Behavioural Studies and Electric Vehicles

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Psychology, OBU

- Involvement in BMW MINI E Trial
- Comprehensive involvement in UK ULCV Trial
  - Overview of methods
- Research Findings:
  - Drivers’ adaptation to the transition from ICE to EV
  - Charging behaviour (routines, infrastructure, barriers)
Ultra Low Carbon Vehicle Demonstrator Programme (BMW MINI E, 2009-2011)

- **Methodological** expertise
  - Questionnaire design/analysis
    - Chart changes over time (scaled responses, prices, attitudes)
  - Interview design/analysis
    - Focus on concrete experience
    - Enables us to assess unanticipated areas of importance to the end user

- **Psychological** expertise
  - Reveal the critical factors underpinning
    - Initial attitudes/motivations
    - Adaptation to new technology
    - Successful/unsuccessful behavioural change
TSB ULCV Demonstrator Programme

Allied Electric Vehicles
Scottish Power
Axeon Batteries
Strathclyde University,
Glasgow City Council

Nissan, Smith Electric Vehicles, AVID,
Liberty Electric Cars, Peugeot
Gateshead Council
Future Transport Systems
Newcastle University (TORG)

BMW Mini-E
Scottish and Southern Energy
Oxford Brookes University

Delta Motorsport, Westfield Sports Cars
Ecotricity Cars, Lightning, AEA Technology,
Green Motion Eco Car Hire

Jaguar Land Rover (Tata), Smart,
Mitsubishi, Microcab
Eon Energy
Arup
Coventry and Birmingham City Councils
Aston and Coventry Universities

Ford
Scottish and Southern Energy
Strathclyde University

Toyota
EDF Energy
MET Police, Transport for London, GCDA

Smart UK
Nudge Advisory

TSB ULCV Demonstrator Programme

[Image of various electric vehicles]
TSB ULCV Demonstrator Programme

• Electric Vehicles:
  – Initial motivations, expectations, experiences, and behaviours of users
  – The adaptations and developments vis-à-vis “normal behaviour”
  – What strengths and limitations are experienced?
    • Challenges and whether these are overcome (and how)
  – What factors influence acceptance of electric vehicles
  – Based on experiences, how could vehicles (and overall system) be improved for the user

• Samples:
  – Private Users (gender; high vs. low mileage; sole car vs multiple car household)
  – Fleet Users (Individual and Pool)
  – Fleet Managers
TSB ULCV Demonstrator Programme

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- **TSB (innovative platform steering group)**
  - Environmental Issues
  - Driveability
  - Reliability
  - Charging
  - Daily Usability
  - Range Issues
  - Suitability as Sole Car vs. Additional Car
  - Desirable Vehicle
  - Status/Image
  - Cost

**Questionnaires Interview**
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**How:**

Structured questionnaires
Interviews
*(telephone, focus groups)*

1. **Before vehicle use**
   1. Immediately prior to use
      *(questionnaire and telephone interview)*

2. **During vehicle use** *(depending on trial length)*
   1. One week *(telephone interviews with users)*
   2. E.g., 3 and 6 months *(questionnaires)*

3. **End of trial**
   1. Questionnaire and focus groups
Initial Interview

1. How did you feel when you found out you had been selected as a participant in this trial?
   - Have you driven an electric vehicle or hybrid vehicle before?
     - [If so, ask participant to specify the vehicle and extent of experience]

2. For you personally, what are the most important reasons for taking part in the trial?
   - What do you expect to get from your participation?
   - In effect, you’ll be involved in testing innovative transport technology. To what extent does that interest you?
   - What do you think the car will feel like to drive?
     - Listen (and prompt) for acceleration, braking, reliability, monitoring displays, low noise

3. Do you feel that powering cars in a way that limits environmental damage is important?
   - Do you feel that electric cars will be environmentally friendly?

• Open-ended...RAs/Post-Doc...Trained to prompt...Rich info – direct impact on manufacturers’ & government understanding of key issues
Pre-Experience Interview

E. Behavioural intentions

9. Can you tell me about your driving in a typical day?
   - [Listen, and prompt, for: length of trip, type of trip, urban vs. rural, time of day, work vs. non-work]
   - Will you make any changes to your journeys due to having an electric car?
   - Do you anticipate any difficulties?

F. Assessing confidence in using a plug-in vehicles

10. Do you think that your life will change at all with the new car?
    - What things will you have to get used to?
    - What will you do when you have to go on a long journey?

11. What will be the biggest differences between using an electric vehicle and your current car?
    - Are you confident in dealing with the differences?
    - What will be the first things you need to get used to?
      - [refer to answer from question 10 in terms of which bits will need to be adapted to first etc]
    - What will take the longest to get used to?
1 Week Interview

A. Adapting to the transition

1. I’d like to hear about the transition from having your normal vehicle to having your EV/HV.
   - Can you describe the differences between having your normal car and having your _________
   - Has having the _________ been as you’d expected?
   - What has been the biggest thing you’ve needed to adapt to?
   - What adaptations have been easy?
   - Has your typical day changed?
   - Has your driving style changed
     - In what way?
1 Week Interview

B. Charging

2. Can you tell me about charging your ____________
   - Have there been any difficulties?
   - What has been straightforward?
   - Have you established a routine?

