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A population's leisure network: Descriptive statistics and a model-based analysis of leisure-contact selection

M. Kowald (ETH Zürich)
T. Arentze (Eindhoven University of Technology)
K.W. Axhausen (ETH Zürich)

IVT
ETH
Zurich

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Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Motivation

- Leisure is an important travel segment

- It is different from other forms of travel and more strongly influenced by external factors

- A consideration of a person's social contacts adds explanatory power when approaching and explaining leisure travel patterns

  →   Include social contacts' influence in agent based simulations

Friendship selection model

Utility $\quad U_{ij} = V_{ij} + \varepsilon_{ij}$ $\qquad\qquad\qquad$ *f*(Distance, attribute similarity)

Thresholds $\quad v_i, v_j$ $\qquad\qquad\qquad\qquad$ *f*(Costs, odds of meeting)

Probability $\quad p_{ij} = \Pr(U_{ij} > v_i \wedge U_{ij} > v_j)$

Model $\quad p_{ij} = \dfrac{\exp(V_{ij})}{\exp[\max(v_i, v_j)] + \exp(V_{ij})}$

Approach to generate a population-wide network

1. Estimate the friendship selection model
   - Observed personal networks of a sample of individuals provide positive observations
   - A sample from the national population provide negative observations
   - Use maximum likelihood estimation

2. Simulate encounters between persons on a national scale and use the friendship selection model

   - The common friend factor is taken into account by using a two-step process
   - The network generation procedure can be used in large-scale agent-based travel simulation

