Familiar strangers: A network of encounters

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Why is transport planning interested?
DUE, SO & SUE in transport models

Wardrop (1952):

1. The journey times on all the routes actually used are equal, and less than those which would be experienced by a single vehicle on any unused route.
2. The average journey time is a minimum.

Daganzo and Sheffi’s (1977) define SUE for the aggregate case:

“In a SUE network, no user believes he can improve his travel time by unilaterally changing routes.”
But how about the social context?
e.g. how much is destination choice as a joint choice?

Destination choice:

- Awareness set of the agent
- Personal time and budget constraints
- Individual utility maximisation

Or?

- Joint awareness set of participants
- Joint set of constraints
- Negotiation of the emerging choice
- Or joint utility maximisation
Number of accompanying travellers

- Short vacation
- Excursion: nature
- Other
- Excursion: culture
- Meeting friends
- Further education (leisure)
- Garden/ cottage
- Voluntary work
- Disco, pub, restaurant, cinema
- Meeting relatives/family
- Window shopping
- Pick up/drop off/attendance
- Group/club meeting
- Family duty
- Cemetery
- Active sports
- Education
- Long-term shopping
- Walk or stroll
- Daily shopping
- Private business
- Private business (doctor,...)
- Work

- Household members travelling along
- Other persons travelling along
- Dog travelling along

Axhausen et al., 2007
Required travel for leisure meetings of ego-alter

Distance between home locations [km]

Important contact

- No
- Yes

Schlich et al., 2002
Travel and social networks
Benchmarking the current state

- Numbers of contacts
- Distance distributions
- Clustering
- Geographies
- Frequency and mode of contact
Number of contacts reported

Number of contacts named

Percent

Frei and Axhausen, 2007
Great circle distances between “leisure” contacts: Snowball

Frequency

0 100 200 300 400

log-transformed distances [km]

0 0.1 1 10 100 1000 10000

Daten: Schneeballbefragung IVT, Siehe Kowald et al. 2012
Example of a social network geography
Size of network geometries

95%-confidence ellipse of the social network geography
Comparisons
Contact “density” – shares by distance class

Great circle distance [km]  
Density

- Zurich  
- Eindhoven  
- Switzerland  
- Concepcion  
- Toronto
Shares of contact by mode

Face-to-face

Telephone

Internet

Great circle distance [km]

Zurich
Eindhoven
Switzerland
Concepcion

Kowald et al., forthcoming
A low level network as a building block
Smart card records as a source

- Boarding Stop ID
- Card ID, Passenger Type, Travel Mode,
- Bus Service Number, Ride Start Time (Date), Bus Registration No. Direction
- Alighting Stop ID, Ride Duration, Ride Distance, Fare Paid,
- Metro Transfer Number, Boarding Station ID, Ride Start Time (Date), Ö
Number of contacts versus usage frequency

Sun et al., 2013
Encounter density over the days

Sun et al., 2013
Encounter density of the days: Cut-out

Sun et al., 2013
... Friday
... the weekly summary
A small world network in Singapore‘s busses

- One component by Wednesday

- Diameter: 6

- Characteristic path length: 2.95
  - (random: 2.63)

- Average clustering coefficient: 0.19
  - (random: 4.5×10⁻⁴)

- Small-world
A small world network in Singapore’s busses, but uneven
Integration
Schedule detail possibilities (in current stable MATSim)

Number and type of activities
Sequence of activities

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start and duration of activity</td>
<td>(Kowald, Tan, Fourie)</td>
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<tr>
<td>Composition of the group undertaking the activity</td>
<td></td>
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<tr>
<td>Expenditure division</td>
<td>(Kowald, Tan, Fourie)</td>
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<tr>
<td>Location of the activity</td>
<td>(Horni)</td>
</tr>
<tr>
<td>Movement between sequential locations</td>
<td></td>
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<tr>
<td>Location of access and egress from the mean of transport</td>
<td>(Waraich)</td>
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<tr>
<td>Parking search and type</td>
<td>(Ciari)</td>
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<tr>
<td>Vehicle/means of transport</td>
<td>(Chakirov)</td>
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<tr>
<td>Route/service</td>
<td>(Dubernet, Fourie)</td>
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<tr>
<td>Group travelling together</td>
<td></td>
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<tr>
<td>Expenditure division</td>
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Integration and future work

• Generation of artificial social networks (Arentze et al., 2012) (degree, clustering, distances)

• Repeat of Switzerland Snowball

• Measurement of network size (leisure, work, civic engagement)

• Measurement of network dynamics (Timmerman’s ERC project)

• Integration of network choice/decision making model (Dubernet)
Travel and social networks: Contributors to our work

Social networks and their geographies:
  • Timo Ohnmacht
  • Andreas Frei
  • Matthias Kowald
  • Lijun Sun
  • Andreas Diekmann, ETH Zürich
  • Jonas Larsen, Roskilde/John Urry, Lancaster

Integration into agent-based models
  • Thibaut Dubernet
  • Pieter Fourie

Social network generation
  • Theo Arentze, TU Eindhoven
Questions?
Questions?

www.matsim.org
www.ivt.ethz.ch
www.futurecities.ethz.ch
www.senozon.com
Literature and references


