2016 Japan-America Frontiers of Engineering Symposium

Connection between Social Networks, the Built Environment, and Travel Behavior in the ICT Era

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What I will be talking about

- Changing paradigms in urban planning
- **The built environment effect on travel behavior**
- Changing lifestyle and activity patterns
- **Social networks and travel**

Comfort

Freedom

Mobility

Access

Status

Air pollution

Climate change

Privilege

Social [in]equality

Declining city centers

The built environment effect

Climate change

Car dependency

Privilege

Air pollution

Declining city centers

Social [in]equality

Paradigm shift in the conceptualization of what constitutes good urban development: **New Urbanism, Smart Growth, Compact cities.**

From auto-centered to human-centered

Research efforts put in establishing a **causal relationship between the built environment and travel behavior.**

Does this causal effect exist?

Urban sprawl in Las Vegas, Nevada

Downtown Portland, Oregon

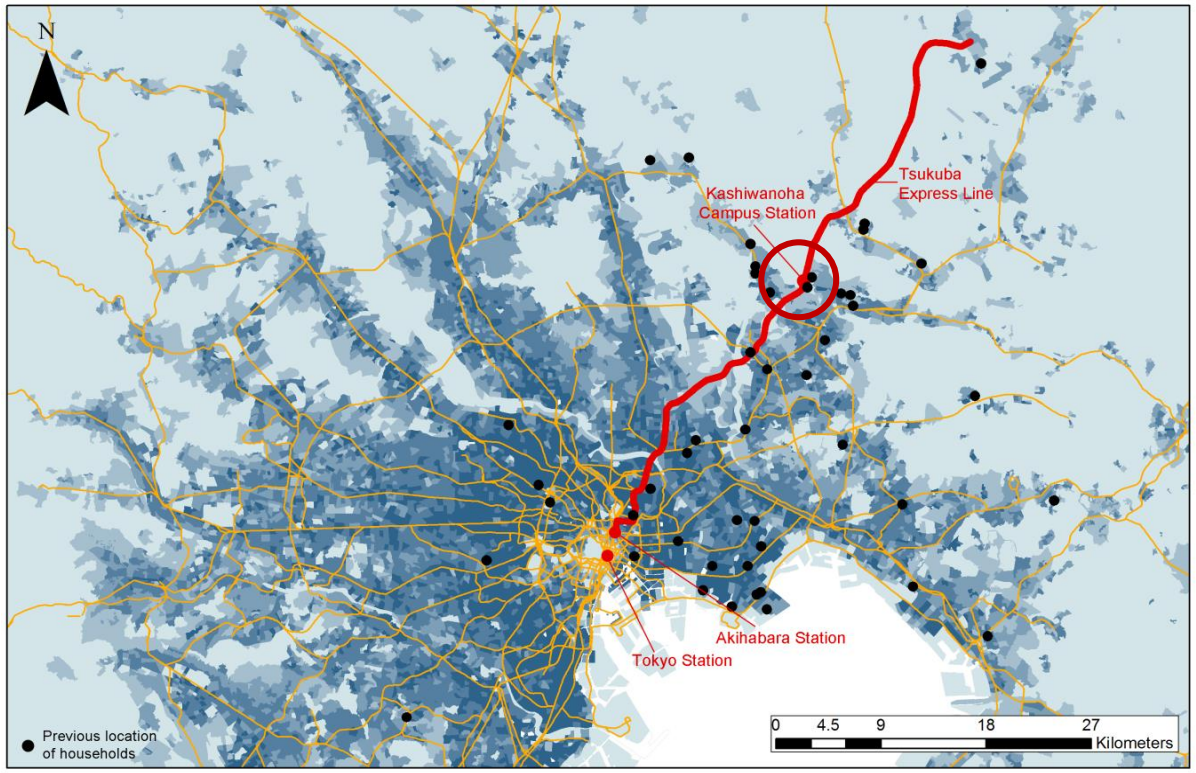
The built environment effect:

Some evidence from Japan (I)

Panel data study on new movers to *"Kashiwa no Ha"* Japan.

Observed changes

Activity frequency nearby	21% ↑
Activity frequency faraway	20% ↓
Activities by car	41% ↓
Activities by transit	6% ↓
Activities by non-motorized modes	39% ↑



Sample distribution of Kashiwa no ha case study

August 2007 (Before moving)	December 2007 (Before moving)	Autumn 2008 (After moving)
Individual travel behavior and lifestyle before moving.	Intention of future travel behavior after moving.	Individual travel behavior and lifestyle after moving.
t_0		t_1

Fixed-effect model of activity frequency

Time varying HH characteristics; Time varying BE characteristics

$$Y_{it} - \bar{Y}_i = \beta(X_{it} - \bar{X}_i) + \gamma(Z_{it} - \bar{Z}_i) + \varepsilon_{it} - \bar{\varepsilon}_i$$

HH: Households; BE: Built Environment

Factors associated with behavioral change

- Δ Distance to nearest rail station
- Δ Number of shopping facilities nearby
- Δ Distance to nearest shopping facilities (Groceries, retail)
- Δ car ownership

Troncoso Parady, G., Chikaraishi, M., Takami, K., Harata, N. (2014)

The built environment effect:

Some evidence from Japan (II)

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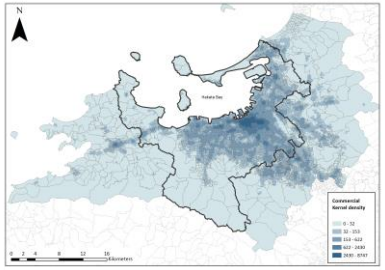
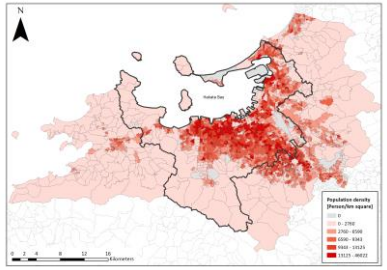
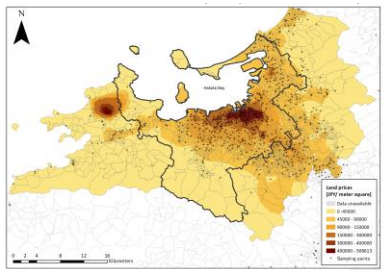
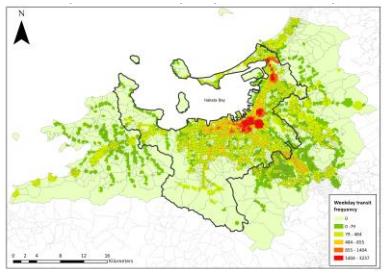
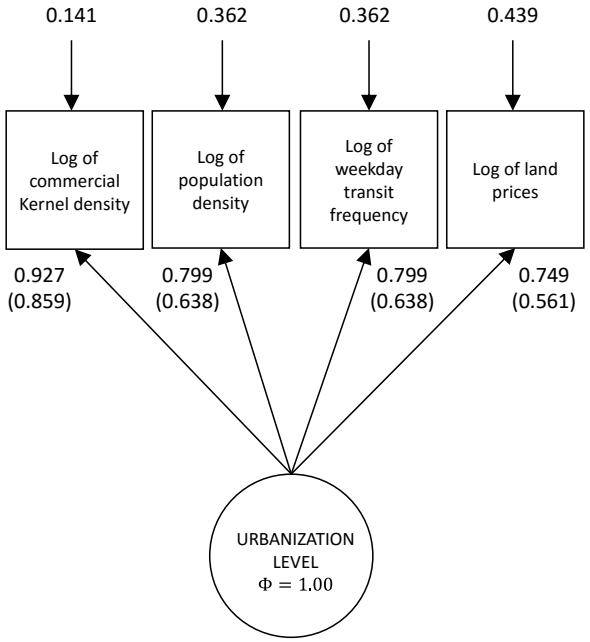
Who lives where? Estimating the propensity to live in urbanized areas


