State of LEV (e-bike) Research

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Transportation Research Board (TRB) Activities

- Joint subcommittee revived in 2011 under TRB’s Bicycling committee (chaired by J. Dill)
- Current co-chairs C. Cherry and G. Rose
- Active in developing calls for papers, research need statements, conference sessions etc.
- About 40 people on the roster of members
- TRB is the single largest venue of publishing LEV research
E-bikes in the mainstream: Reviewing a decade of research

- Elliot Fishman (Utrecht U. in Netherlands) and Chris Cherry (UT-Knoxville)
- In Review in “Transport Reviews” journal
Behavioral Research

- Asia (China and Vietnam)
- Europe
- North America
- Australia
Behavioral Research: Asia

- China
Behavioral Research: Asia

- China: e-bike trip lengths longer than bicycle

Fig. 3. Previous e-bike studies and potential mode shift.
Behavioral Research: Asia

- Vietnam
  - E-bikes can’t compete with gas scooters
  - E-scooter can compete if it is:
    - High Performing (fast, high range, and low recharge time)
    - Price can be high (WTP for performance)
    - Has strong differential cost incentives

Behavioral Research: Europe

- In Austria...early adopters are predominately comprised of persons >60 years, used for leisure trips, and barely substitute carbon intense modes.
- German naturalistic study reveals some differences among e-bike users and bicyclists
- Surprisingly little (English language) literature

Behavioral Research: N. America

- In bikeshare study in Knoxville:
  - e-bike riders ride longer distances
  - e-bike’s displace 11% car trips (bicycles replace 0%)
- In Sacramento qualitative analysis reveals many motivations for purchase and use
- Nationwide survey by MacArthur found:
  - Almost 65% of respondents replace some car trips

Behavioral Research: Australia

- Similar to NA study
  - Nationwide survey, 60% replace car trips
  - Environmental attitudes were also important
  - 71% of owners over 40 years old
  - Most information gathered online. Women relied on personal recommendations
  - Converted e-bikes mainly owned by men

Safety Research

- China
- Europe
- North America
Safety Research

- Perceptions and Behavior
  - Some riders perceive e-bikes are safer, esp. at intersections (North America and China)
  - In China, e-bike riders with at-fault crash history generally have lower safety attitudes and lower risk perception.
  - Better e-bike performance makes users state they behave better (Popovich) contrary to Langford observations.

Safety Research: China

- Crash and Hospitalization Data
  - Crash burden increasing
  - Going up nearly as fast as e-bike numbers rising
  - E-bike rider injuries more severe than bicyclist injuries
  - Motor vehicle collisions are most serious
  - Head injuries highest proportion of injuries requiring hospitalization—recommend helmets

Safety Research: China

- **Safety Behavior at Intersections**
  - Recent trend in video intersection safety behavior
  - E-bike riders tend to run red lights more than bikes
  - E-bike riders tend to wait less time at red lights
  - E-bike riders generally behave badly at high rates (along with bicyclists).
  - The only worse offender at intersection conflicts are cars.

Safety Research: China

- **E-bike Speed**
  - Three studies investigated cruising speed of e-bike riders
  - All three found ~+40% speed differential with bicycles
  - Main hole in literature is related to fault, vulnerability, and conflict modes

Safety Research: Europe

- Two new studies investigate hospitalization data
  - 23 hospitalizations in Switzerland. Head and upper extremity.
    - Not as severe as China (helmet use and single-vehicle crashes)
  - 294 e-bike crashes in Netherlands
    - Very little difference between bikes
    - E-bikes that displace cars would have positive safety benefits

Safety Research

- **North America**
  - E-bike riders act almost exactly like bicyclists
  - Violate traffic control devices or wrong-way ride at about same rate
  - E-bike riders ride faster on average than bicyclists on some facilities
  - Top speeds are not statistically different

Health Research

- Five key studies, four of which European
  - Pedelec e-bikes provide some physical activity benefits (Metabolic Equivalent Tasks: MET), enough to meet most health guidelines, particularly for unfit
  - Lower than traditional bike
  - Energy/time: E-bikes 11% less than bike and 8% than walking
  - Energy/distance: E-bikes 21% less than bicycling and 62% less than walking*

Fleet (freight and shared) Research

- Bikeshare (and other LEV-share)
Fleet (freight and shared) Research

- Bikeshare (and other LEV-share)

- E-bike trip lengths longer
- More utility errand-type trips
- More comfortable
- People used regular bicycles more than we expected (both free). 30% of bicycle choosers disliked e-bike (43% of women)
- Battery swapping only needed for really high turnover

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Fleet (freight and shared) Research

- Other LEV-share

LEV and EV in shared vehicle system (Paris)

SF/FHWA Value Pricing
Fleet (freight and shared) Research

- Freight (only-mile or last-mile)

Conclude

- Pure safety research usually needs more and detailed data
  - possible but not available in China and not necessarily transferable elsewhere
  - Safety behavior is best proxy we have
  - Big gaps in cause/fault analysis

- Growing base of research in health arena
  - Need more naturalistic data
  - Need data on behavior effect (more riding?)
Conclude

- We know very little about the effect of shared vehicles or other fleets.
- Behavioral data is key to all questions about impacts on the transportation/health system. How do people use e-bikes and what modes do they displace?
Conclude

- They are most energy efficient mode of motorized transportation

- They are the largest adoption of an alternative fuel vehicle in history