# Bevorzugter Zitierstil für diesen Vortrag

Axhausen, K.W. (2014) Social networks and the dynamics of travel, presentation at special seminar at the University of Tokyo, Tokyo, May 2015.

# Social networks and the dynamics of travel

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# Acknowledgements

Social networks:

- Timo Ohnmacht, Andreas Frei
- Matthias Kowald
- Lijun Sun
- Andreas Diekmann, ETH Zürich
- Jonas Larsen, Roskilde/John Urry, Lancaster
- Terasa Tan, Vincent Chua, NUS, Singapore

Agent-based models

- Thibaut Dubernet
- Pieter Fourie

Social network generation

- Theo Arentze, TU EIndhoven

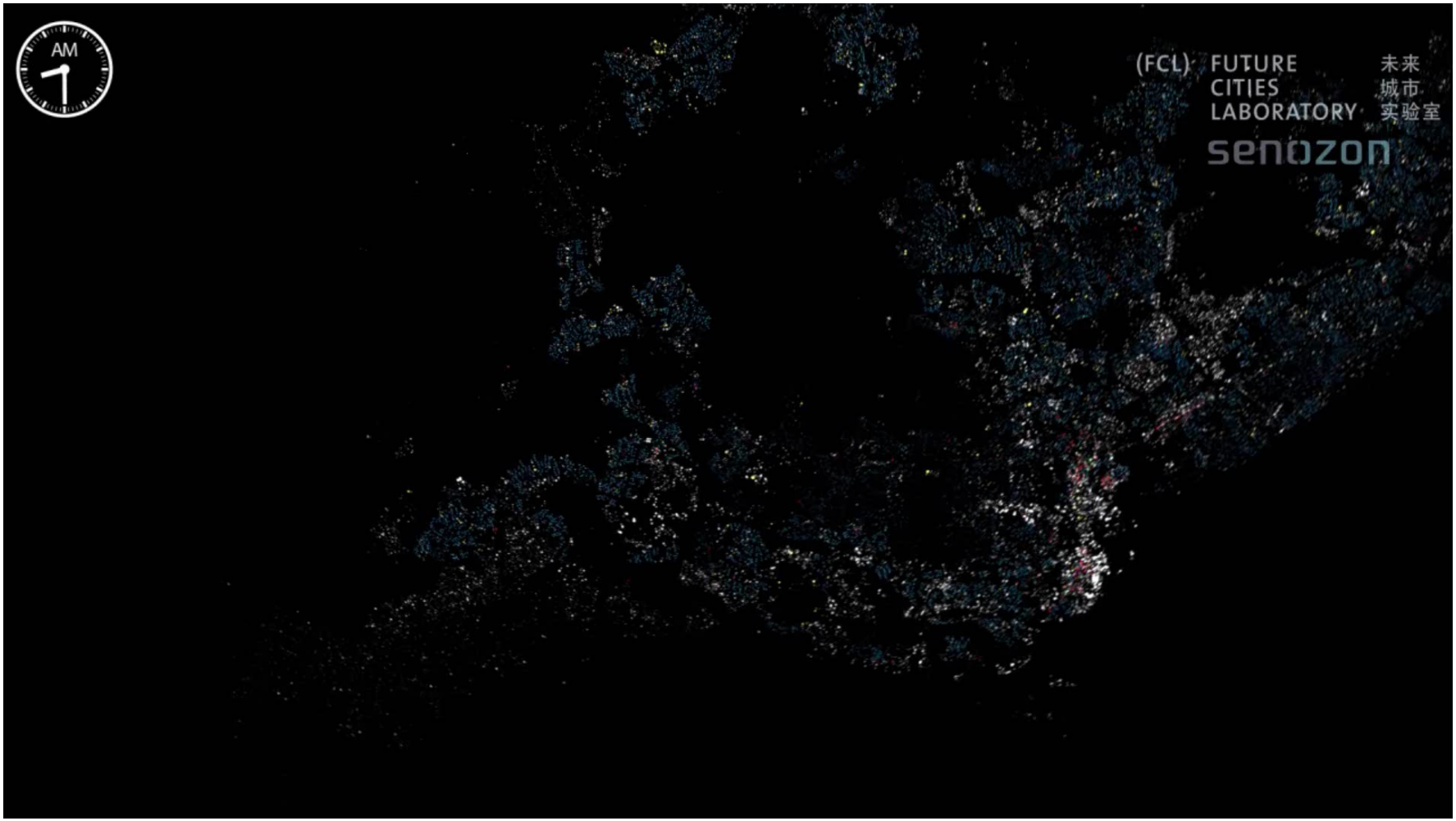
# Acknowledgements

Most of the materials and more is in:

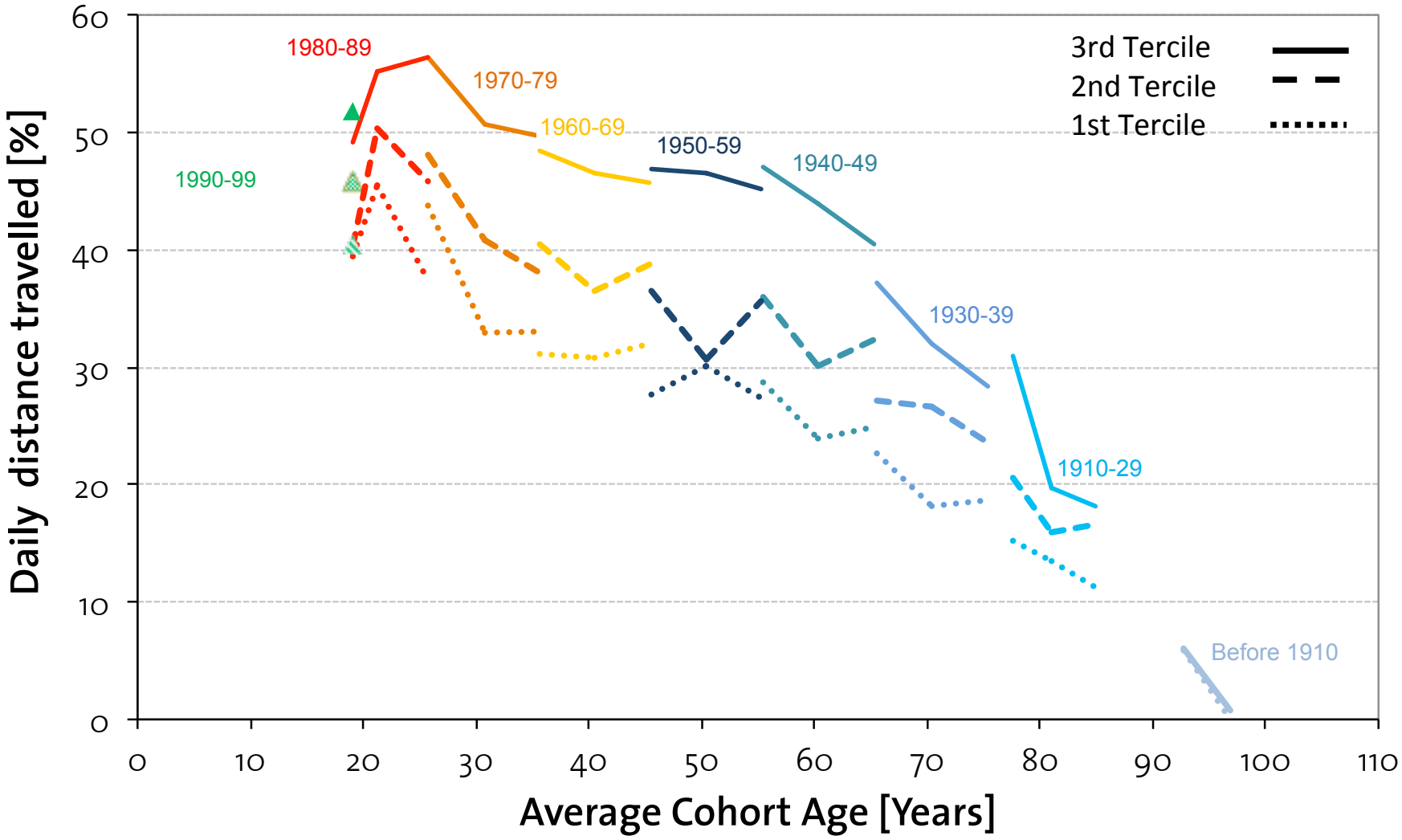
Kowald, M. and K.W. Axhausen (eds.) (2015)
*Social networks and travel behaviour,*
Ashgate