Commercial Kernel density

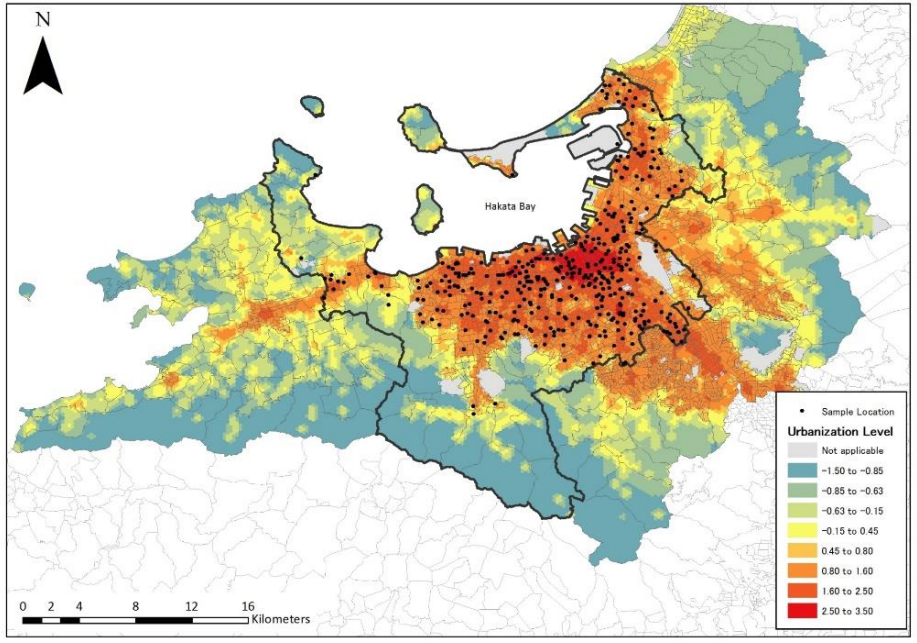

Population density


Land price


Weekday transit frequency



Urbanization level CFA path diagram



Urbanization level index map of Fukuoka City

Factors associated with propensity To live in more urbanized areas

- Life stage (and life events)
- Life style preferences
- Residential environment attitudes & preferences
  - *"Urbanites", "Surburbanites"*
- Mobility tools attitudes & preferences
  - *"Car lovers", "Pro alternative modes"*
  - *Car use habit*
- *Mobility history*

Estimation of urbanization effects on travel behavior via propensity score.

Model		5 Strata Propensity Score model
Car-based activity frequency model(log)	β	-0.217
	t-Stat	-5.110
NMM –based activity frequency model (log)	β	0.177
	t-Stat	3.025

*Maintenance activity frequency

Troncoso Parady, G., Takami, K., Harata N. (2014,2016)

The built environment effect

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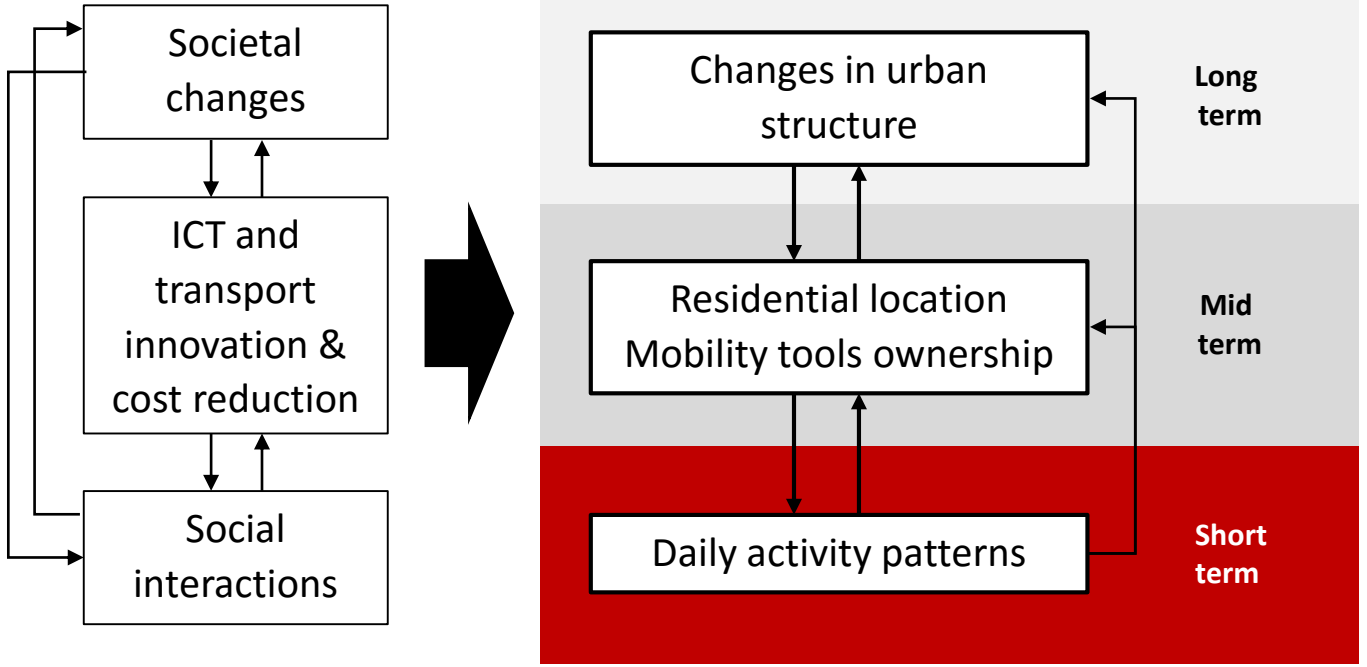
Evidence seems to supports the arguments of compact city policy advocates that mixed-use high densities are conducive to less car dependency and more non-motorized travel, even after controlling for attitudes and preferences.

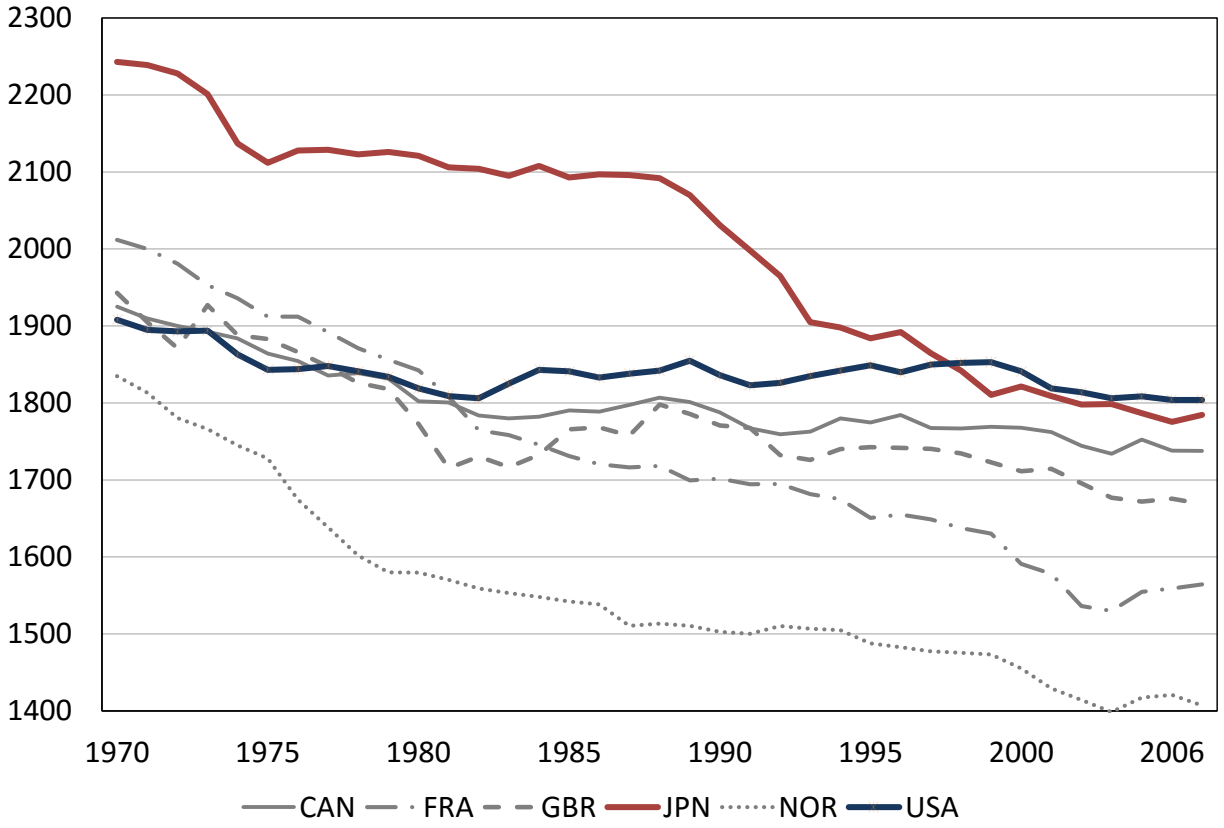
- **Can we realize "Compact Cities"?**
- **Do we have the tools to model these changes in behavior?**