C. Driving

3. Can you tell me what it’s been like to drive the ____________
   - Can you comment on
     - The handling
     - The acceleration
     - The braking
     - The noise
     - The displays
Focus Group Interviews

Focus Group Questions

1. So, you’re giving back your _______ and will go back to driving a conventional vehicle. What do you think that transition will be like?

2. Presumably during the trial there were times when you drove a conventional car rather than take the _______ – how did you find that readjustment?

3. What would have improved your experience over the last 6 months?

4. What are the most important things to focus on for future development?
   - [from perspective of car manufacturers, energy providers, government in terms of financial incentives or charging infrastructure]

- Small group discussion of actual behaviour and reflections about the way in which their experience, knowledge and opinions developed over the course of the trial

- Aim to understand the psychology underlying the underutilisation of technical range

- Accounts of moments when they felt nervous about the charge left – whether this anxiety diminished over time or disappeared until lower charge levels, etc
Pre-Experience Questionnaire

- Questionnaires
- Posted to complete at home – user returns with enclosed SAE
- Respond to questions that lend themselves to “scaled” responses
  - Interest in technology; issues of range, expectations of driving, charging; general attitudes to EVs and environment; personal driving habits and purchasing preferences
Pre-Post Questionnaires

• Mid-Range & End of Trial (Questionnaires)
  - Repeated measures from first questionnaire in order to chart any changes over time/experience (e.g., expectation of range, of sufficient charging time)
  - Additional questions that could not be asked at the first data collection point (e.g., scaled items focussed on the driving experience of the EV/HV)
BMW: Immediate application of findings

Period of adaptation requires learning:

...to charge the car
...the length of time to fully recharge
...a charging routine (time of day, etc)
...the range that can be managed per charge
...the way temperature influences the battery
...the way the battery responds to air-con, heater
...how the car handles and accelerates
...the regenerative braking system
...what the display features mean
...how the lower noise might impact pedestrians
...
Type of Initial Motivation Predicts Successful Behaviour Change

Original Motivation (influences What one does and How one experiences what one does):

Private Users:
Highly intrinsically motivated – joy of driving

Individual Fleet Users:
Identify with wider company aims

Pooled Fleet Users:
Participation because they are told to; neither intrinsically motivated nor identifying with wider company aims

Overall Ramifications:

Private Users & Individual Fleet Users mobilise their resources to overcome difficulties and thereby develop greater self-efficacy (belief in themselves), have a wider variety of sustained driving experiences, and adapt more fully to the car. These people become positive models and influence agents for others

Pooled Users give in to the challenge, have low self-efficacy, a low opinion of the vehicle, have a small amount of driving experiences, and do not attempt to adapt to the car. They become negative models and influence agents for others
Would Speed of Charging Suit the Daily Routine?

Charts showing whether the charging time would suit their daily routine

Pre Experience

3 Months Experience

Unsuitable

Suitable
What is a low level of charge?

*After 3 months use

Chart showing what users considered to be ‘low charge’*
Plugging-In times becomes routine

- Whenever possible
- When prompted by the warning light
- At a regular interval

Chart showing when users charged their cars
Distribution of battery state of charge at the start of a charge.
Is public charging necessary?

Charts showing whether a public charging infrastructure is essential
In total energy terms for the lifetime of a typical fossil-fuelled vehicle, it takes 15% to make it and **85% is expended in its’ use and maintenance.**

How to save energy in use by cars (**the 85% in-use phase)**:

- Alternative fuels
- Improved energy management (cooling, etc)
- Reduced rolling resistance
- More efficient engines – using F1 experience
- Improved aerodynamics – wind-tunnel work
- Alternative powertrain – electric cars
- Light-weighting – composites, new metal alloys

*New EPSRC £4.7m 8-university project “Towards affordable, closed-loop, recyclable future structures (TARF-LCV)”*

Products must be designed for end-of-life. SVEC is engaged in materials recovery techniques, disassembly technologies incl. disbond-on-demand adhesives.
Oxfordshire EV Consortium

- Oxfordshire County Council, Oxford City Council, Oxford Brookes University
- Vision to become an exemplar region for improved air quality and build a self-sustaining market for EV’s
- Significant investment commitment from private enterprise – Oxford, UK, Hong Kong, Singapore
- Focus on E-Cars, E-Buses and Light Commercials
- Corporate Car Share Schemes
- Silverstone EV Experience Centre and “Race to road” demonstrators

15 low emission vehicles in BrookesBus fleet