Data collection: Ego-centric networks
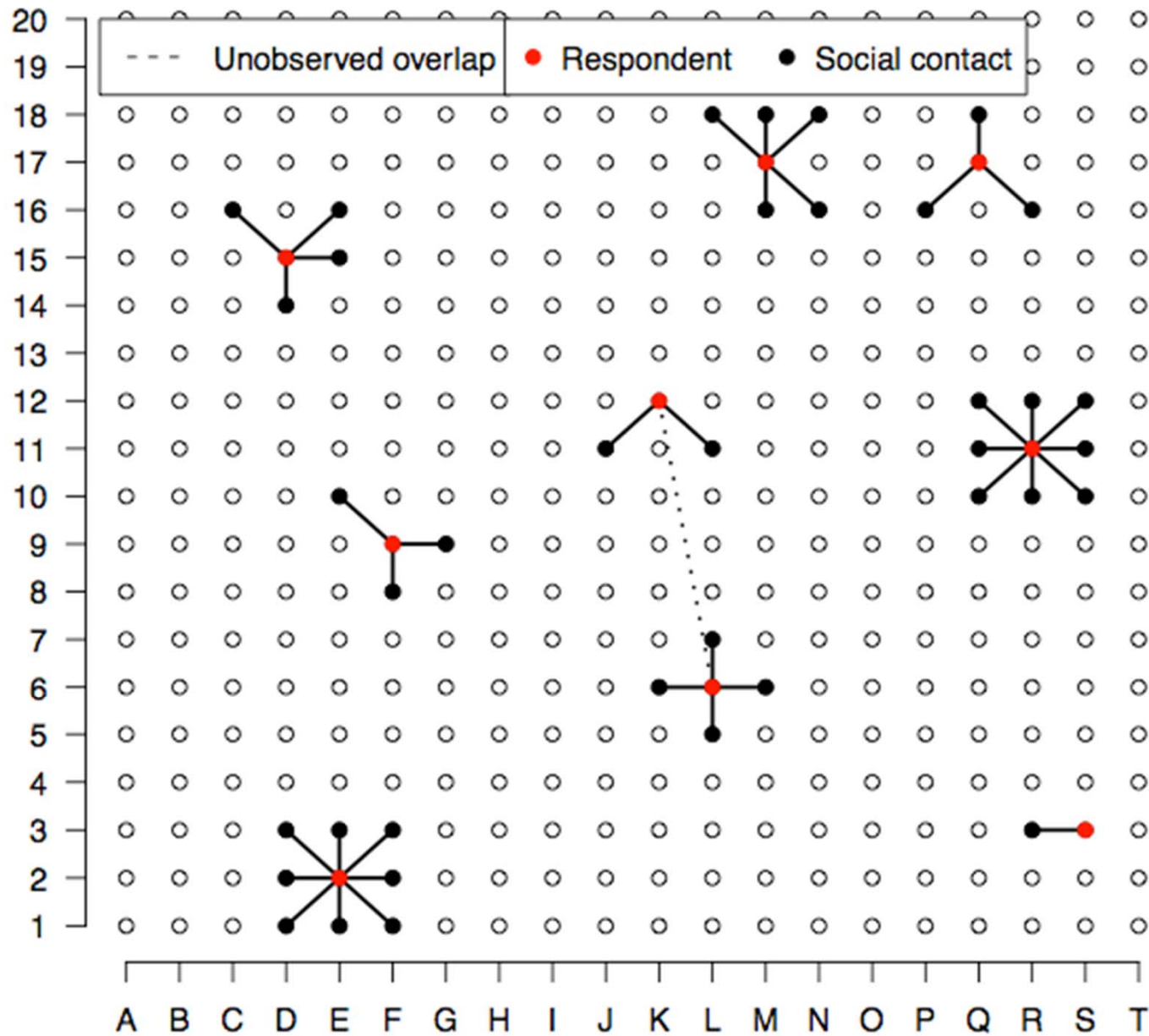
Data collection: A population-wide network
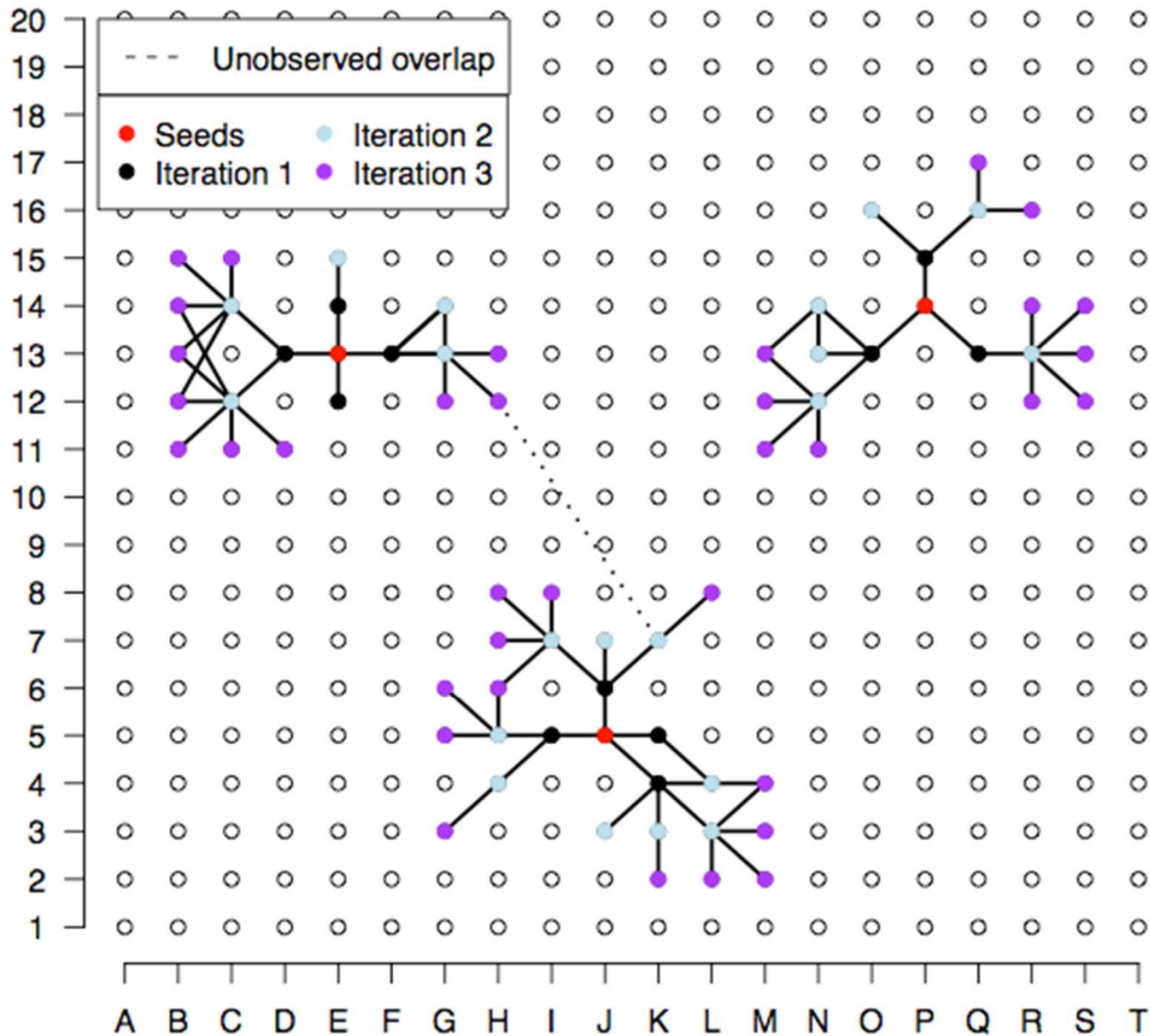
Data collection: A snowball sample in Switzerland