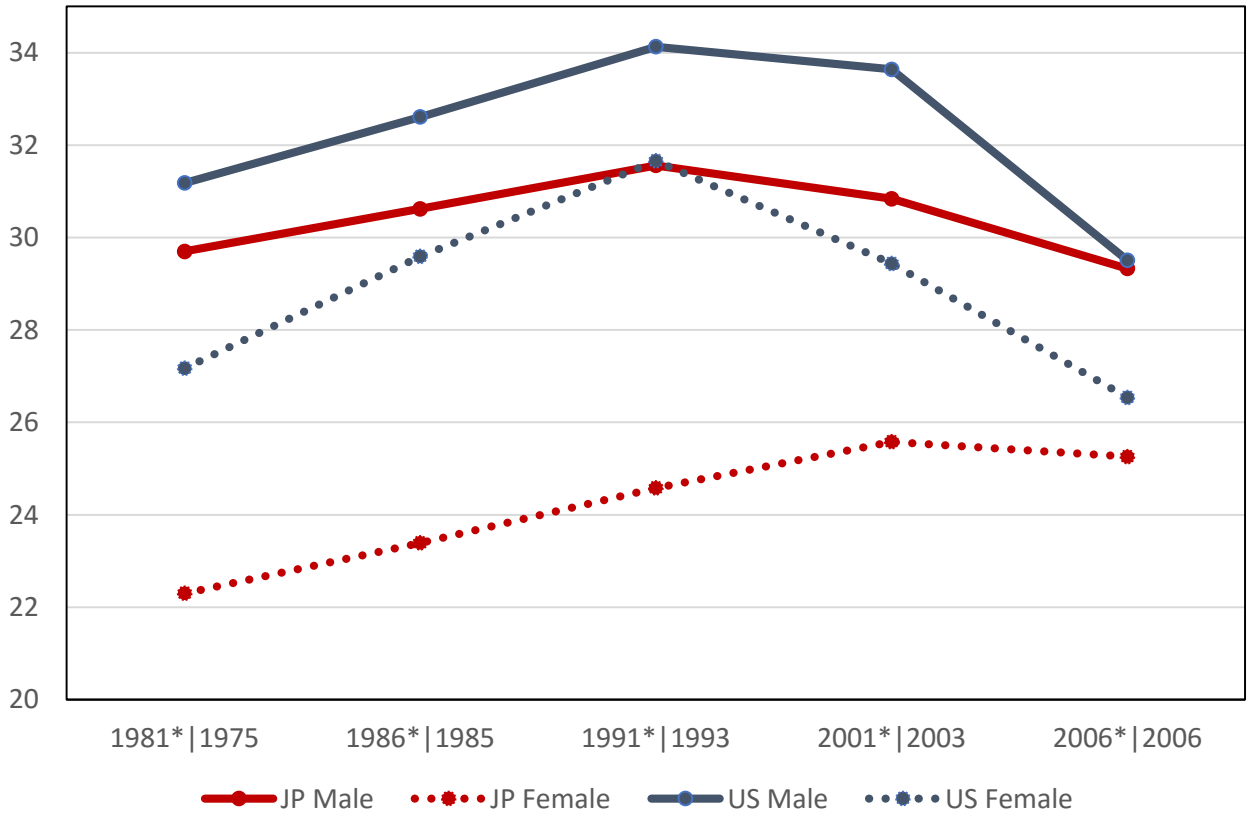
Adapted from Ben-akiva and Bowman (1998)

Some relevant societal changes

Changes in use of time



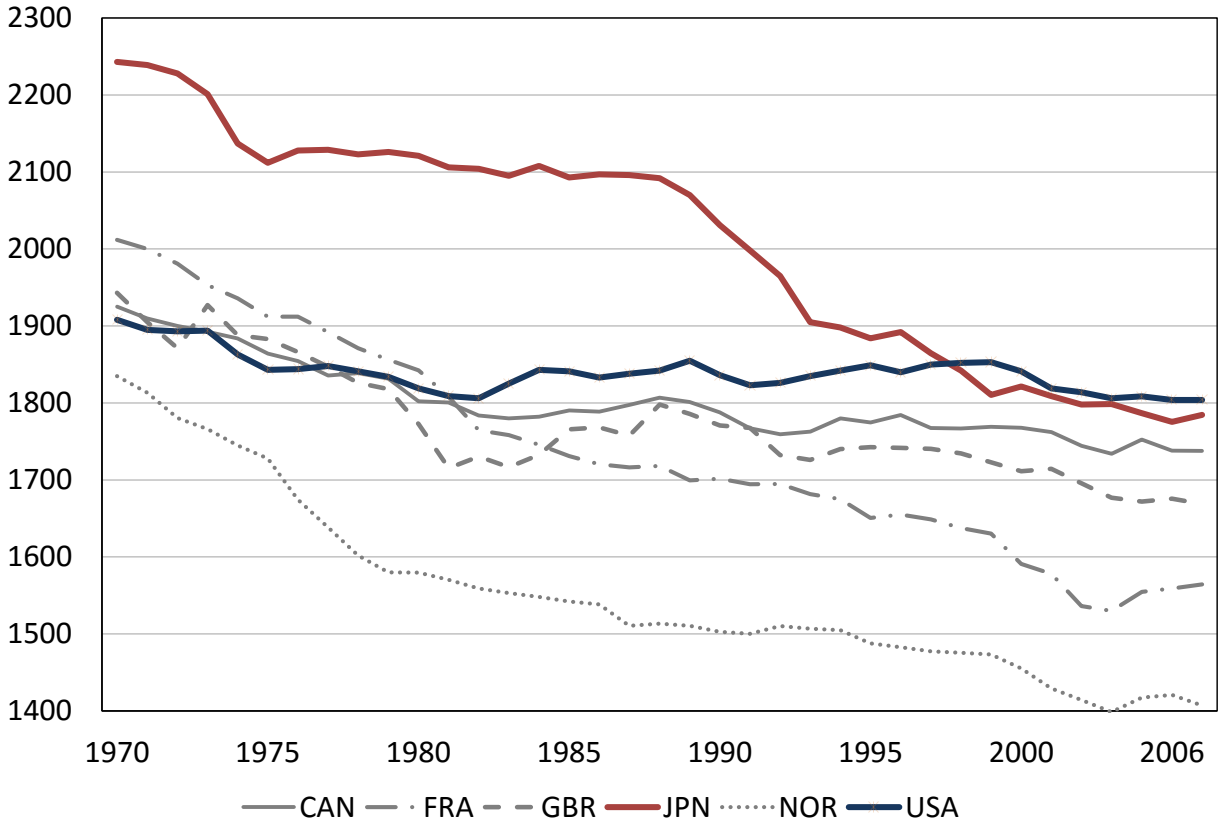
Trends in annual hours worked by total employed population
Adapted from OECD Social Indicators (2009)



Trends in weekly leisure time allocation (hours)
(full-time employee; demography fixed)
Adapted from Kuroda (2010)

