Do cyclists on e-bikes behave differently than cyclists on traditional bicycles?

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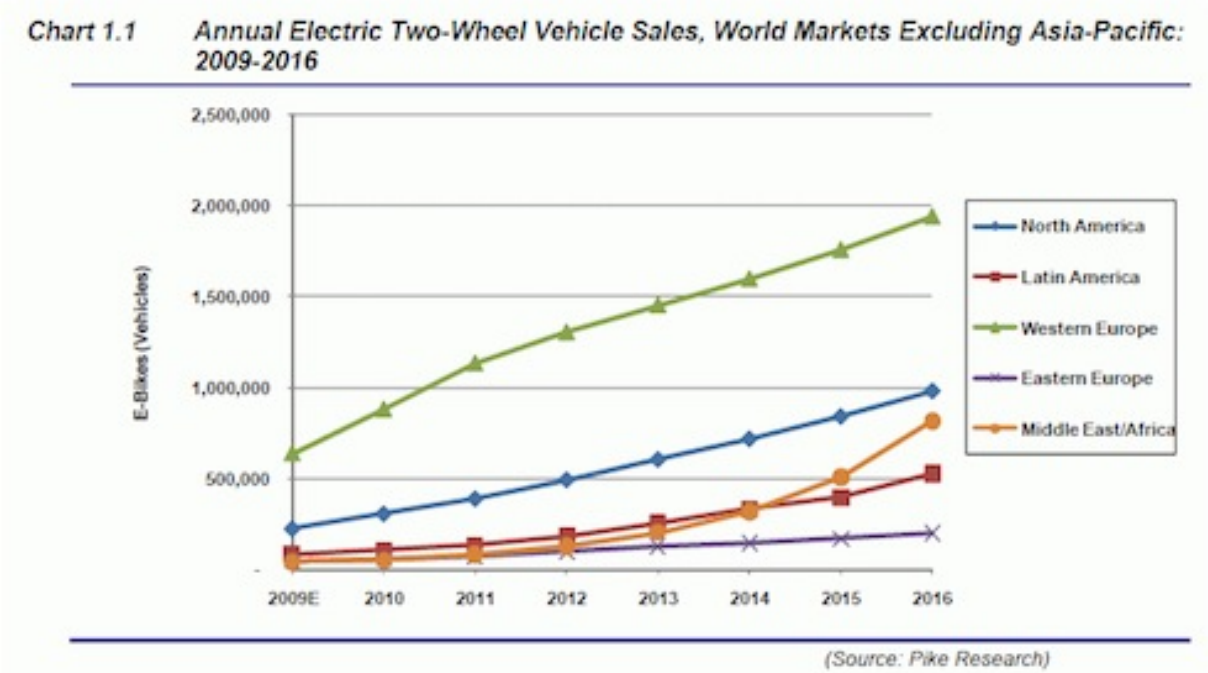
E-bike sales

Worlwide (without Asia-Pacific market)



[http://www.electric-bicycle-guide.com/electric-bicycle-statistics.html]

E-bike sales

E-bikes use is not specifically regulated:

- No license/insurance required.
- No age requirement existing.

E-bikes are faster than normal bikes[1,2] => higher risks?

Do e-bikes riders behave differently from riders of traditional bikes?

[1] Dozza, Bianchi Piccinini & Werneke (2014), TRF.

[2] Lin et al. (2008), TRR.

Objective

To determine differences between e-bike and traditional bikers for:

- Cycling conditions.
- Road-user interactions.
- Crossing conditions.

Using data from two naturalistic studies:

- Study 1: traditional bikes.
- Study 2: e-bikes.

Study 1 – Traditional bikes

- Camera (HD 30fps)
- Inertial Measurement Units (100 Hz)
- GPS (10 Hz)
- Brake Force Sensors
- Cyclist Sensor
- Logger
- Modem
- Simple HMI

Study 2 – E-bikes

- Data Logger
- GPS
- Inertial Measurement Unit
- Camera
- Brake Sensor
- Pedal Sensor
- Current Sensor
- Brake Switches
- Push Button
- Switch

Methods

Participants:

- Traditional bikes: 16 cyclists (26-66 years; M = 39.1; SD = 11.4).
- E-bikes: 12 cyclists (22-50 years; M = 37.6; SD = 10.3).

