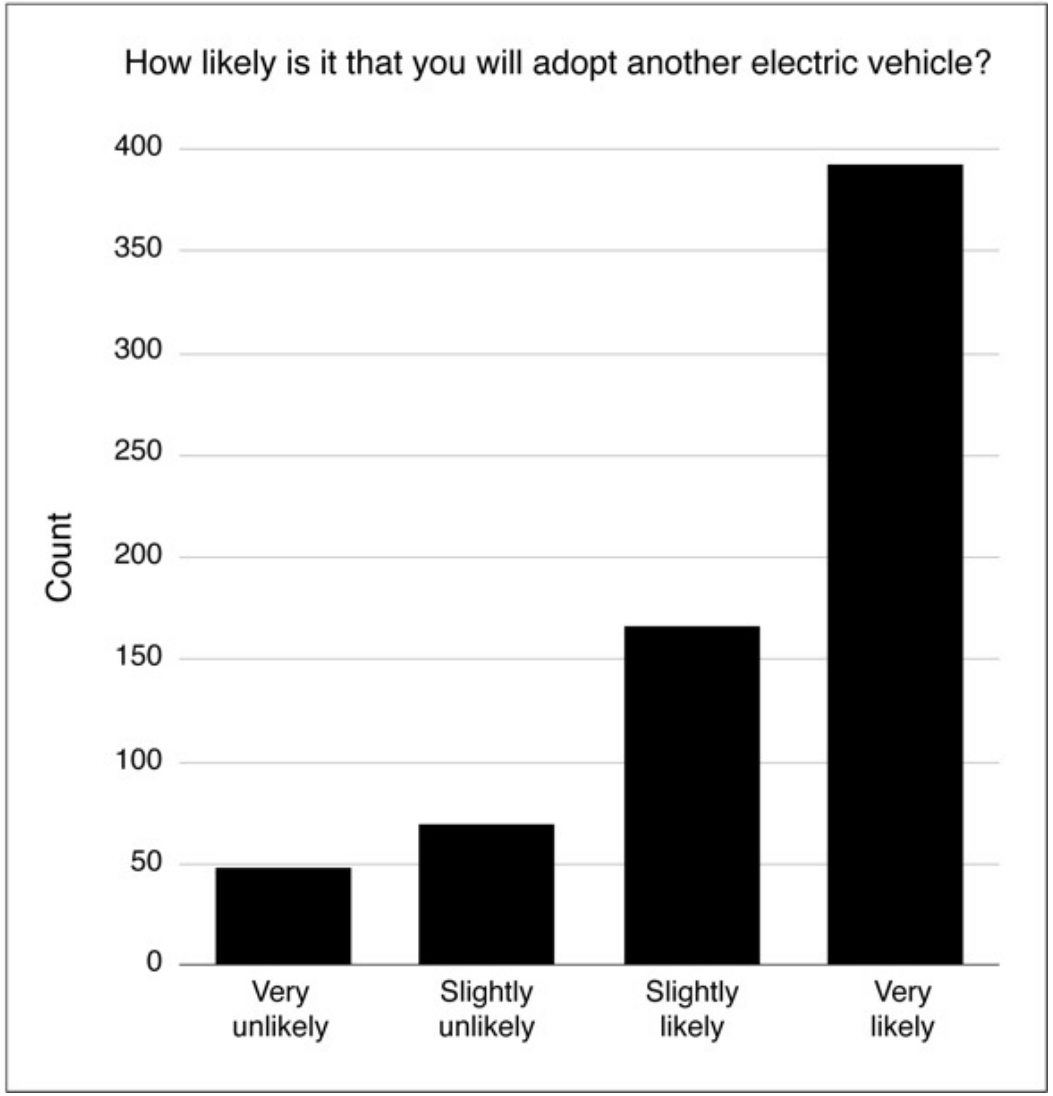
Figure shows variables important in distinguishing owners who charge early at the workplace (pre-11am) from those who charge later in the day (post-11am). Kendall's τ indicates the direction of the association between independent and dependent variable.

(* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$)

Evidence of emerging challenges and discontinuance



Ranking of concerns regarding EVs. Later owners indicated cybersecurity and data privacy—crucial to anticipate and address such risks.



Policy implications

- Evolutions occurring; important to identify and address *some*.
- Several emergent challenges as the transition to EVs unfolds.
  - Entities commissioning new infrastructure might wish to consider that attitudes to workplace charging are evolving.
    - Relying on operating experience might prove unreliable in investment planning.
    - Unclear how we might modify workplace charging to align with changing electric grid. Various interventions have been proposed; urgent study required to determine which are prudent.
  - Whether related to privacy or other concerns, must pay attention to whether plateaus might emerge in adoption, absent strong mandates that force shift.

This work was supported by the University of California Carbon Neutrality Initiative, administered through the University's Office of the President