Some relevant societal changes

Changes in use of time



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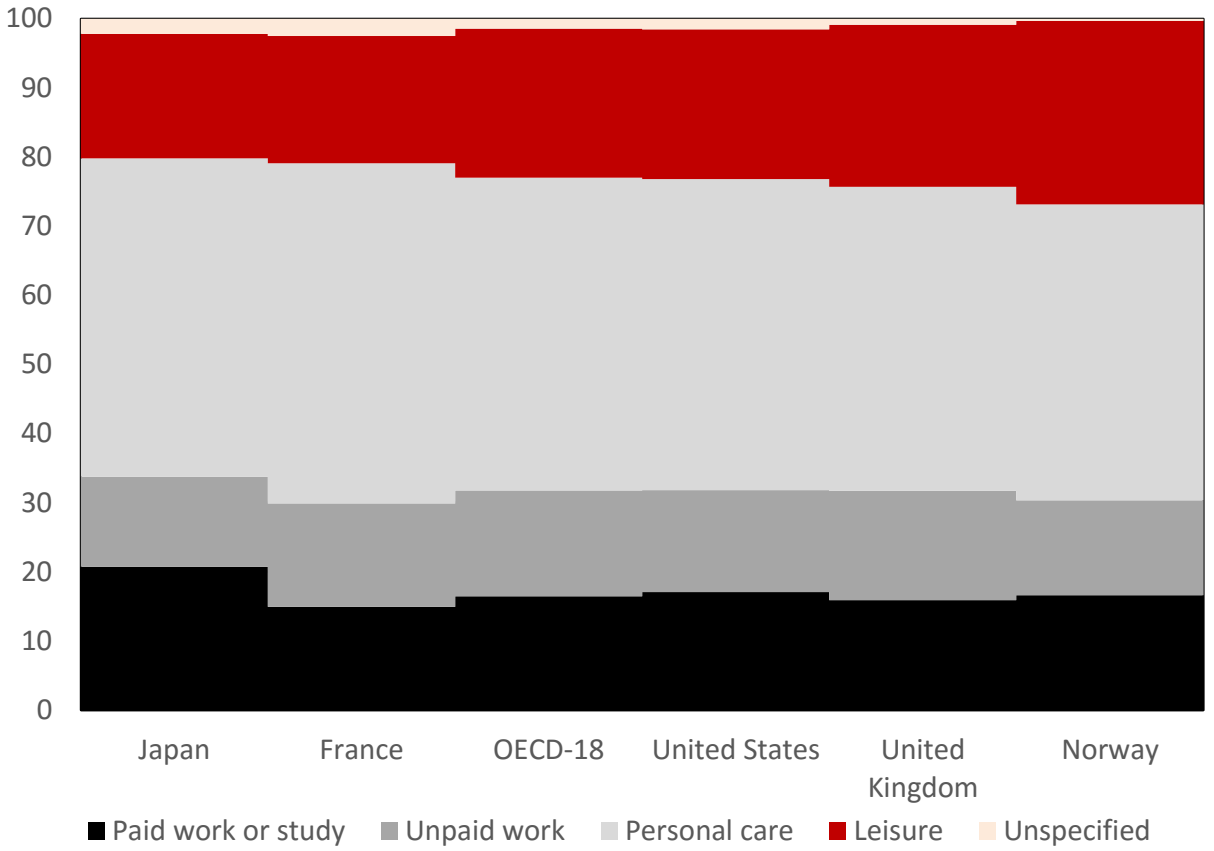


Share of time taken by leisure and other activities across an average day
Adapted from OECD Social Indicators (2009)

Some relevant societal changes

Changes in lifestyle patterns

End of the lifetime employment system

Changes in working patterns

Not in Education Employment or Training (NEET)

Freeters (Free+Arbiter)

“Parasite singles”

車離れ

“Kuruma-banare”

(Letting go of the car)

関係優先志向

“Kankei Yūsen shikō”

(Relationship prioritization)

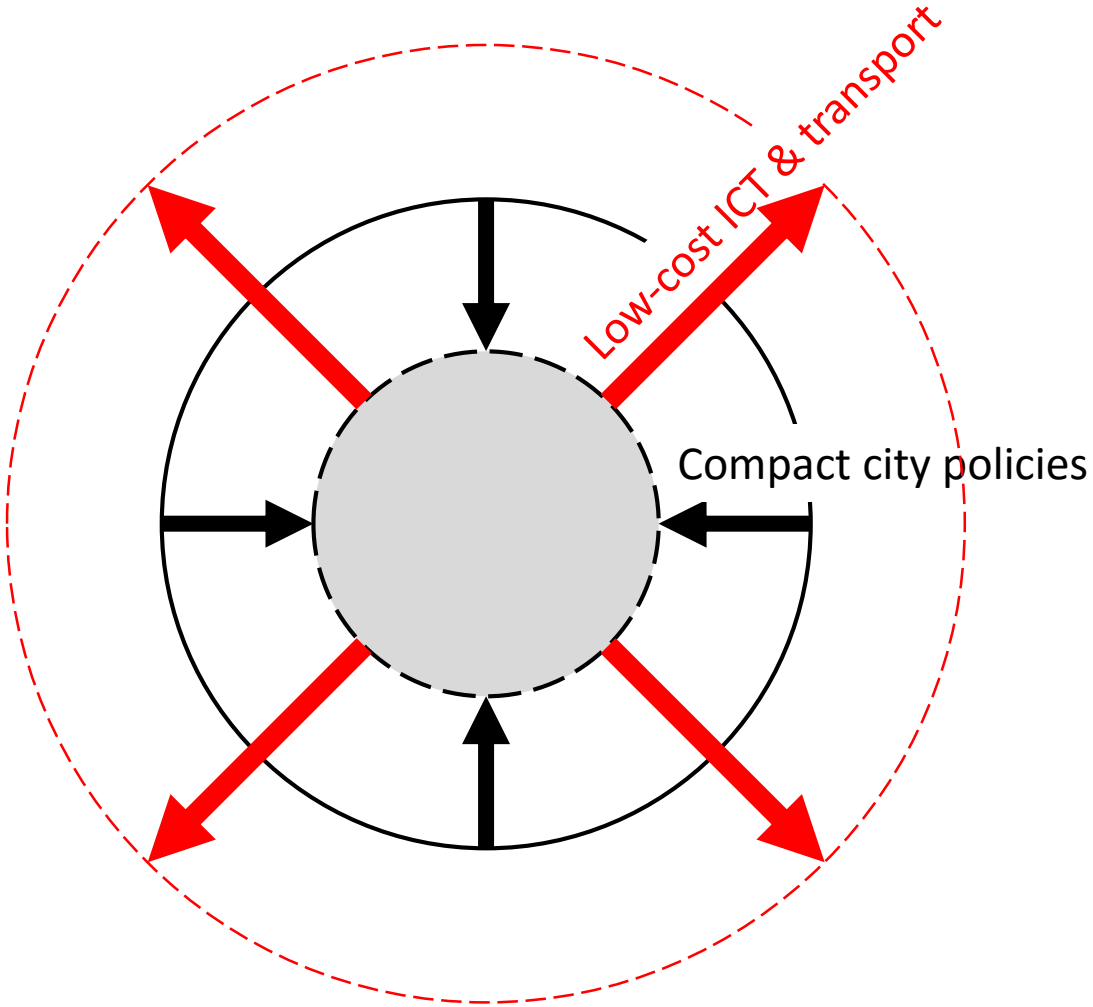
文化の島宇宙化

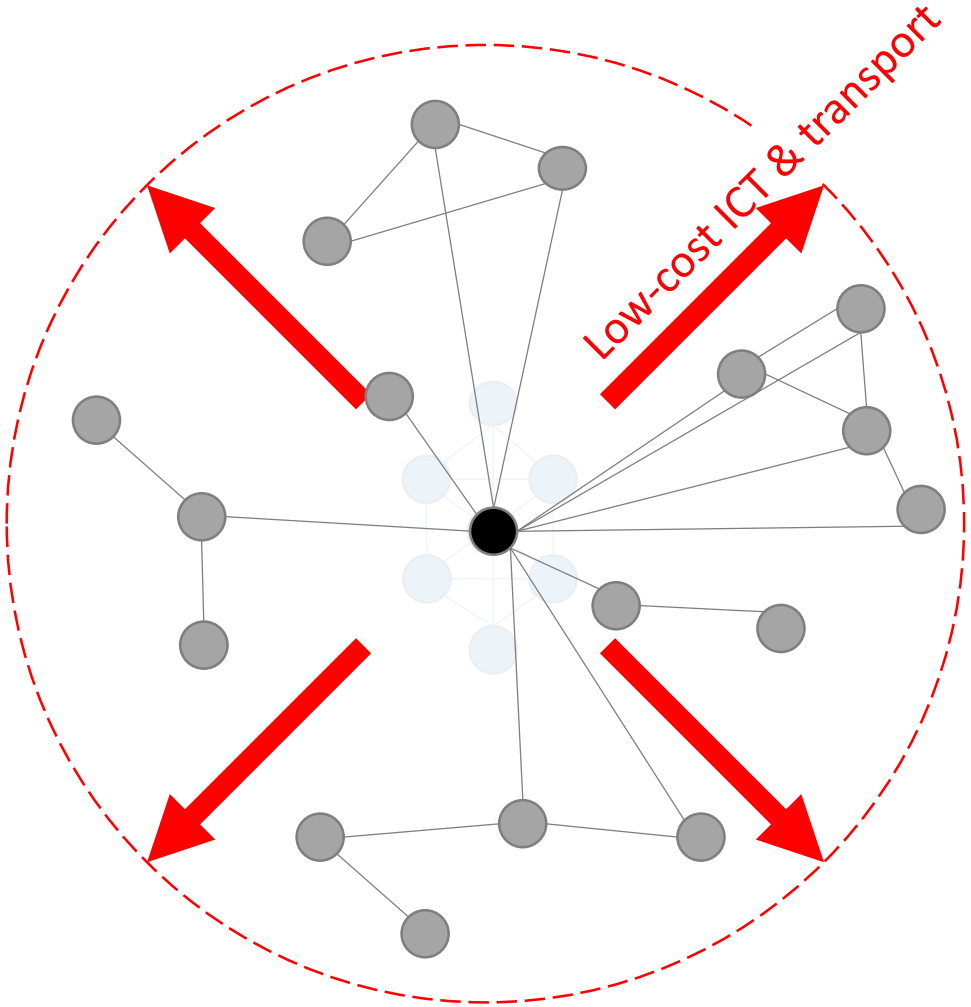
“Bunka no Shima Uchūka”

