

# Bevorzugter Zitierstil für diesen Vortrag

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Axhausen, K.W. (2014) Social networks and the dynamics of travel, keynote presentation at the 3rd Symposium of the European Association for Research in Transportation(hEART 2014), Leeds, September 2014.

# Social networks and the dynamics of travel

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IVT

ETH

Zürich

September 2014

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**ETH**

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Swiss Federal Institute of Technology Zurich

# Acknowledgements

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## Social networks:

- Timo Ohnmacht
- Andreas Frei
- Matthias Kowald
- Lijun Sun
- Andreas Diekmann, ETH Zürich
- Jonas Larsen, Roskilde/John Urry, Lancaster

## Agent-based models

- Thibaut Dubernet
- Pieter Fourie

## Social network generation

- Theo Arentze, TU Eindhoven

# Acknowledgements

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Most of the materials and more will be in:

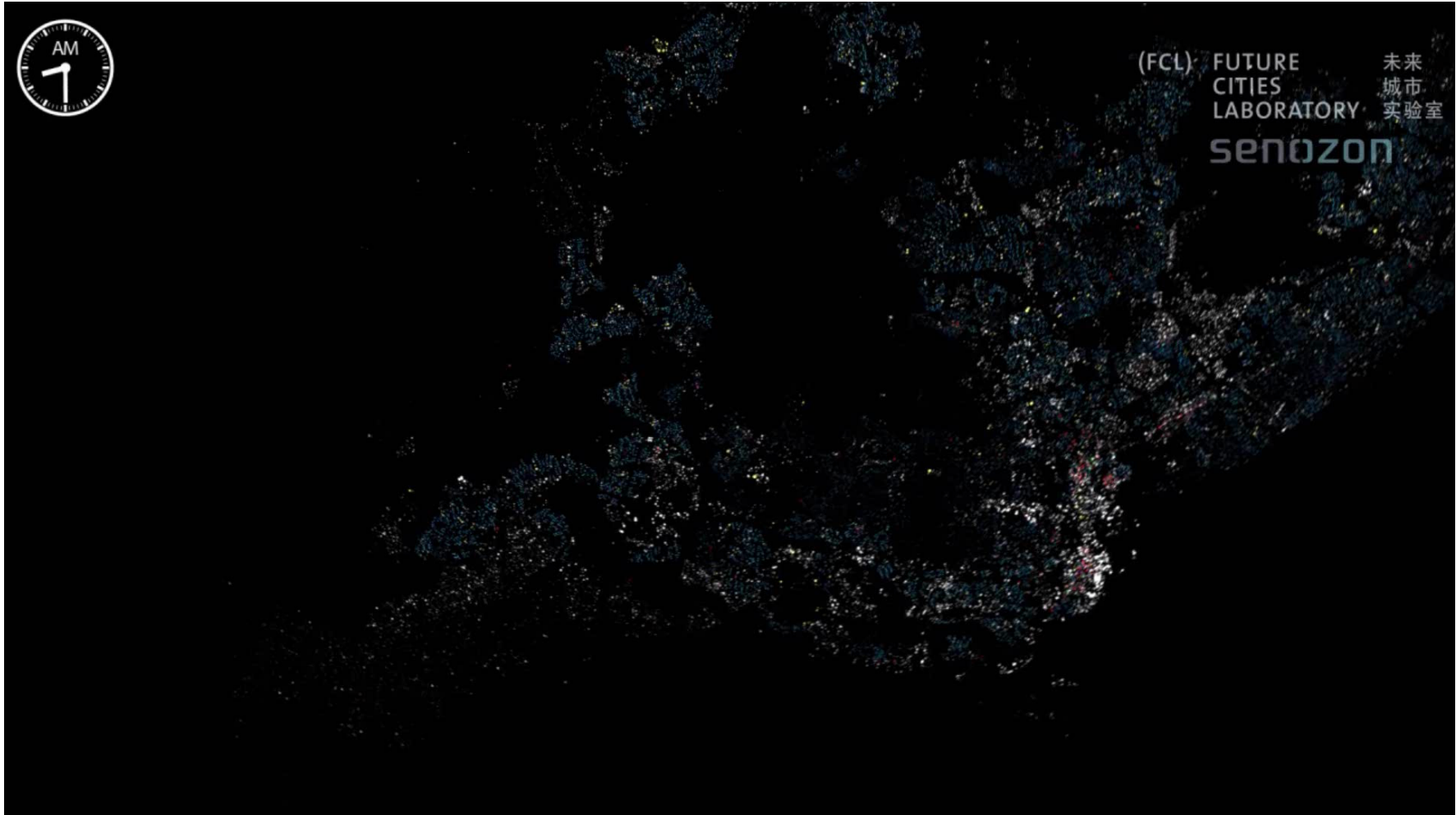
Kowald, M. and K.W. Axhausen (eds.) (2015)  
*Social networks and travel behaviour*,  
Ashgate

# Why the interest ?

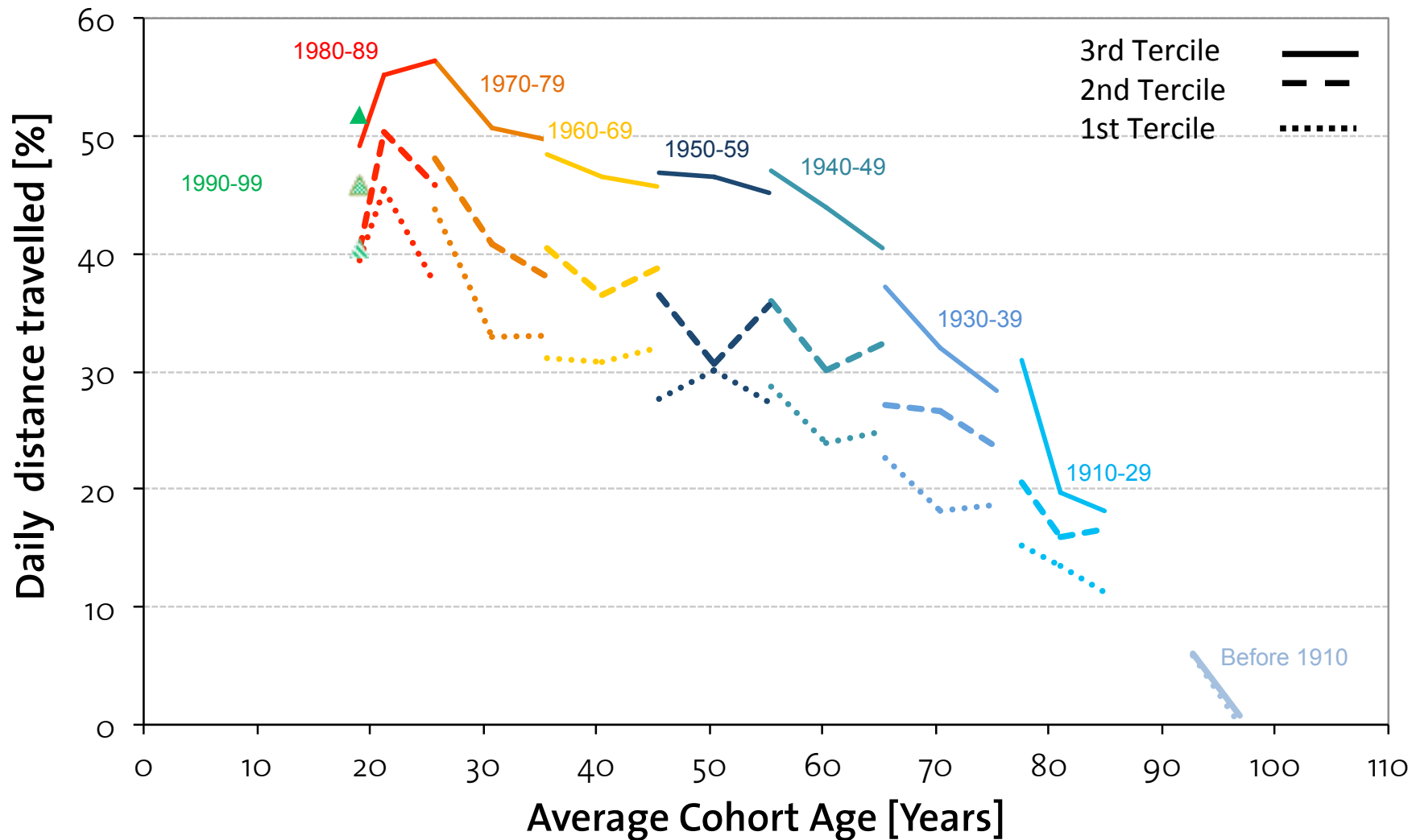
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# An agent-based model of travel demand: e.g. Singapore

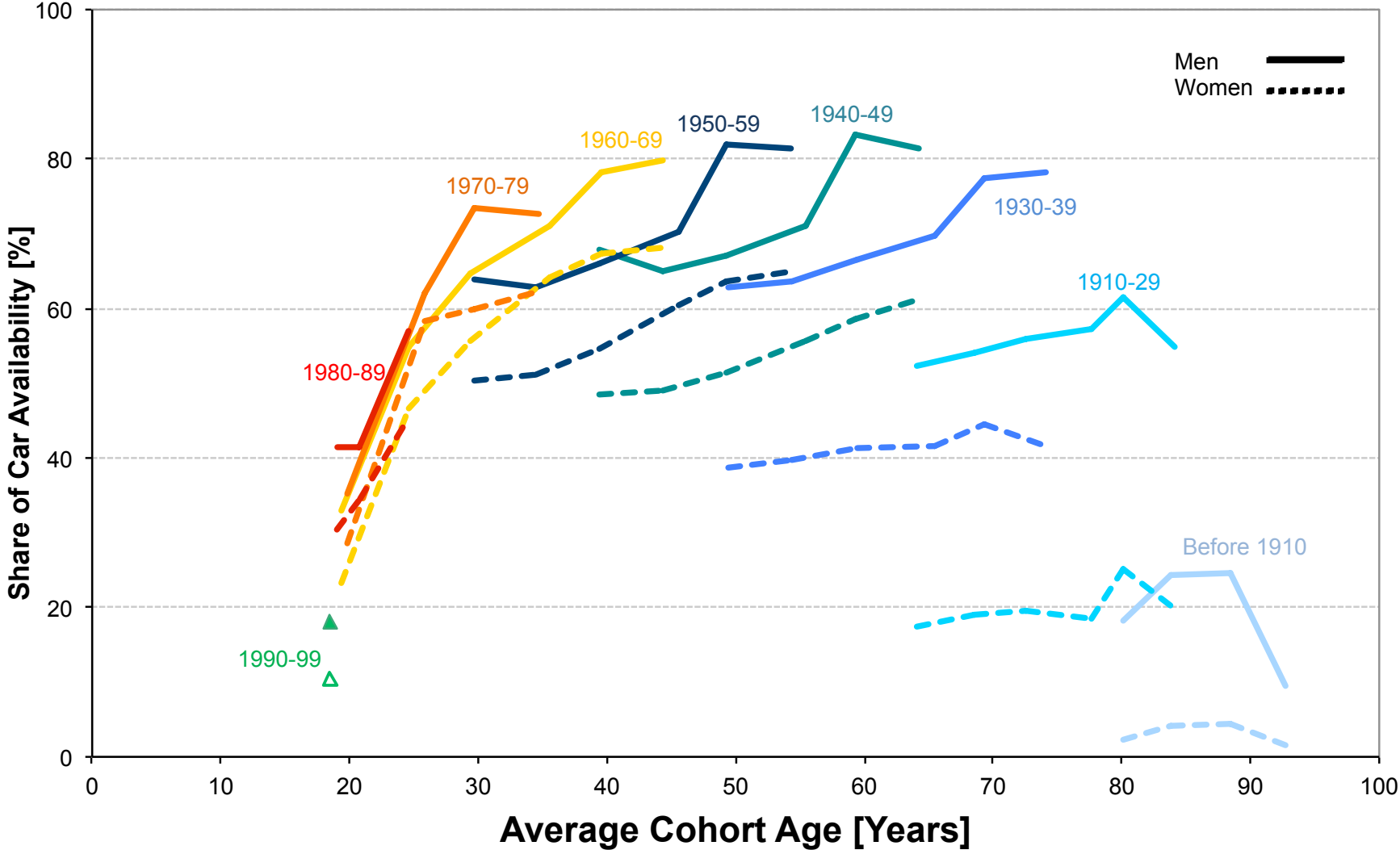
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# Avg. daily distance travelled by income tercile (1980 – 2010)



