What if you live in the wrong neighborhood?

The impact of neighborhood type dissonance on distance traveled

あなたは間違っている地区に住んでいるのか

近隣地区の不一致が走行距離に及ぼす影響について

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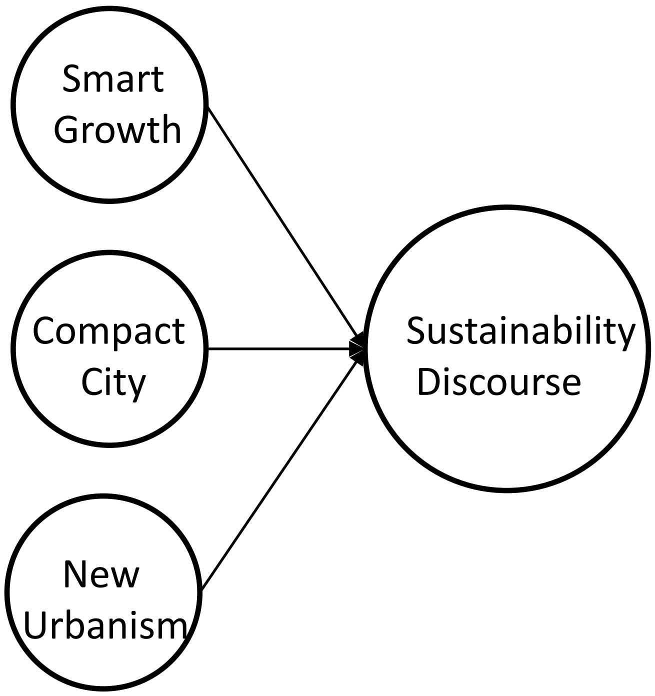
変な日本語申し訳ありません

Presentation Outline

発表の流れ

Research Background
研究背景



The main premise being:

High density mixed use cities might significantly reduce car travel distances.

基本的な前提:

高密度及び混合土地利用度によって自動車走行距離を削減できることである。

The underlying implication being:

The built environment exerts a strong enough influence on individuals and households to effectively change their travel behavior.

前提の含み:

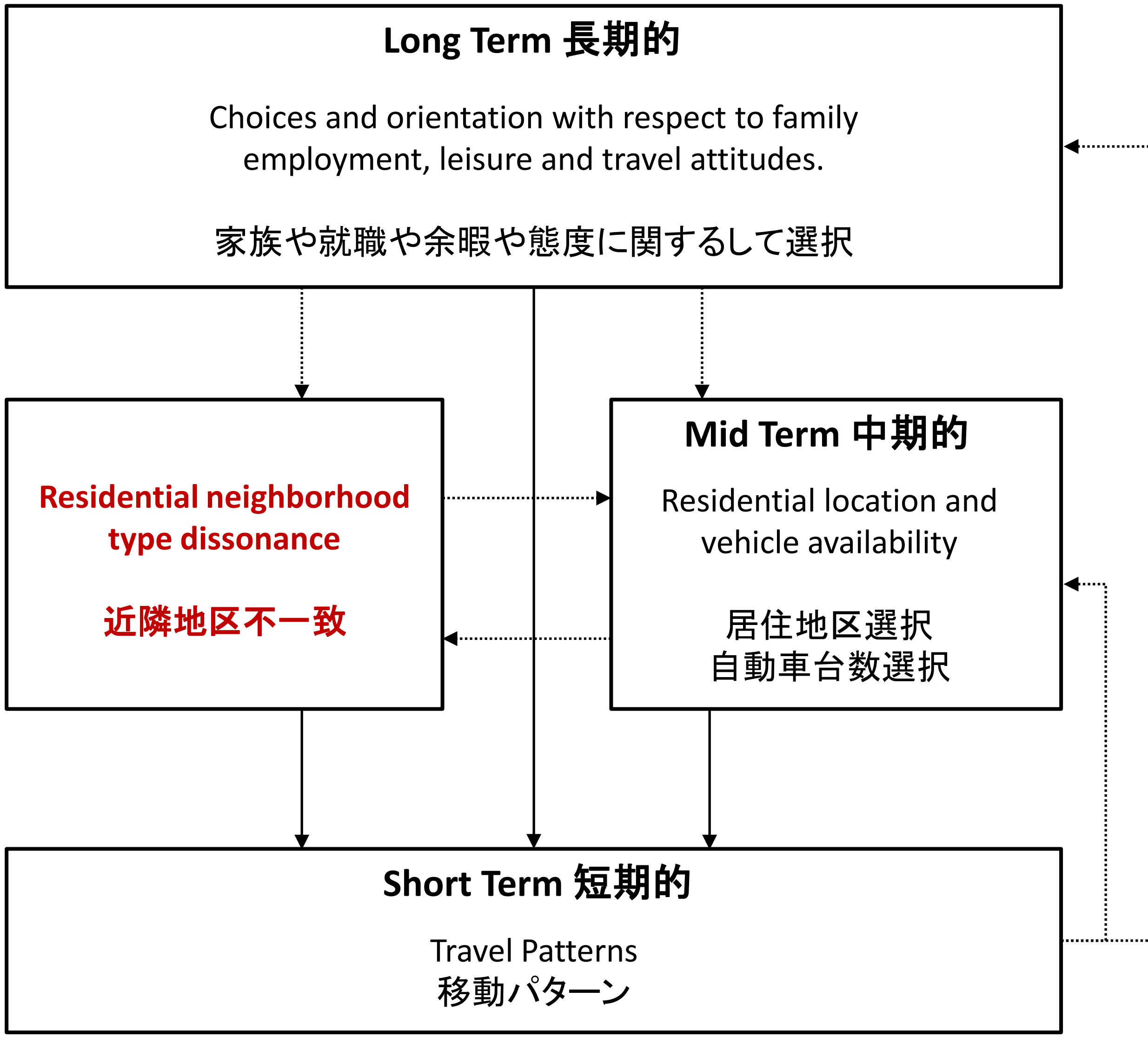
都市構造*は個人及び世帯に交通行動を変えさせるほど強い影響を与えることである。

都市構造:構築環境、土地利用、人口密度

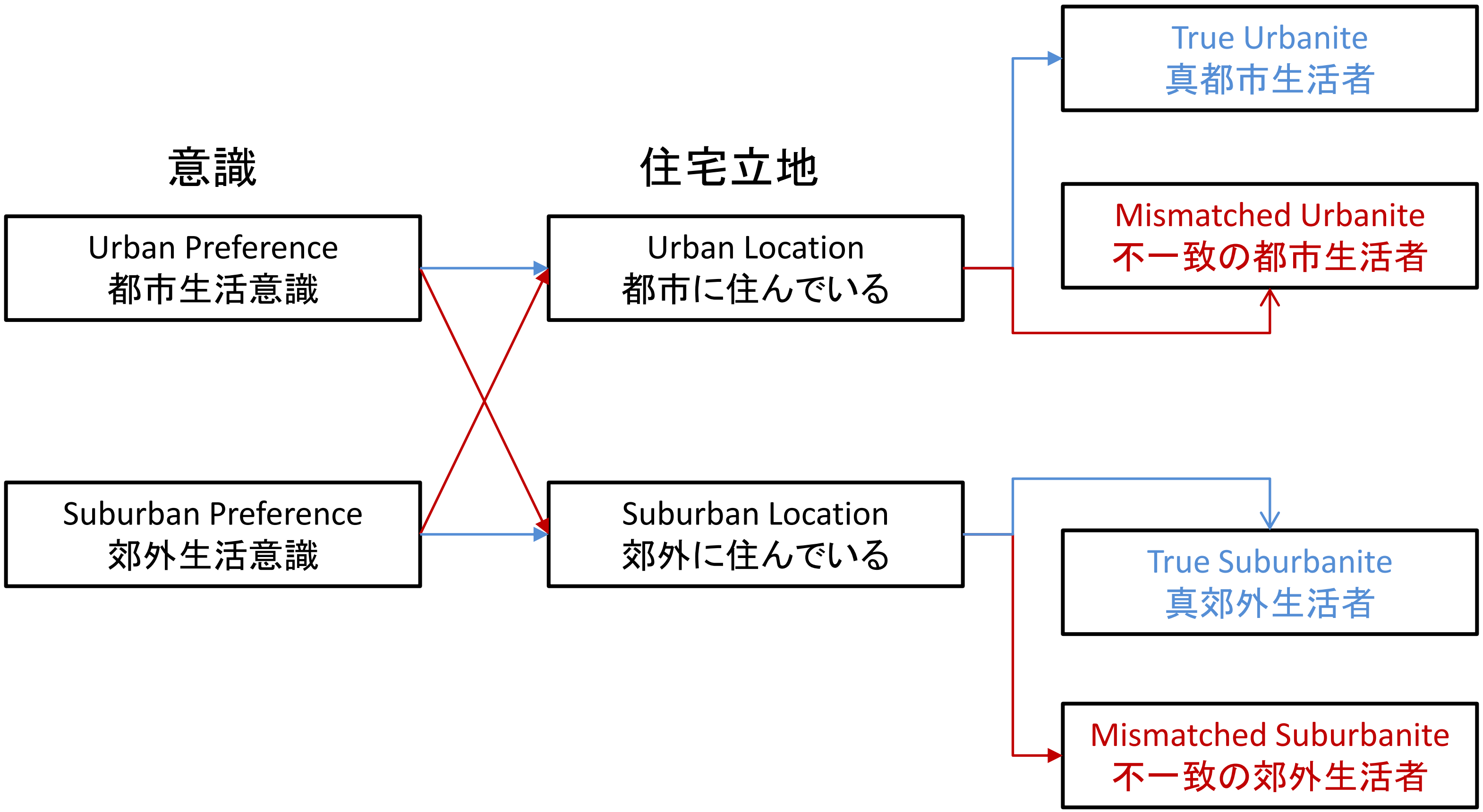
Research Background
研究背景

東京大学
都市交通研究室

Conceptual Framework
概念的枠組み

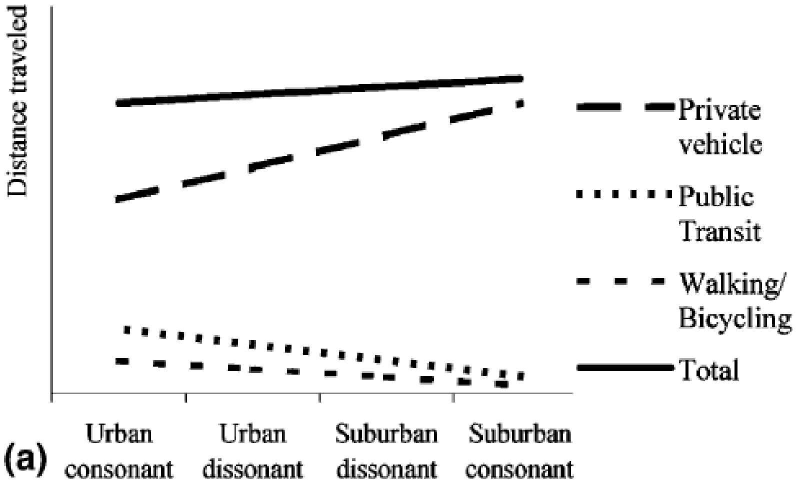


Conceptual Framework
概念的枠組み

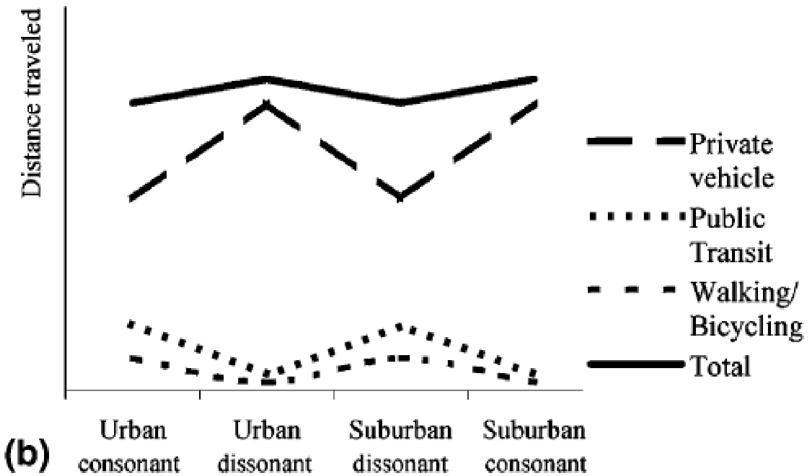


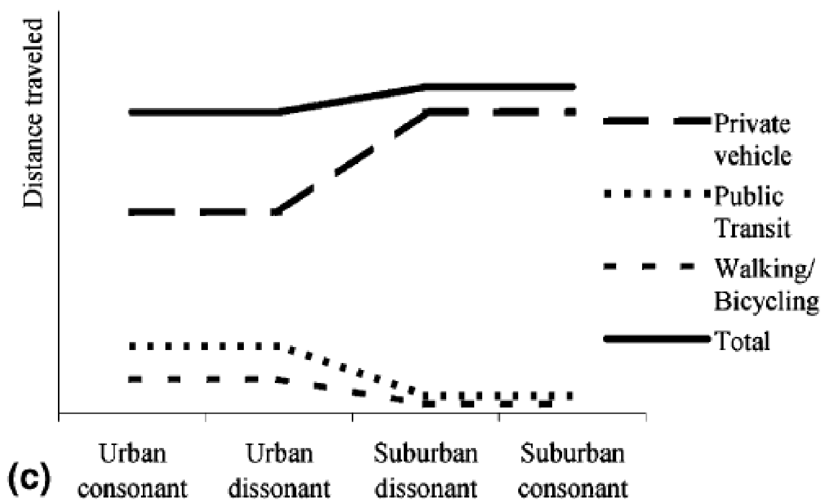
Conceptual Framework
概念的枠組み

a）土地利用と意識は同様に重要



b）意識のみ重要





c）土地利用のみは重要
（自己選択影響なし）

Methodological Approach
研究のアプローチ

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東京大学

Estimating the mismatch：
不一致性の推定

不一致性 = f(個人意識、近隣地区特性)

	都心地区	郊外地区	

Summary of spatial structure indicators for the communities surveyed

	North San Francisco	Pleasant Hill	Concord
Density	High	Intermediate	Low
Business locations	Throughout the neighborhood	Central near BART and Freeway	Western end of the eighborhood
Distance to San Francisco Central Business District	5 km	41 km	46 km
Street pattern	Grid	Fragmented	Radiating
Topography	Hills	Flat	Flat
Freeway access	I-80 1.5 km East	I-680 transects the community	I-680 on the western side; Hwy 24 transects the community
BART access	None	Southeast of neighborhood	West side of the neighborhood
Bus lines	21 Bus routes	3 Bus routes	3 Bus routes
Sidewalks	Wide	Discontinuous	Discontinuous, missing
Walking	Common	Hazardous	Hazardous

Source: After Kitamura et al. (1997).

Estimating the mismatch：
不一致性の推定

不一致性 = f(個人意識、近隣地区特性)

Table 2. Pattern matrix for the six attitude factors (source: Mokhtarian et al, 2001; Redmond, 2000).