(Cultural isolation)

Some relevant societal changes

Low-cost ICT and transport

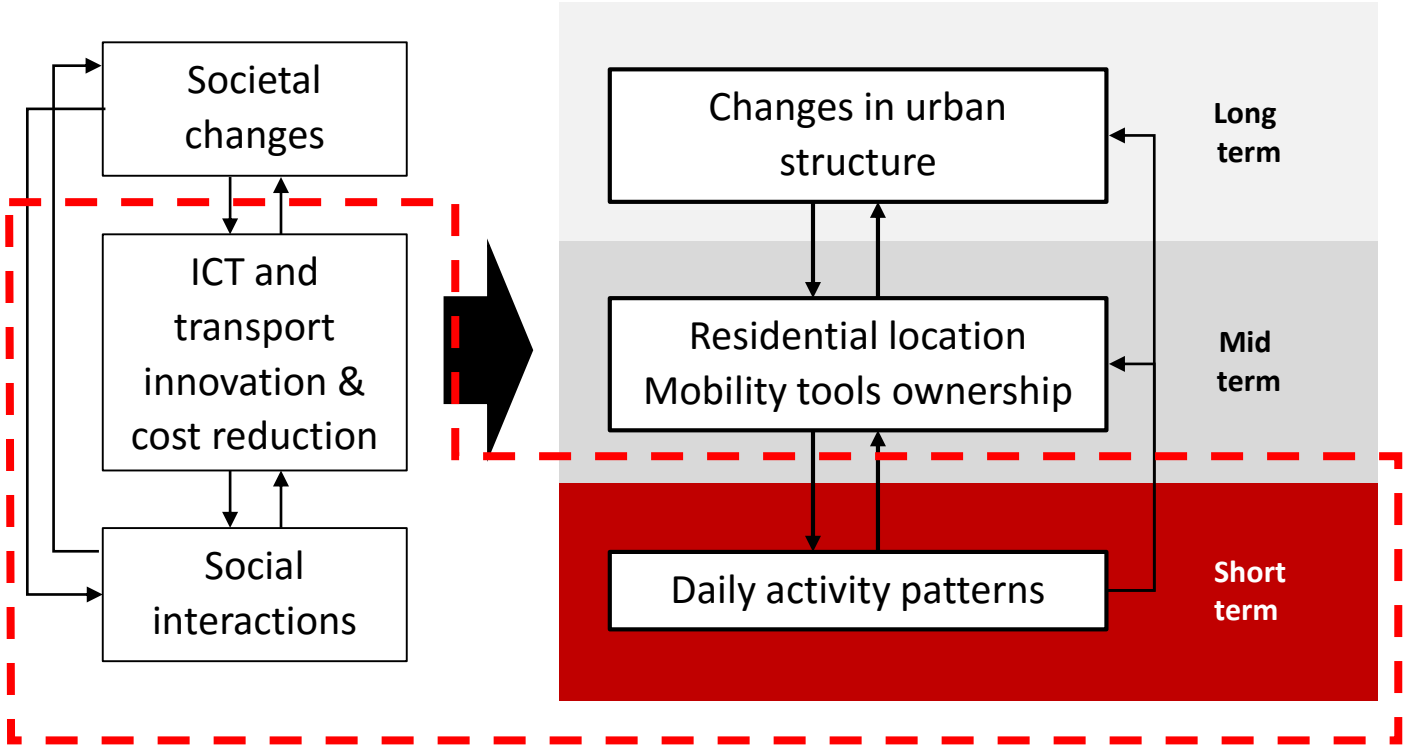




Social networks and travel

- Decreasing working hours, increasing productivity & discretionary time budgets
- Low cost ICT and transportation means we are more connected than ever!
- Changes in lifestyles and activity patterns

- Contemporary activity patterns **much more complex than the "average 1950's household"** the traditional transportation models were based on.



Social networks and travel

Why is this important?

Meet Bob, architect, 31 years old, living with his girlfriend
A Ph.D. candidate. US$75,000 yearly income,

For some reason, close to his girlfriend's relatives
Not so much to his own relatives though

Knows a few folks at the office, not to many though, casual drinks,
City boy, not to close to his neighbors, but says hello when passing,

Likes walking, not really into cars, Likes living downtown,

Closest friends are (now) from his Cross-Fit class,
Always posting on Facebook about it, always!

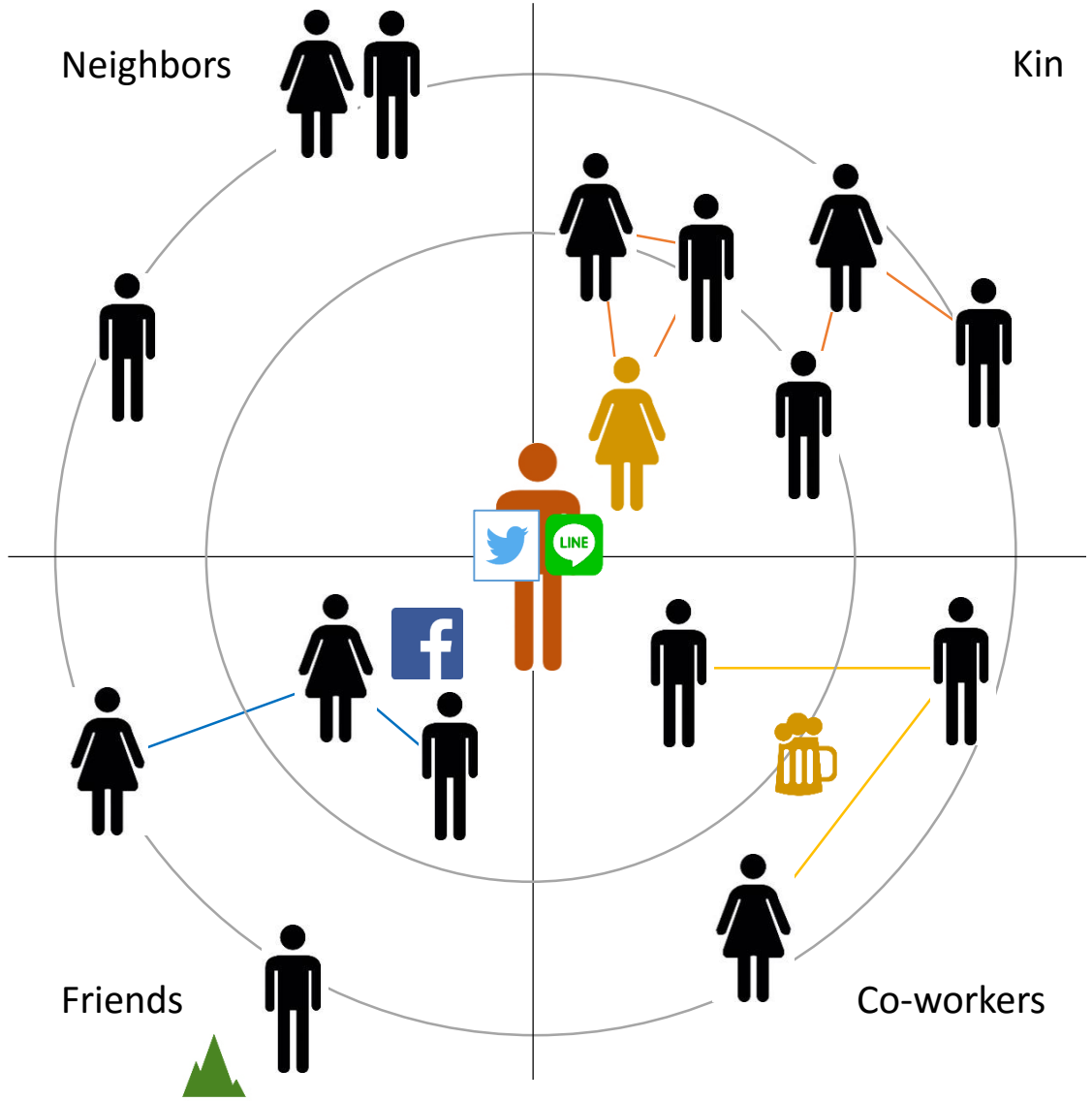
Likes the occasional get-away to the mountains,