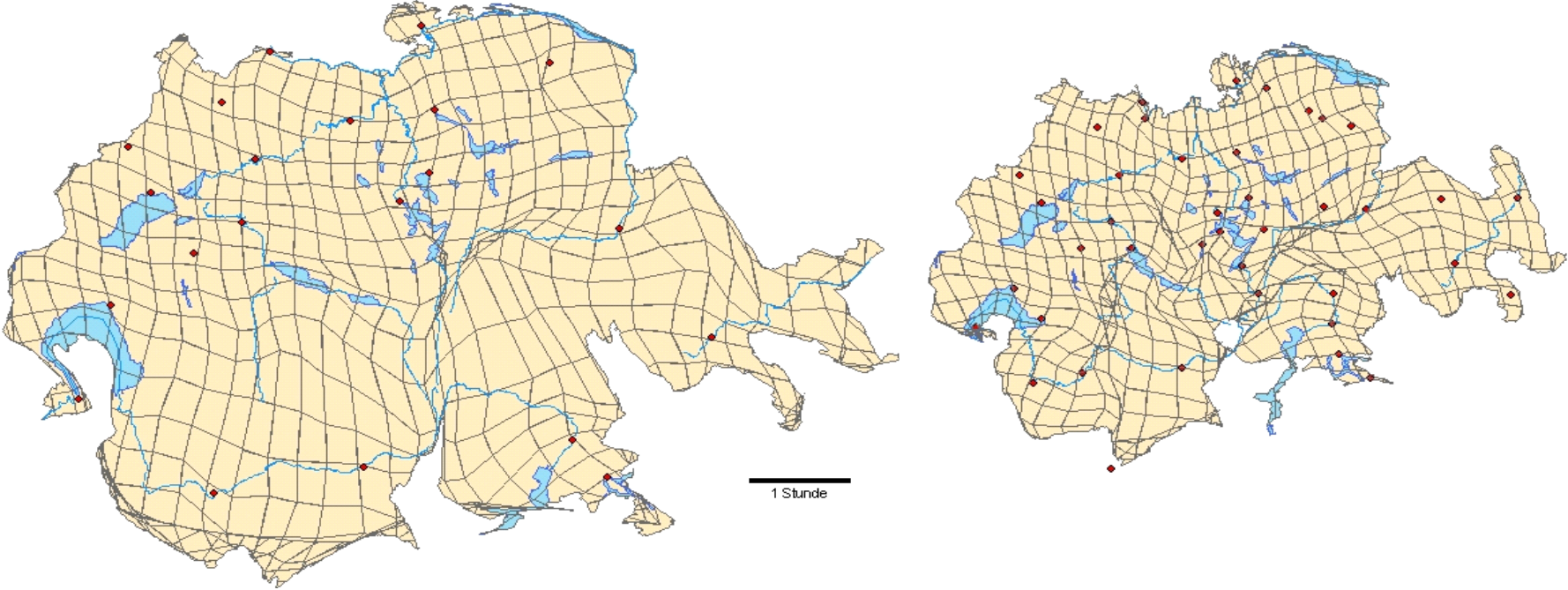
# Car always available (Switzerland 1980 – 2010)





# Road based – Switzerland 1950 and 2000

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## Leisure travel in the 2000's

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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

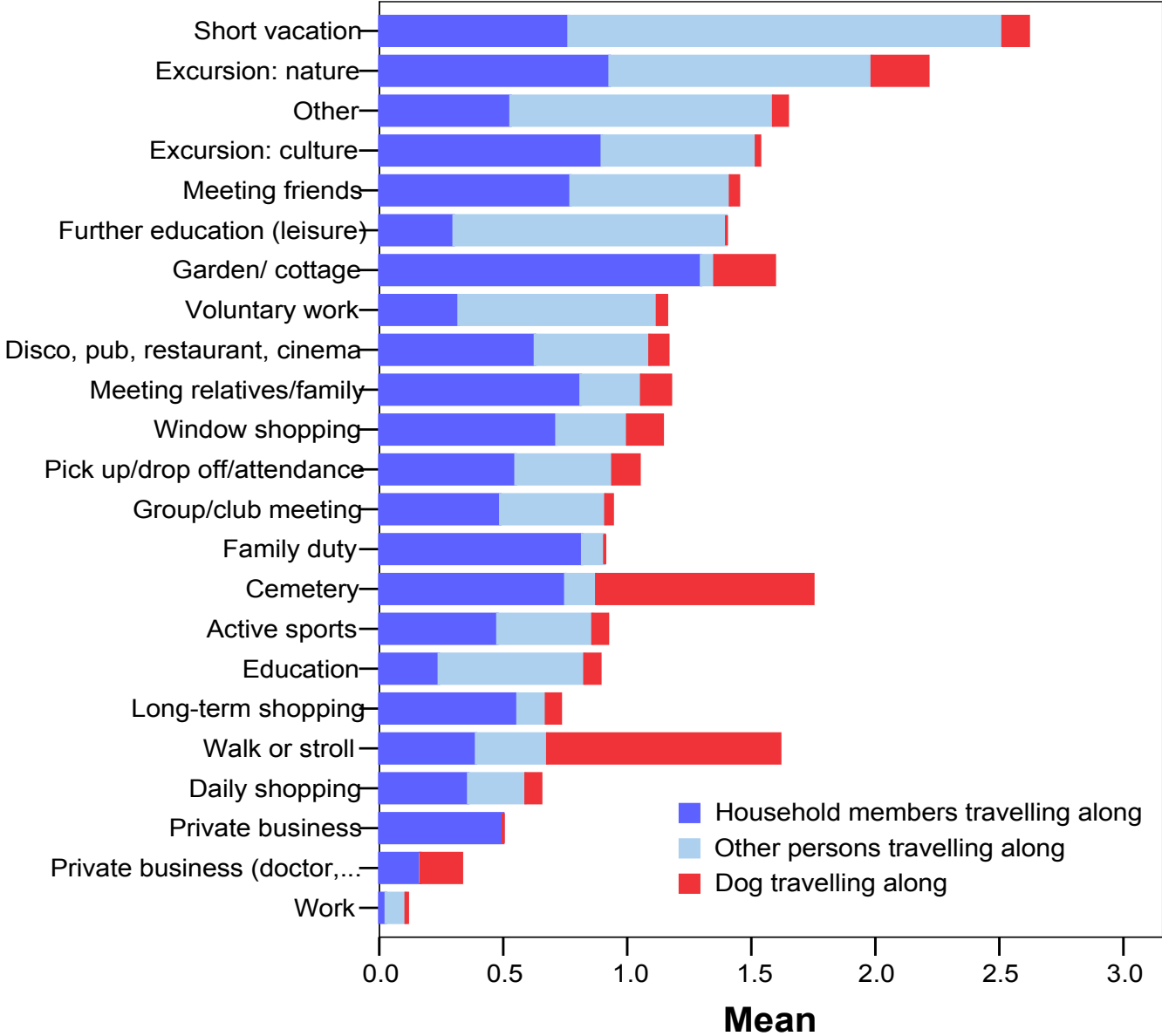
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Type	Number/year	km/journey
Vacation (5 days plus)	1.0	1600
Short vacation (2-4 days)	1.2	410
Other journeys with overnight stays	0.3	410
Day excursions	6.0	200
Business trip with overnight stay	1.2	500
Business trip without overnight stay	1.2	150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

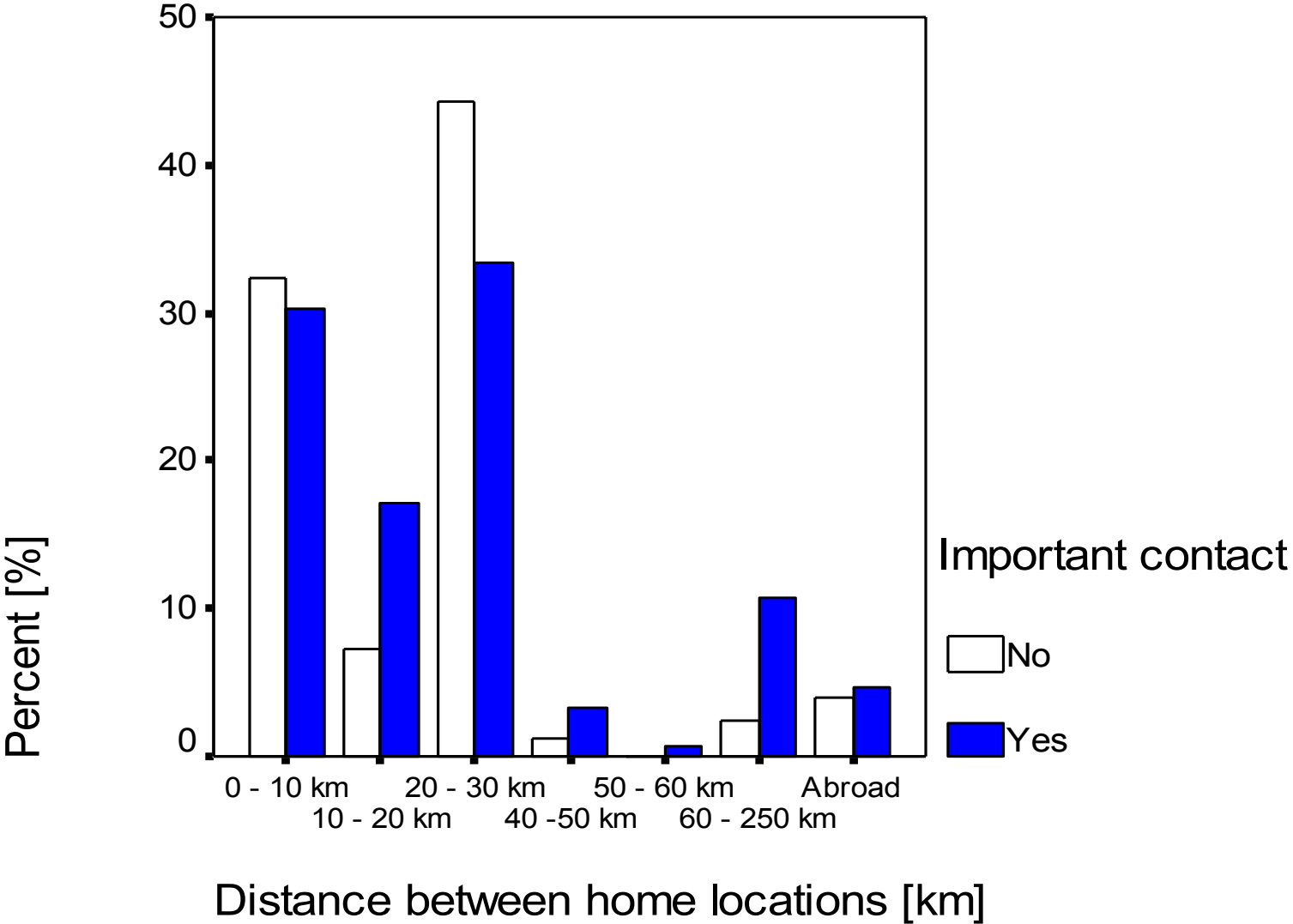
# Why social networks in transport/spatial planning ?

