

The Impact of Time-Space Prism Accessibility on Time Allocation and its Propagation through Intra-Household Interaction

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ITM 2010 @Tempe, AZ

Introduction

- Using **time-space prism accessibility** in travel modeling to link land use and behavior
- An example of using time-space prism accessibility in a **time use model** considering **intra-household interaction**

Location-based vs. Individual-based

Location-based accessibility

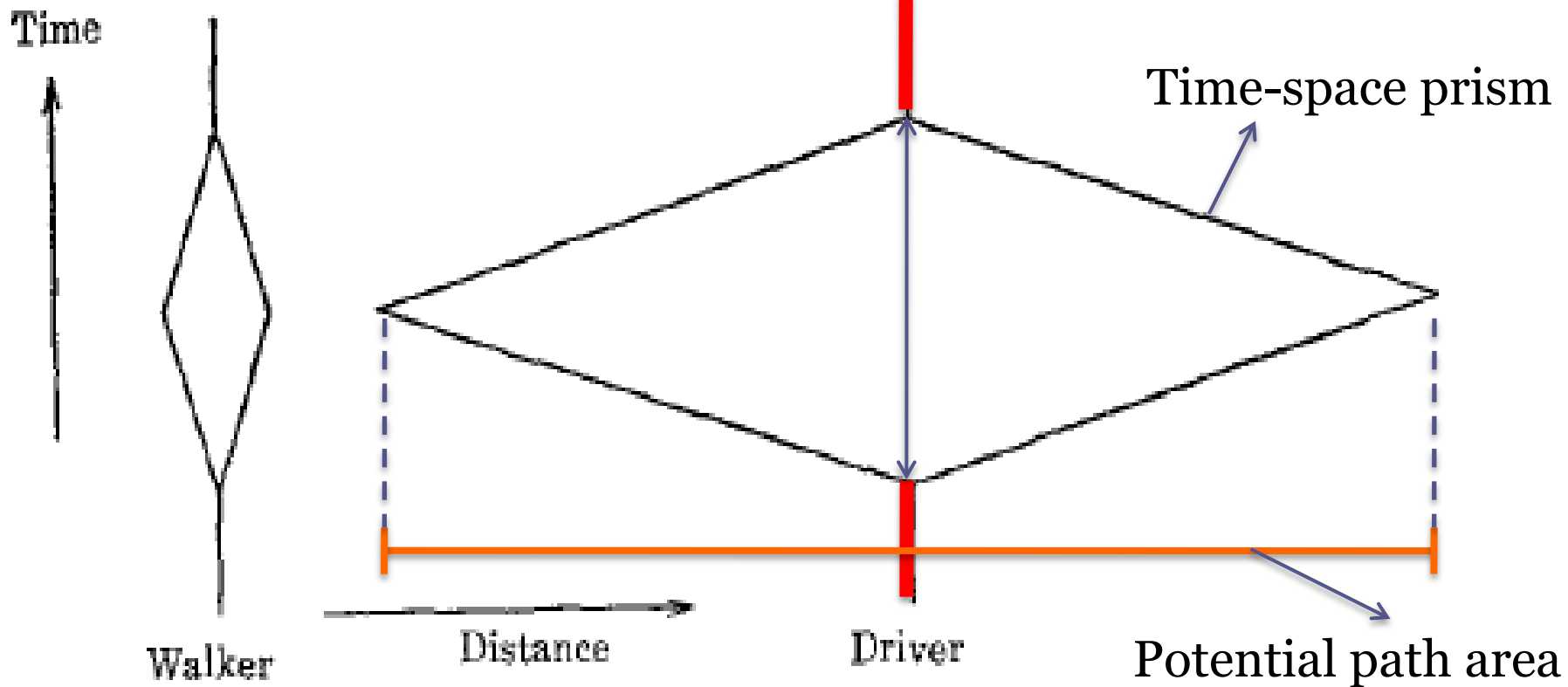
- Opportunities that are accessible from a location
- Accessible or not
 - Travel time or travel distance from a location

Individual-based accessibility

- Net opportunities that each individual experiences with his/her unfolding schedules during a day
- Accessible or not
 - **Spatio-temporal constraints and time budget** of each individual

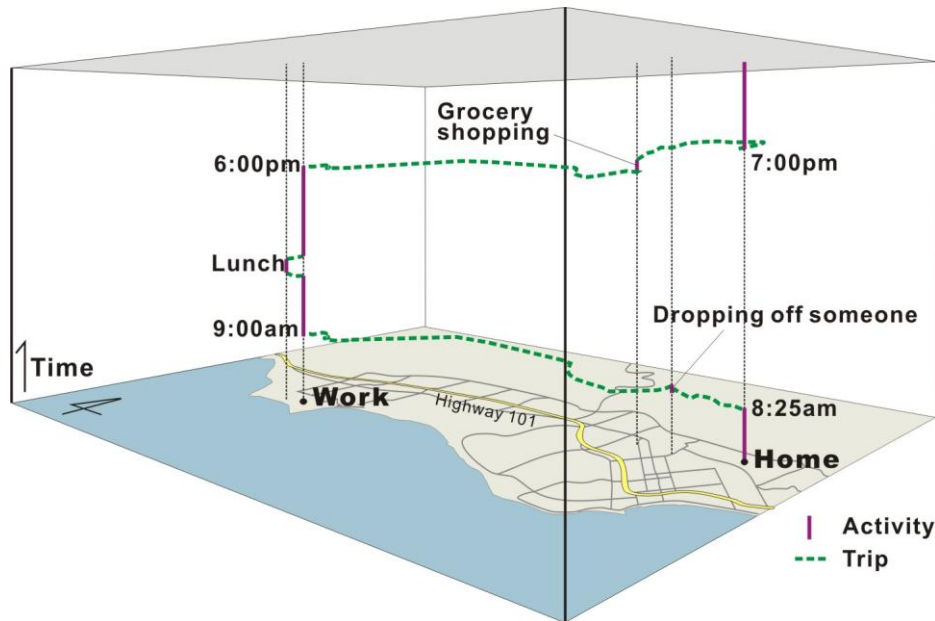
Hägerstrand (1970)

Maximum Daily Prism:

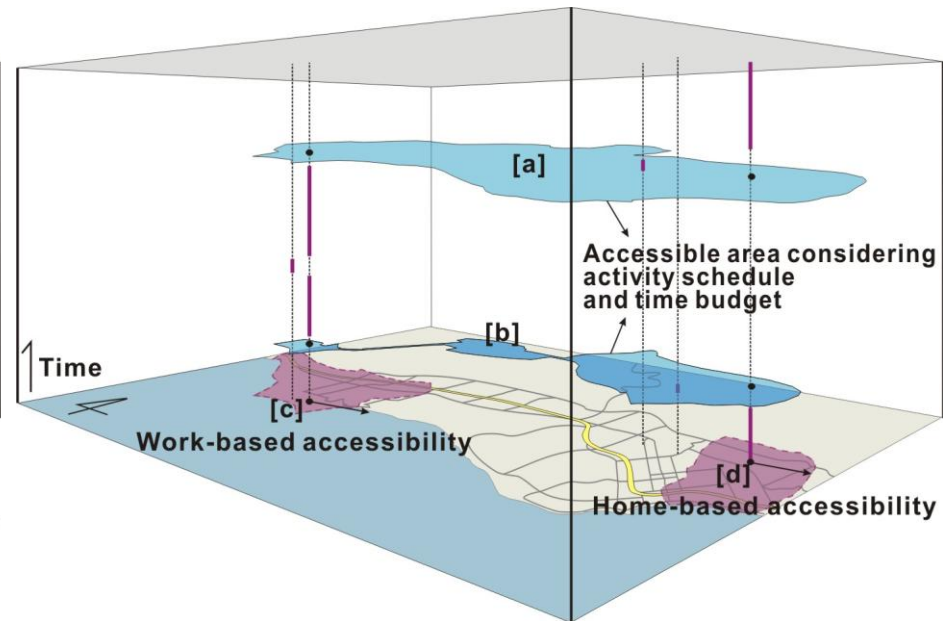


Time-space prism accessibility measurement

John's time-space path during a day



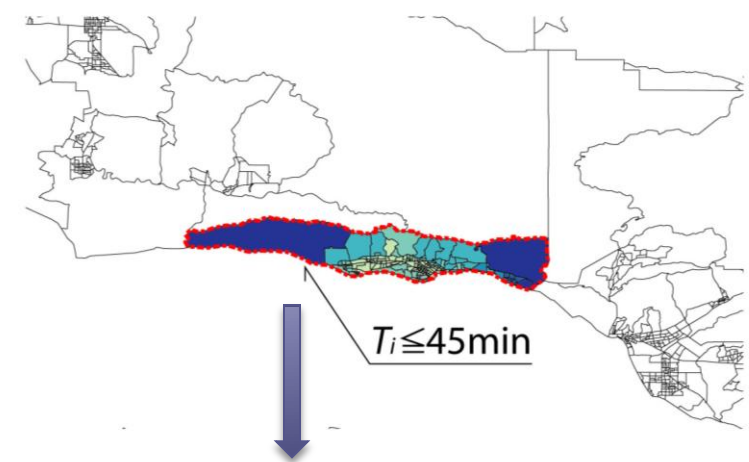
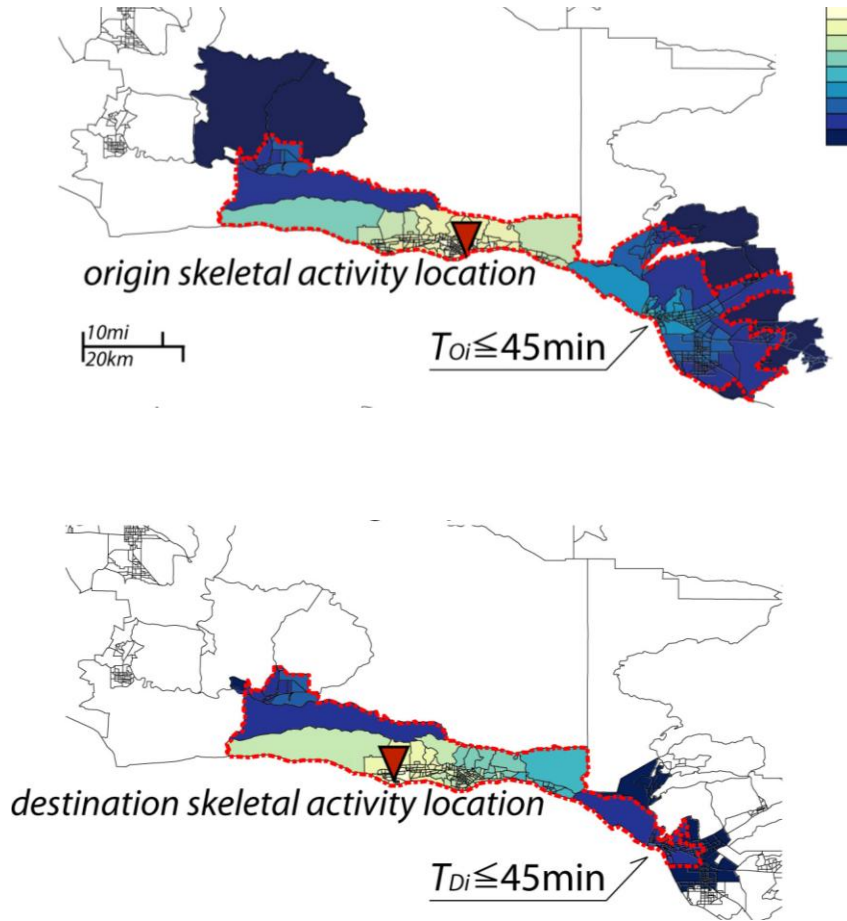
Accessibility measures