原因分析によって潜在変数を推定

	Pro-high-density	Pro-environ-mental-policy	Commute benefit	Travel freedom	Travel dislike	Travel stress
Living in a multiple family unit would not give me enough privacy	−0.617					
I like living in a neighborhood where there is a lot going on	0.486					
Having shops and services within walking distance of my home is important to me	0.401	0.243				
I like to have a large yard at my home	−0.323					
To improve air quality, I am willing to pay a little more to use an electric or other clean-fuel vehicle		0.641				
We should raise the price of gasoline to reduce congestion and air pollution		0.617				
We need more public transportation, even if taxes have to pay for a lot of the costs		0.612				
I limit my auto travel to help improve congestion and air quality		0.372				
We can find cost-effective technological solutions to the problem of air pollution		0.353				
We need more highways even if taxes have to pay for a lot of the costs		−0.194				
My commute is a real hassle			−0.695			
My commute trip is a useful transition between home and work			0.583			
The traveling that I need to do interferes with doing other things I like			−0.530			
I use my commute time productively			0.467			
Travel time is generally wasted time			−0.461			
Getting stuck in traffic doesn't bother me too much			0.419			
In terms of local travel, I have the freedom to go anywhere I want to				0.511		
In terms of long-distance travel, I have the freedom to go anywhere I want to				0.422		
The vehicles I travel in are comfortable				0.295		
It is nice to be able to do errands on the way to or from work				0.269		
I am willing to pay a toll to travel on an uncongested road				0.212		
Traveling is boring					0.621	
I like exploring new places					−0.537	
The only good thing about traveling is arriving at your destination					0.525	
Getting there is half the fun					−0.465	
I worry about my safety when I travel						0.544
Traveling makes me nervous						0.537
Traveling is generally tiring for me						0.410
I'd rather have someone else do the driving						0.329
I tend to get sick when traveling						0.318
I am uncomfortable being around people I don't know when I travel						0.297
I like traveling alone						−0.194

Methodological Approach
研究のアプローチ

都市交通研究室 東京大学

Estimating the mismatch :
不一致性の推定

不一致性 = f(個人意識、近隣地区特性)

MM1=
ダミー変数

$$MM1=\begin{cases}1 & \text{if } PROHIDENS_i < 0, \text{ for } NSF_i = 1\\ 1 & \text{if } PROHIDENS_i > 0, \text{ for } PH_i = 1, CON_i = 1\\ 0 & \text{otherwise}\end{cases}$$

MM2=
連続変数

$$MM2=\begin{cases}PROHIDENS_{max} - \min(PROHIDENS_{max}, PROHIDENS_i), \text{FOR } NSF_i = 1\\ \mathrm{Max}(PROHIDENS_{i,}\ PROHIDENS_{min}) - PROHIDENS_{min} \text{ for } PH_i = 1, CON_i = 1\end{cases}$$

$MM3 = M1_i \times ATTACH_i$ (ATTACH: 1= ATTACHED, 2=SOMEWHAT ATTACHED, 3=NOT ATTACCHED)
尺度変数

地区愛着度（1～3）

$MM4 = M2_i \times ATTACH_i$ (ATTACH: 1= ATTACHED, 2=SOMEWHAT ATTACHED, 3=NOT ATTACCHED)
連続変数

MM5=
ダミー変数

$$MM5=\begin{cases}1 & \text{if } PROHIDENS_i < -0.192^*, \text{ for } NSF_i = 1\\ 1 & \text{if } PROHIDENS_i > 0.307^*, \text{ for } PH_i = 1\\ 1 & \text{if } PROHIDENS_i > 0.098^*, \text{ for } CON_i = 1\\ 0 & \text{otherwise}\end{cases}$$

*地区平均値∓1標準偏差

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Estimating the mismatch：
不一致性の推定

地区不一致性によって手段別走行距離

Table 4
The relationship between weekly distance traveled by mode (in miles) and the presence and extent of residential neighborhood dissonance, by residential neighborhood

