Activity space and social network geographies: Growth ahead?

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Research support by

- ETH Zürich
- ifmo, Berlin
- NRF, Singapore
- UK Department of Transport, London
- VW Stiftung, Wolfsburg
Why social networks in transport/spatial planning?
Example: 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

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

<table>
<thead>
<tr>
<th>Distance between home locations [km]</th>
<th>Percent [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10 km</td>
<td>50</td>
</tr>
<tr>
<td>10 - 20 km</td>
<td>40</td>
</tr>
<tr>
<td>20 - 30 km</td>
<td>30</td>
</tr>
<tr>
<td>30 - 40 km</td>
<td>20</td>
</tr>
<tr>
<td>40 - 50 km</td>
<td>10</td>
</tr>
<tr>
<td>50 - 60 km</td>
<td>0</td>
</tr>
<tr>
<td>60 - 250 km</td>
<td>0</td>
</tr>
<tr>
<td>Abroad</td>
<td>0</td>
</tr>
</tbody>
</table>

Important contact:
- No
- Yes

Schlich et al., 2002
**Example: Residential location choice in Kt. Zürich**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>t-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent/Income</td>
<td>-5.51</td>
<td>***</td>
</tr>
<tr>
<td>log(m2/head)</td>
<td>0.98</td>
<td>***</td>
</tr>
<tr>
<td>Frequency weighted mean distance to friends</td>
<td>-8.16</td>
<td>*</td>
</tr>
<tr>
<td>Exponent (friends)</td>
<td>0.22</td>
<td>**</td>
</tr>
<tr>
<td>Mean distance to work/school</td>
<td>-1.59</td>
<td>**</td>
</tr>
<tr>
<td>Exponent (distance to work)</td>
<td>0.37</td>
<td>**</td>
</tr>
<tr>
<td>Travel time to Bürkliplatz</td>
<td>0.02</td>
<td>**</td>
</tr>
<tr>
<td>log(transit accessibility) * &quot;No car&quot;</td>
<td>0.41</td>
<td>**</td>
</tr>
<tr>
<td>log(car accessibility) * “Car&quot;</td>
<td>-0.30</td>
<td>**</td>
</tr>
<tr>
<td>Share of equally sized HH within 1 km</td>
<td>0.02</td>
<td>*</td>
</tr>
<tr>
<td>Population density within 1 km</td>
<td>0.01</td>
<td>**</td>
</tr>
<tr>
<td>Share of empty flats in municipality</td>
<td>-0.11</td>
<td></td>
</tr>
</tbody>
</table>

N= 683, rho² = 0.2128; * > 0.1; ** > 0.05; *** > 0.01
A shrinking world

Coach and sailing boat until 1840

Steam ship and locomotive, 1840 - 1930

Propeller aircraft, 1930-1950

Jets, from 1950

Dicken, 1998
In-commuter sheds of the ten largest Swiss towns

Nach Botte, 2003
Travel and social networks
Starting point

Maintenance of the social networks requires:

- Face to face interaction
- Balanced by other forms of interaction
- Travel ~ Physical spread of the contacts
- Trade-off between loosing contacts and “social” capital and investing in new contacts closer to home
Definition of a social network

The topology of a social network describes

- Which person/firm (node) is linked to which other persons/firms
- By contacts (links) of a certain quality (impedance or cost)

Closeness $\sim \frac{1}{\text{Impedance}}$
Position: Person as a network member

- „contacts“
- Household members
Position: Person as a member of multiple networks

Individual

„contacts“

Household member
Position: Individual in the biographical context

- Biography
- Learning
- Projects

Personal world
Position: Individual in the biographical networked context

- Personal worlds of others
- Social capital: stock of joint abilities
- Personal world
- Projects
- Activity space
  - Social network geography
  - Mobility tools

Biography → Learning
Example of a local activity space

Female, 24
Full time
Single
216 trips / 6 weeks
Example of a social network geography
Example of a mobility biography (UK architect)

Larsen, Urry and Axhausen, 2006
Why further growth?

Participation of all in the productivity increases (real quality adjusted income growth)

Drastic reductions of the generalised costs of travel and telecommunication

(Substantial) replacement of local personalised links by anonymous instruments of social integration
Productivity growth in Western Europe

Adapted from Galor and Weil (2000)
Price deflation for telecommunication

Index [1995 = 100]

US International and interstate average revenue per minute

Year

Nach FCC (2001)
An abstract model?