Period of data collection:

- Traditional bikes: August-November 2012.
- E-bikes: August-November 2013.

Km of cycling collected:

- Traditional bikes: 1549 km.
- E-bikes: 1474 km.

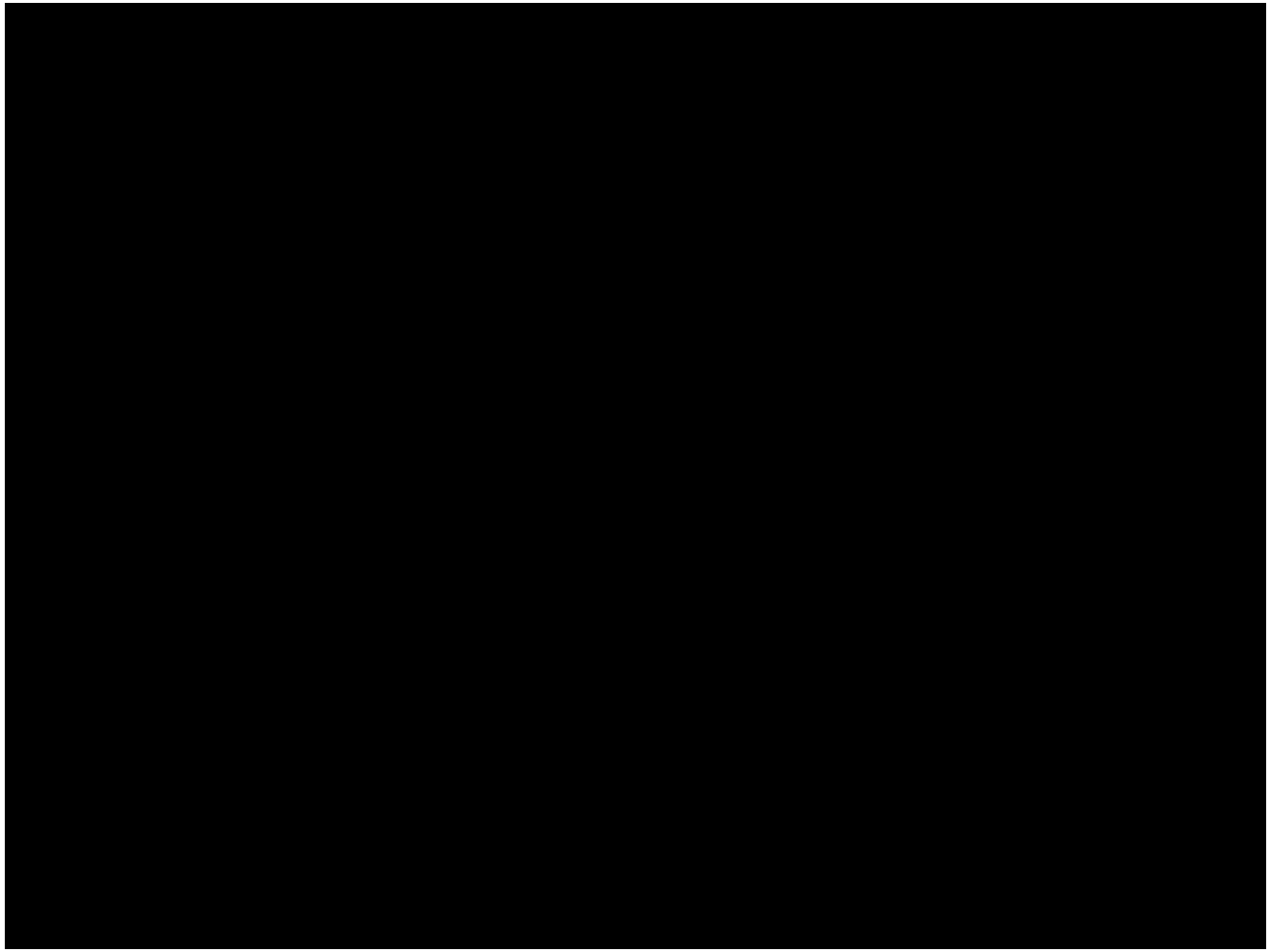
Methods

Video generation procedure:

Five 30-s video clips were randomly selected for each participant, based on the total time ridden.