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# Example: Number of accompanying travellers



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



# Example: Heterogeneity in choice

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## 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	***
<b>Frequency weighted mean distance to friends</b>	<b>-8.16</b>	*
<b>Exponent (friends)</b>	<b>0.22</b>	**
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 <sup>2</sup> = 0.2128; * > 0.1; ** > 0.05; *** > 0.01		



# Travel and social networks

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# Benchmarking the current state

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- 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

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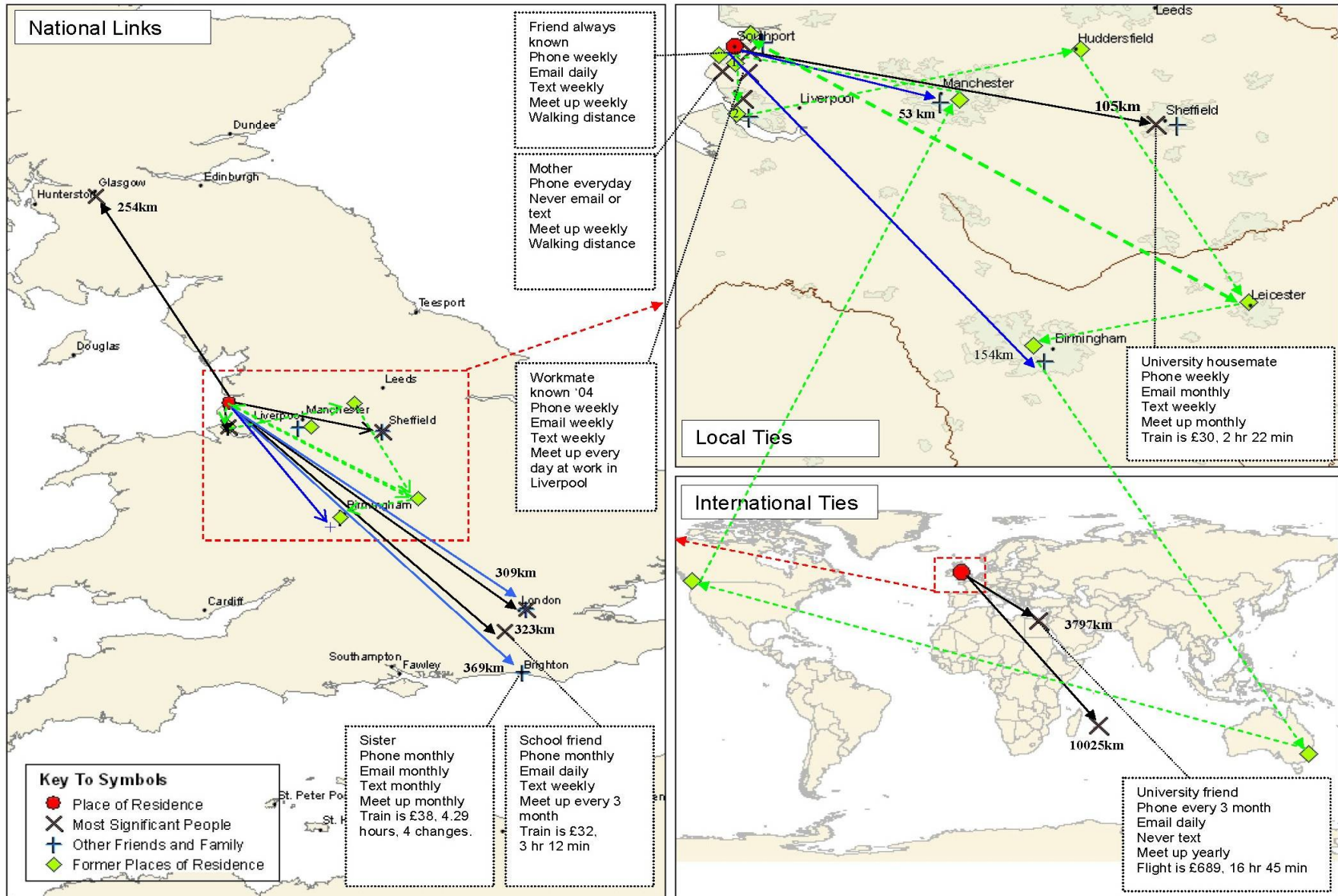
- Surveys of social geographies & mobility biographies
  - Egocentric
  - Snowball
- Travel diaries
  - One-Day
  - Multiple days
- With/without information about the presence of others
- With/without named co-travellers, co-present persons

## Social network surveys @ IVT

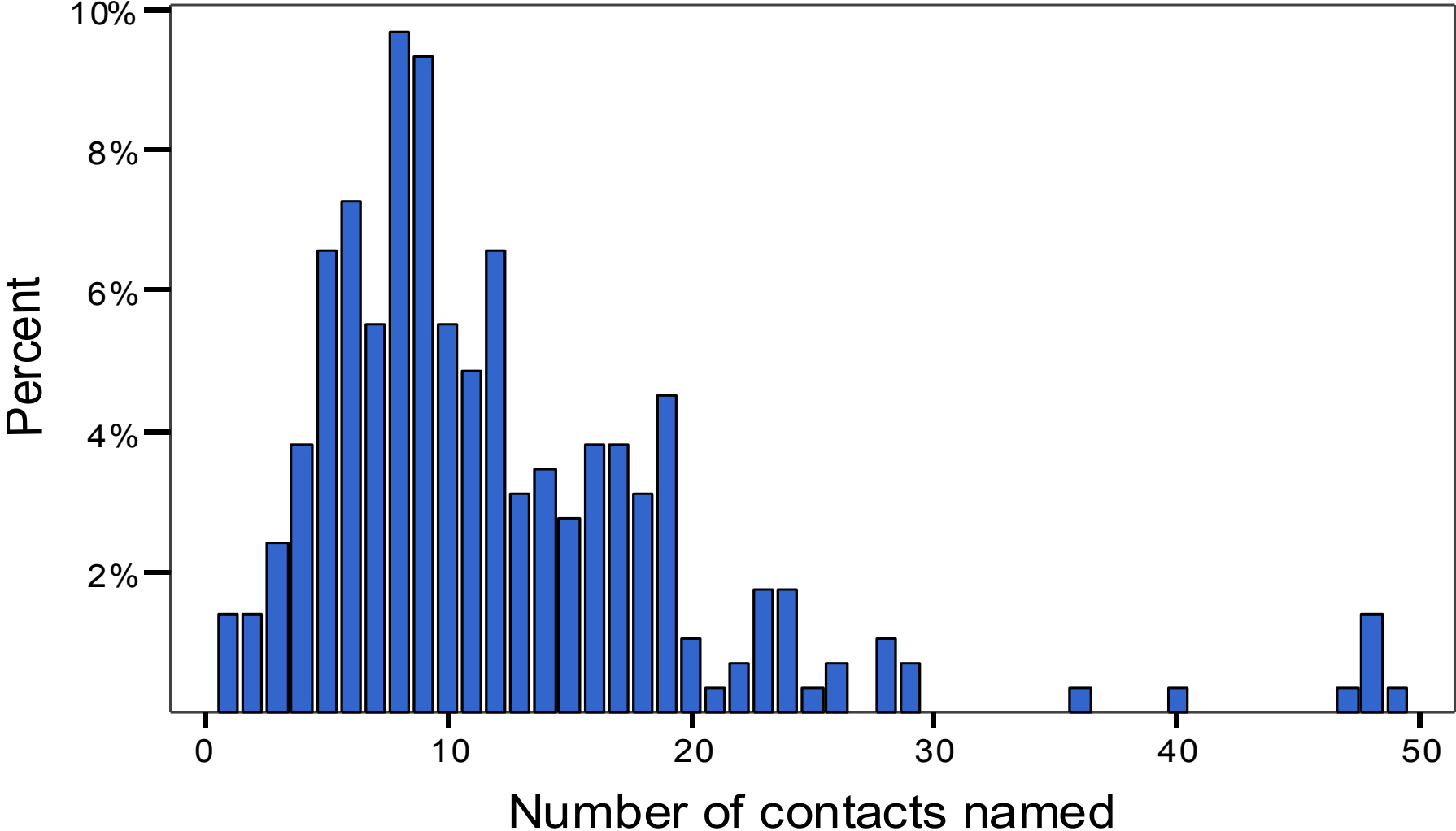
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- Ohnmacht: 50 egos qualitative/quantitative in Zürich
- Larsen/Urry: 24 egos qualitative/quantitative in NE England
- Frei: 300 egos quantitative in Zürich
- Kowald: snowball; 750 egos quantitative worldwide (starting with 40 egos in Kanton Zürich)(12000 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