# Why the interest ?

# An agent-based model of travel demand: e.g. Singapore

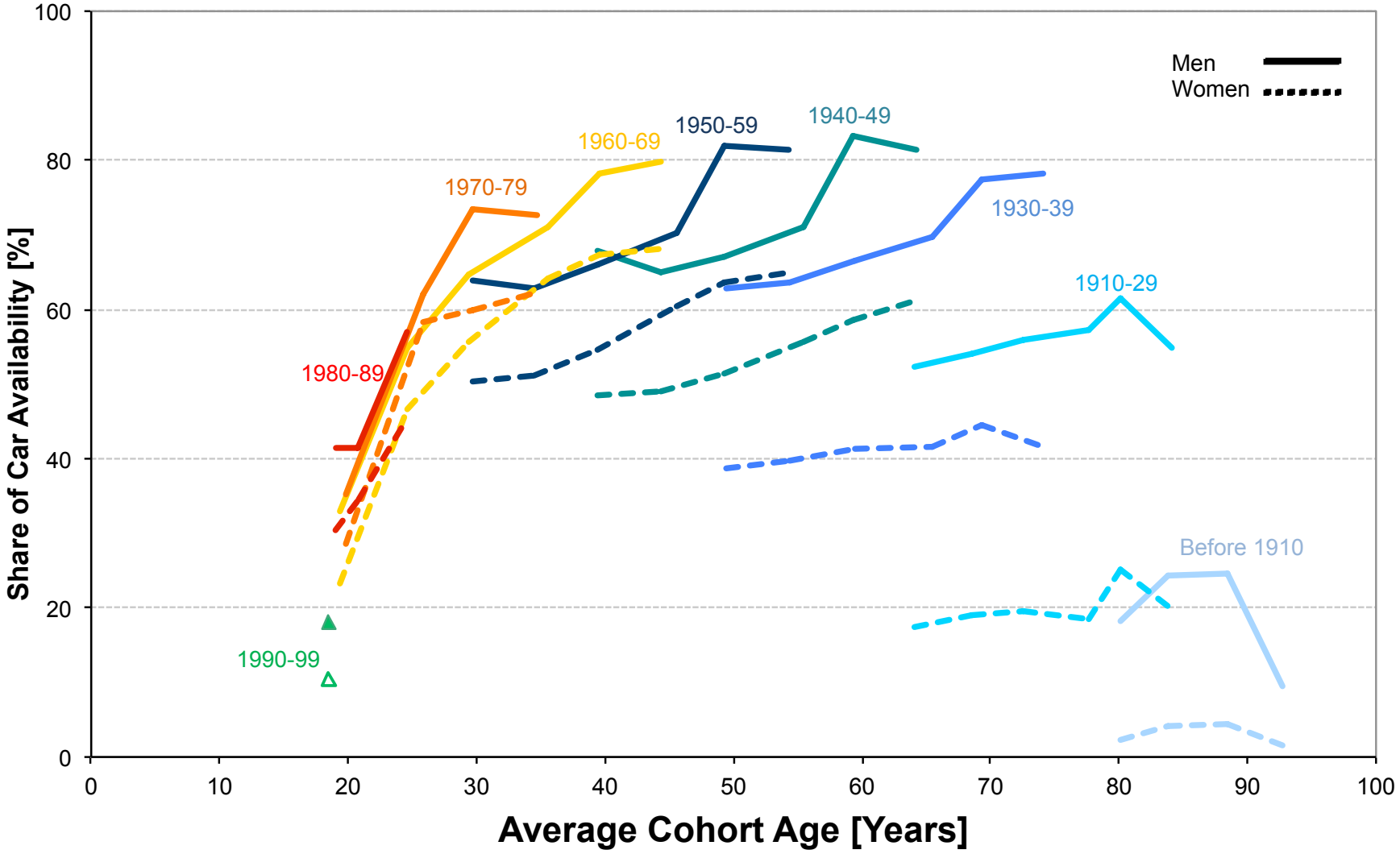


# Avg. daily distance travelled by income tercile (1980 – 2010)

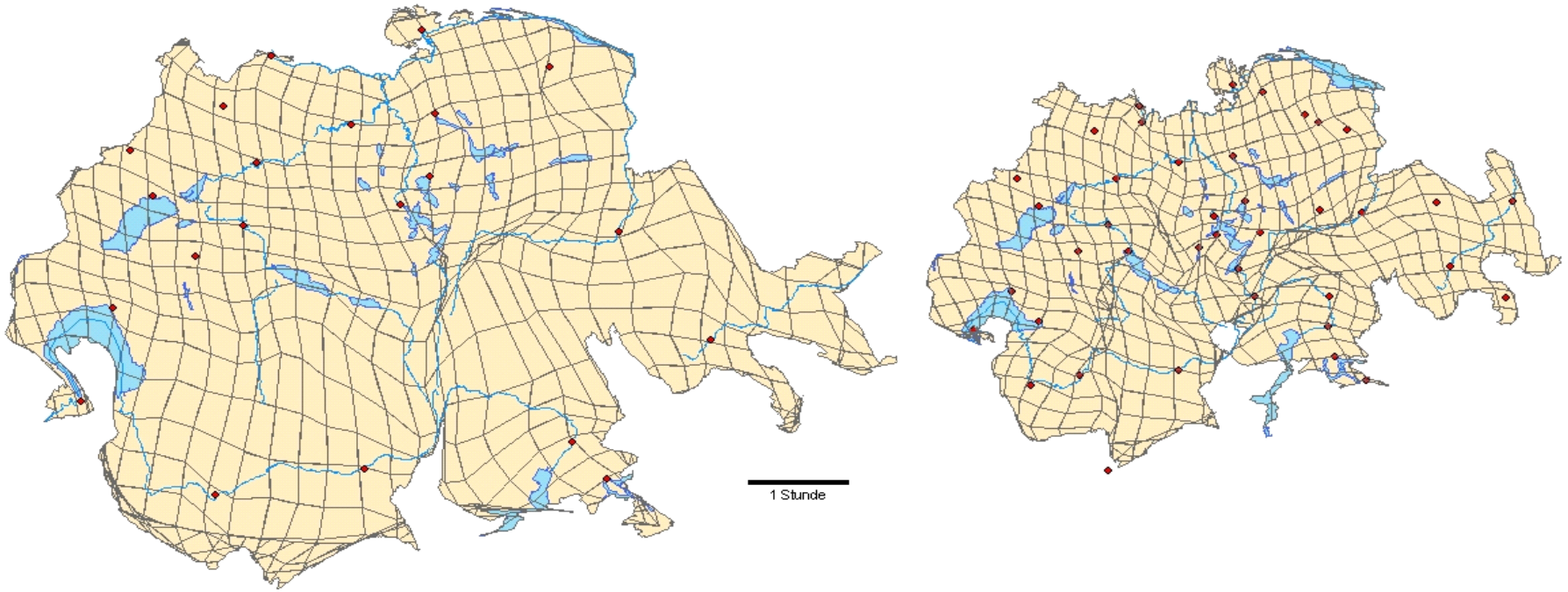



Marmolejo and Ciari, 2013

# Car always available (Switzerland 1980 – 2010)



# Road based – Switzerland 1950 and 2000




Scherer, 2004

# Leisure travel in the 2000‘s

| Trip purpose | Switzerland | Germany | UK | USA |
|---|---|---|---|---|
| Leisure | 40.2 | 17.4 | 41.0 | 9.4 |
| Work/School | 36.5 | 57.0 | 32.0 | 33.5 |
| Shopping/Private business | 12.8 | 15.9 | 12.0 | 11.9 |
| Escorting others | 4.8 | 9.7 | 15.0 | - |
| Others | 5.7 | - | - | 45.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

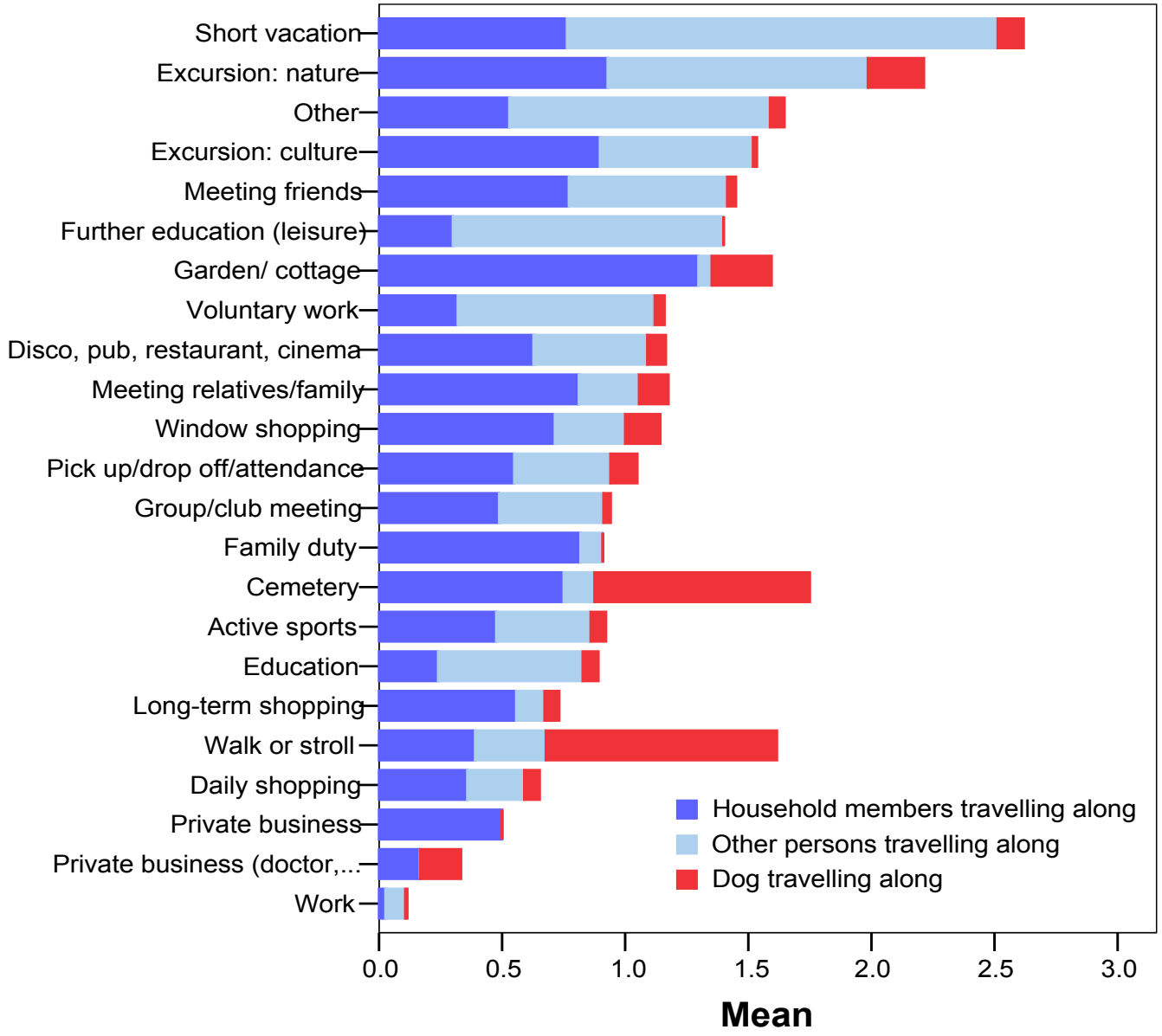
# Long distance journeys (100km+) in Germany, 2010's

| Type | Number/year | km/journey |
|---|---|---|
| Vacation (5 days plus) | 1.0 | 1600 |
| Short vacation (2-4 days) | 1.2 | 410 |
| Other journeys with overnight stays | 0.3 | 410 |
| Day excursions | 6.0 | 200 |
| Business trip with overnight stay | 1.2 | 500 |
| Business trip without overnight stay | 1.2 | 150 |
| Long-distance commuting and other trips | 5.0 | 150 |

Frick und Grimm, 2014

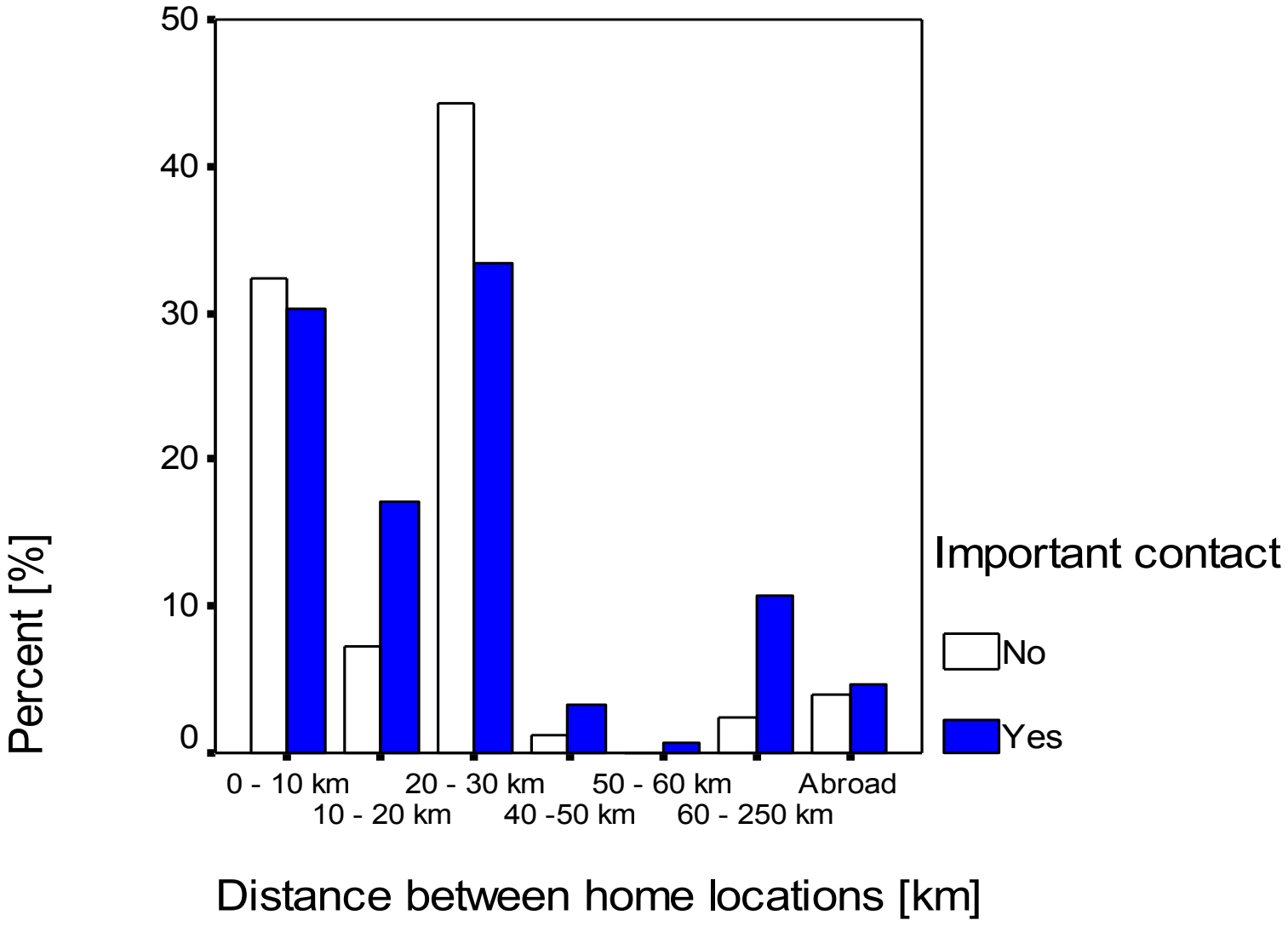
# Why social networks in transport/spatial planning ?

# Example: Number of accompanying travellers




Axhausen et al., 2007

# Example: Required travel for leisure meetings of ego-alter




Schlich et al., 2002

# Example: Heterogenity in choice

Location choice

- WTP
- Taste
- Joint choice with family, friends, persons to meet
- Schedule constraints
- Social constraints

For mode choice in addition

- Luggage
- Company
- Weather
- Temperature

# Example: Residential location choice in Kt. Zürich

| Variable | Beta | t-Test |
|---|---|---|
| Rent/Income | -5.51 | *** |
| log(m2/head) | 0.98 | *** |
| **Frequency weighted mean distance to friends** | **-8.16** | * |
| **Exponent (friends)** | **0.22** | ** |
| Mean distance to work/school | -1.59 | ** |
| Exponent (distance to work) | 0.37 | ** |
| Travel time to Bürkliplatz | 0.02 | ** |
| log(transit accessibility) * "No car" | 0.41 | ** |
| log(car accessibility) * “Car" | -0.30 | ** |
| Share of equally sized HH within 1 km | 0.02 | * |
| Population density within 1 km | 0.01 | ** |
| Share of empty flats in municipality | -0.11 | |
| N= 683, $rho^2$ = 0.2128; * > 0.1; ** > 0.05; *** > 0.01 | | |

# Travel and social networks

# 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

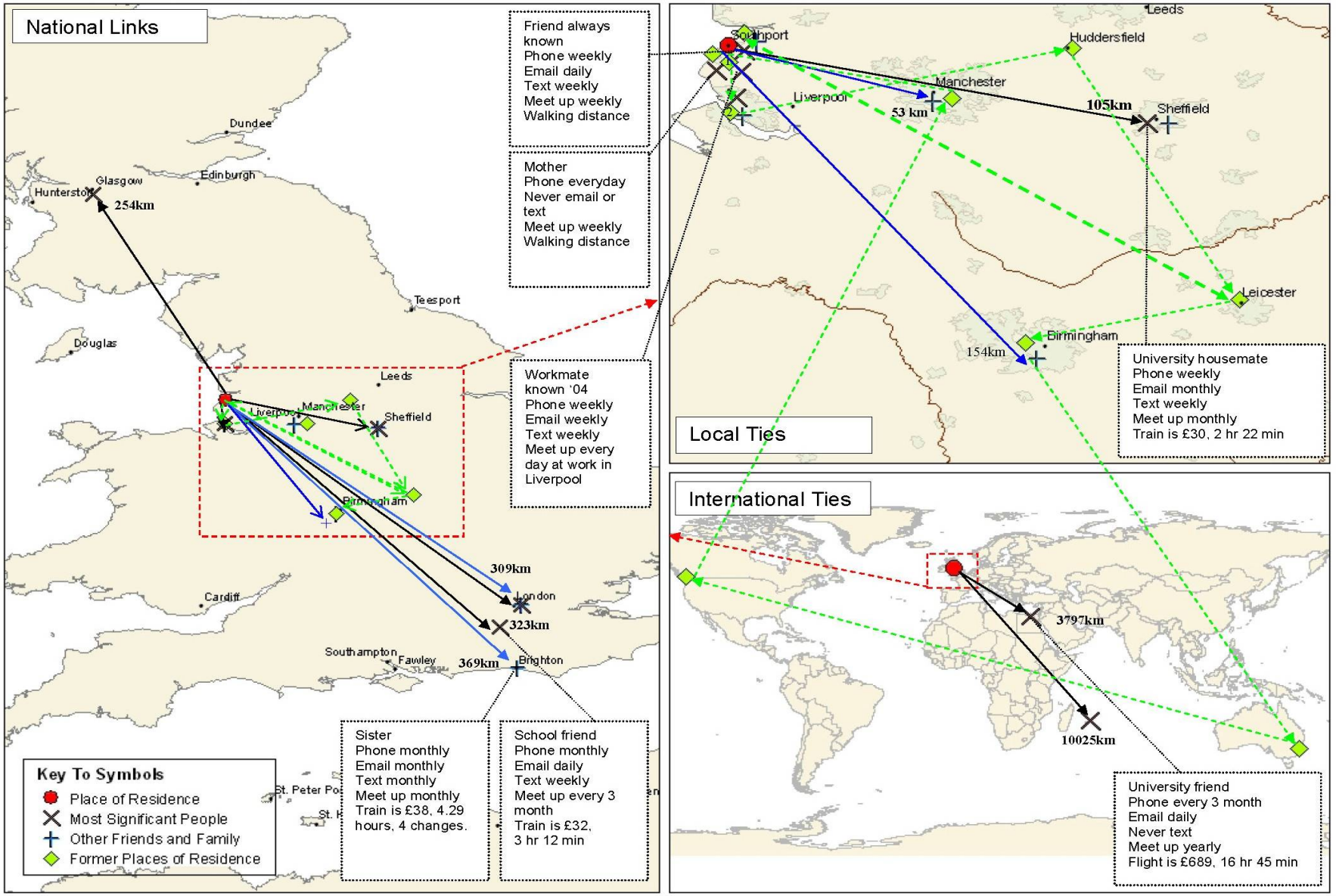
- Tan, Chua: 411 egos using 11 prompts

- Kowald: snowball; 750 egos quantitative worldwide (starting with 40 egos in Kanton Zürich)(12000 alters in total) (8 day diary included)