		Private vehicle			Rail			Bus			Walking/jogging/bicycling		
		North San Francisco	Pleasant Hill	Concord	North San Francisco	Pleasant Hill	Concord	North San Francisco	Pleasant Hill	Concord	North San Francisco	Pleasant Hill	Concord
Average weekly distance traveled													
MM1	0 (consonant)	114.8	$\boxed{223.2}$	$\boxed{210.0}$	$\boxed{7.7}$	21.0	23.0	13.3[a]	0.4	0.6	$\boxed{12.1}$	$\boxed{8.0}$	6.3
	1 (dissonant)	$\boxed{134.7}$	219.6	207.1	4.3	$\boxed{25.9}$	$\boxed{32.5}$	7.6	0.6	1.2	10.4	7.7	$\boxed{7.3}$
MM3	0 (consonant)	115.6[b]	223.5	210.4	7.7[b]	21.3	23.1	13.3[b]	0.4[c]	0.6[c]	12.0[b]	8.0	6.3
	1 (dissonant)	134.5	187.4	21.8	5.1	26.0	16.9	8.0	0.8	0.5	10.0	8.0	7.0
	2 (more dissonant)	136.9	247.4	190.5	4.4	30.0	46.2	7.8	0.6	0.0	11.1	8.7	8.0
	3 (most dissonant)	119.7	249.6	255.7	0.2	13.7	40.0	6.9	0.0	8.6	11.9	4.4	5.8
MM5	0 (consonant)	117.3	222.7	211.6	7.0	21.9	22.7	12.6[d]	0.4	0.6	11.9	8.0	6.3
	1 (dissonant)	131.7	219.4	199.1	6.0	24.5	36.9	8.7	0.6	1.4	10.5	7.5	7.6
Correlation with distance													
MM2		0.081*	−0.042	−0.036	−0.114**	0.051	0.166**	−0.142**	0.088	0.110*	−0.078*	−0.005	0.089
MM4		0.043	0.029	−0.020	−0.100*	0.069	0.168**	−0.099**	0.091	0.163**	−0.040	−0.007	0.073

Note: The numbers of cases per neighborhood type dissonance category are identical to those shown in Table 3.
* $p < 0.10$.
** $p < 0.05$.
[a] Kruskal–Wallis test yields statistically significant within-neighborhood differences with $p < 0.10$.
[b] t-Test yields statistically significant within-neighborhood differences with $p < 0.10$.
[c] t-Test yields statistically significant within-neighborhood differences with $p < 0.05$.
[d] Kruskal–Wallis test yields statistically significant within-neighborhood differences with $p < 0.05$.

東京大学 都市交通研究室

Tobit Model for selectivity bias：
選択性バイアスの修正のトビットモデル

Huh?

簡単にいうと

① 外出の選択のモデル → 離散被説明変数 → プロビット選択モデル

z is discrete

$$z^*_i = \alpha' x_i + u_i$$

$$z_i = \begin{cases} 0 & \text{if} \quad z^*_i \leq 0 \\ z^*_i & \text{if} \quad z^*_i > 0 \end{cases}$$

M 手段で外出しない

M 手段で外出する

② 走行距離のモデル → 連続被説明変数 → トビットモデル

0に切断データ

Y is continuous (Truncated at zero)

$$y^*_i = \beta' x_i + \varepsilon_i$$

$$y_i = \begin{cases} 0 & \text{if} \quad y^*_i \leq 0 \\ y^*_i & \text{if} \quad y^*_i > 0 \end{cases}$$

ポイント1： Corr[ε,u]=ρ

ポイント2: $z_i = 1$の場合のみ、$[y_i, x_i]$を観測できる

Model Structure
モデル構造について

Estimated Models:
推定されたモデル：

- **総合走行距離**
- **自動車走行距離**
- **鉄道**
  - 鉄道選択モデル
  - 鉄道走行距離
- **バス**
  - バス選択モデル
  - バス走行距離
- **徒歩・自転車**
  - 徒歩・自転車選択モデル
  - 徒歩・自転車走行距離

Estimation Results
推定結果

- **総合走行距離**
- 普通のトビットモデル
- MM5の効果は都市人のみ
- 意識効果＜土地利用

- **自動車走行距離**
- 普通のトビットモデル
- 不一致都市生活者は真都市生活者より長い。
- フールモデルでMMの効果がなくなる

Tobit regression models for total weekly distance traveled and distance by private vehicle