Usually goes with an old friend from school,

Used to be really close, now are a bit distanced,

Heavy twitter and line user, hates phone calls

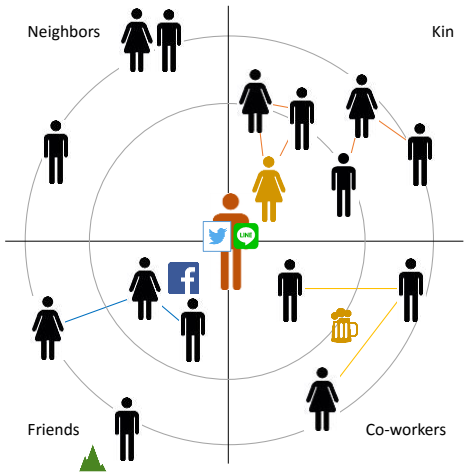
The list goes on….



Bob's ego-centric social network (based on Wellman 2011)

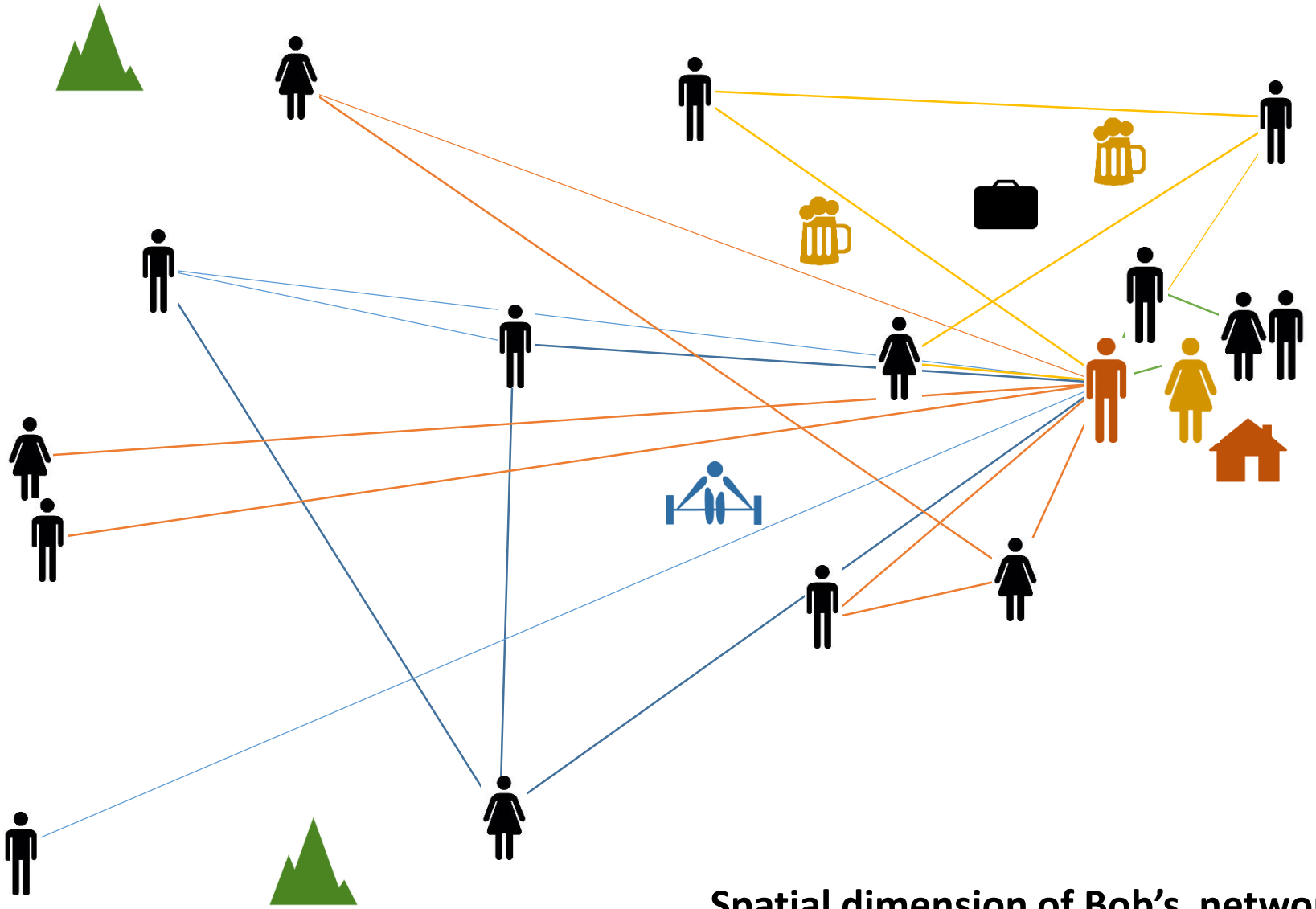
Social networks and travel

Why is this important?



Traditional travel behavior models are full of “questionable assumptions”

- *Traditional households (papa, mama, kid, single worker, city center employment, etc.)*
- *Independent decision making*
- *Focused modeling commuting trips*



Spatial dimension of Bob’s network

Social networks and travel

What do we seek to answer?

- General characteristics of social networks
- The role of ICT on social interactions
  - Mode substitution effects given ego-alter distances?
  - Is ICT a substitute or a complement of travel?
- The interactions between social networks, ICT and travel behavior?
  - How does my network affect my travel choices? and Vice versa.
  - Particular focus on discretionary and leisure travel
    - *Highly variable*
    - *[Relatively] few spatio-temporal constraints*
    - *Very, very hard to predict*

Social networks and travel

Data & Methods

- **Travel behavior:**
  - Direct questioning (trip/activity frequencies)
  - Travel diary (one day or multiple days)
  - Person-probe data (one day or multiple days)

Information on travel characteristics

- What?
- When?
- Where?
- How?(travel mode)
- **With whom?**

- **Ego-centric social networks:**
  - Name generators
    - *Random sampling, Snowball sampling*

Information on the network

- Network size
- Network density
- Network distribution
- Etc.