- Kowald/Diekmann: 2000 respondents of the Swiss Environment Survey – 5 core alters

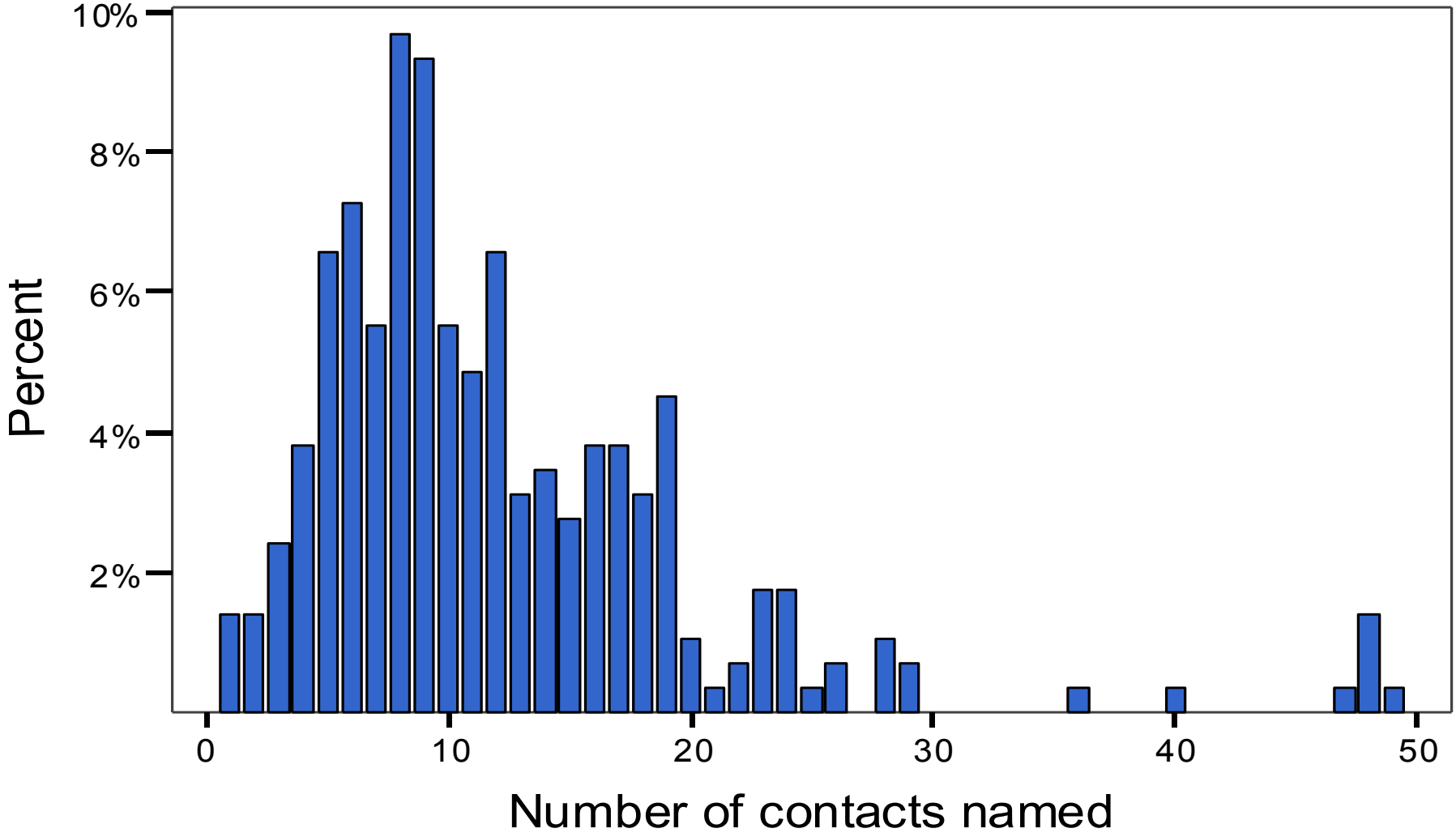
- Sun: Smart card use on busses in Singapore