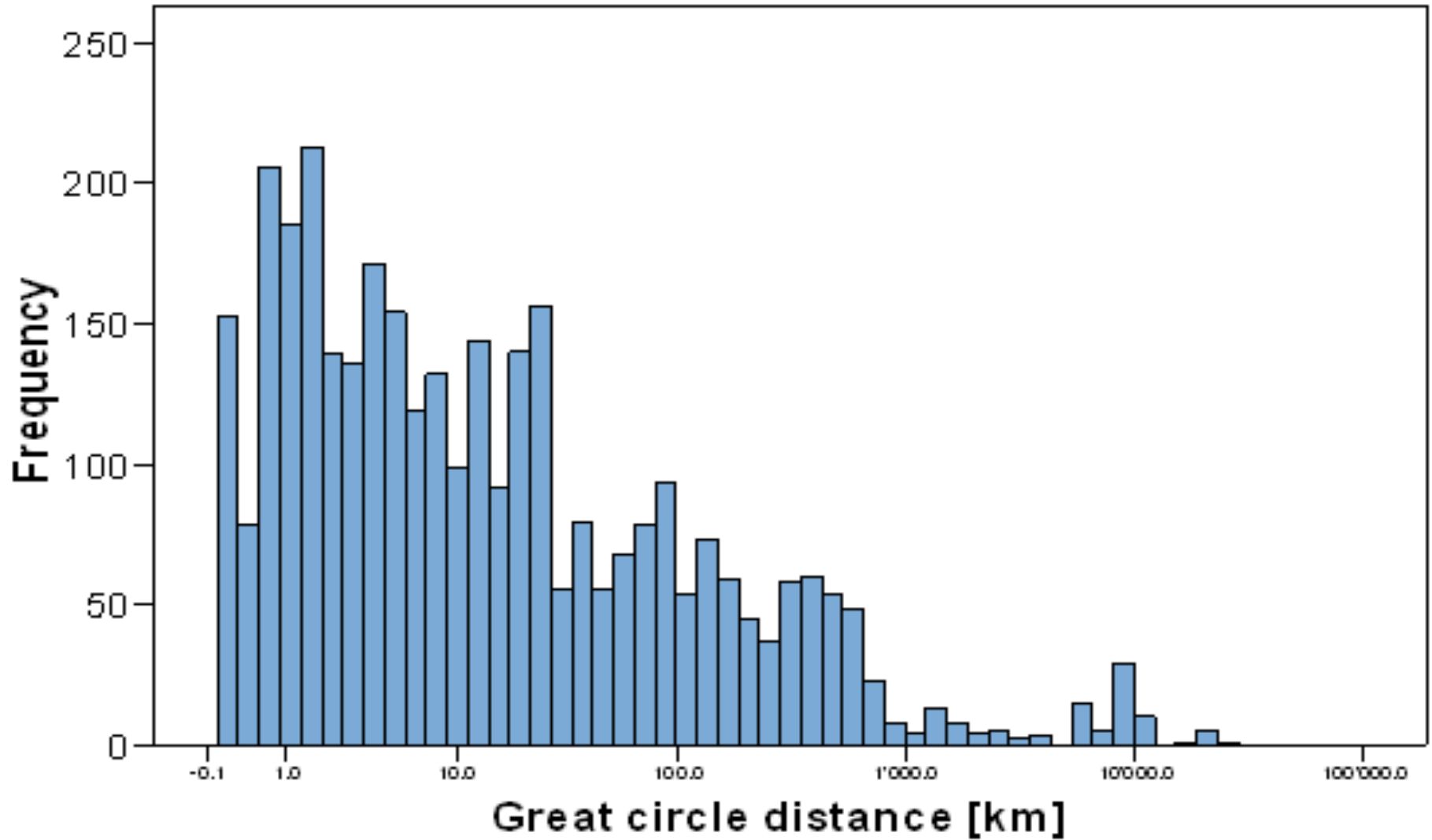


# Number of contacts reported



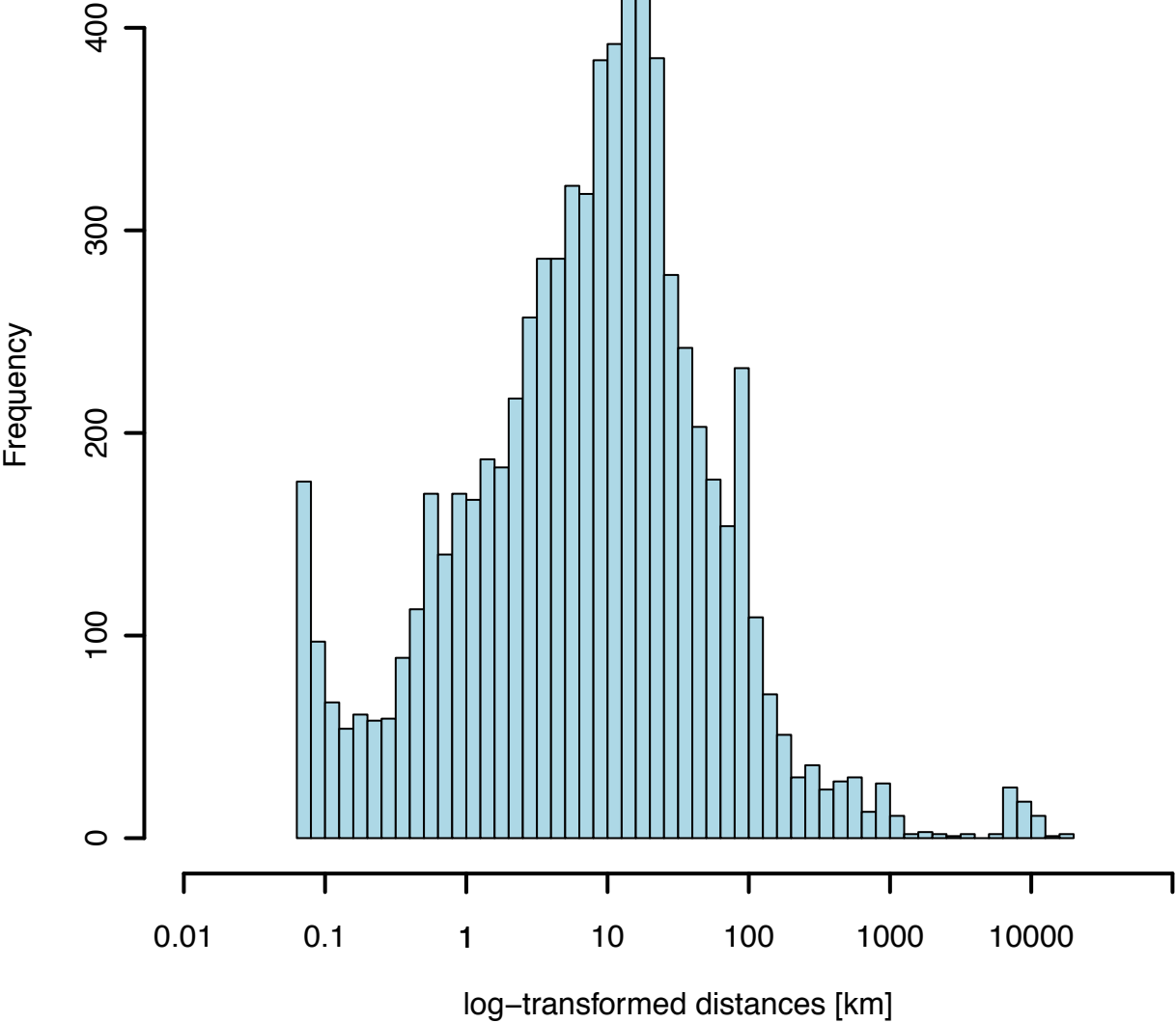
# Great circle distances between “leisure” contacts: Zürich

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# Great circle distances between “leisure” contacts: Snowball

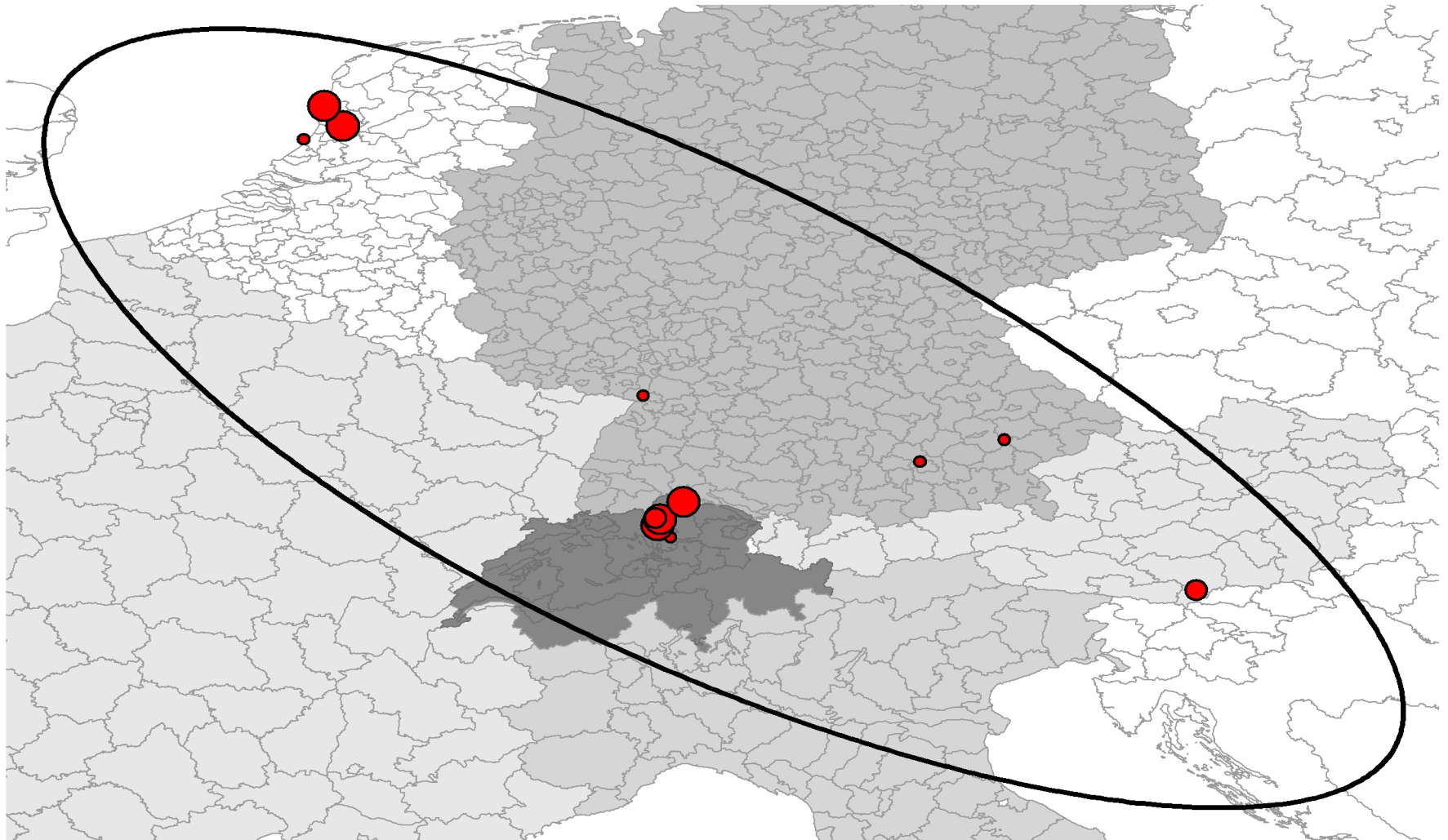
Daten: Schneeballbefragung IVT, Siehe Kowald et al. 2012



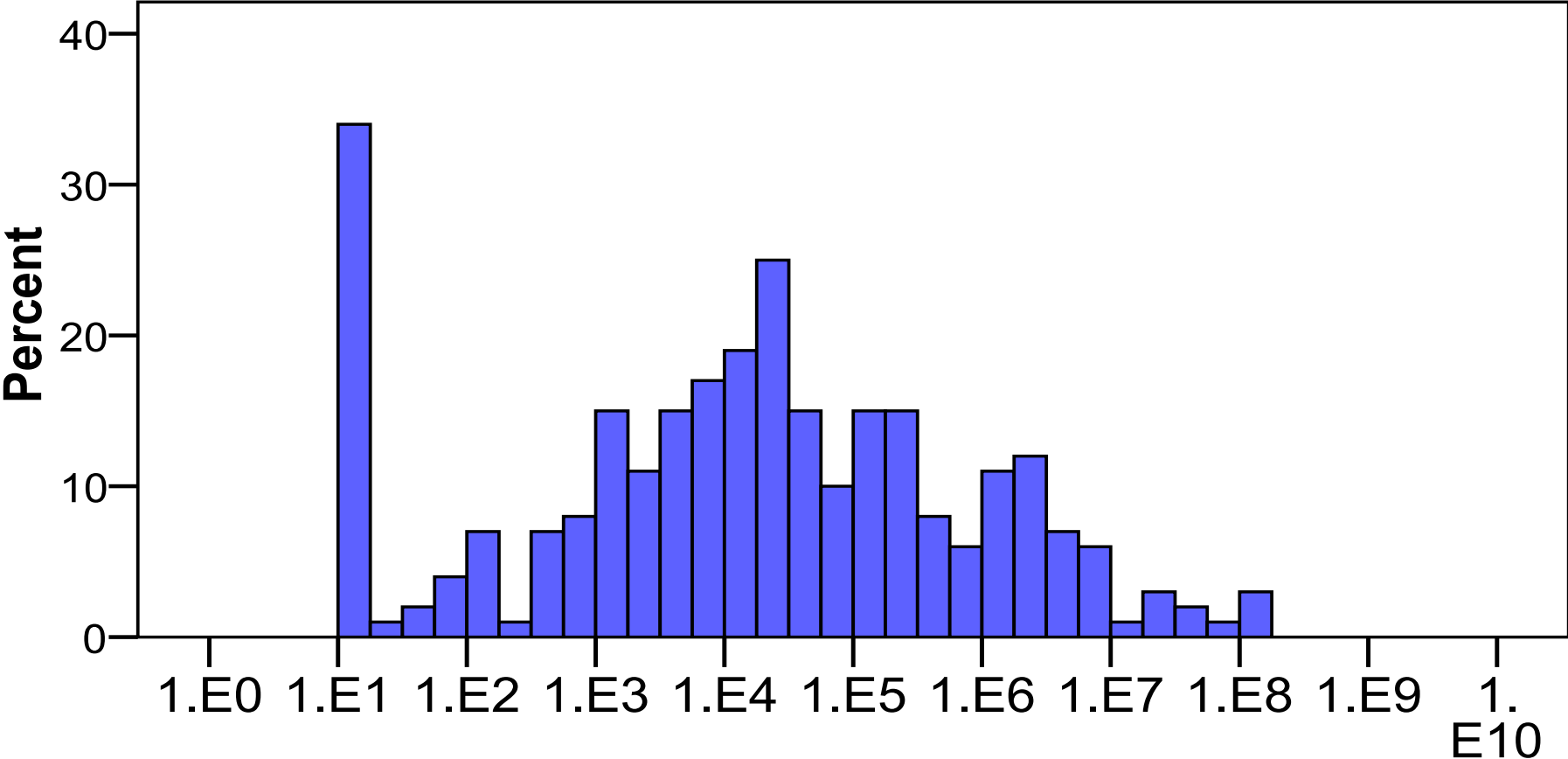


# Example of a social network geography

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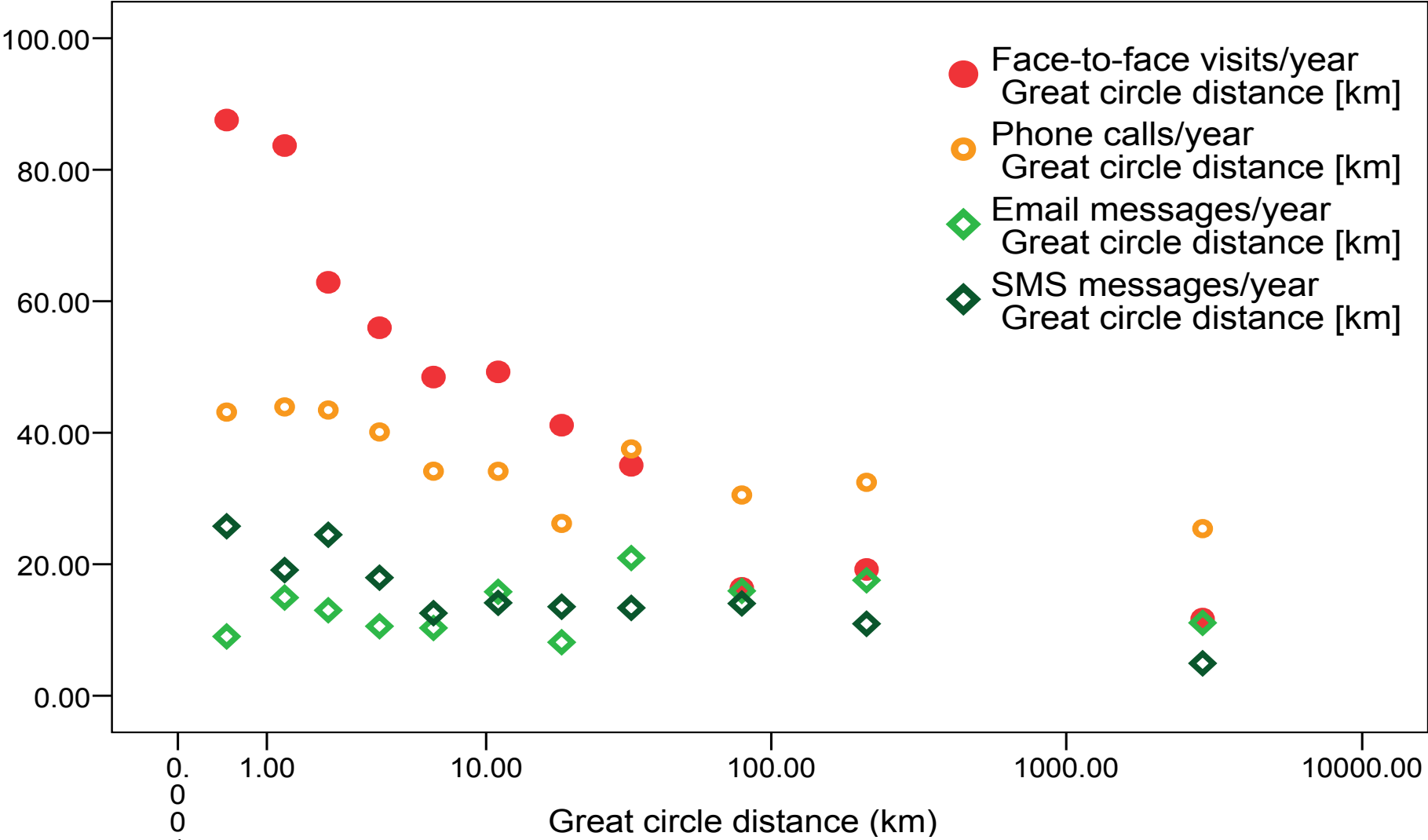