Data

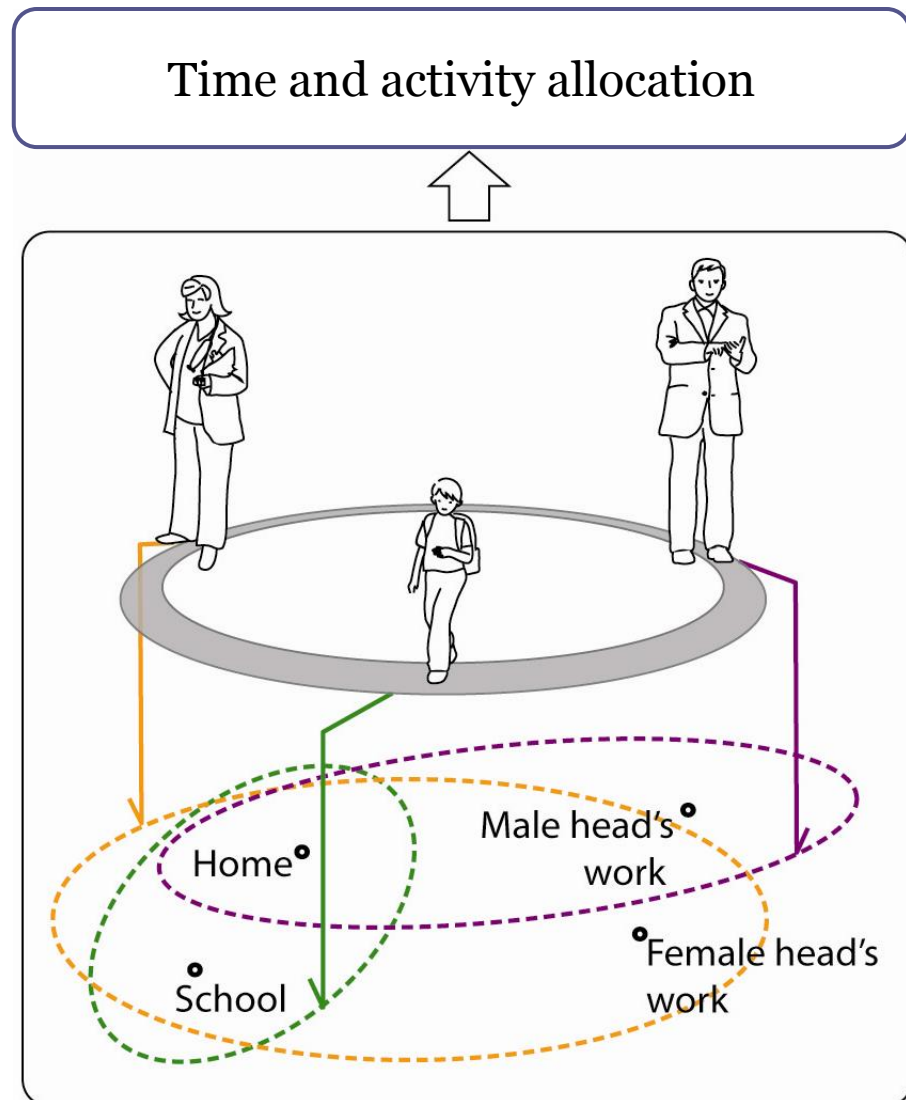
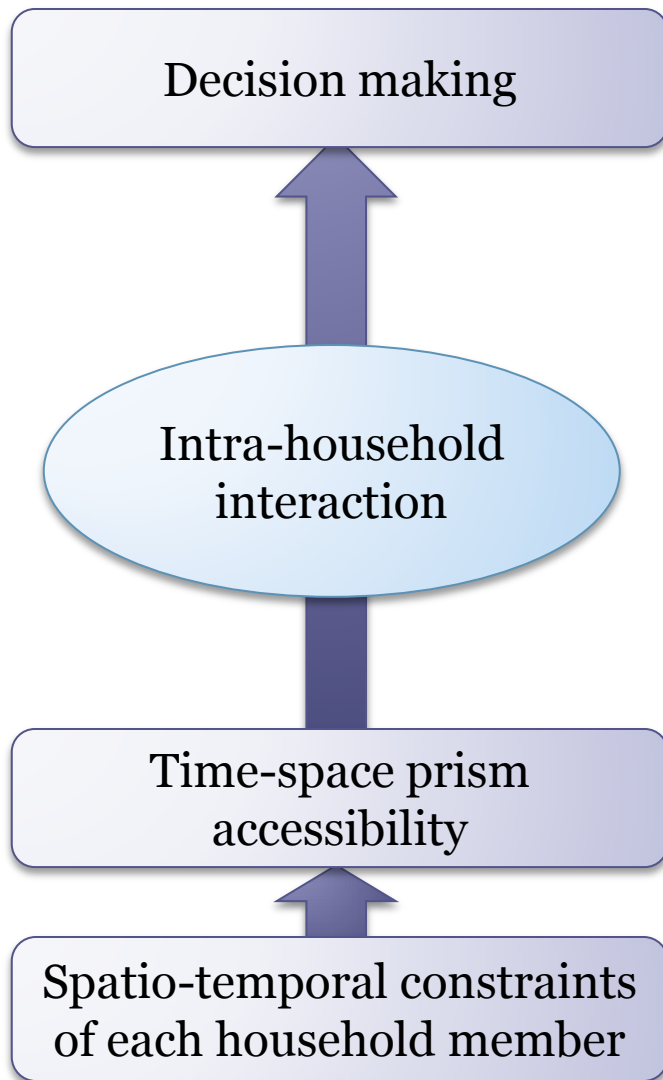
- California statewide household travel survey
 - Collected in years 2000-2001
 - 17,040 households / 40,146 individuals
- Dynamap/transportation by TeleAtlas
 - Types of road network
 - Speed limit, turn restriction, one-way information, etc.
- US Census 2000
 - Number of employees in block group unit