# Biography of an architect, about thirty



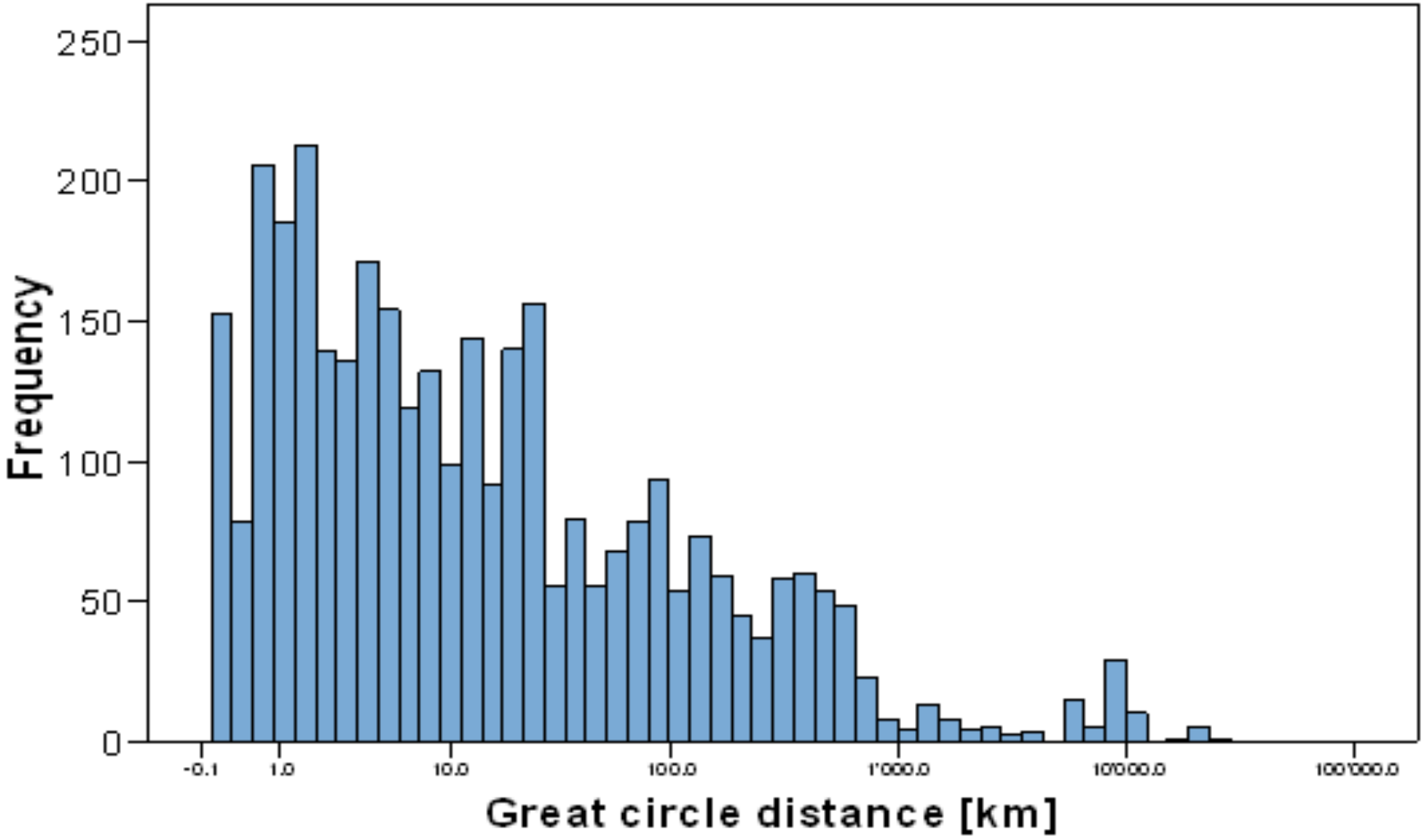

Larsen, Urry and Axhausen, 2006

# Number of contacts reported



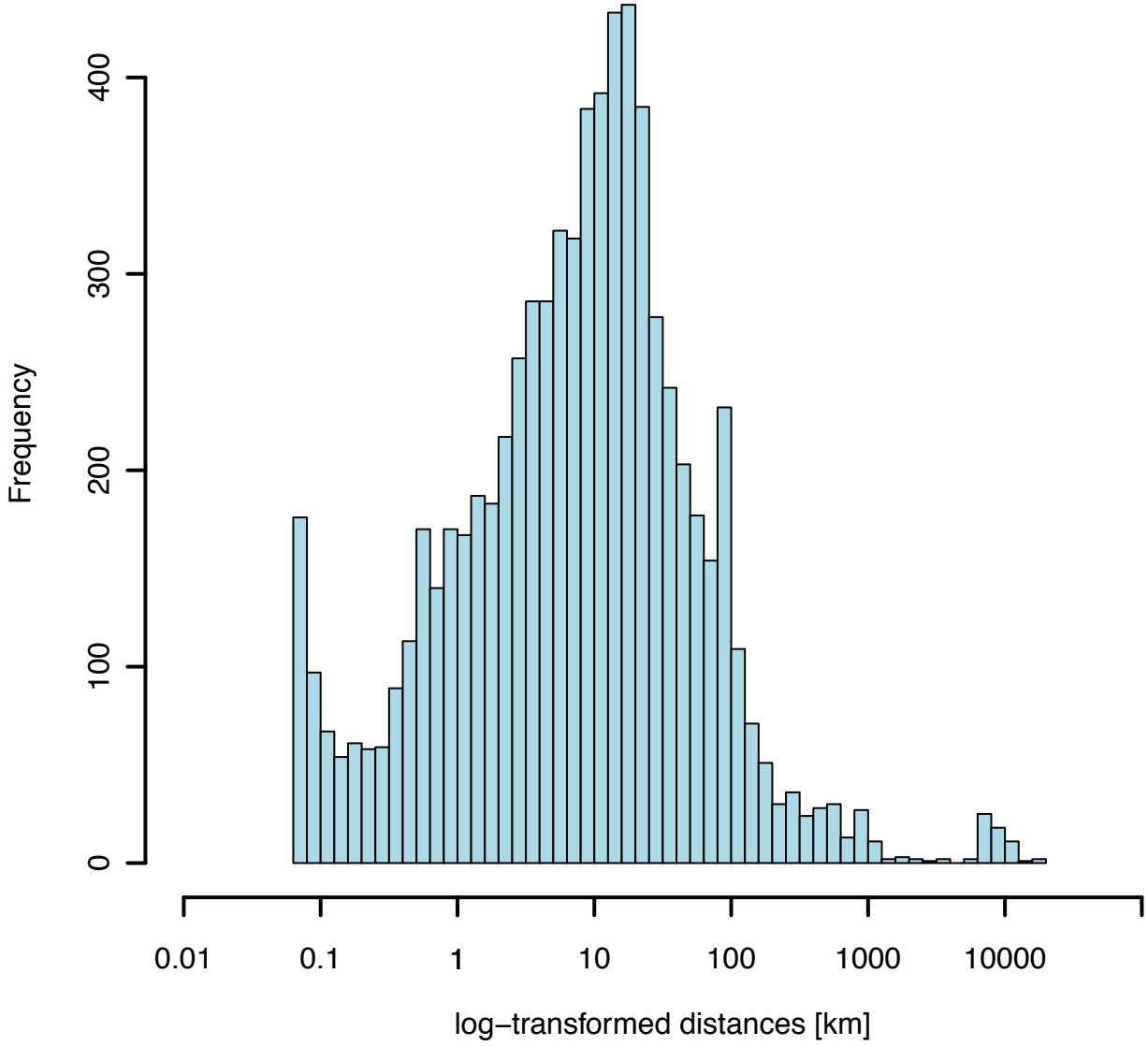

Frei and Axhausen, 2007

# Great circle distances between “leisure” contacts: Zürich



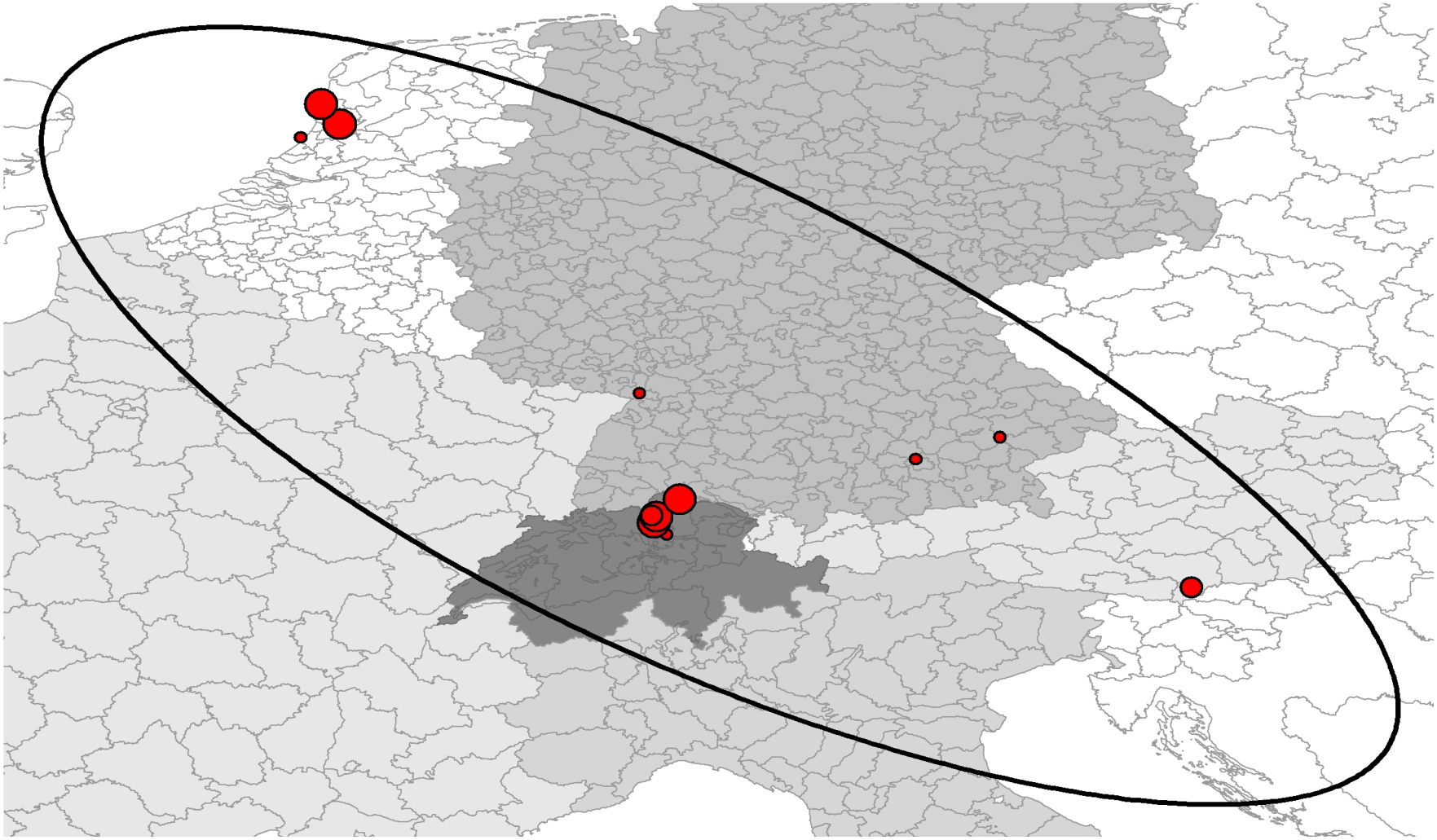

Frei and Axhausen, 2007

# Great circle distances between “leisure” contacts: Snowball

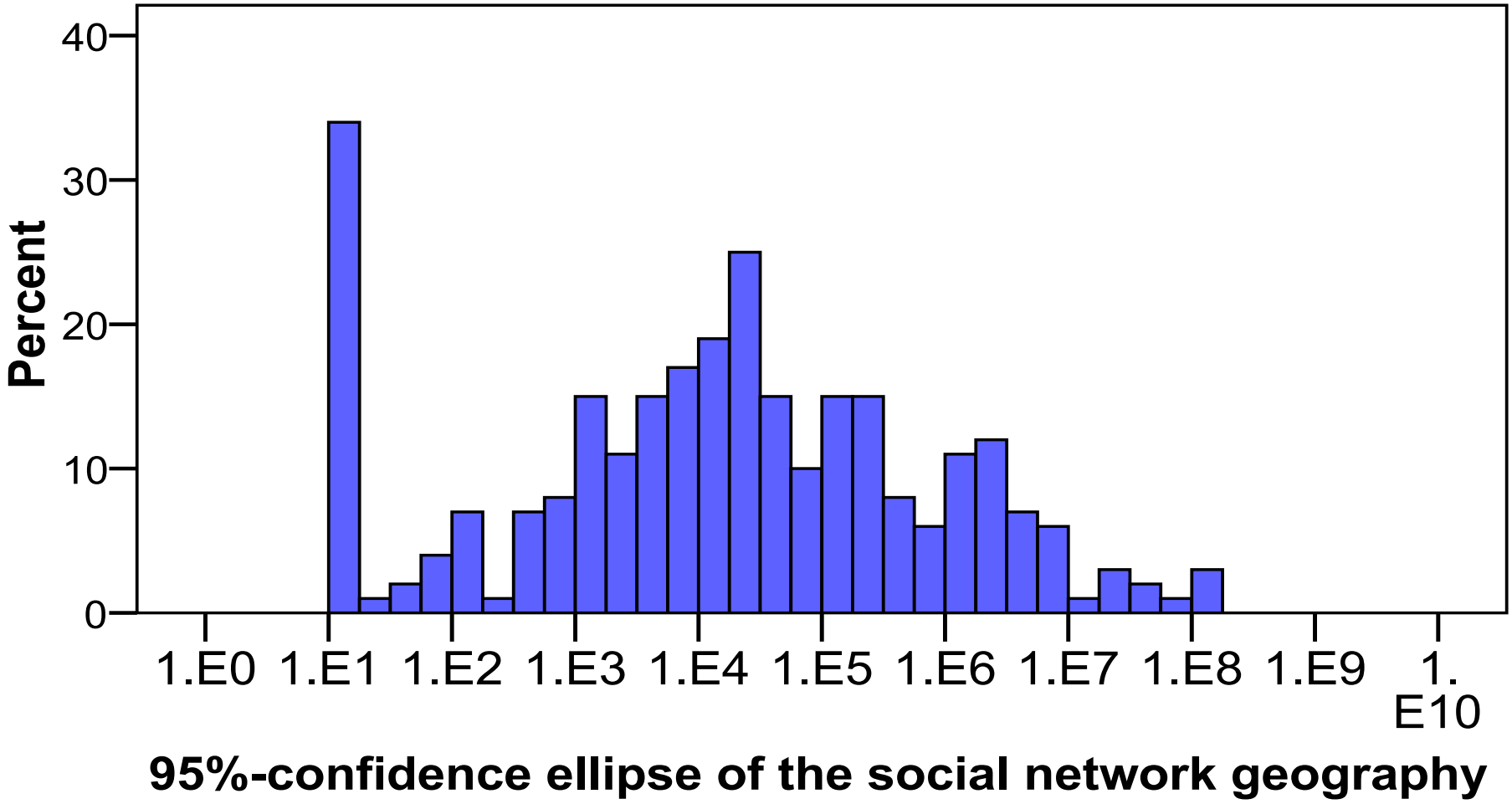



Daten: Schneeballbefragung IVT, Siehe Kowald et al. 2012

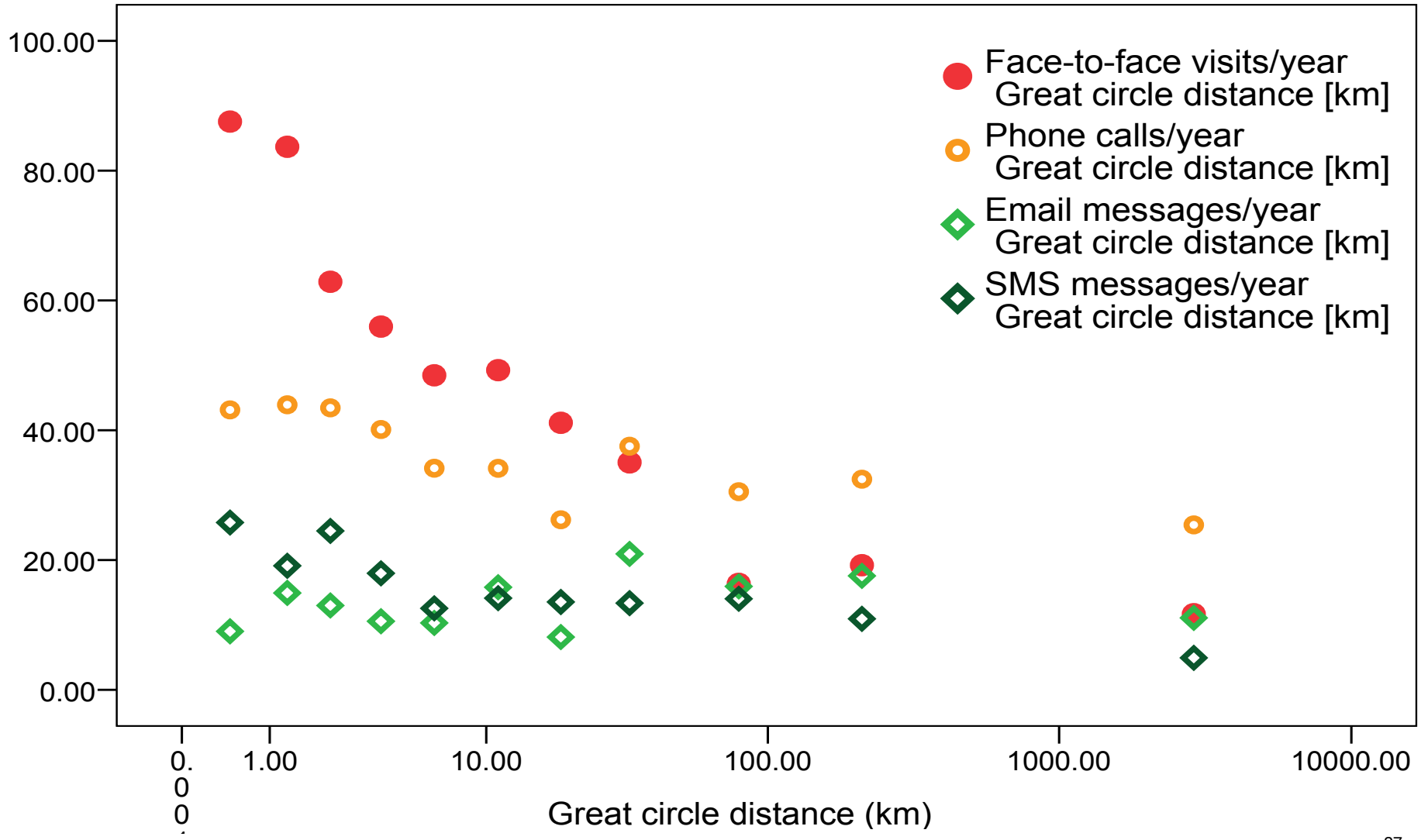
# Example of a social network geography



# Size of network geometries



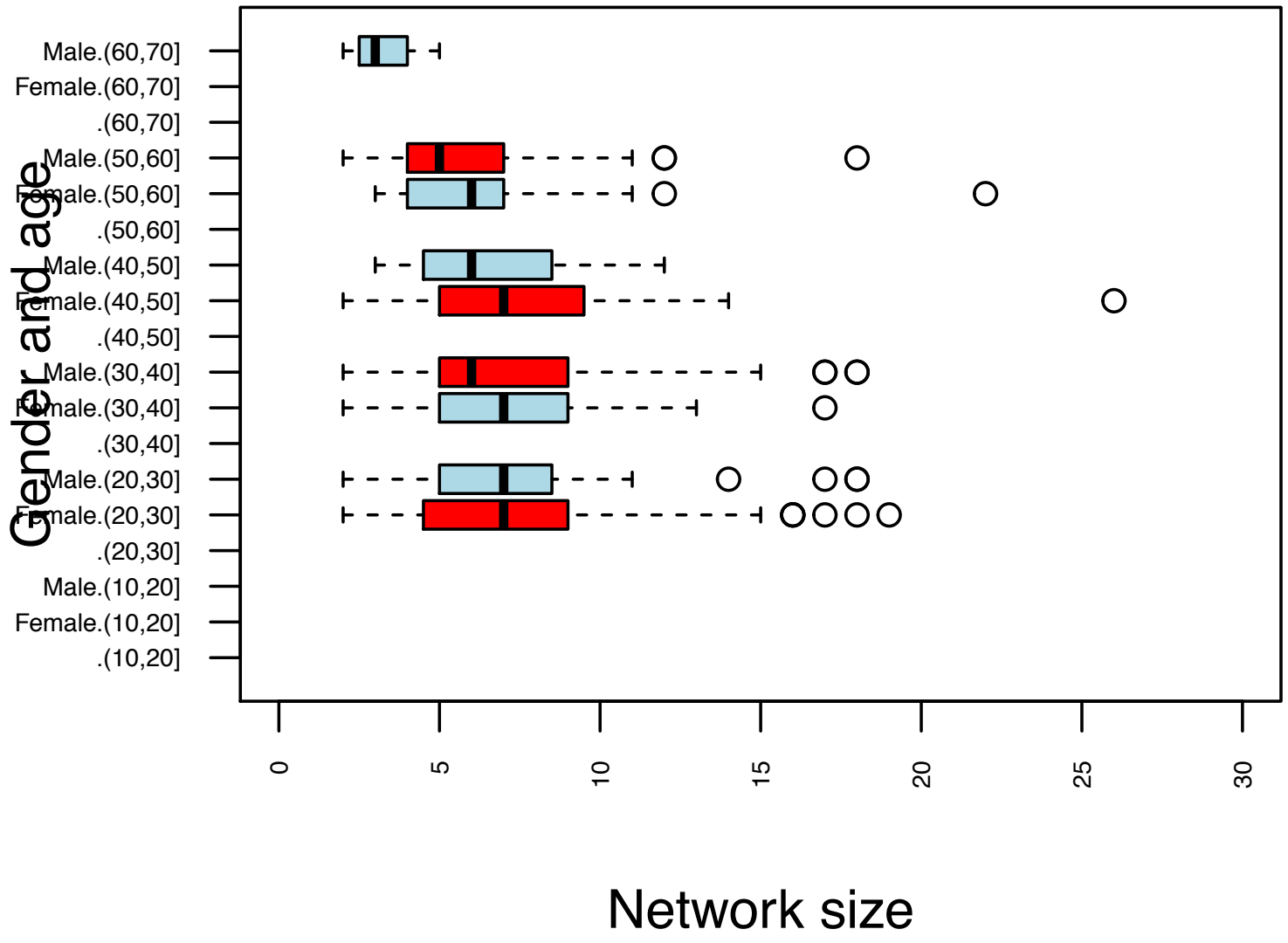
# Interactions by mode and distance between homes