Information the network members

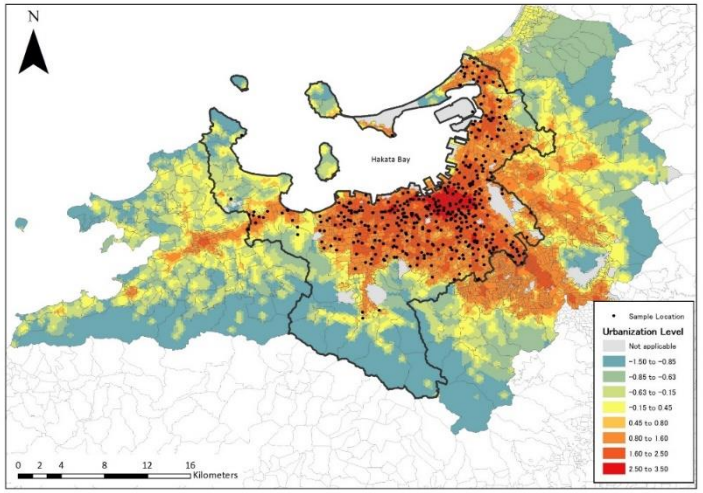
- Tie strength
- Distance from ego
- Contact frequency by mode

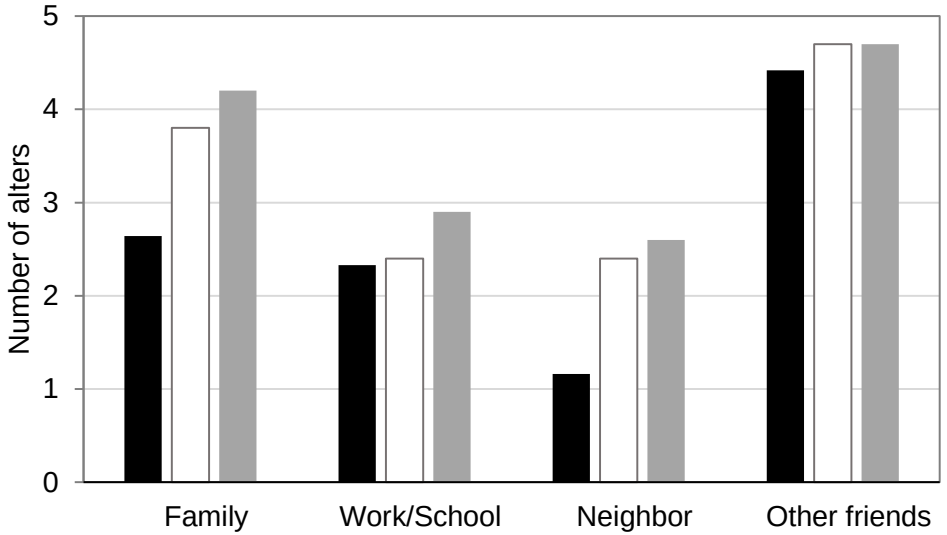
Social networks and travel

A Japanese case study

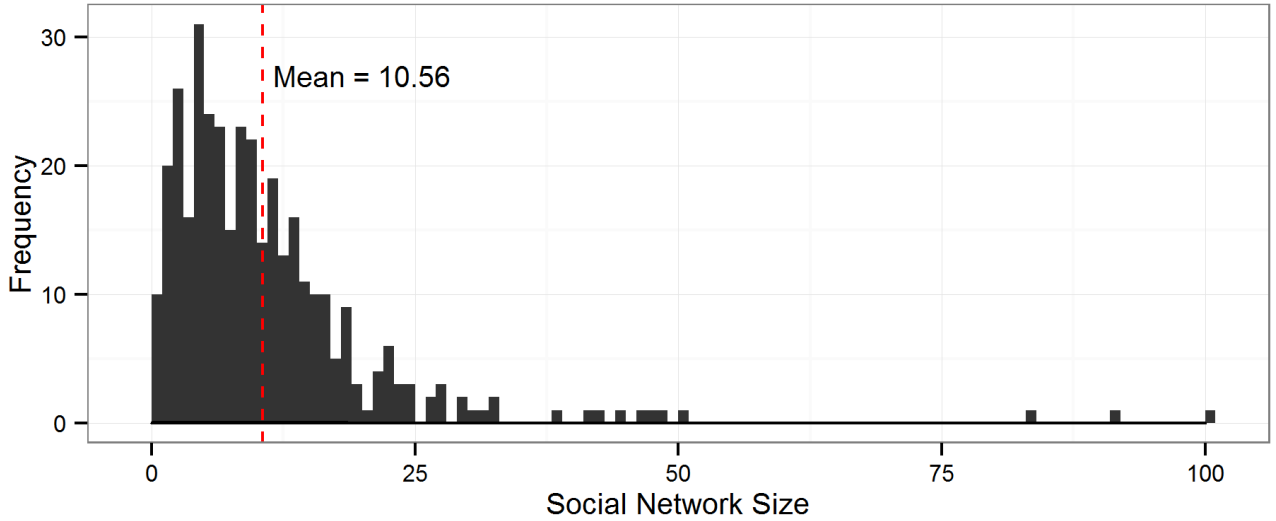
Survey Flow

- Individual and Household
- Personal Network
- Mobility Biography
- Attitudes & Preferences
- Travel Behavior (activity frequency)
- Personality Traits (Big-5)

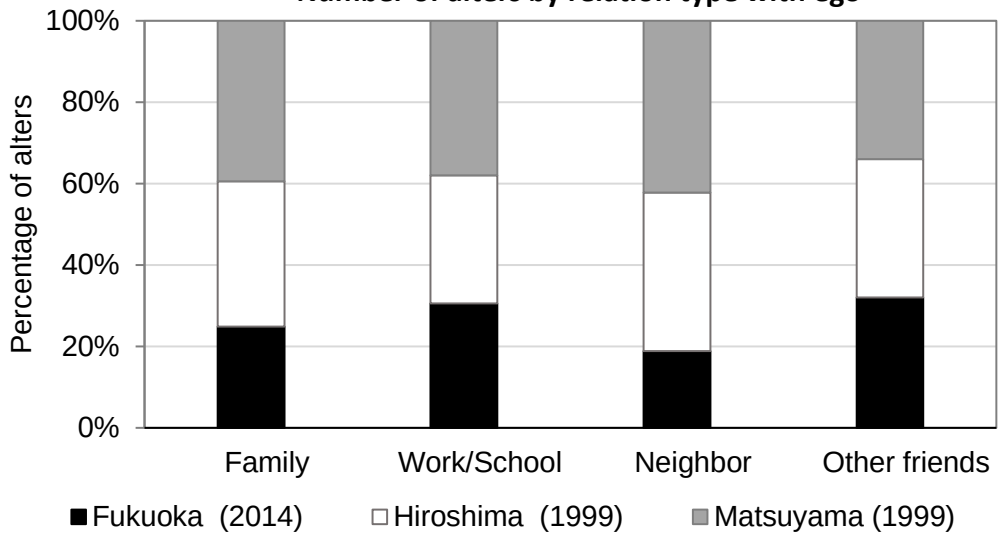




Number of alters by relation type with ego



Social network size histogram (Fukuoka survey)