	n	Ratio of same...		Distance...	
		...age	...sex	...mean	...std.dev.
Ego-Alter	6546	0.526	0.659	20.240	4.327
Alter-Alter	2887	0.426	0.565	22.991	9.912
All	9433	0.495	0.631	21.082	13.437

Population sample data: national Swiss travel survey

- Data: Swiss Micro-census on Mobility and Transport (MZMV), 2005

- Large survey population (33'390 respondents from 31'950 households), weighted to represent the Swiss population

→ Draw random sample of 100 persons for each ego to add negative observations

Estimation sample

Similarity of actors' characteristics [%]	Tie present	Tie absent
Same sex	65.9	49.8
Same civil status	66.5	46.7
Same language	98.2	74.4
Same age	52.5	18.0
Age difference of one category	30.4	32.5
Age difference of two categories	14.3	27.2
Age difference of three categories	2.12	15.4
Age difference of four categories	0.8	6.8
Same educational level	56.8	41.3
Educational difference of one category	40.3	50.1
Educational difference of two categories	2.89	8.7
Same status of home municipality	57.6	34.9

Tie selection: A utility based decision model (MMNL)

Parameter	Estimate	t-value
Alternative: No relation		
Threshold	2.02	8.36
Alternative: Relation		
Effects from Homo- or Heterophily		
Same sex	1.150	23.05
Same age	2.270	30.29
Age difference of two levels	-0.342	-5.63
Age difference of three levels	-0.953	-8.66
Age difference of four levels	-0.539	-3.02
Same educational level	0.861	6.77
Educational difference of one level	1.300	10.07
Same level of civil status	0.341	8.40
Same size of home municipality	0.696	12.75

Tie selection: A utility based decision model (MMNL)

Parameter	Estimate	t-value
Alternative: Relation		
At least one actor is...		
...of age level 1 (< 23 years)	0.820	4.58
...of age level 3 (37 - 49 years)	1.320	8.15
...of age level 4 (50 - 64 years)	1.570	19.87
...of age level 5 (> 65 years)	1.190	6.64
...of educational level 1 (mandatory school)	-2.000	-18.20
...of educational level 2 (apprenticeship)	-0.770	-4.68
...a female	1.530	17.52
...of urban level 2 (town)	0.906	13.97
...of urban level 3 (rural municipality)	1.300	12.04

Tie selection: A utility based decision model (MMNL)

Parameter	Estimate	t-value
Alternative: Relation		
Interaction effects with distance		
Age level 3 * distance [log(KM)]	-0.516	-5.81
Age level 5 * distance [log(KM)]	1.090	11.92
Educational level 2 * distance [log(KM)]	-0.783	-7.94
Interaction effects between dummies		
Age level 1 * educational level 2	-0.961	-5.30
Age level 3 * educational level 1	0.831	6.42
Age level 3 * educational level 2	0.783	7.50
Age level 5 * educational level 2	-0.626	-5.67
Age level 5 * female	-1.040	-9.47
Urban level 3 * education level 2	-0.322	-2.91

Tie selection: A utility based decision model (MMNL)

Parameter	Estimate	t-value
Alternative: Relation		
Random effects		
Distance [log(KM)]	-3.720	-32.45
Distance std. dev [log(KM)]	-0.917	-26.50
Adjusted Rho^2	0.724	
N	50'167	

Conclusions and outlook

1. Employing a sample on overlapping personal leisure networks and a nationally representative sample to add non-chosen ties between actors resulted in a choice set of leisure relationships

2. Utility based decision models on the presence or absence of leisure relations showed major influences for spatial distance and combinations of personal characteristics

3. Model results can be used for an implementation in agent based (travel demand) simulations which allows a consideration of effects from a population-wide (leisure) network

4. Both, encounter simulation and data analysis can be extended with further personal characteristics and variables for the time dynamics of relationships