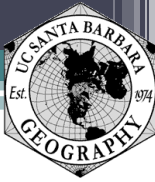
Measurement in GIS



Number of employees
Total segment km by network type

Conceptual model: intra-household interaction





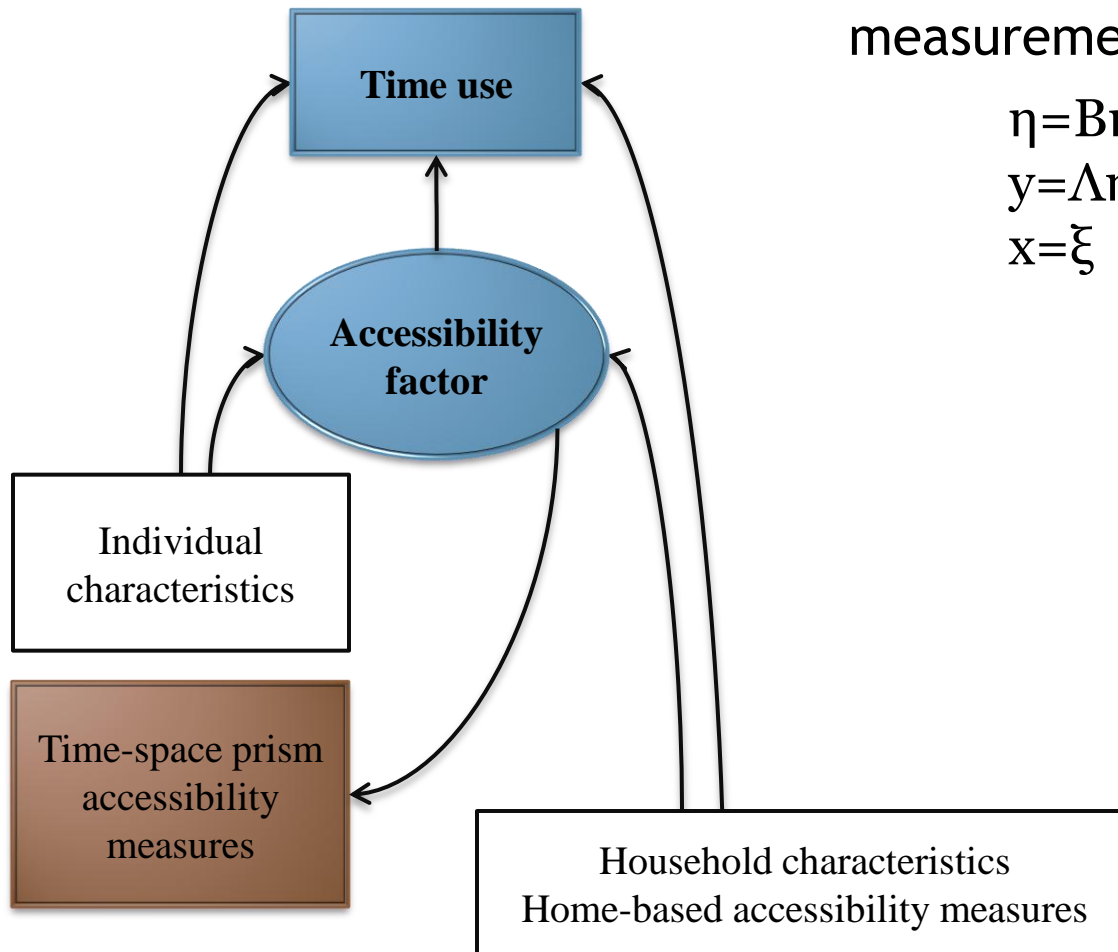
Endogeneity of time-space prism accessibility

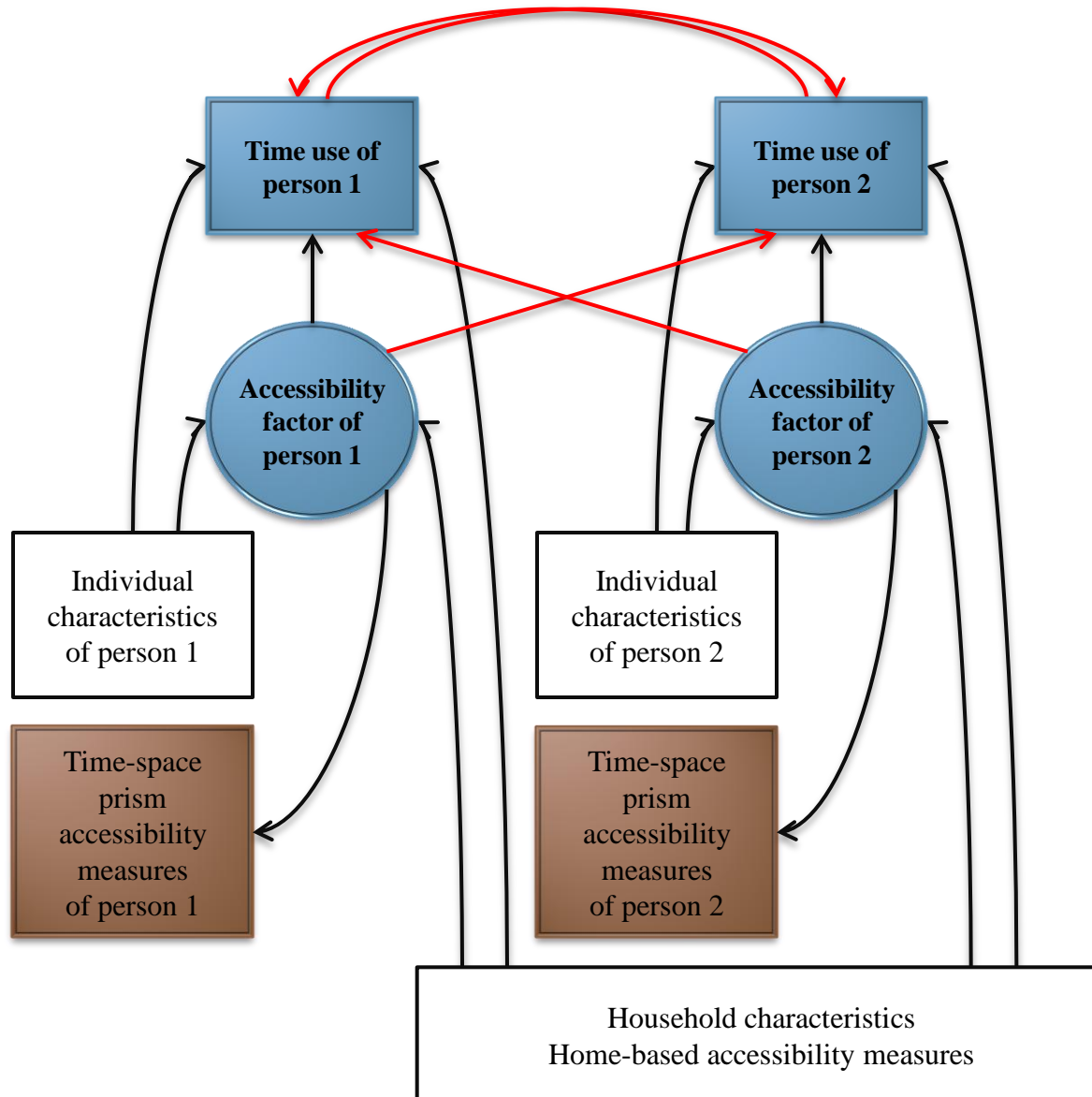
- Interdependency between time use and time-space prism accessibility
- Time-space prism accessibility varies depending on long-term location choices (home, work, school...)
- Spatio-temporal constraints and time budget are related with individual characteristics