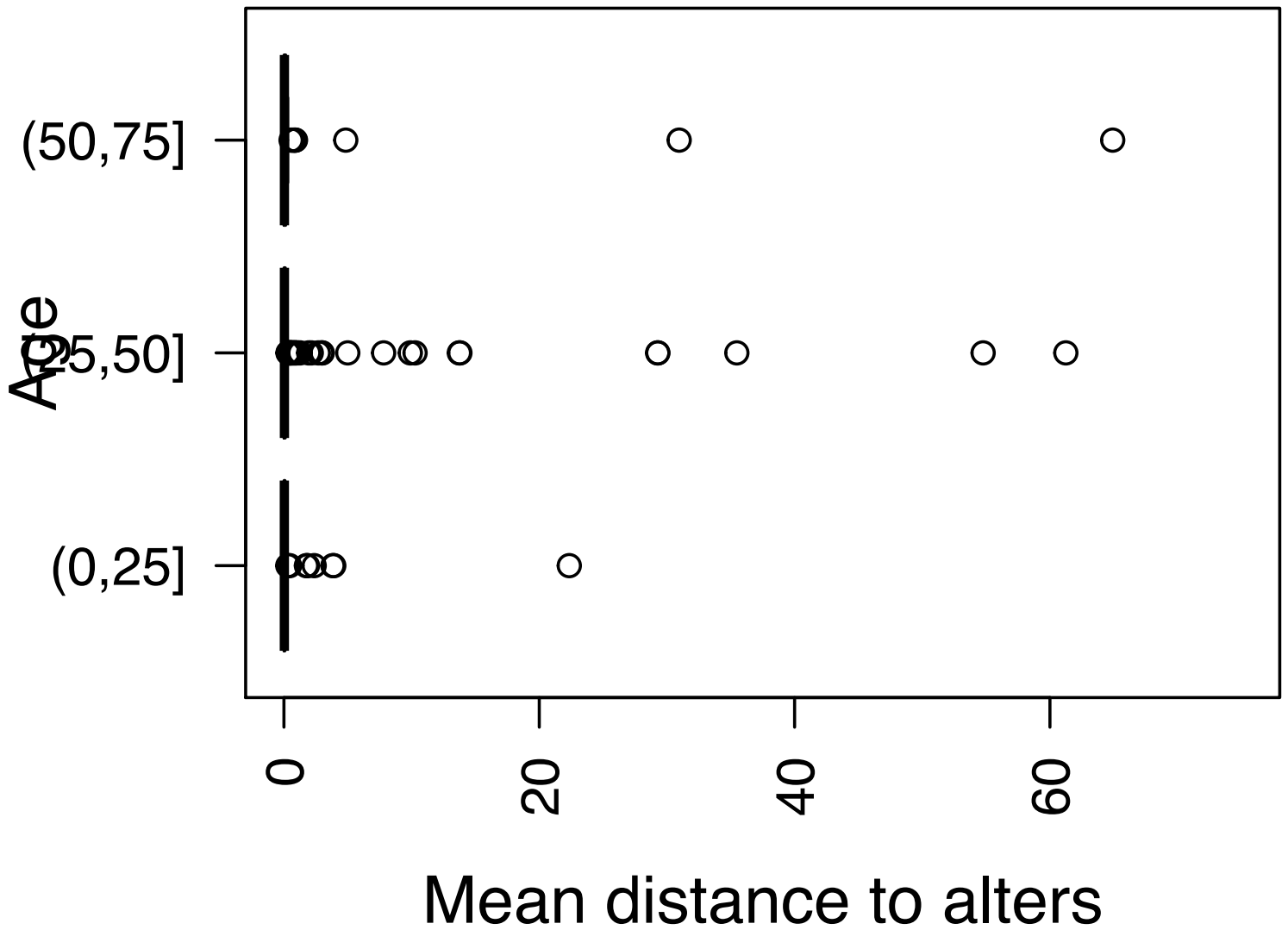

Frei and Axhausen, 2007

# Singapore 2014, some few new results

# Singapore 2014, network size

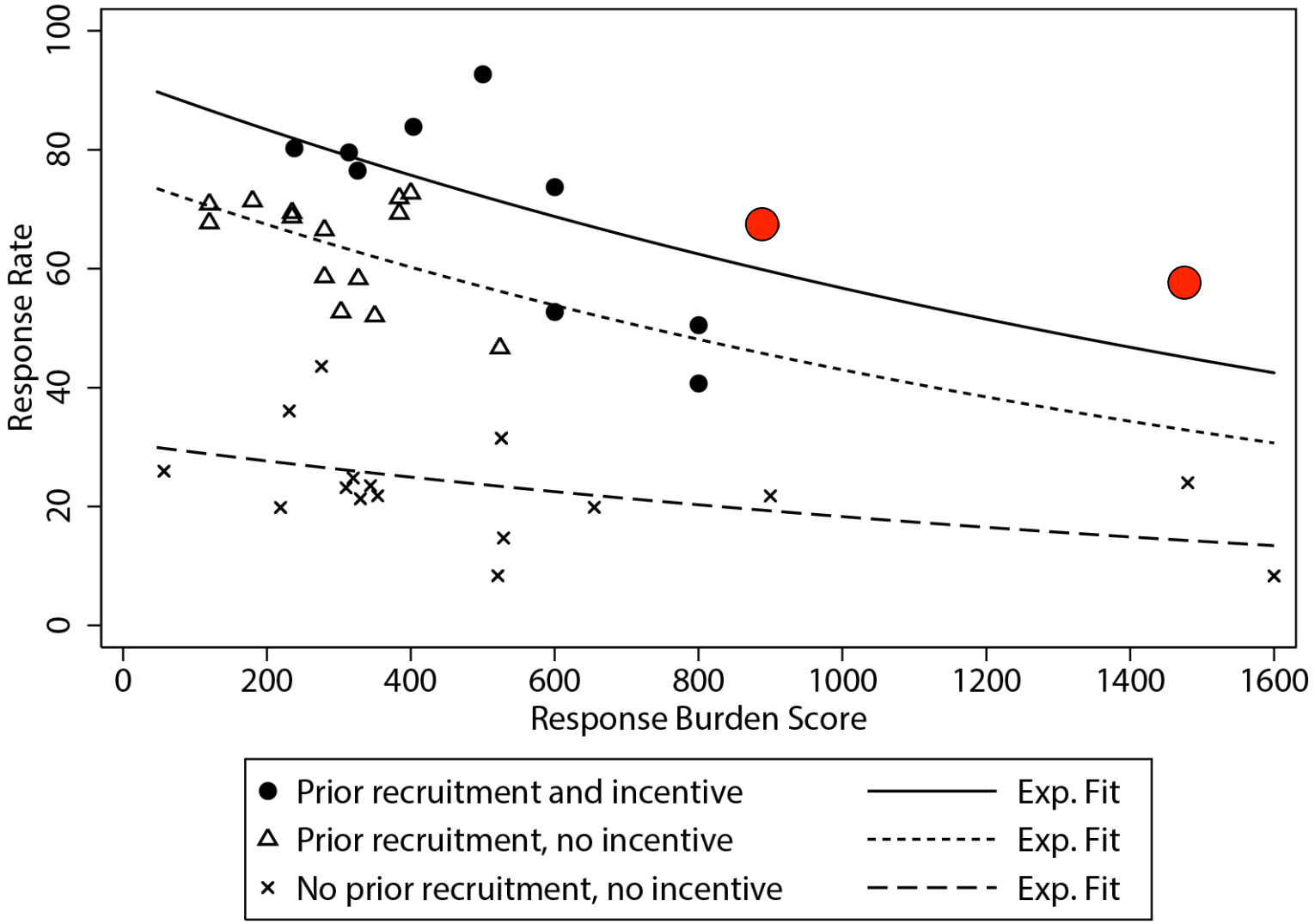


# Singapore 2014, mean distance to alters



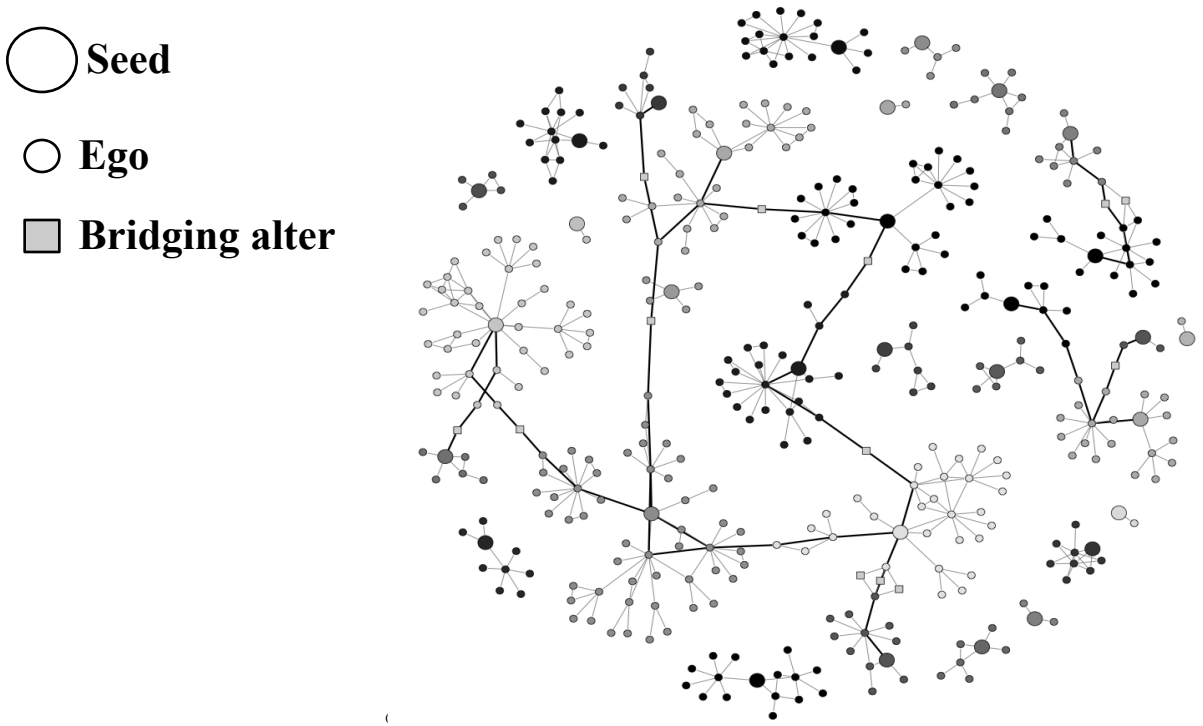
# 2010/11 Snowball survey

# Response rate and response burden (IVT surveys)




Kowald and Axhausen, 2011

# Behind egos' horizons: The connected 'snowball'-graph




Kowald and Axhausen, 2011

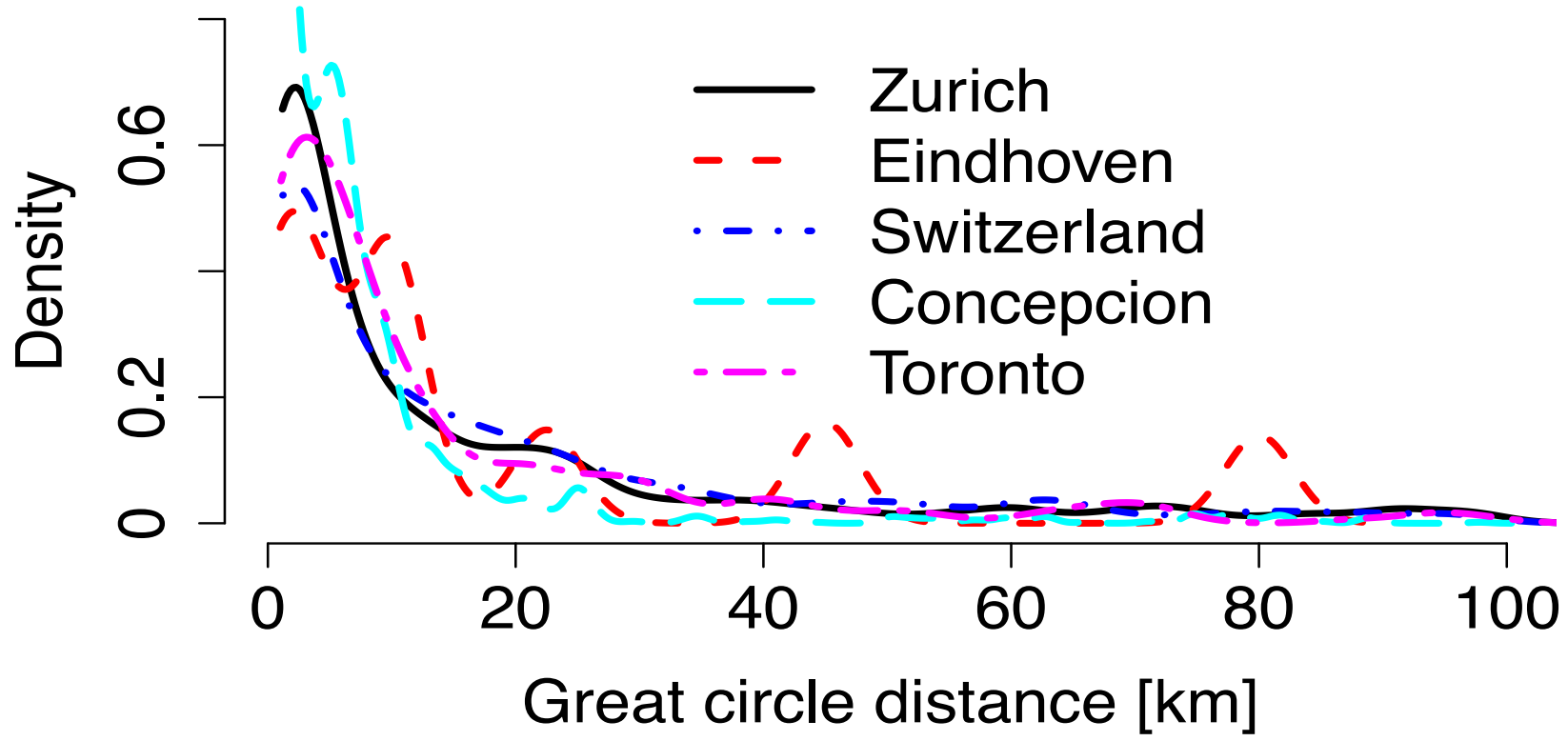
| | Vertices | Edges | Density | Components | Triangles |
|---|---|---|---|---|---|
| Without sociogram | 6'584 | 7'349 | 0.000 | 19 | 0.017 |
| With sociogram | 6'584 | 32'671 | 0.002 | 19 | 0.518 |