# Size of network geometries



**95%-confidence ellipse of the social network geography**

# Interactions by mode and distance between homes

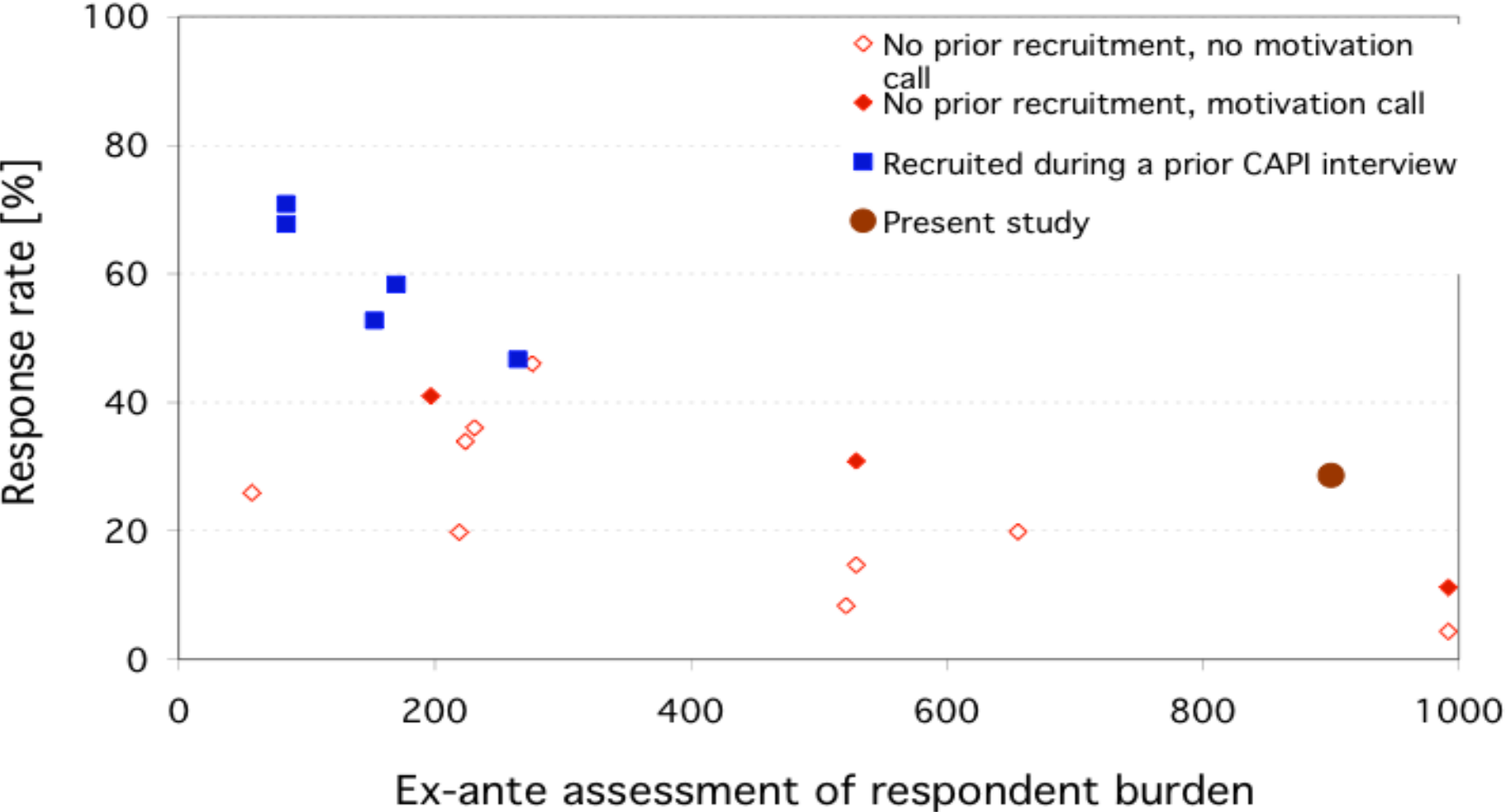


Frei and Axhausen, 2007

# 2010/11 Snowball survey

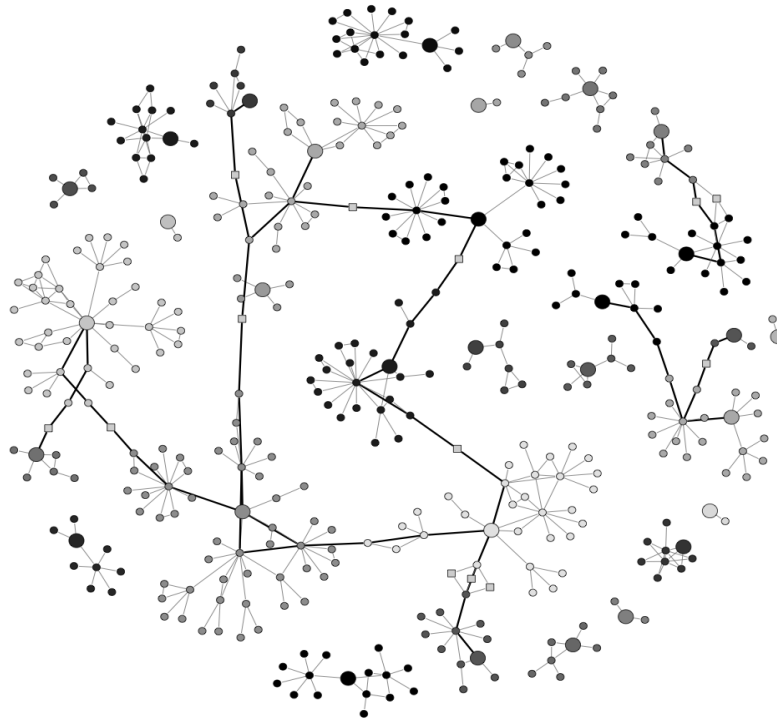
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# Response rate and response burden (IVT surveys)



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

- Seed
- Ego
- Bridging alter



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

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# Transport motivated social network surveys

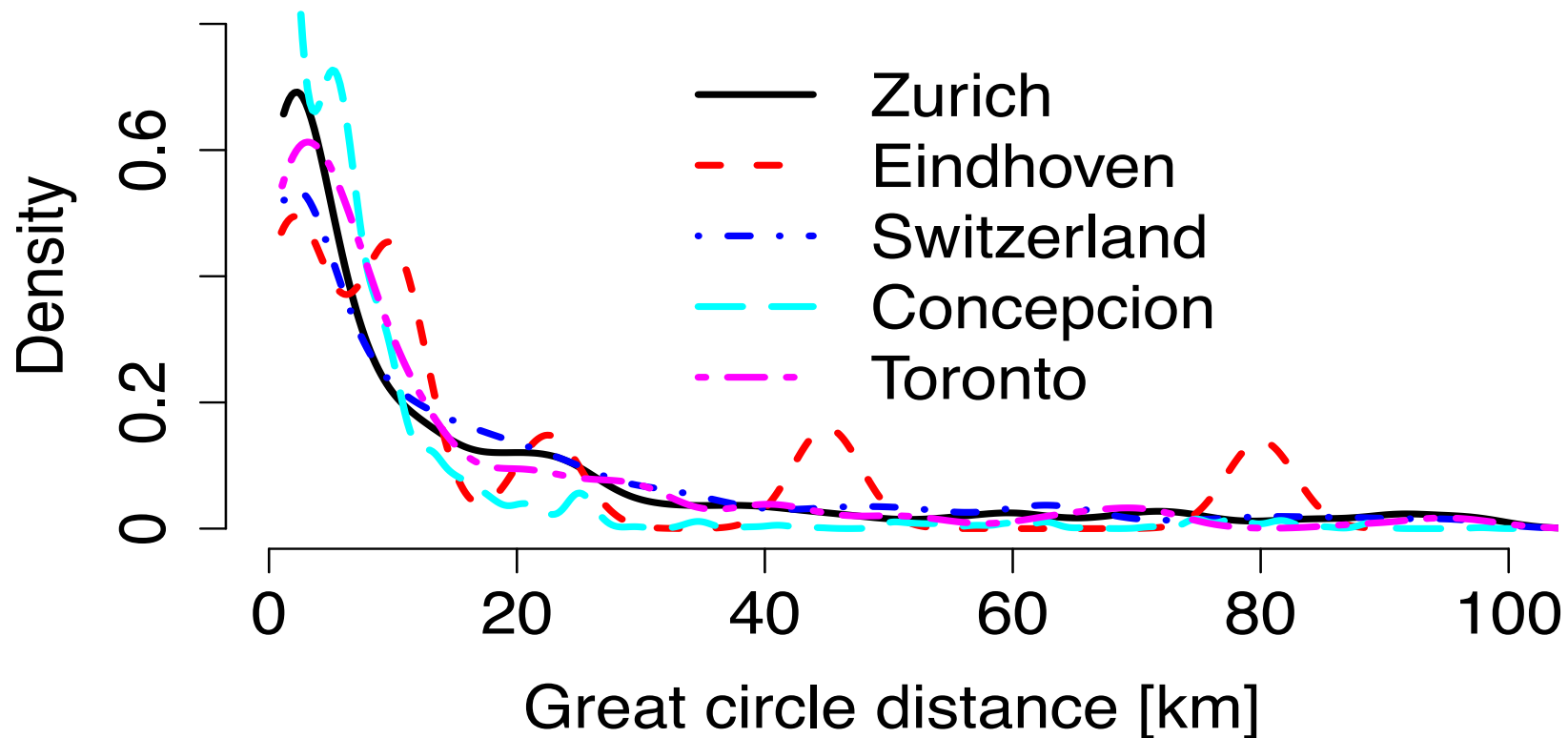
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- East York, Ontario (Wellman, Carrasco et al.)
- Eindhoven, Netherlands (Arentze, Van der Berg)
- Concepcion, Chile (Carrasco)
- City of Zürich (Frei)
- Kanton Zürich snowball (Kowald)

