Road safety and bicycle usage impacts of unbundling vehicular and cycle traffic in Dutch urban networks

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Introduction: Crash modelling

Basic crash prediction model (CPM):
- \( E(\lambda) = \alpha V^\beta e^{\sum y_i x_i} = \alpha V_c^{\beta_1} V_m^{\beta_2} \sum R_i \)

Estimated using Negative Binomial Regression Modelling
Traditionally there is much research attention for infrastructure along distributor roads.
Less attention for the impact of road networks and street hierarchies

The Dutch hierarchical classification of roads:

- *Through roads* with a flow function
- *Access roads* to give access and for sojourning
- In between are *distributors*:
  - Flow function on road sections
  - Exchange of traffic at intersections
Examples

Scale (0.5km=0.31 mile)
Distributor road
Examples

Scale (0.5 km = 0.31 mile)

Distributor road
Research question

• What is the impact of separating bicycle traffic from the distributor road network, here called ‘unbundling’, on road safety and bicycle use

• Road safety: bicycle-motor vehicle crashes
• Bicycle use: bicycle mode share
Unbundling: separation by routes through traffic-calmed areas
Unbundling: grade-separated intersections, bicycle tunnels and bridges, to cross distributor roads
Operationalization and measurement

• Two measures:
  – Routes through residential areas (share of the route)
  – Grade-separated intersections to cross distributors per km

As both appeared to be highly correlated they were combined in one ‘unbundling measure’ using Principal Component Analysis

• Measurement:
  – Reconstruction of routes using a cycling route planner for all 66 Dutch municipalities having over 50,000 inhabitants
  – Trips drawn from the National Travel Survey (NTS)
Hypotheses

• Unbundling corresponds positively with cycling safety and bicycle usage
  – Road safety: reduced exposure to high speed motor traffic
  – Bicycle usage: improved competitiveness of cycling compared to driving in terms of trip length:
    • Shorts cuts for cyclists where roads are closed to cars
    • Standalone paths and grade-separated intersections
    • Allowance of contraflow cycling on one-way streets

NB this is an indirect effect via the length of car trips divided by those by bicycle (tested using SEM)
Descriptive statistics

• On average per municipality (2004-2009):
  – 5 fatalities and 85 hospitalizations among cyclists
  – Bicycle mode share: 34% for trips up to 7.5 km

• Below: 66 municipalities split in three equally large groups according to the degree of unbundling
Results cycling safety

• Less crashes than expected in municipalities with a higher degree of unbundling (based on traffic volumes, density, and age distribution)
Results bicycle use

• Unbundling measures tend to improve the competitiveness of cycling (length of trips by car divided by those by bicycle), thereby slightly increasing bicycle mode share.
Conclusions

• Unbundling:
  – Increases cycling safety
  – Slightly increases bicycle mode share due to shorter trips by bicycle compared to those by car
Discussion

- Other effects not studied here:
  - Other crash types: also a positive effect
  - Unbundling decreases cyclists’ exposure to exhaust fumes and noise
  - Subjective (road) safety
  - Depending on the types of measures implemented, it may worsen feelings of personal security, e.g. remote standalone paths or bicycle tunnels
Questions

Paper available at:
http://www.ejtir.tbm.tudelft.nl/issues/2013_03/pdf/2013_03_03.pdf
Example: high level of unbundling (Houten)

- Almost 50,000 inhabitants
- Two large residential areas
- Bicycle tunnels at crucial locations within the network
- High level of unbundling: almost any trip is made without travelling along or crossing distributors

Railway station
City centre
Small shopping centre
Distributor road (50 or 70 km/h)
Residential area (access roads; 30 km/h)
Industrial zone/office buildings