# Comparisons

# Transport motivated social network surveys

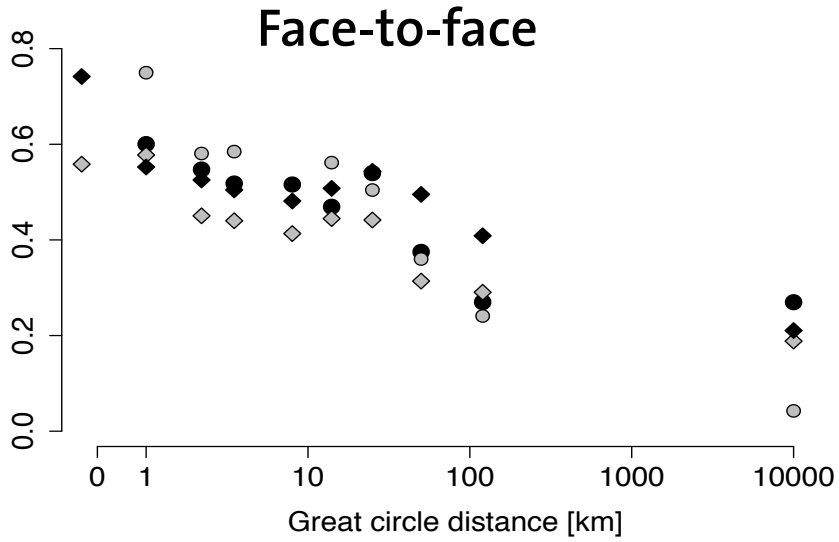
- East York, Ontario (Wellman, Carrasco et al.)
- Eindhoven, Netherlands (Arentze, Van der Berg)
- Concepcion, Chile (Carrasco)
- City of Zürich (Frei)
- Kanton Zürich snowball (Kowald)

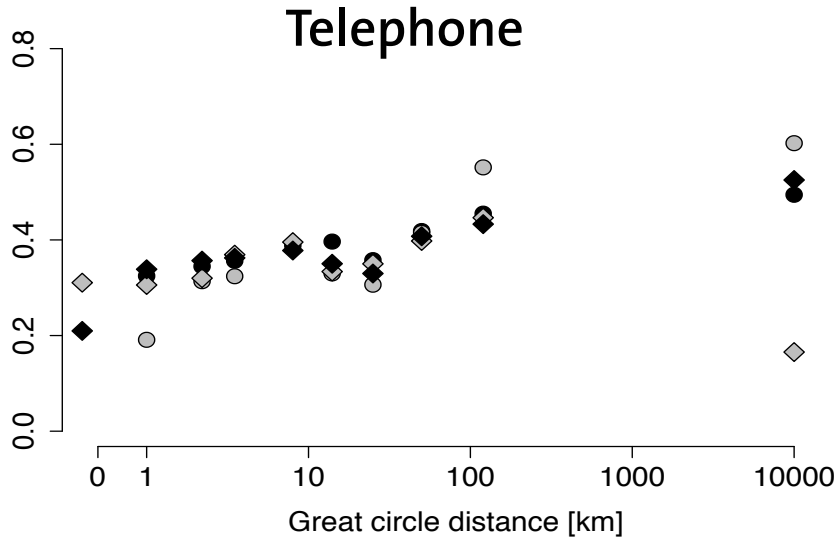
# Contact “density” – shares by distance class