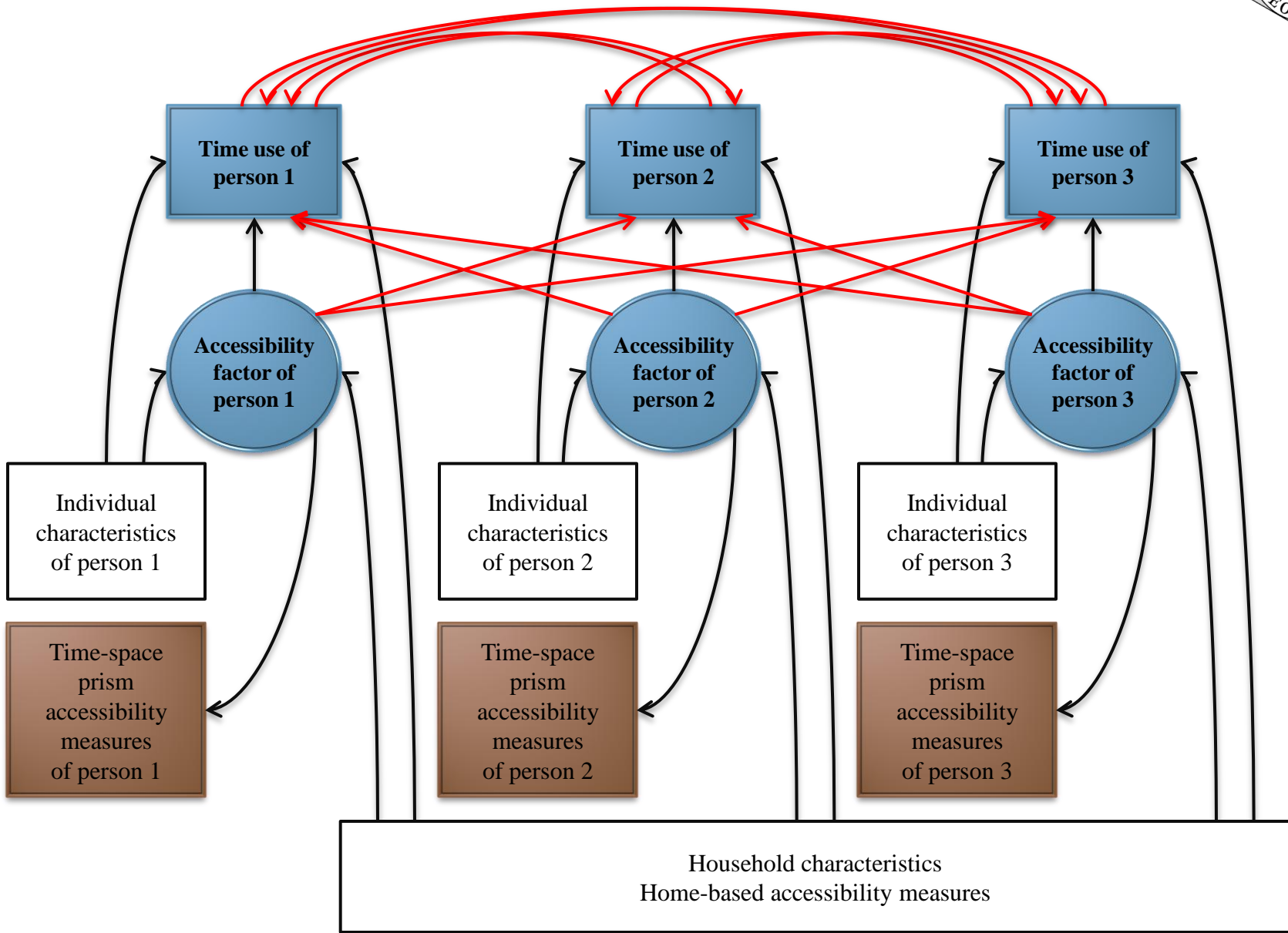
Structural Equation Model

SEM with latent variables and measurement variables

$$\eta = B\eta + \Gamma\xi + \zeta$$
$$y = \Lambda\eta + \epsilon$$
$$x = \xi$$



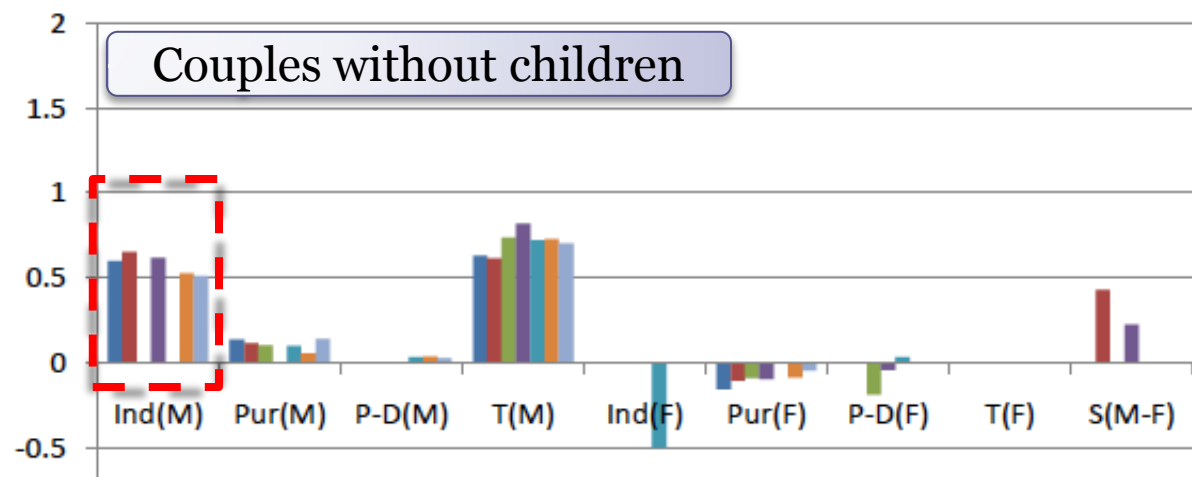




Household life cycle stages

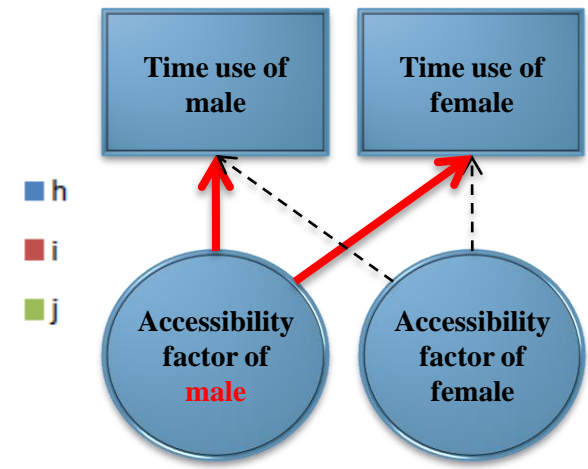
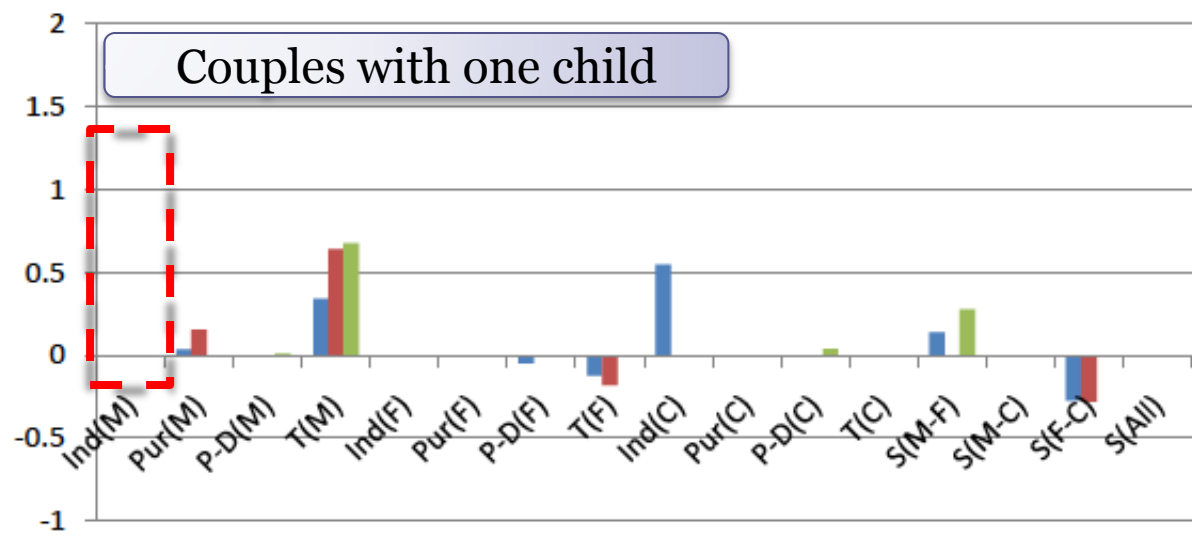
- Households are grouped depending on
 - Existence of children
 - Without children or one child
 - Male and female heads' ages
 - ~44, 45~64, 65~74, and 75+
