User-Range Interaction

Can I reach my destination? Or do I already have to charge?

- Advancing BEVs: Not only battery capacity ➔ key design goal ➔ usable range
- Address human factors of range & enable optimal utilization of range
- Essential for developing sustainable electric mobility systems [1][2]
- Prerequisite: understanding user-range interaction
- Dealing with BEV range = control task – ACOR model [3][4]

- Individual comfortable range = actual usable range = target for system design
- Key task: understanding dynamics (variance) in comfortable range

Research questions:
(Q1) Transfer of resource interaction styles from combustion vehicle to BEV
(Q2) Level of practical experience vs. comfortable range?
(Q3) Relevance of comfortable range for BEV acceptance?

Method

Field trial setup & BEV
- BEV field trial focused on user-range interaction [5]
- Data collection before (T0), after 6 weeks (T1), after 12 weeks (T2)
- BMW ActiveE (130-160 km range)

Participants
- People applied for three-month lease (370-450€ per month, N = 673 applicants)
- Requirement: mobility profile leading to frequent interaction with range
- N = 74, M_age = 43.4 years (SD = 9.3), 16% female, 58% university degree

Scales and measures
Comfortable range scenario task - CRST (label: ComfRange-BEV) [T0,T1,T2]
- Assesses preferred proportional comfortable range utilization (+ score values += comfortable range – = range safety buffers)
- Standardized scenario & special response grid to identify threshold value [α]
- Comfortable range indicator combustion vehicle (label: ComfRange-CV) [T0]
- Minimalistic CRST: standardized scenario & 2 items from CRST = range experience given certain available range buffer, Cronbach’s α = .71
- General low-range aversiveness CV (label: LowRangeAverse-CV) [T0]
- 4 items (e.g. “I always want to have a fuel reserve in the tank.”), α = .81
- BEV Acceptance (label: Accept-BEV) [T2]
- 9-item scale of Van der Laan, Heino, & De Waard, 1997 [7]
- Sub-scales satisfaction (α = .83) & usefulness (α = .78), all items α = .88

Results

(Q1) Transfer of resource interaction from combustion vehicle (CV) to BEV
- ComfRange-CV (T0) vs. ComfRange-BEV (T0,T1,T2):
  - T0-T0: r = .43, p < .001
  - T0-T1: r = .48, p < .001
  - T0-T2: r = .22, p = .042
- LowRangeAverse-CV (T0) vs. ComfRange-BEV (T1,T2):
  - T0-T0: r = .32, p = .004
  - T0-T1: r = .30, p = .006
  - T0-T2: r = .06, p = .304

(Q2) The role of practical experience for comfortable range
- Total distance driven with BEV (T1,T2) vs. ComfRange-BEV (T1,T2):
  - T1-T1: r = .33, p = .004
  - T2-T2: r = .34, p = .004

(Q3) Relevance of comfortable range for BEV acceptance
- ComfRange-BEV (T2) vs. ...
  - general BEV satisfaction (T2): r = .39, p = .001
  - general BEV usefulness (T2): r = .33, p < .004
  - composite BEV acceptance (T2): r = .41, p < .001

Conclusions

(Q1): Results indicate considerable transfer of resource interaction styles
- Notable: ComfRange-CV not only accounts for T0-ComfRange-BEV (i.e., drivers without BEV experience)
- CV comfortable range predicts usable range after first adaptation to BEV (T1)
- However: weak effect for T2 – further research into adaptation process needed

(Q2): Higher levels of practical experience related to higher comfortable range
- Adds to body of evidence showing relevance of practical experience [3][6]
- Comfortable range is not only a function of habits from CV usage

(Q3): Higher comfortable range positively related to general BEV acceptance
- Remarkable given many other possible predictors of BEV acceptance
- Results in perspective: one step in the agenda of developing a comprehensive understanding of user-range interaction = user interaction with limited resources
- Contribution to knowledge related to human factors in low-resource systems [8]

Meet the e-mobility user group at Technische Universität Chemnitz

References:

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