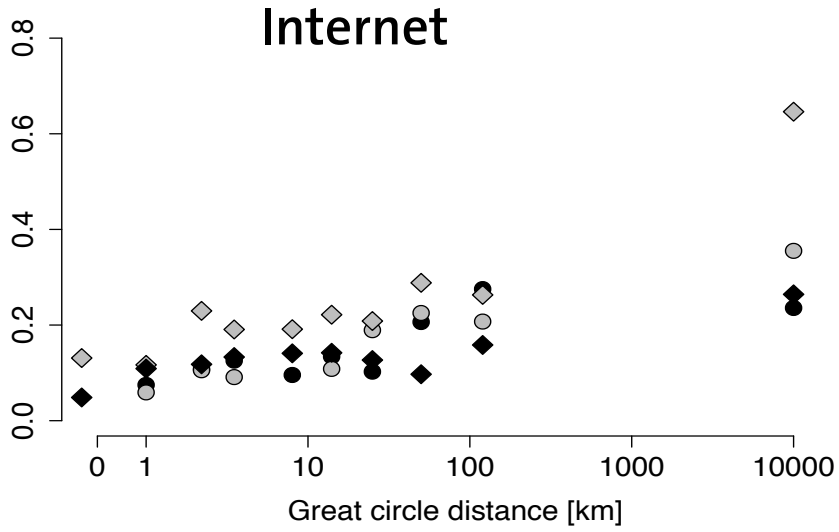



Kowald et al., forthcoming

# Shares of contact by mode



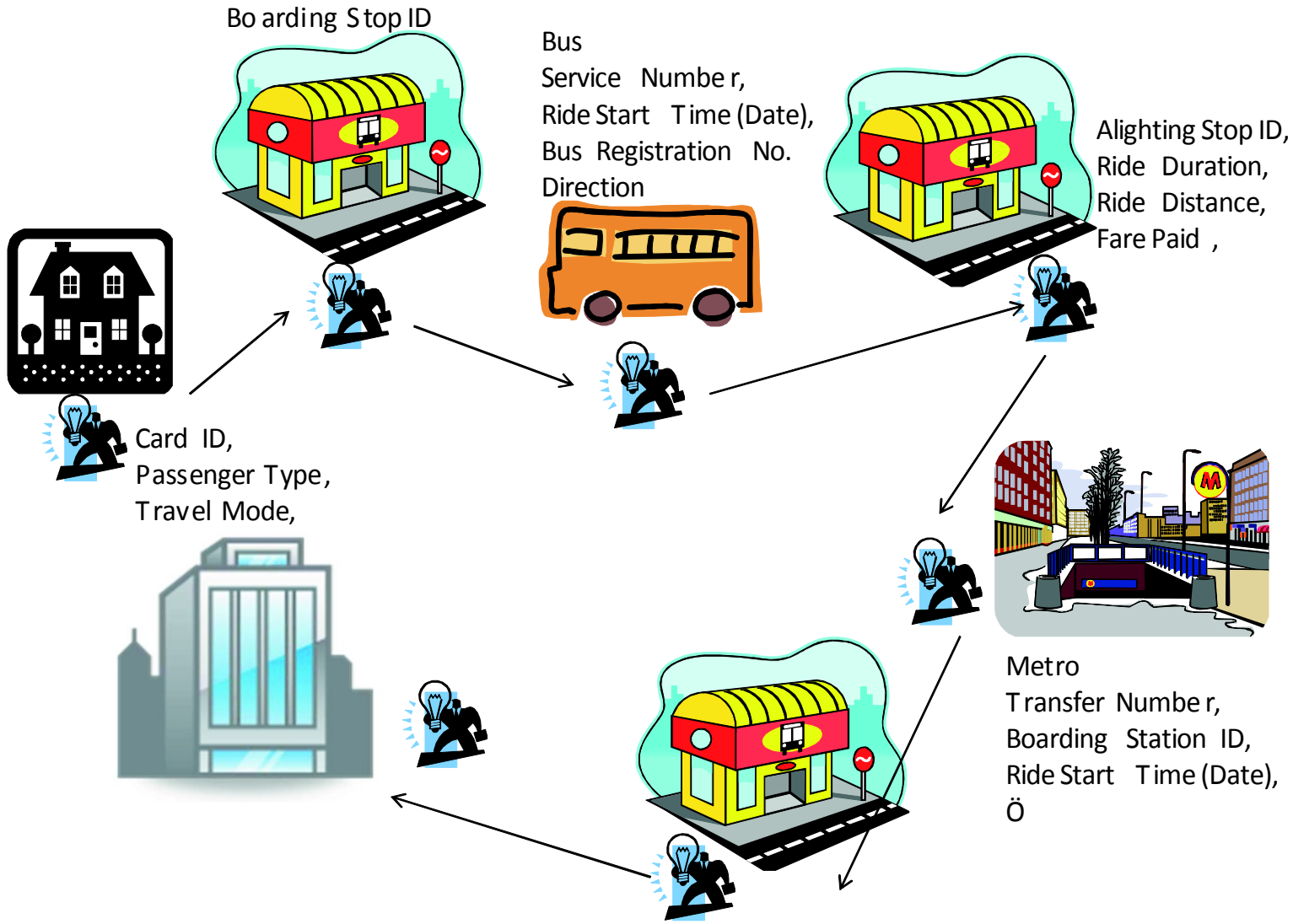





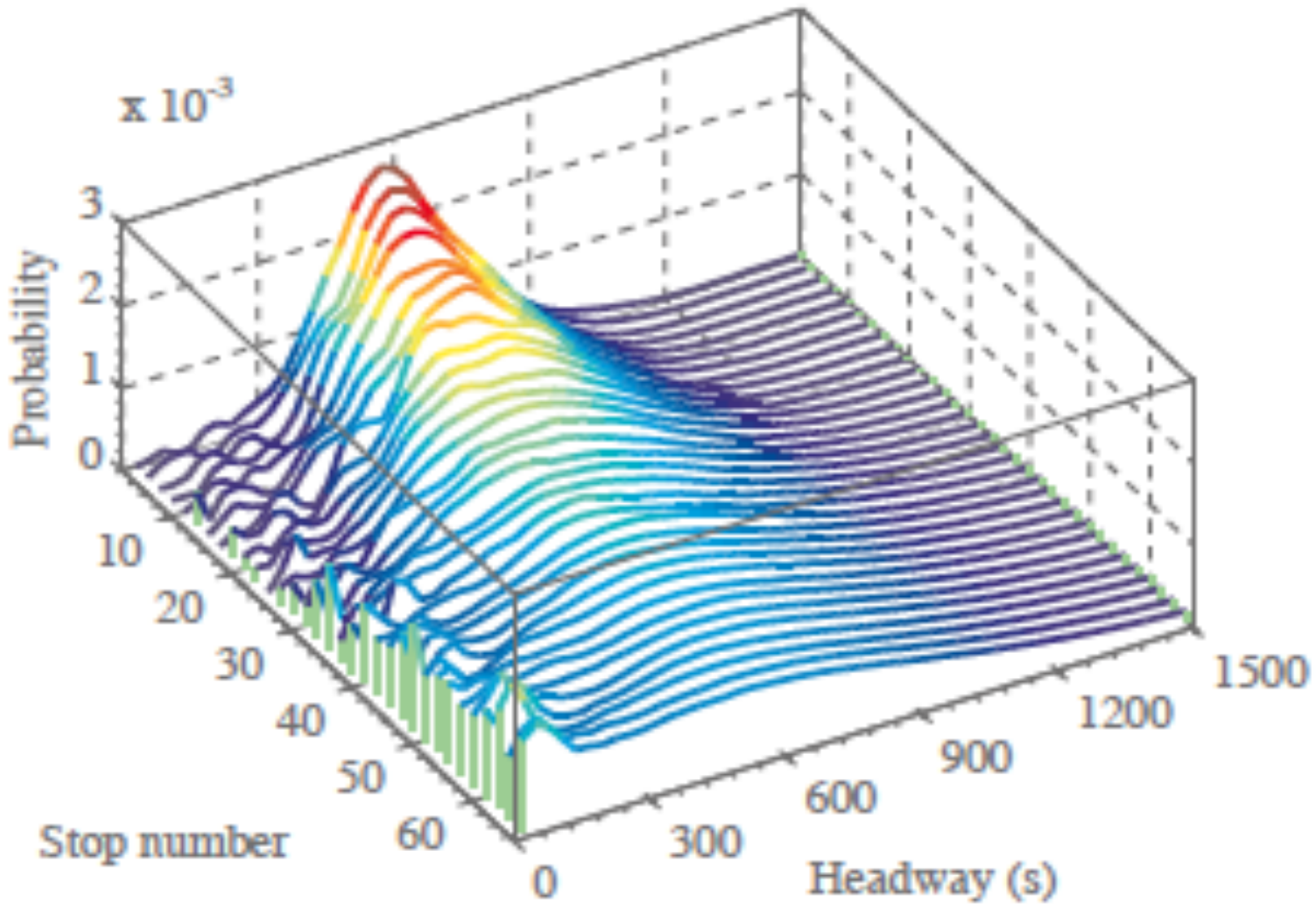
Kowald et al., forthcoming

# Low level networks as a building block

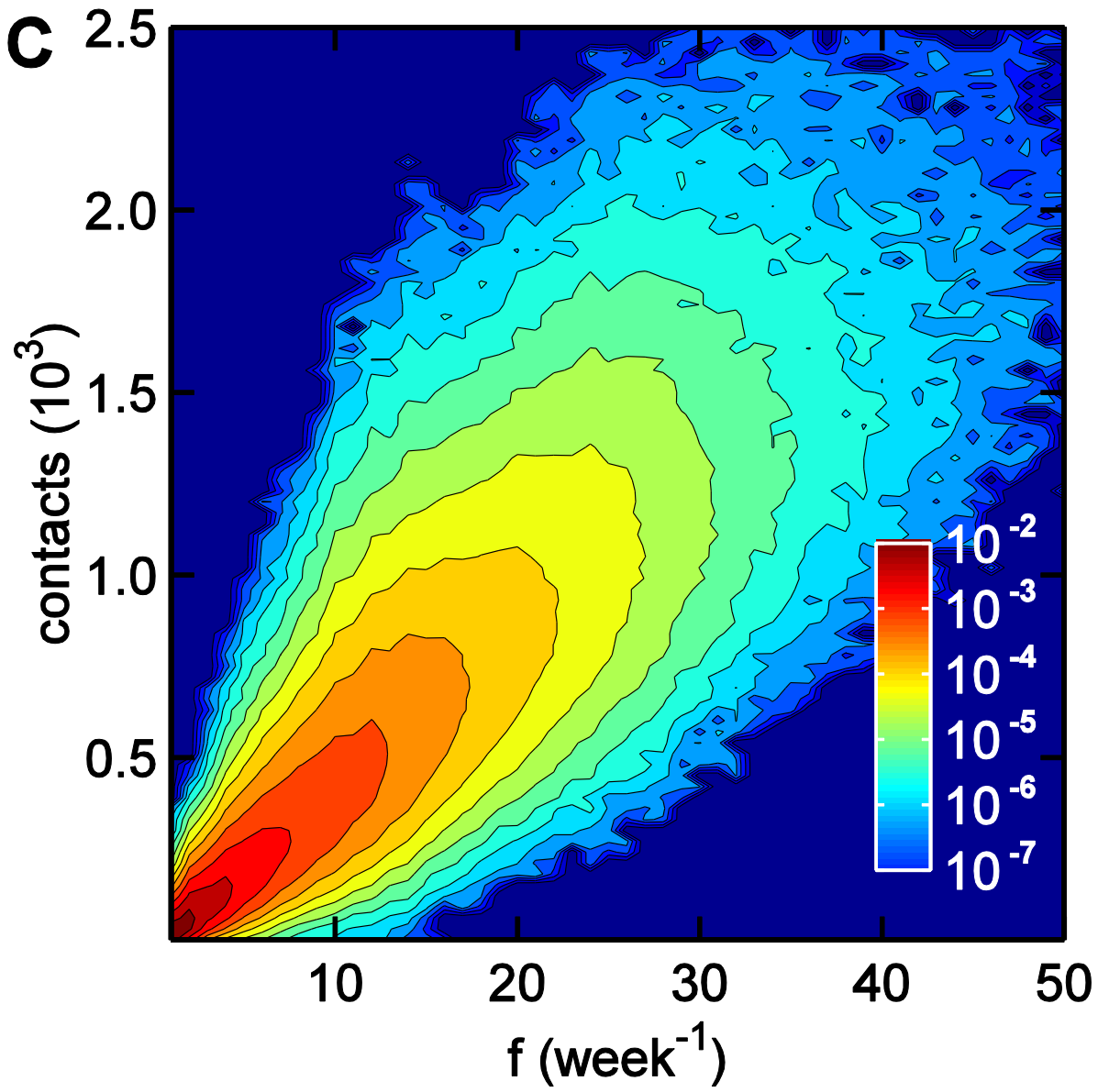
# Smart card records as a source



# Arrival distribution along a line

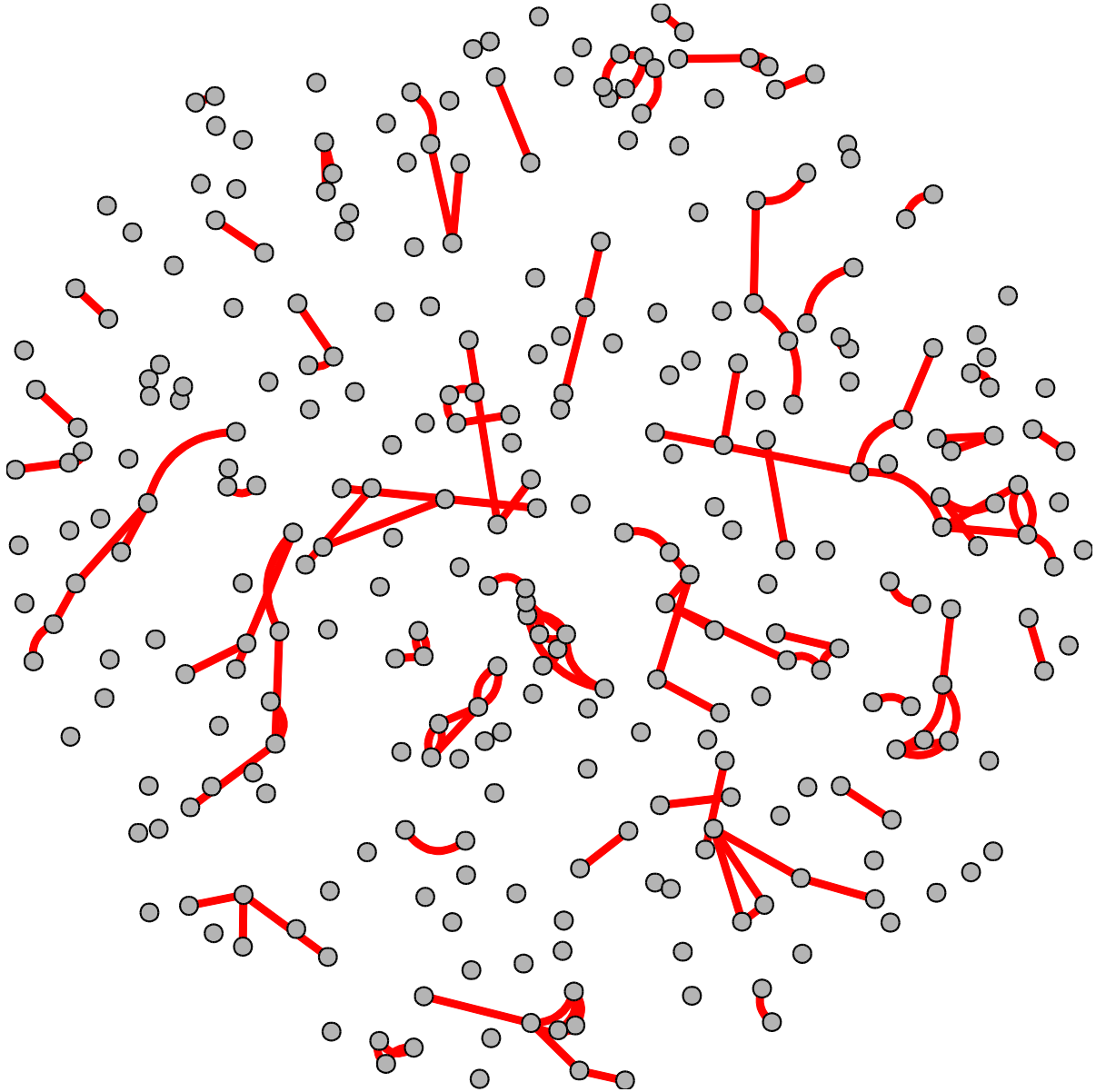


# Number of contacts versus usage frequency

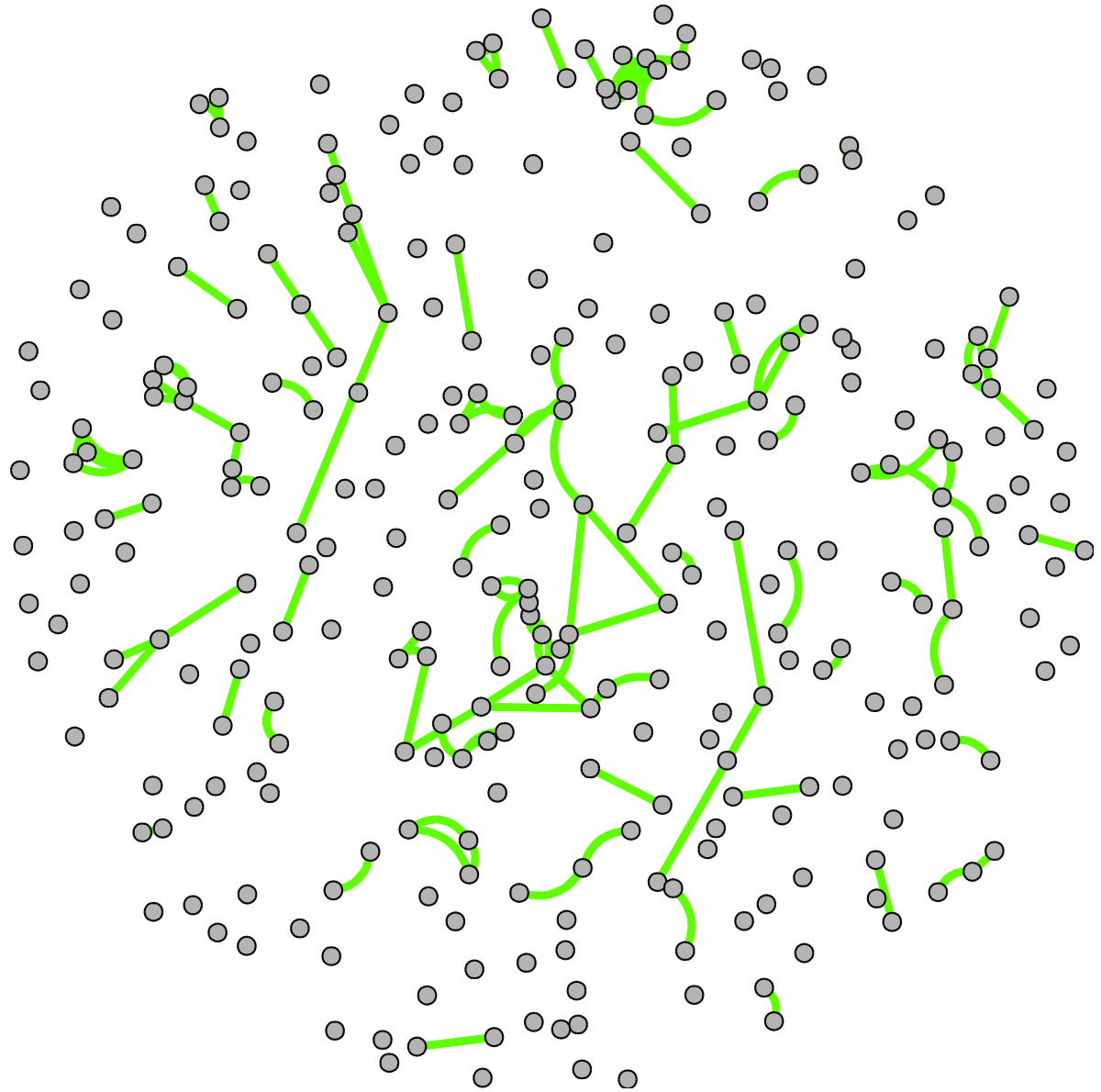



Sun et al., 2013

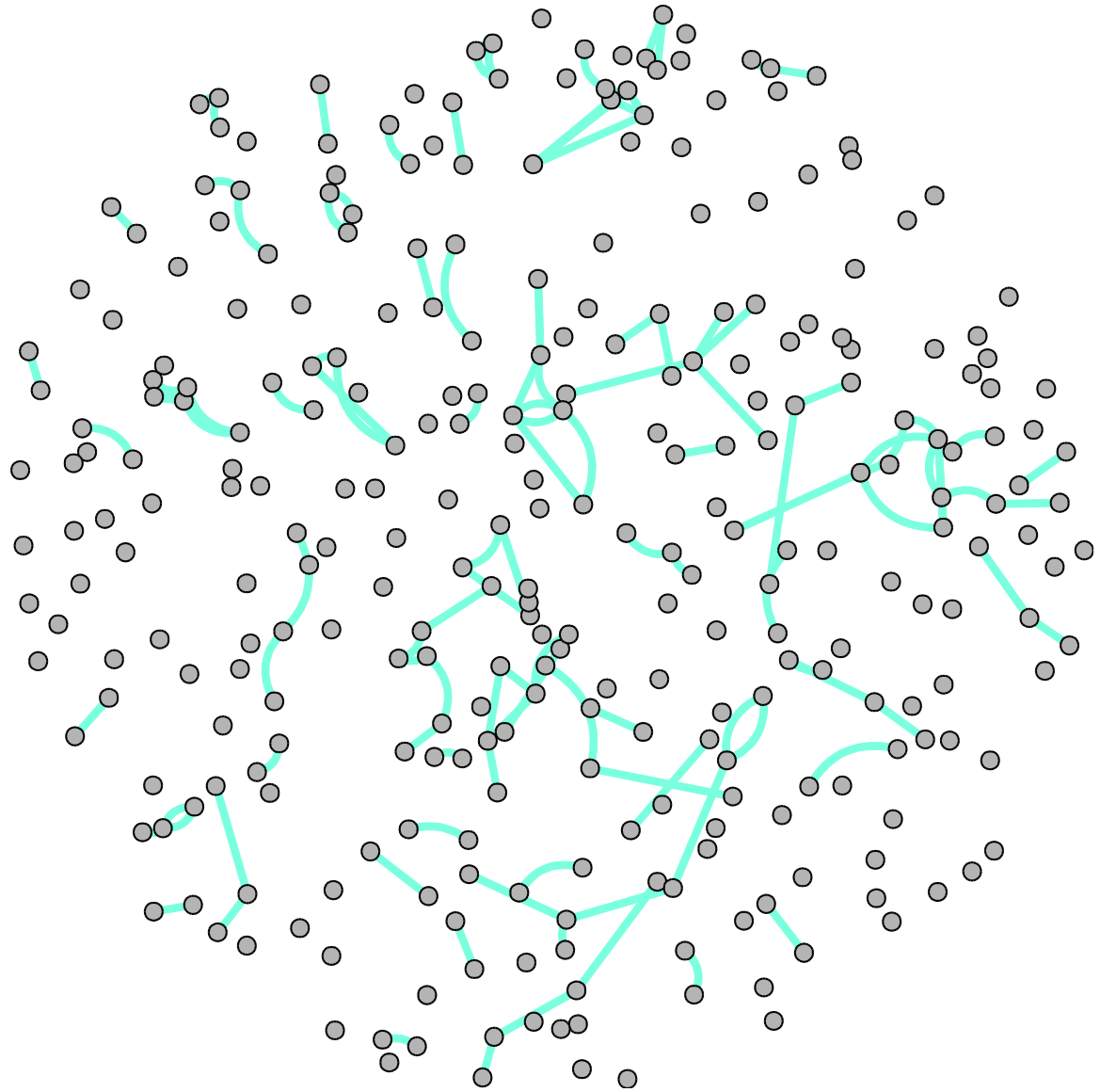
# Monday



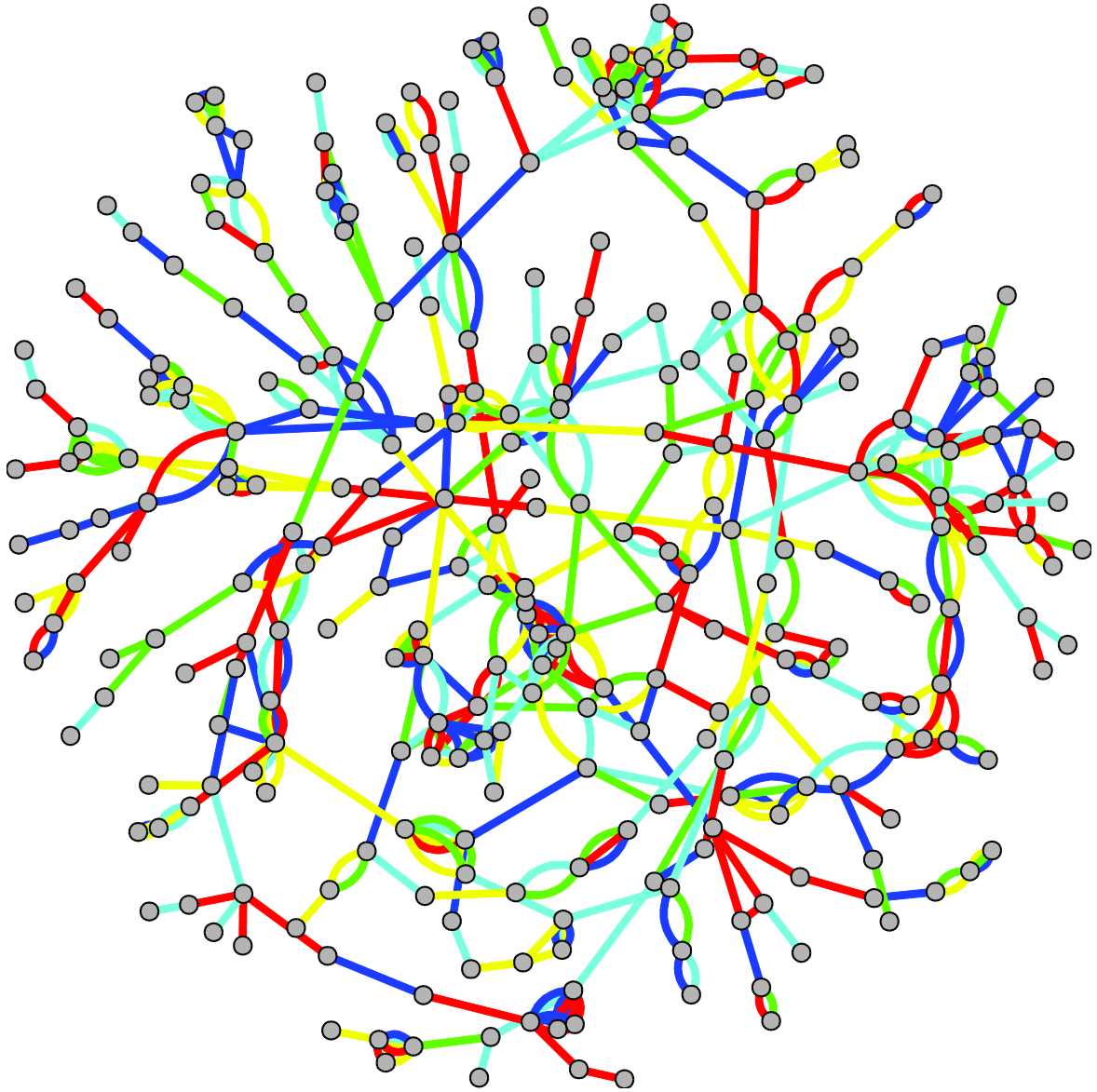
# Tuesday



# ... Friday



# ... the weekly summary

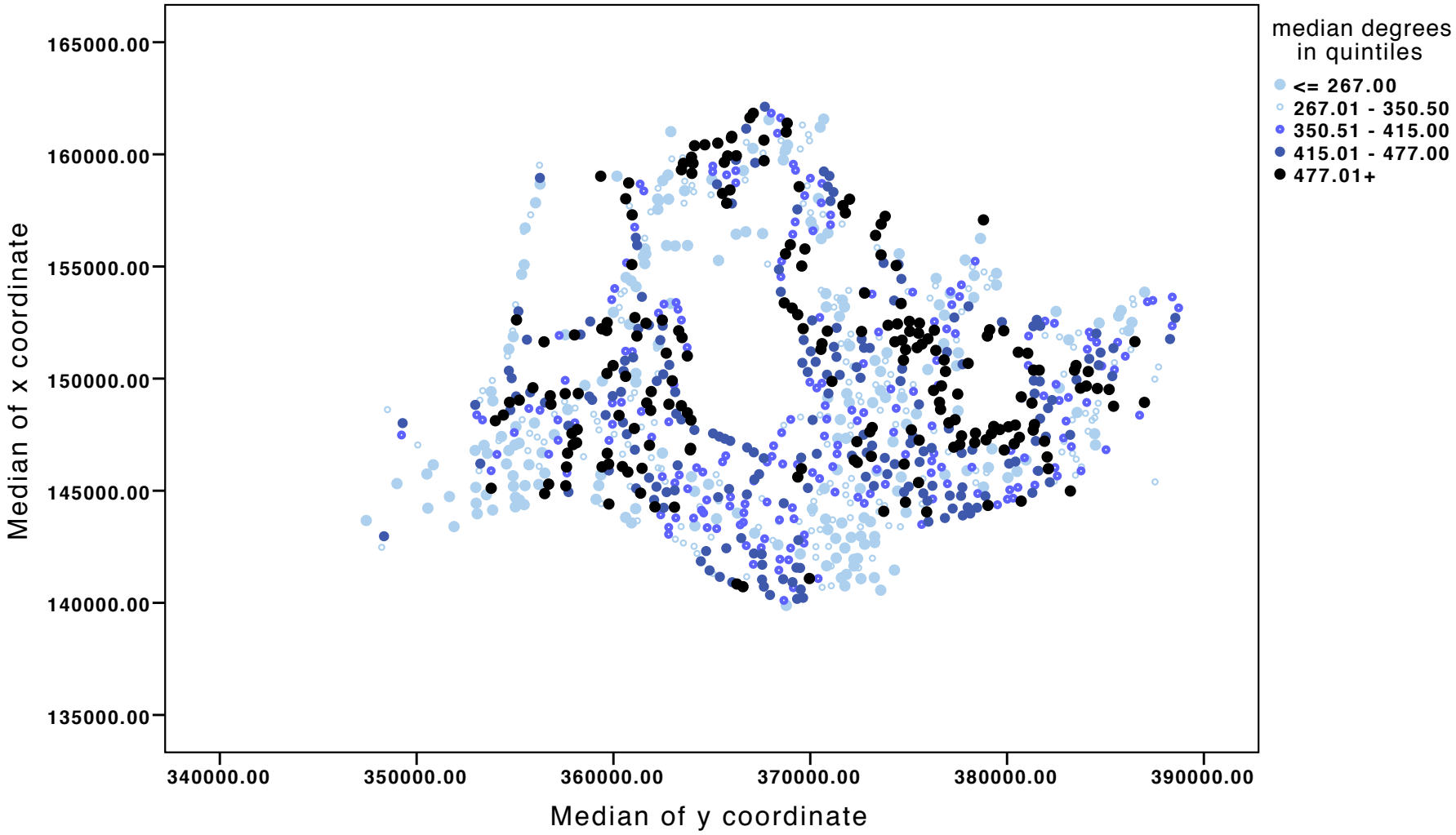


Sun, 2013