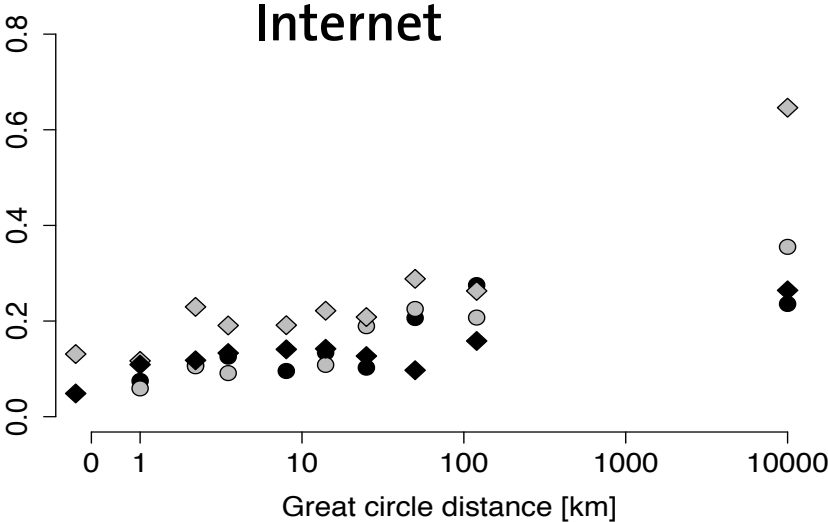
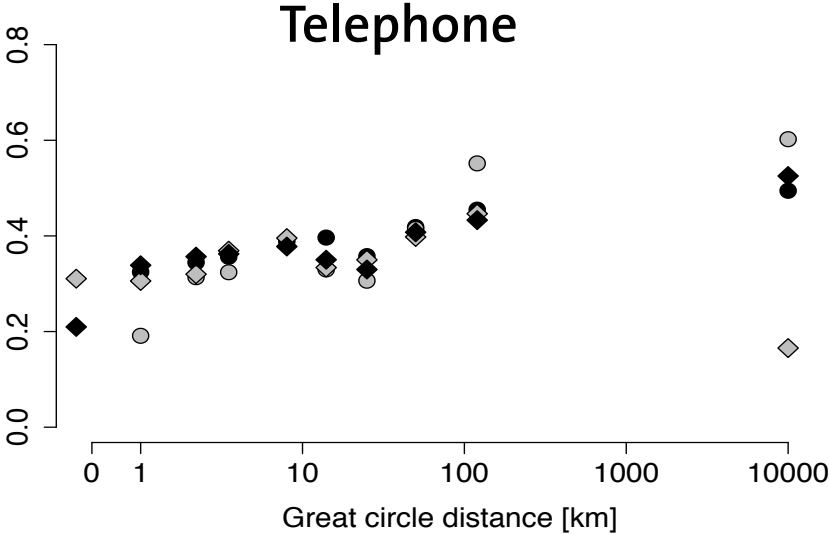
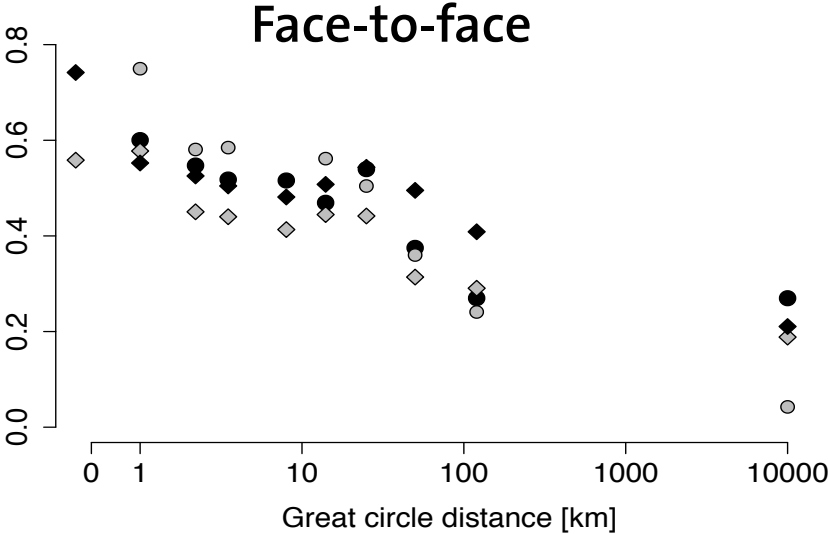


# Contact “density” – shares by distance class

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# Shares of contact by mode

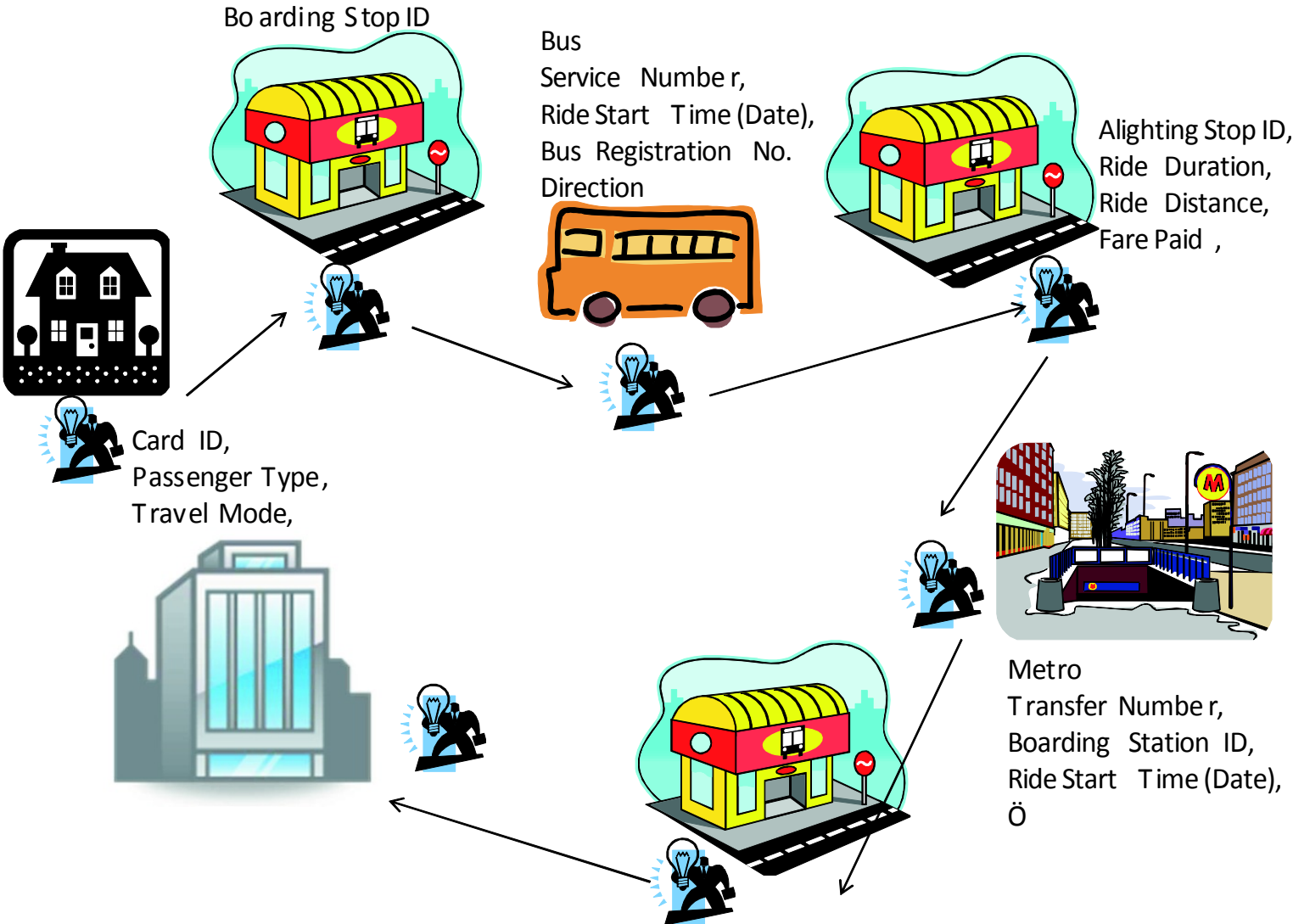


- Zurich
- Eindhoven
- ◇ Switzerland
- ◆ Concepcion

# Low level networks as a building block

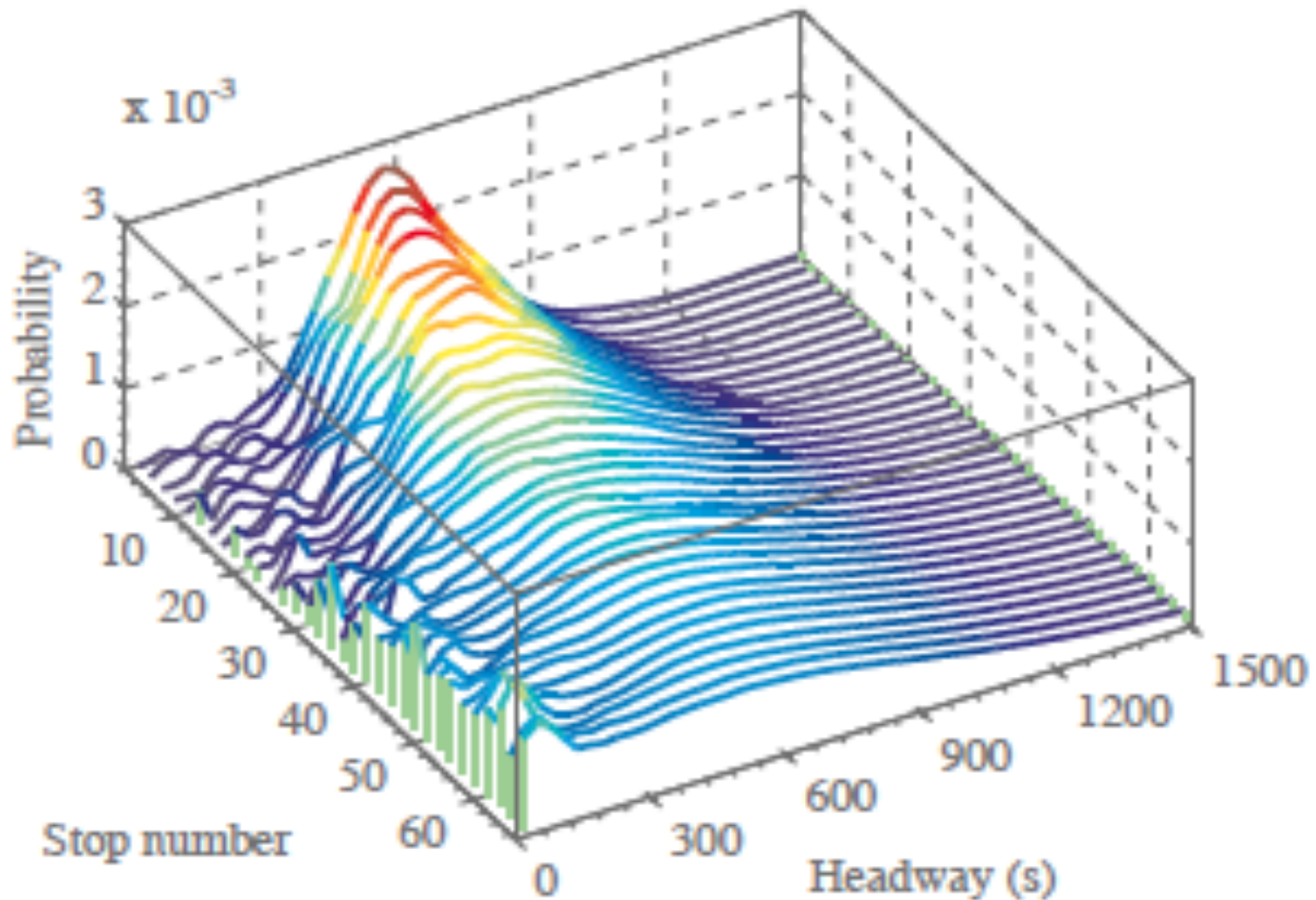
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# Smart card records as a source