 - Two heads' employment status
- 4,830 couples without children
 - 7 life cycle stages including 2 senior groups
- 1,435 couples with one child
 - 3 life cycle stages

Total effects from male head's accessibility factor

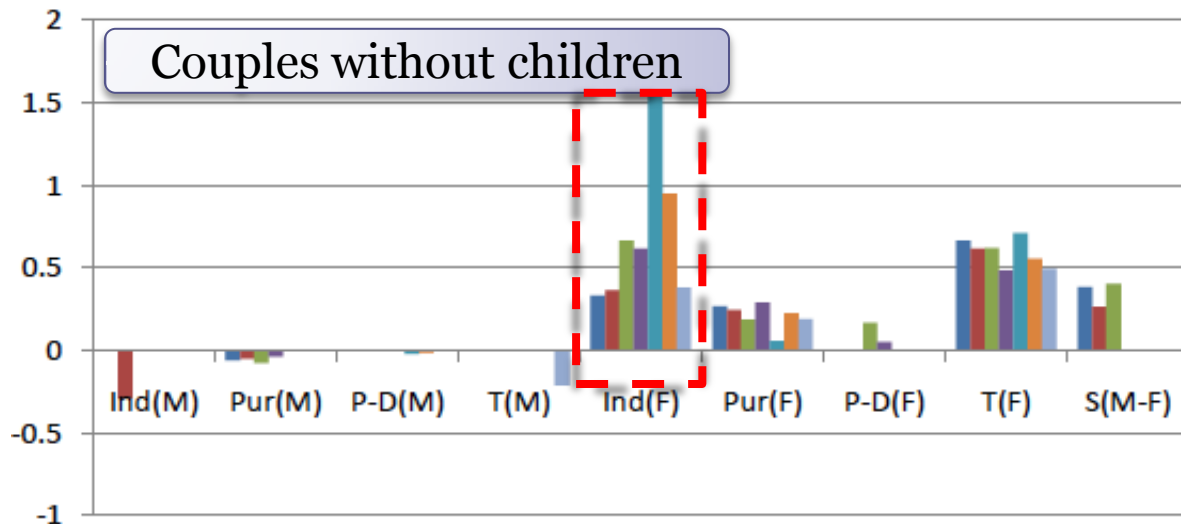


- a
- b
- c
- d
- e
- f
- g

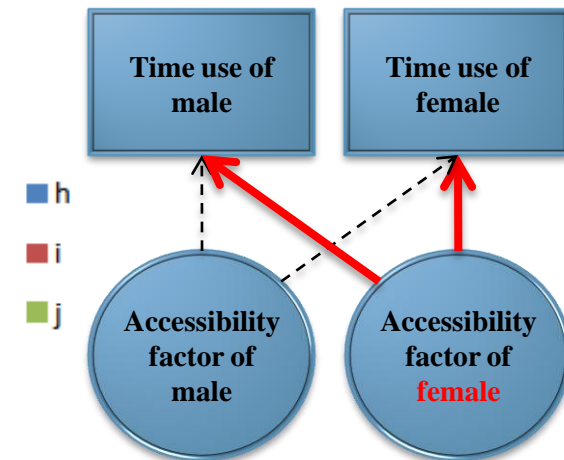
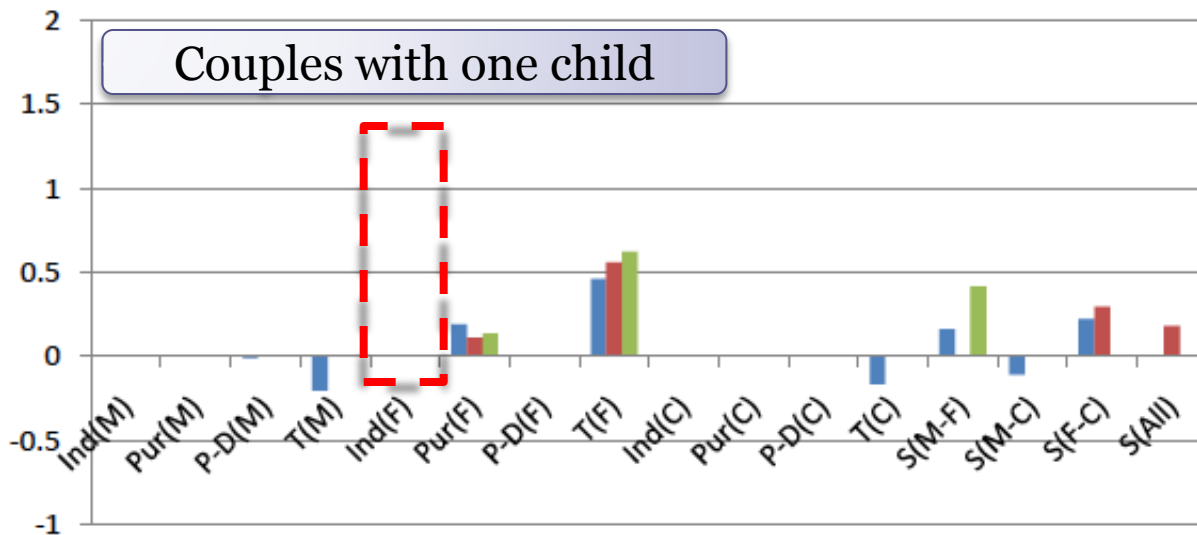
Ind: Independent
 Pur: Purchasing
 P-D: Picking-up/
 Dropping-off
 T: Trip
 S: Shared
 (M): male head
 (F): female head
 (C): child