- Wages
- Specialisation
- Fleet comfort
- Housing consumption
- vtt's et al.
- Energy
- Tours
- pkm
- vkm
- k

Elasticity > 0
Elasticity < 0

Migration

Professional and personal activity space
Social networks
Social networks: Hypothesis 1

The size of spread (geography) of the social networks is inversely proportional to the generalised costs of communication (travel and telecommunication)

Additional result: Small geographies make it more likely that any two persons are linked through multiple networks

Corollary: The feeling of personal safety (“eyes on the street”) is proportional to the density of local links
Locally coherent networks (of the past ?)
Spatially non-coherent networks (today ?)

Scales could be different!
Social networks: Hypotheses 2a and b

Persons belong to more networks today
Persons keep more contacts alive then earlier

• More leisure time over the life cycle
• Drastically reduced costs of communication
• Copying of messages has become nearly free
Social networks: Hypotheses 3

Contacts have become more selective

- No need to make do with the „neighbours“
Social networks: Hypothesis 4

The distribution of contacts intensity has become more left skewed

- Selectivity of contacts
- Time requirements for acquiring the background knowledge about the references of the other persons
- Less gossip
- Fewer random meetings
Shift in contact intensity

![Graph showing the effort expended on each member vs. the rank of the member.](image)
Detour: The question of “milieu”

How do milieux constitute themselves? (socially effective, stable “crowds” without strong links)

- Definition of style
- Transmission of fashion
- Membership rules

How do they work in a society without a clear apex?
How do they spread?
What role do commercial providers of milieux play?
What power do they have?
Social networks: Hypothesis 5

The average knowledge about the contacts of own contacts is reduced by the increasing skew of the contact intensity:

- Less knowledge about everyday life and contact
- Lower visibility of many technologically enabled contacts

Corollary 1: The impact of gossip/news can be less well predicted

Corollary 2: The distance decay of “network supervision” should be spatially less steep then in the past; the friends of ones friends are likely to be present in the same milieux independent of location.
Social networks: Assumption

The selectivity is being increased by the general availability of mobile phones:

- More spontaneous patterns of time use
- Fewer predictable availabilities at certain (time-space) locations
Hypotheses summarized

- Message costs
- k
- Migration
- Professional activity space
- Number of networks
- Network geography
- Personal activity space
- Left skew of intensity distribution
- Network overlap

Elasticity > 0
Elasticity < 0
Setting the benchmark
First set of research issues

Benchmarking the current state:

• Numbers of contacts
• Distance distributions
• Geographies
• Frequency and mode of contact

• Productivity
• Levels of local anomie
• Levels of local trust
• Level of place attachment
Empirical strategy

- Surveys of social geographies & mobility biographies
  - Egocentric
  - Snowball
- Travel diaries
  - One-Day
  - Multiple days
- With/without information about the presence of others
- With/without named co-travellers, co-present persons
Social network surveys @ IVT

• Ohnmacht: 50 egos qualitative/quantitative in Zürich

• Larsen/Urry: 24 egos qualitative/quantitative in NE England

• Frei: 300 egos quantitative in Zürich

• Kowald: snowball; 750 egos quantitative worldwide (with core in Kanton Zürich) (8 day diary included)
Number of contacts reported

Percent

Number of contacts named

Frei and Axhausen, 2007
Distances between home locations
Size of network geometries

95%-confidence ellipse of the social network geography
Ratio of contacts to population

Ratios at 1km: 39; 2km: 9; 3km: 5

Frei and Axhausen, 2007
Interactions by mode and distance between homes

Frei and Axhausen, 2007
2010/11 Snowball survey
Challenges of snowball sampling

Challenges:

- Start with representative seeds
- Avoid selection bias
- React to homogeneous clusters
- Correct the overrepresentation of ‘socializers’ and underrepresentation of ‘isolates’
Response rate and response burden (IVT surveys)

Kowald and Axhausen, 2011
Behind egos’ horizons: The connected ‘snowball’-graph

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Edges</th>
<th>Density</th>
<th>Components</th>
<th>Triangles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without sociogram</td>
<td>6,584</td>
<td>7,349</td>
<td>0.000</td>
<td>19</td>
<td>0.017</td>
</tr>
<tr>
<td>With sociogram</td>
<td>6,584</td>
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<td>0.002</td>
<td>19</td>
<td>0.518</td>
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</tbody>
</table>