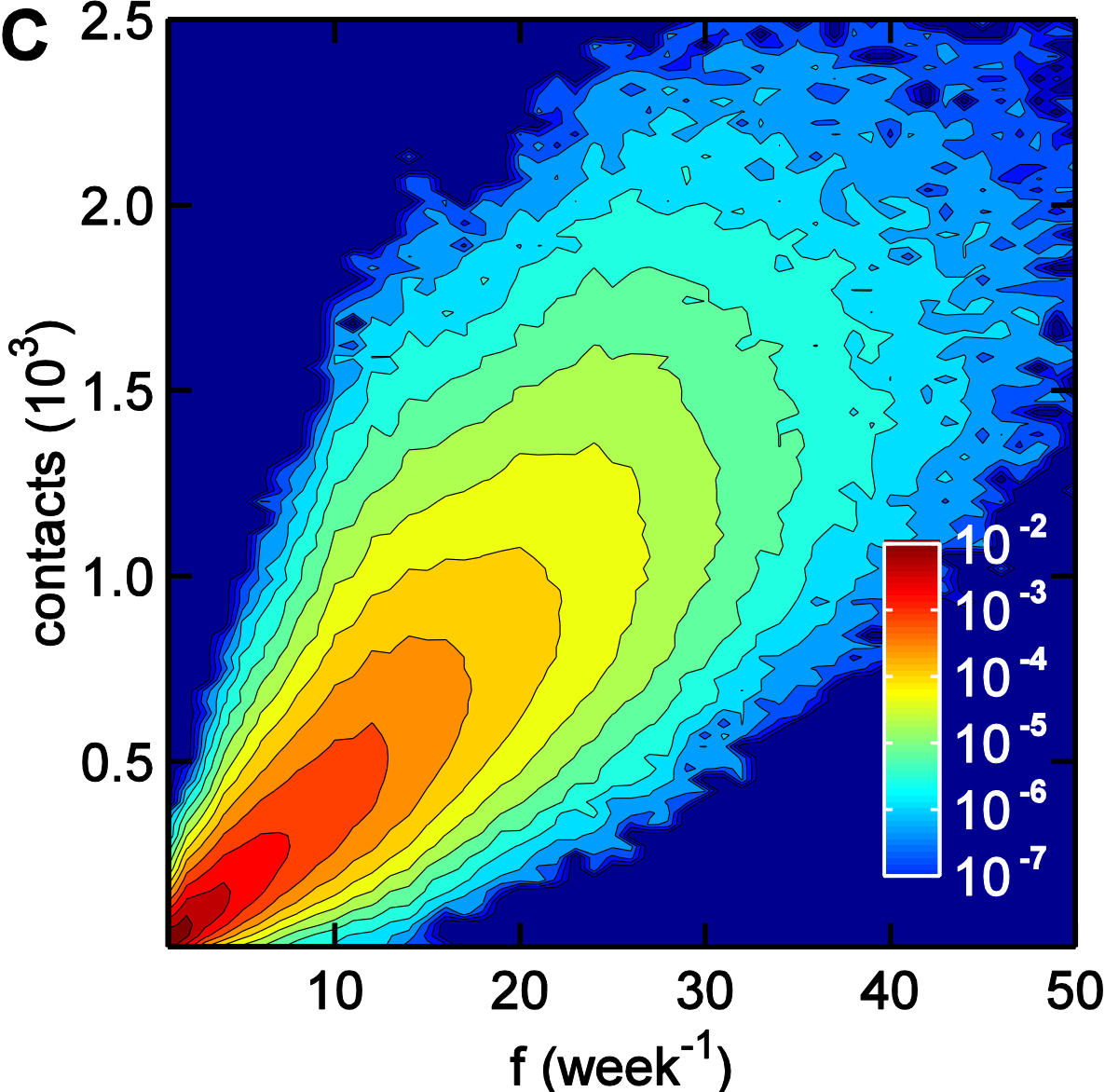


# Arrival distribution along a line

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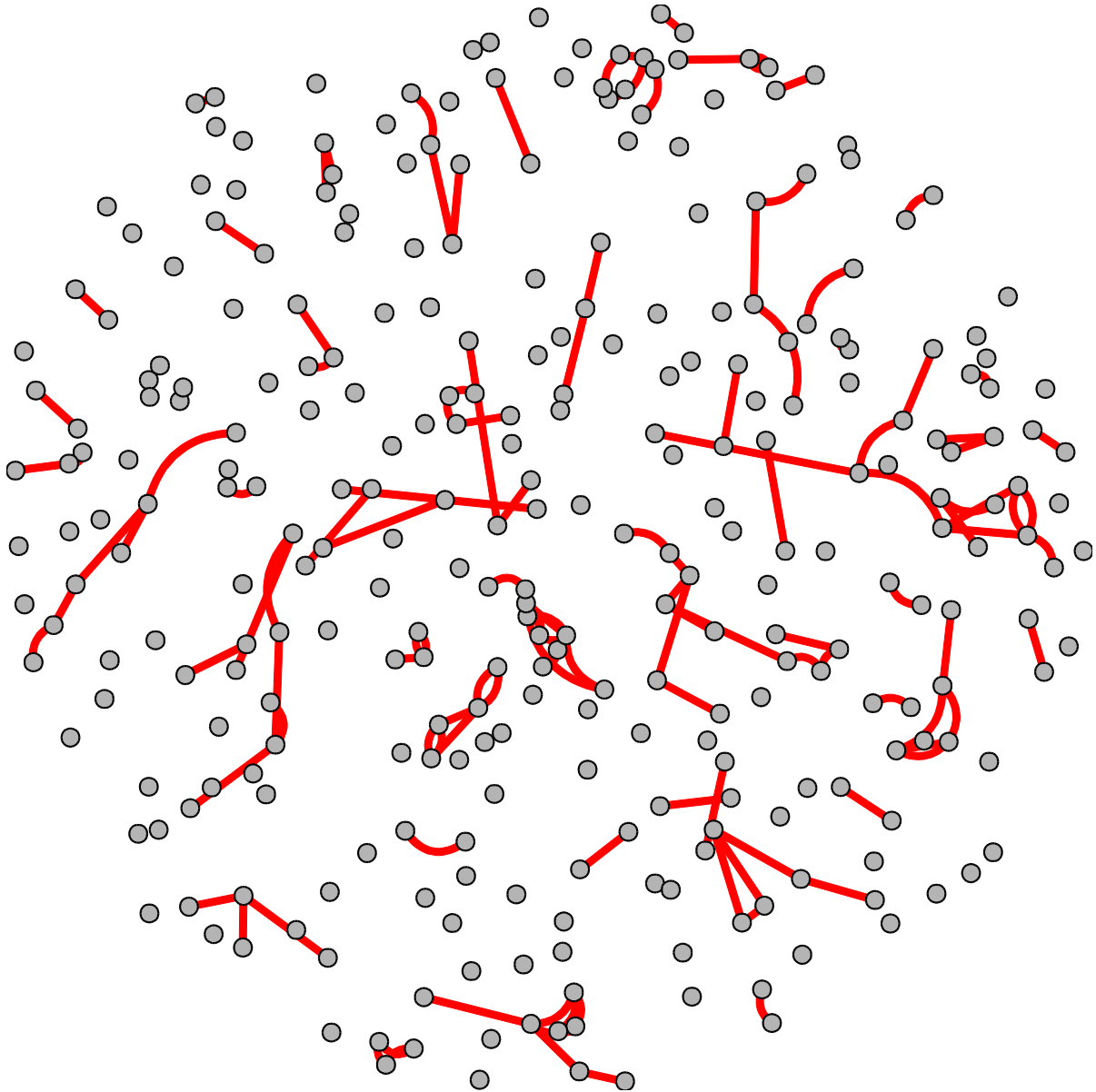


# Number of contacts versus usage frequency



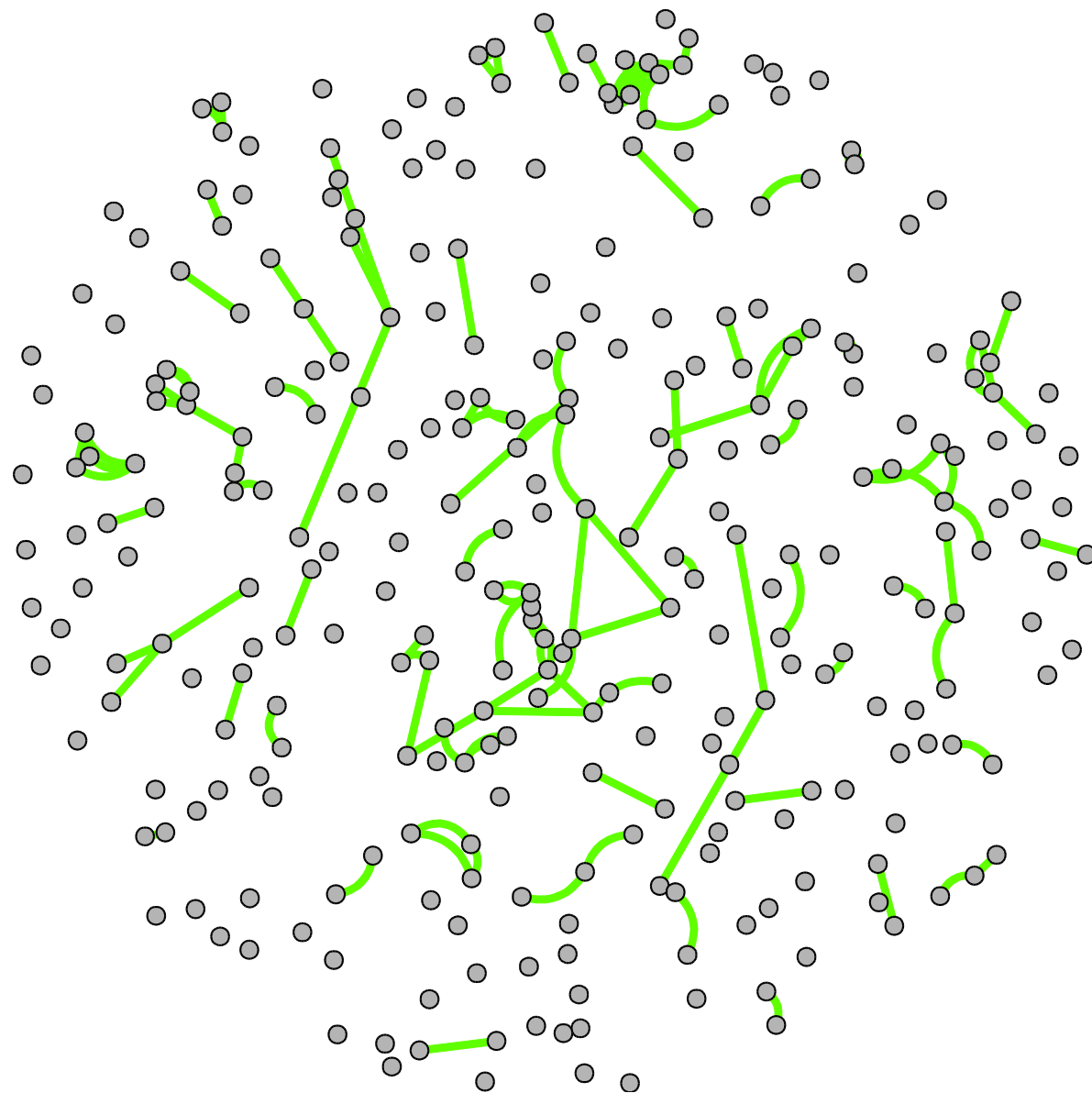
# Monday

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# Tuesday

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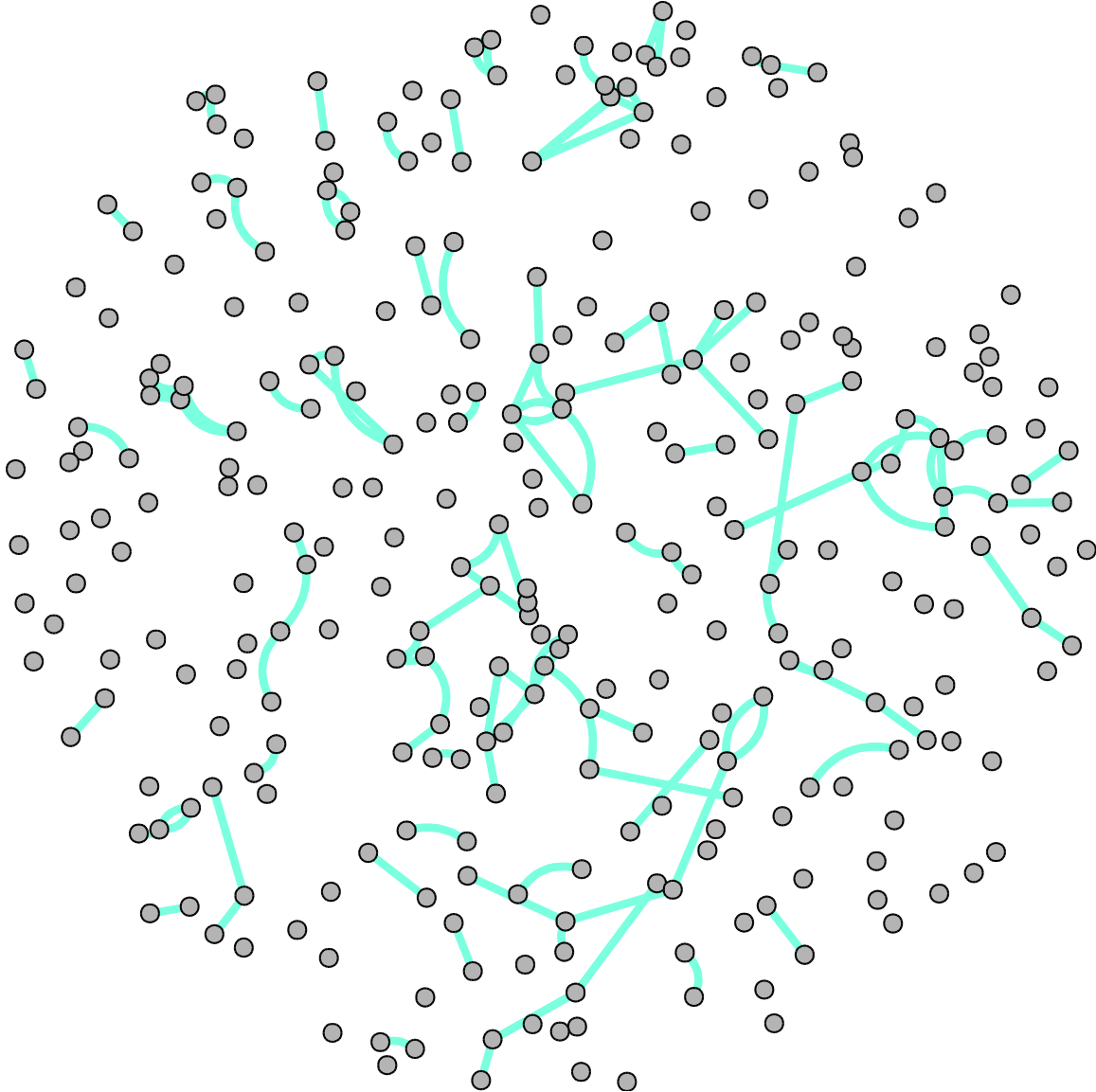