Total effects from female head's accessibility factor

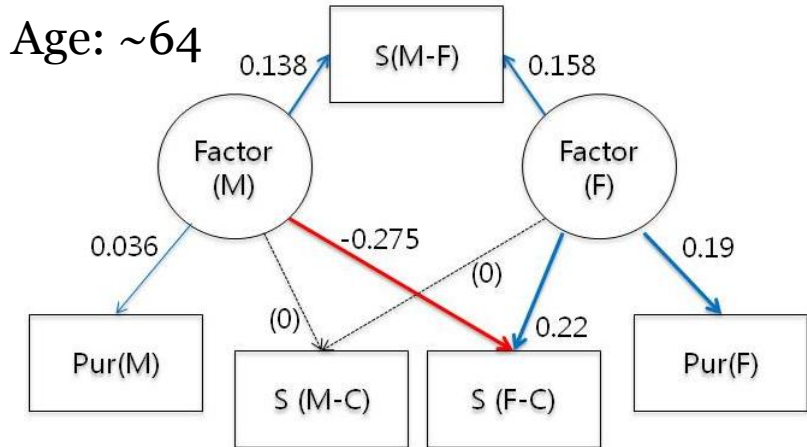


- a
 - b
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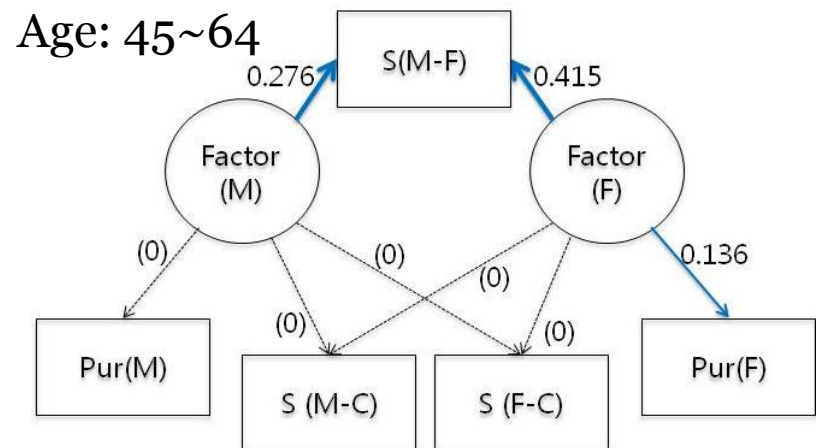
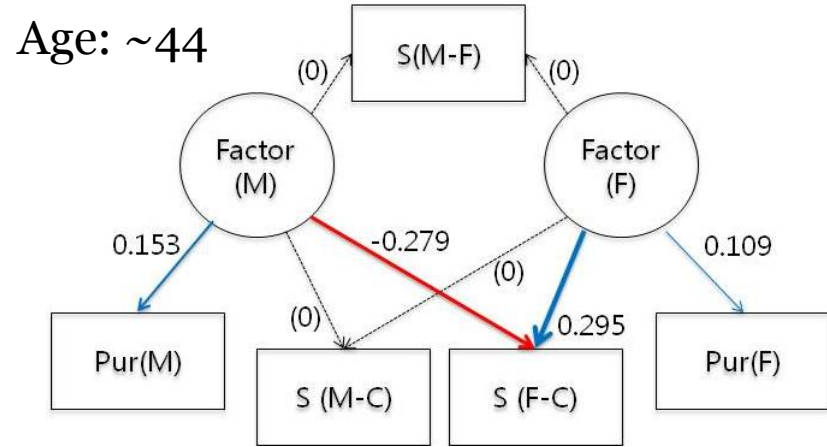