# 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: $4.5 \times 10^{-4}$)
- Small-world
  - Watts DJ & Strogatz SH (1998) Collective dynamics of ‘small-world’networks. Nature 393:440-442.

# A small world network in Singapore‘s busses, but uneven



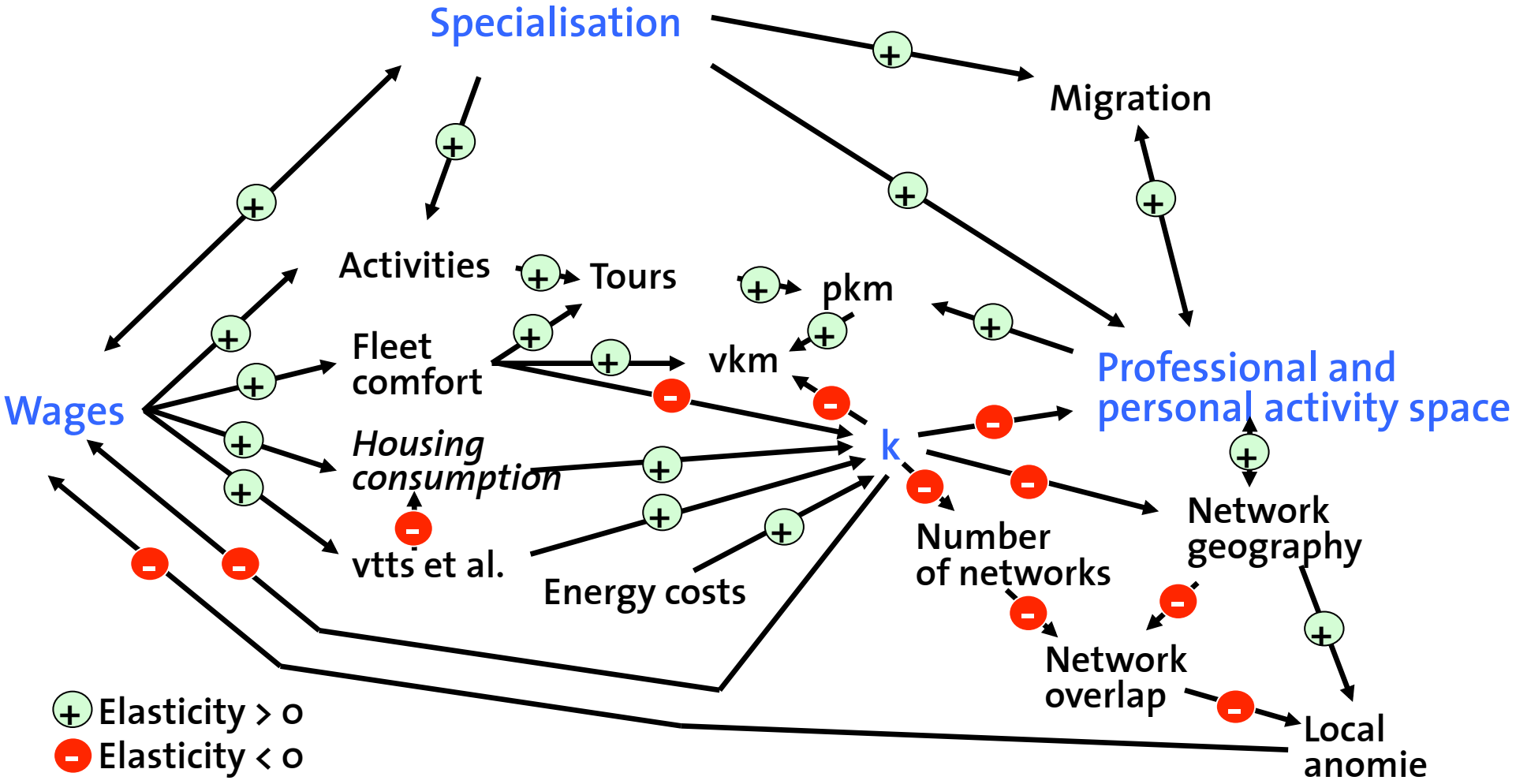
# Integration

# 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, Carrasco's Concepcion survey)
- Measurement of anomie, trust and social network geography
- Integration of network choice/decision making model (Dubernet)

# Integration, again

# Some hypotheses for travel behaviour and more



# Questions ?

www.ivt.ethz.ch

www.matsim.org

www.futurecities.ethz.ch

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