Sun, 2013



... Friday

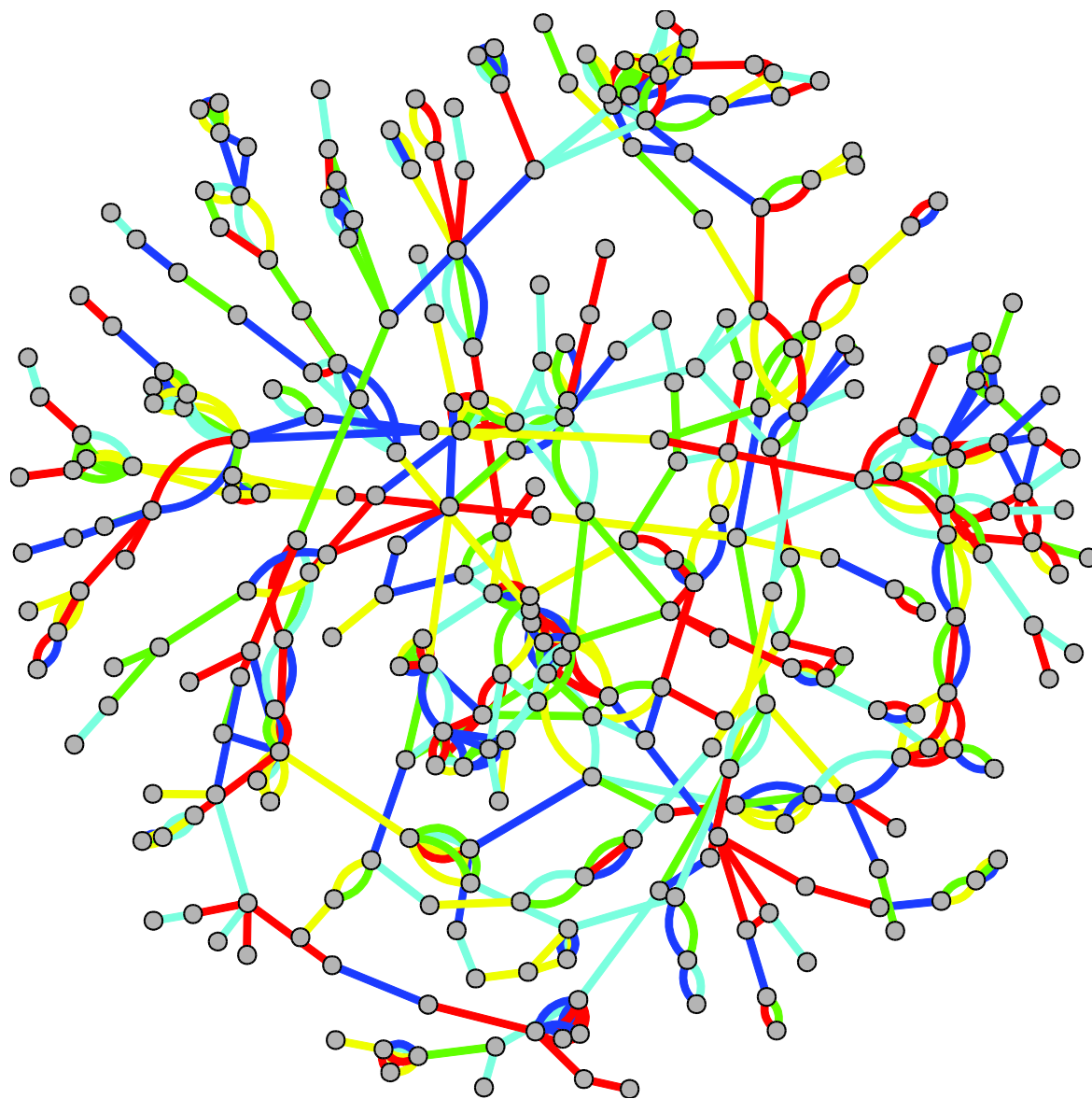
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Sun, 2013

# ... the weekly summary

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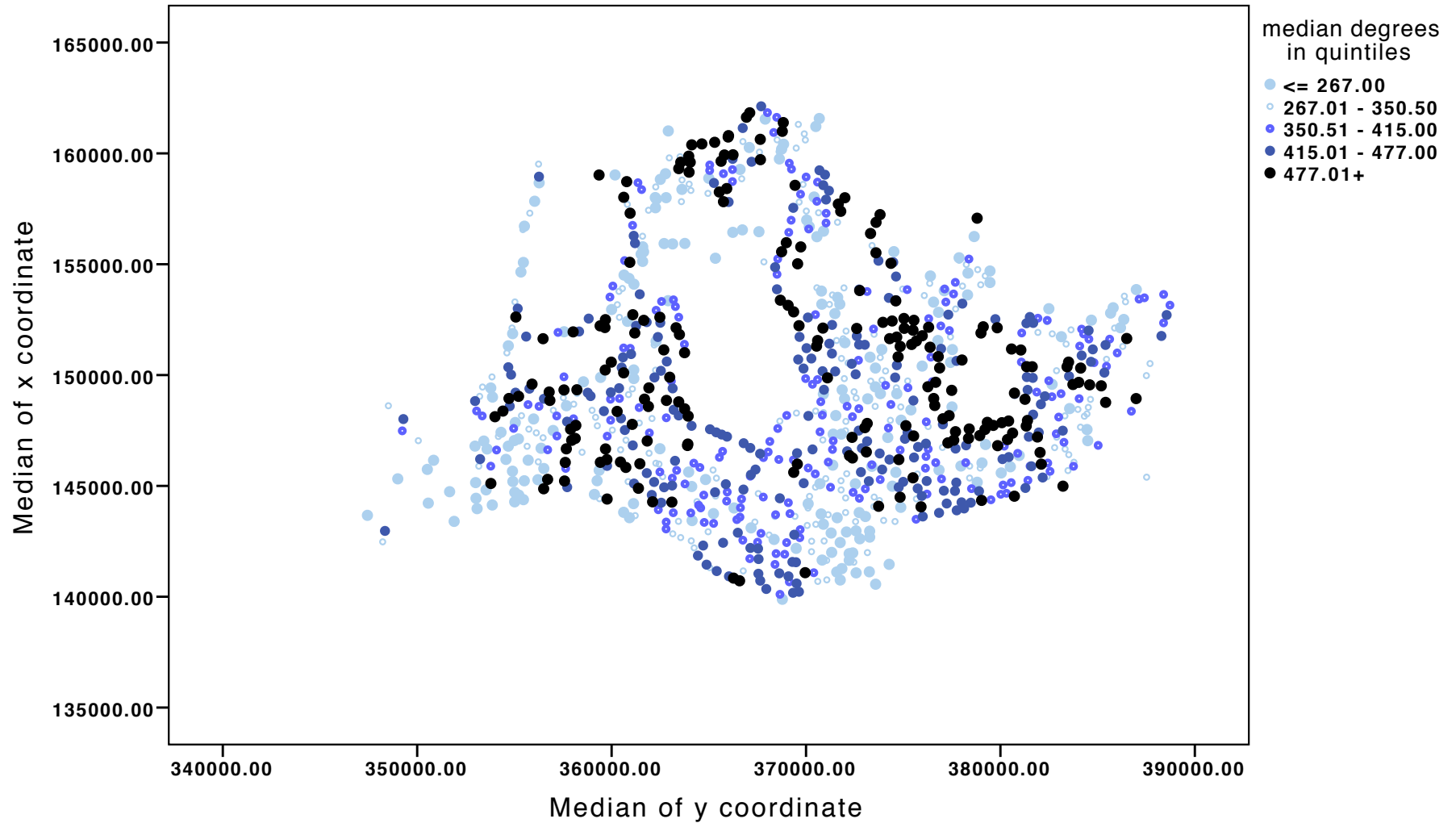


# A small world network in Singapore's busses

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- 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

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# Integration and future work

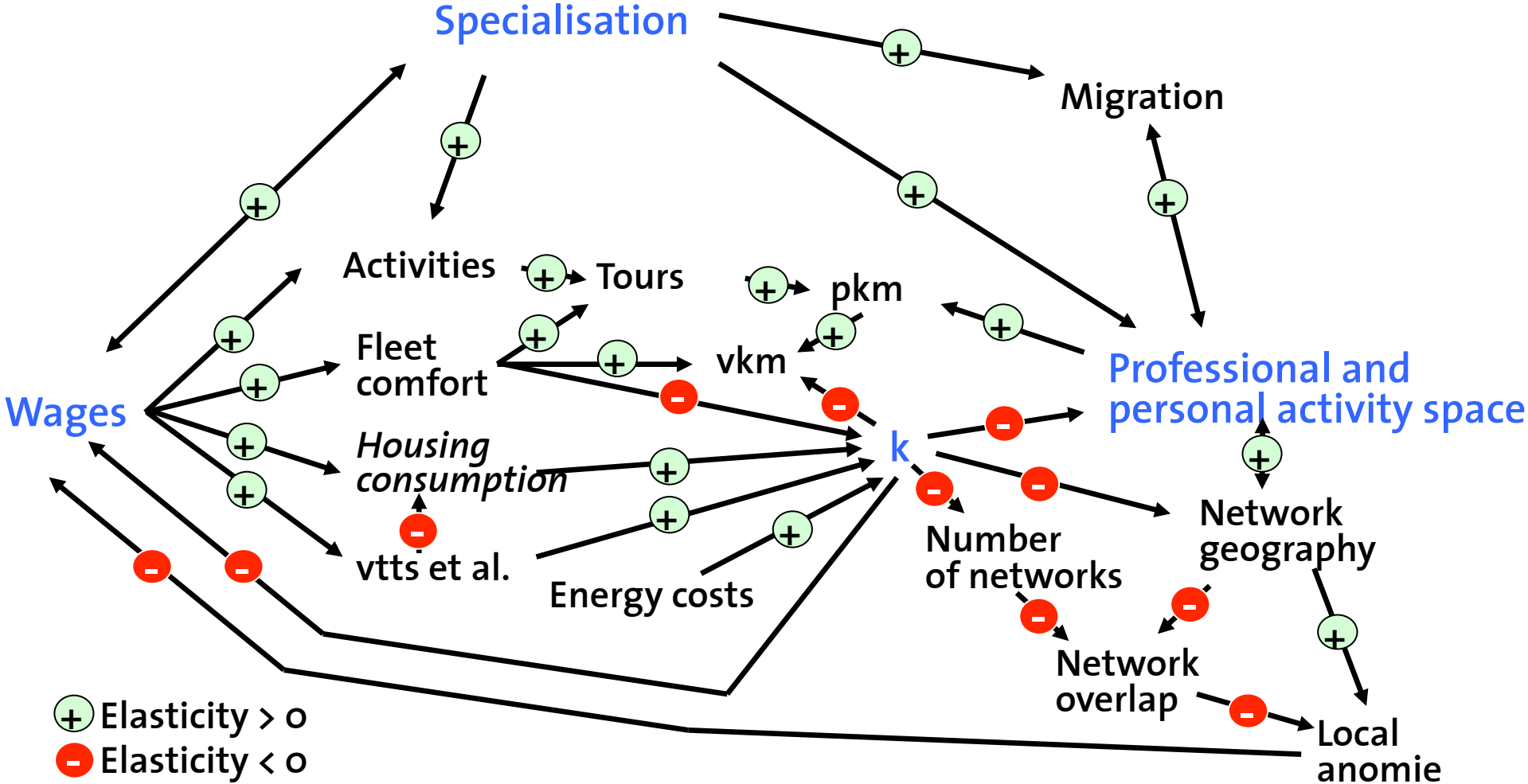
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- Generation of artificial social networks (Arentze et al., 2012) (degree, clustering, distances)
- Repeat of Switzerland Snowball
- Measurement of network size (leisure, work, civic engagement)
- Measurement of network dynamics (Timmerman's ERC project, Carrasco's Concepcion survey)
- Measurement of anomie, trust and social network geography
- Integration of network choice/decision making model (Dubernet)

# Integration, again

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# Some hypotheses for travel behaviour and more





## Questions ?

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[www.ivt.ethz.ch](http://www.ivt.ethz.ch)

[www.matsim.org](http://www.matsim.org)

[www.futurecities.ethz.ch](http://www.futurecities.ethz.ch)

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