Detailed comparison for couples with one child

Only male head employed



Both heads employed

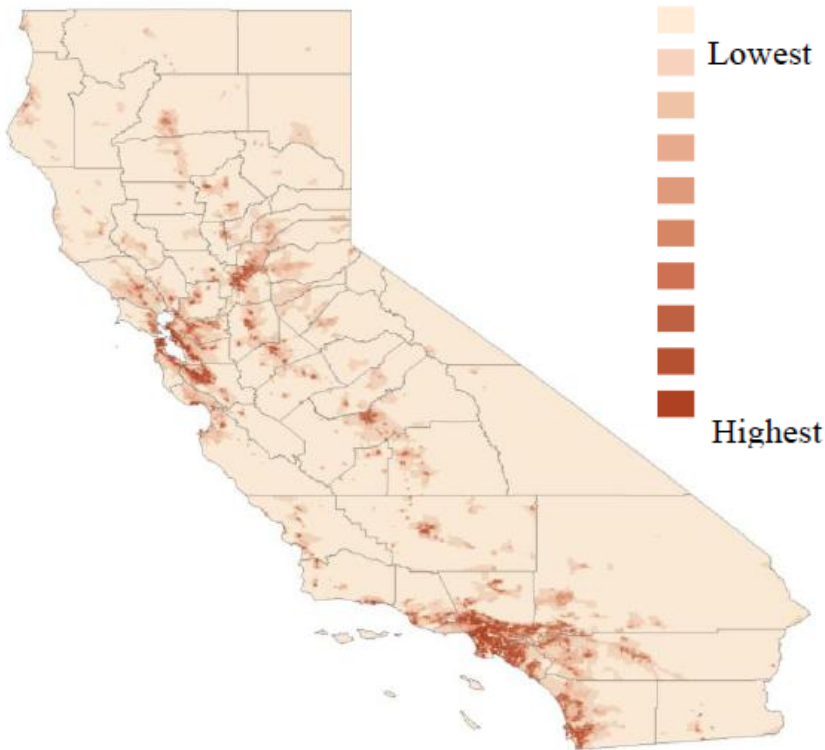


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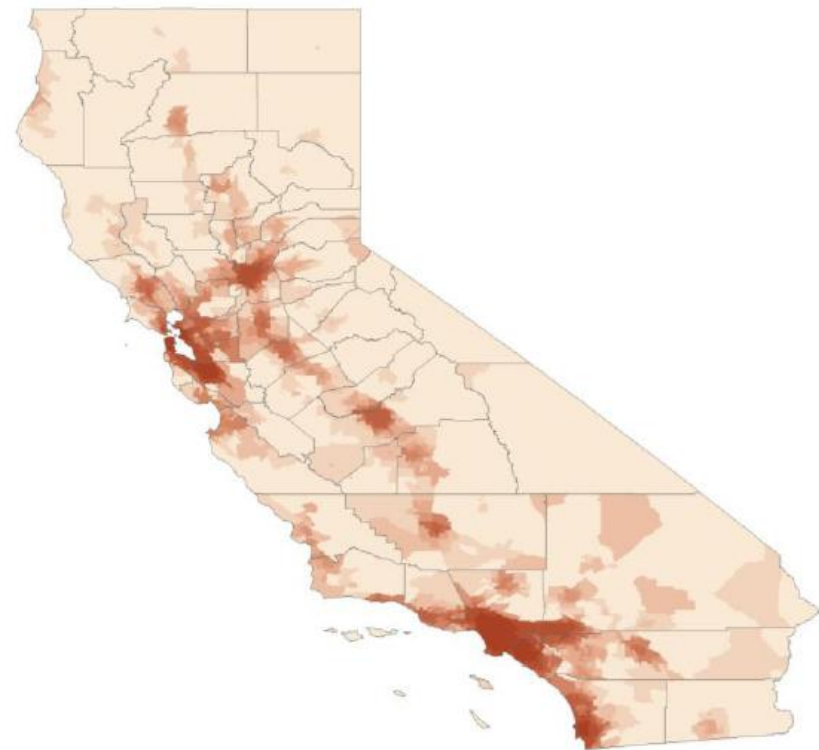
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Impact of land use characteristics around home location on accessibility factor

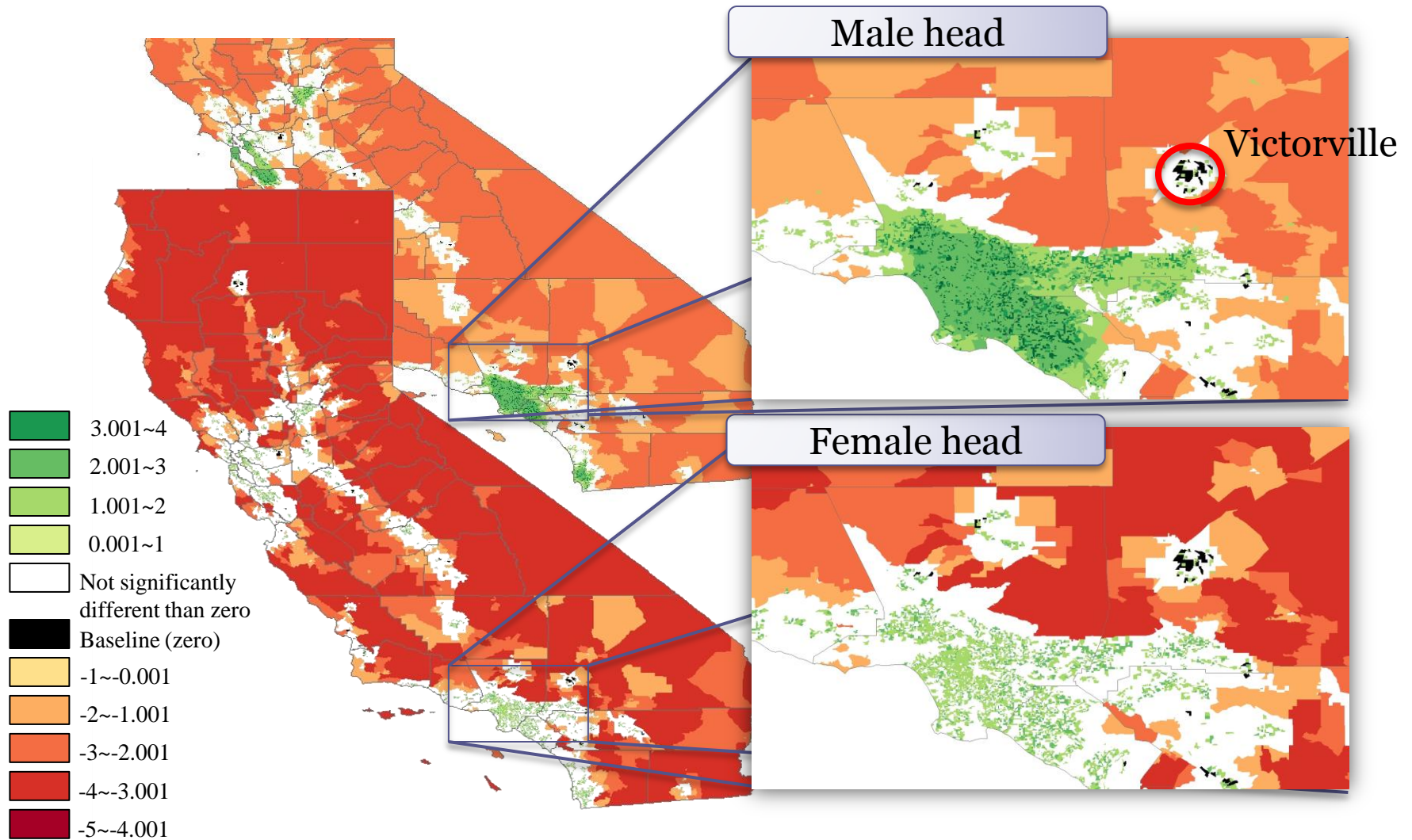
Household density



Employees within 20min's travel

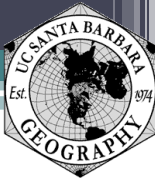


Couples without children both heads employed, between 45-64 years old



Conclusions

- Time-space prism accessibility measures
 - bridge land use and time use in a more comprehensive way
 - show different association patterns with time allocation across life cycle stages, and
 - will help estimating the impact of land use policies for different segments of the population.
- Future work
 - Test this methodology with better data from the SCAG simulation project
 - Finer spatial resolution
 - Multi-modal network
 - Time dependent traveling speed
 - Opening and closing time of activity opportunity



Thank You

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