Kowald and Axhausen, 2011
## Personal networks (of egos with sociogram)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>1st qu.</th>
<th>Median</th>
<th>3rd qu.</th>
<th>St.-dev.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of alters</strong></td>
<td>21.5</td>
<td>13.5</td>
<td>20.0</td>
<td>29.0</td>
<td>10.1</td>
<td>38.0</td>
</tr>
<tr>
<td><strong>Number of relations</strong></td>
<td>46.4</td>
<td>10.0</td>
<td>23.0</td>
<td>56.5</td>
<td>61.0</td>
<td>398.0</td>
</tr>
<tr>
<td><strong>Isolates</strong></td>
<td>6.7</td>
<td>2.0</td>
<td>5.0</td>
<td>10.0</td>
<td>6.1</td>
<td>33.0</td>
</tr>
<tr>
<td><strong>Cliques</strong></td>
<td>4.2</td>
<td>2.0</td>
<td>4.0</td>
<td>5.0</td>
<td>2.7</td>
<td>19.0</td>
</tr>
<tr>
<td><strong>Components (w/o isolates)</strong></td>
<td>2.6</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>1.5</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Centralization</strong></td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Betweenness</strong></td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.5</td>
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Kowald and Axhausen, 2011
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Kowald and Axhausen, 2011
Comparisons
Transport motivated social network surveys

East York, Ontario (Wellman, Carrasco et al.)

Eindhoven, Netherlands (Arentze, Van der Berg)

Concepcion, Chile (Carrasco)

City of Zürich (Frei)

Kanton Zürich snowball (Kowald)
Contact “density” – shares by distance class
Shares of contact by mode

**Face-to-face**

- Zurich
- Eindhoven
- Switzerland
- Concepcion

**Telephone**

**Internet**
What next?
Example: Improve impact assessment (Singapore 1.0)

Video available at http://www.vimeo.com/24822377
Next steps

• Singapore social network survey

• Generation of social networks for the synthetic population (See Arentze et al., 2011)

• New models of joint scheduling

• Measurement of local trust (See e.g. Rick Grannis)
Policy implications
Expected impacts: localised anomie

Reduced number and intensity of local contacts should reduce the local level of trust:

- Growing investment into safeguarding the person and the home
- Reduced exposure to risk during travel, i.e. less travel by public transport, cycling and walking
Expected impacts: Improved welfare

The social networks should be more homogeneous and therefore more productive for their members.

But, the selectivity excludes the „less attractive“ persons who are disadvantaged through a reduced ability to travel or a reduced ability to participate in activities.
When will the marginal benefits become zero?

.... the localised anomie stresses the other mechanism of social inclusion too strongly

.... the costs of private protection become too high

.... the environmental impacts become too threatening

.... the trend in the costs of travel changes
Back to the future?
Questions?

www.ivt.ethz.ch
Literature and references


Literature and references

Arbeitsberichte Verkehrs- und Raumplanung, 686, IVT, ETH Zürich, Zürich
Frei, A. and K.W. Axhausen (2007) Size and structure of social netowrk geographies,
Arbeitsberichte Verkehrs- und Raumplanung, 439, IVT, ETH Zürich, Zürich.
Appendix
Biographies: Hypothesis 1

The style of travelling during childhood and adolescence, i.e. of the parents, forms the style of the next generation

- The emotional response to (types of) locations is transferred
- The desire for variety seeking is transferred
- The attitude to travelling is transferred
Biographies: Hypothesis 2

Action spaces grow over the duration of the life course

Assumption: They grow exponentially with the number of main locations (work places; home locations) via involvement with third parties
The elements of the activity repertoire age
The current size of the activity space remains constant through continuous innovations

- Locations and activity supply change over time
- Idealisation of locations/activities through memory processes and generalisation
Mobidrive: Number of unique locations and trips

Number of local trips

Number of unique local locations
Variance of activity spaces: A Mobidrive example

Male, Full time

Black: Working days
Blue: Weekend

Line width:
Weeks 1+2; 3+4 and 5+6
A microscopic level explanation?

Specialisation

Migration

Professional and personal activity space

Network geography

Local anomie

Wages

Activities

Tours

Fleet comfort

Housing consumption

vtts et al.

Energy

vtm

pkm

k

Number of networks

Network overlap

Elasticity > 0

Elasticity < 0