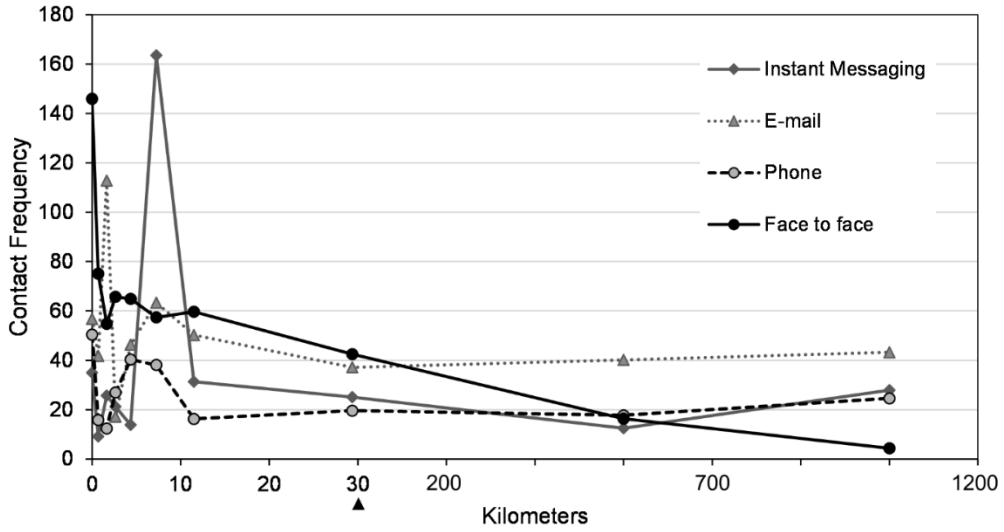


Comparison of percentage of alters by relation type with ego

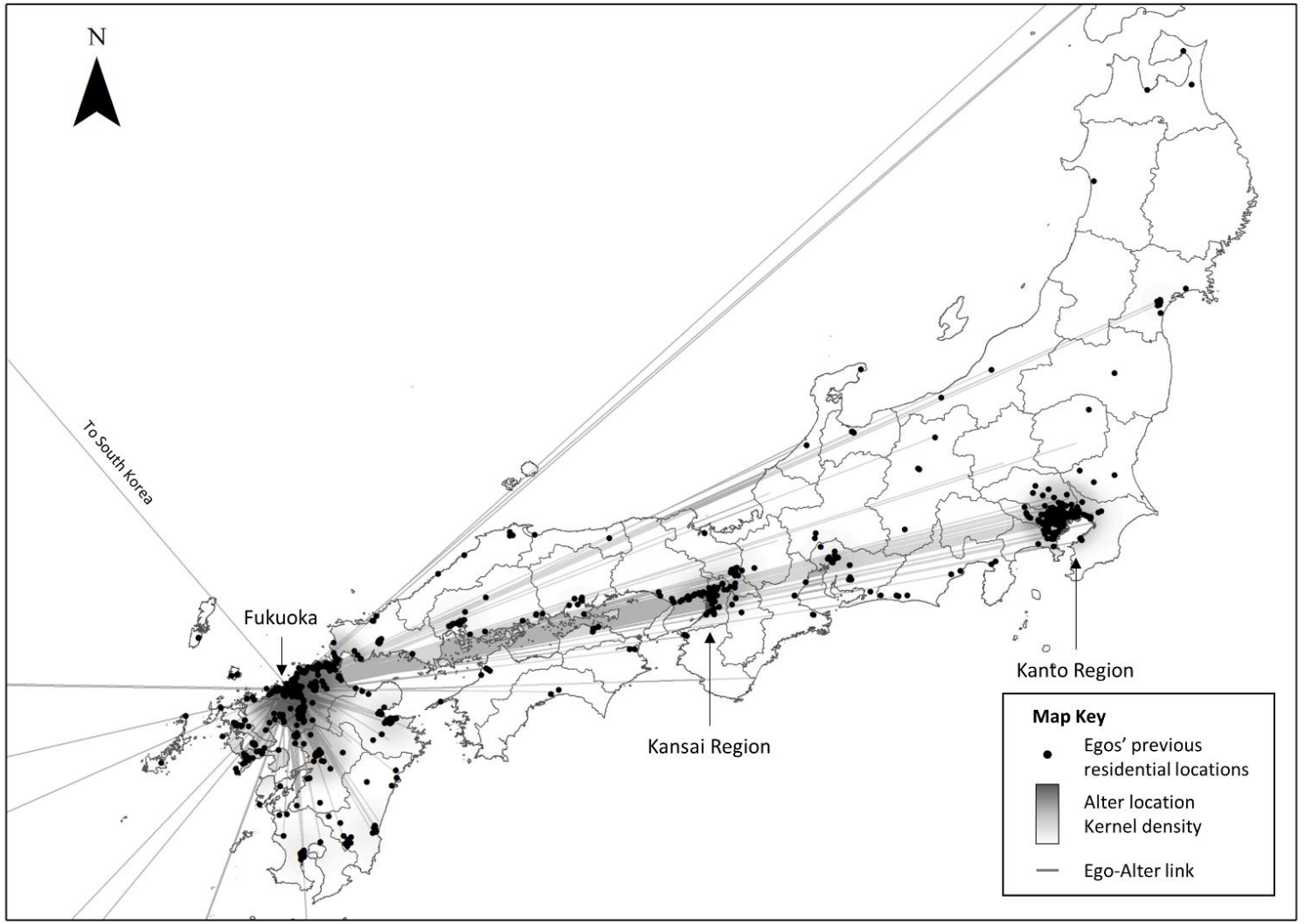
Hiroshima and Matsuyama data source: Otani 1999

Social networks and travel

A Japanese case study



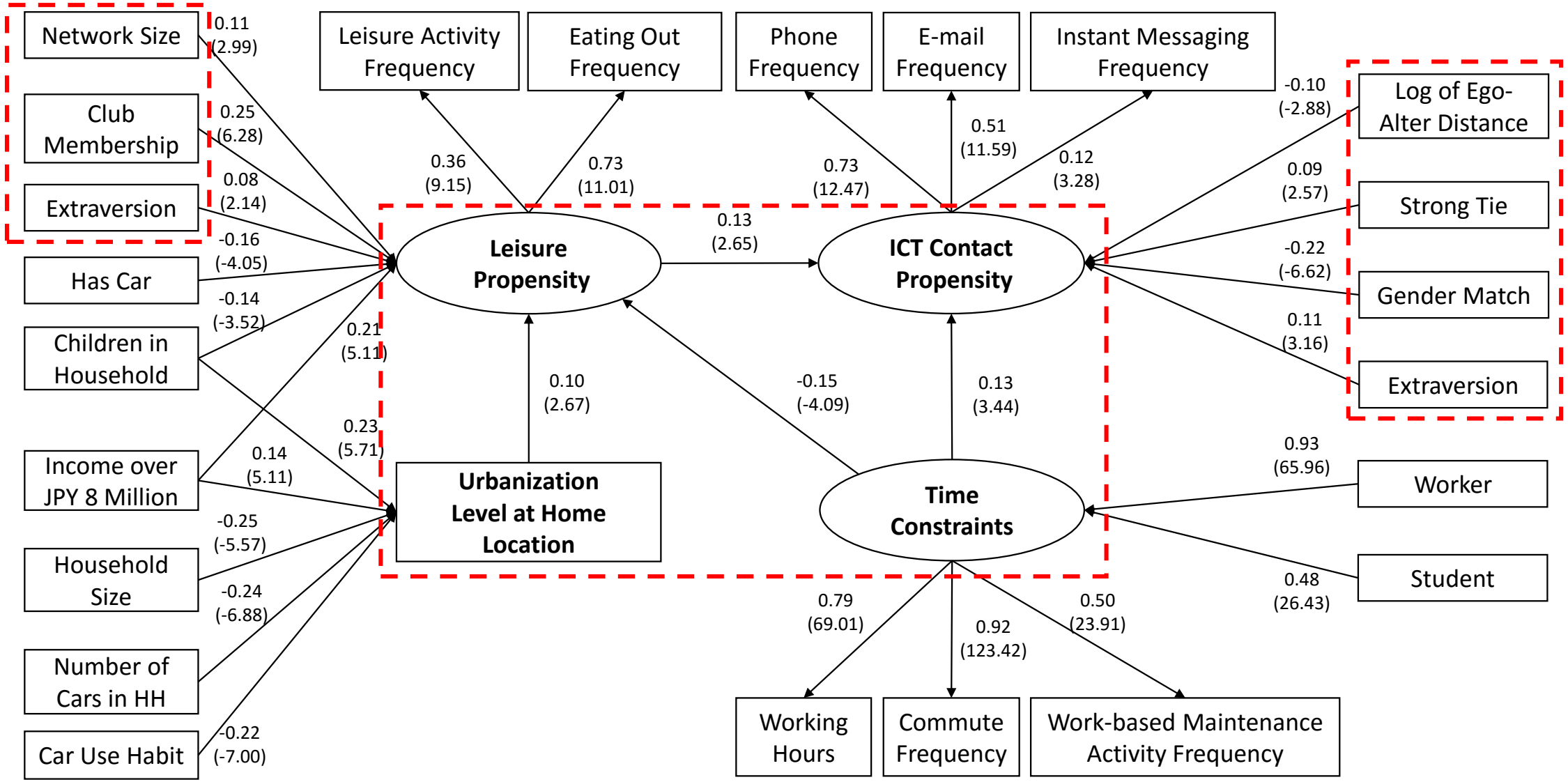
Contact frequency by mode given ego-alter great circle distances (Fukuoka survey)



Spatial distribution of egos' previous residential locations and alters' current locations (Fukuoka survey)

Social networks and travel

A Japanese case study



Goodness of Fit Statistics: Chi square 295.33, d.f. 133(0.00), RMSEA 0.029 C.I. (0.025-0.034) p-value 1.000, SRMR 0.03, CFI 0.96, TLI 0.95

Limitations and challenges
Future developments in the field

- Data collection is very expensive
  - Economically
  - Response burden
- Privacy issues in data collection
- Lack of established theory joining the two fields

- Using SNS data to complement social network data
- Moving beyond descriptive analysis of social networks towards a theoretical model of social networks, interactions and travel behavior decisions (short, mid-term, long-term)
  - The potential of game theory remains largely unexplored

In a nutshell

- Changing paradigms in urban planning. But, can we realize this new paradigms?
- To be able to answer that question, need to look in to societal and technological changes to better understand long term, mid term and short term decisions.
- Moving beyond the 1950's prototypical household models & incorporate changes in lifestyles and activity patterns.
- Understanding complex travel behavior in a network context.