- 80 video clips for traditional bicycles.
- 60 video clips for e-bikes.

Videos analysed



Data analysis

1. Cycling conditions (type of cycle path, width of cycle path, uphill/downhill, presence of crossings).

Data analysis

2. Interactions with other road users (pedestrians/cyclists overtaken, pedestrians/cyclists met).

Data analysis

3. Crossing conditions (pedestrians/cyclists/vehicle crossing, presence of traffic light, crossing with red light).

Data analysis

Questionnaire data used to integrate the objective coding.

Information captured (only for e-bikes):

- Change in mobility patterns.
- Interaction with other road users.
- Behaviour at crossings.

Results

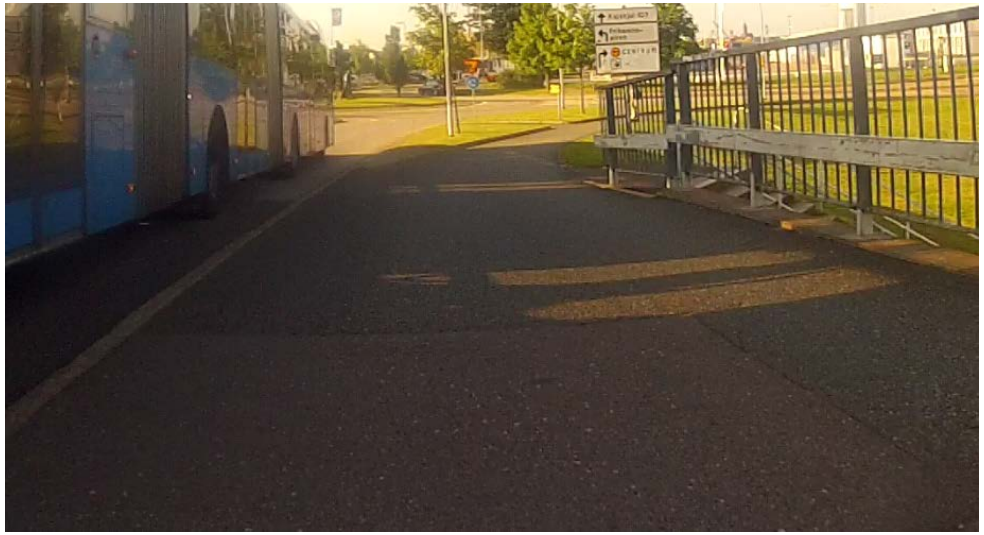
Cycling conditions (video coding)

E-bikes traveling more frequently on asphalted and extra-wide paths*.

* Statistically significant

Results

Cycling conditions (video coding)



E-bikes traveling more frequently on non-flat cycle paths.

* Statistically significant

Results

Cycling conditions (video coding)

E-bikes coming to more crossings* in the 30-s video clip.

* Statistically significant

Results

Interactions with other road users (video coding)

E-bikes overtaking and meeting* more cyclists.

* Statistically significant

Results

Interactions with other road users (video coding)

E-bikes overtaking* and meeting* more pedestrians.

* Statistically significant

Results

Crossing conditions (video coding)

Not enough data to reach significant conclusions.

Results

Questionnaire data (e-bikes)

- With e-bikes:
  - More cycling uphill and in adverse weather.
  - Longer distances covered.
  - More cyclists overtaken.
  - Uncomfortable feelings in sharing cycle paths with pedestrians.
  - More concentration required.
  - Different behaviour at intersections.

Discussion

- E-bikers are faster => more frequent interactions with road users, more task demand and more cognitive load:
  - Improve visibility/identity (e.g. through lights).
  - Increase situation awareness for cyclists and other road users.
- E-bikers like wide and asphalted cycle paths:
  - Foster changes to cycle paths.
  - Clearer distinction between sidewalks and cycle paths.
- More research required about behaviour at crossings.

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Thanks for your attention!

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