	Log total miles				Log miles by private vehicle			
	Baseline model		Full model		Baseline model		Full model	
	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value
Neighborhood type dissonance								
MM1 for NSF resident					0.364	4.16		
MM5 for NSF resident	0.160	1.74	0.154	1.73				
Residential location and vehicle ownership								
NSF resident	−0.638	−13.30	−0.645	−12.19	−1.495	−13.57	−0.769	−9.89
Ratio of vehicles to valid driver's licenses[b]			0.129	2.69			0.680	8.44
Mobility constraints								
Driving at night							−0.439	−2.99
Using public transit[b]							0.320	2.01
Sociodemographic variables								
Household income (1000 US$)[a,b]			0.005	6.49			0.008	5.98
Part-time employed			−0.138	−2.24			−0.193	−1.98
Occupation in sales[b]			0.219	2.90			0.367	3.03
Female			−0.285	−5.97			−0.177	−2.33
Single working female			0.294	3.89			0.283	2.18
One-worker family			0.276	2.84			0.498	3.21
Multiple adults and workers							−0.268	−1.77
Number of persons with valid driver's license							0.137	2.65
Age (in years)[a]			−0.006	−3.33				
Lifestyle and personality factors								
Adventure seeker factor[b]			0.095	3.60			0.098	2.40
Workaholic factor[b]			0.068	2.38				
Travel attitudes								
Travel stress factor			−0.063	−2.16				
Travel freedom factor							0.231	4.50
Pro-env. solutions factor			−0.065	−2.21			−0.235	−5.32
Liking for travel on a bus			0.060	2.50				
Constant	5.36	166.17	5.103	38.41	5.108	95.79	3.562	13.61
σ	0.812	49.96	0.744	49.96	1.342	48.42	1.187	48.45
N observations	1248		1248		1247		1247	
Log likelihood (constant only)	−1595.1		−1595.1		−2251.4		−2251.4	
Log likelihood (convergence)	−1510.4		−1401.5		−2134.6		−1981.7	
Model improvement (χ^2)	169.4		398.2		233.6		539.2	
Likelihood ratio index	0.053		0.121		0.052		0.120	
McKelvey–Zavoina R^2	0.106		0.213		0.221		0.391	

[a] Category midpoint used as estimate of true value.
[b] Variable known to influence the extent of residential neighborhood type mismatch (see Schwanen and Mokhtarian, 2004).

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Estimation Results
推定結果

- **鉄道選択モデル**
- 不一致都市生活者 （－）
- 不一致郊外生活者 （＋）
- フールモデルで効果が小さくなる

- **鉄道走行距離**
- 上記の関係の反対
- 不一致都市生活者 （＋）
- 不一致郊外生活者 （－）
- フールモデルで効果が小さくなる

Tobit model system for weekly distance traveled by rail

	Baseline model				Full model			
	Selection (use)		Regression (distance)		Selection (use)		Regression (distance)	
	Coef.	t-Value	Coef.	t-Value	Coef.	t-Value	Coef.	t-Value
Neighborhood type dissonance								
MM2 for NSF resident	−0.567	−7.35			−0.343	−5.26		
MM5 for NSF resident			0.871	1.96				
MM4 for PH resident	0.130	3.08						
MM4 for CON resident	0.189	4.18						
MM5 for suburban resident							−1.234	−4.10
Residential location and vehicle ownership								
NSF resident	0.795	7.44	−2.037	−9.29			−2.041	−9.42
Ratio of vehicles to valid driver's licenses[a]					−0.405	−5.60		
Mobility constraints								
Bicycling[a]					0.233	2.36		
Sociodemographics								
Occupation in services					−0.575	−3.03		
Occupation in production/ construction/crafts					−0.578	−2.56		
Professional/technical occupation							0.296	1.81
One-worker family					−0.731	−3.76		
Female in multiple-worker family					−0.295	−2.72		
Personality and lifestyle factors								
Status seeker factor[a]							−0.232	−2.06
Frustrated factor							0.201	2.04
Travel attitudes								
Pro-env. solutions factor					0.333	7.16		
Liking for traveling by rail					0.186	4.78		
Constant	1.088	−15.08	5.857	9.71	−1.083	−6.19	4.770	12.76
σ			1.573	7.45			1.306	16.60
ρ			−0.637	−3.41			−0.245	−1.40
N observations	1353				1353			
Log likelihood (constant only)[b]	−1316.8				−1316.8			
Log likelihood (convergence)	−1157.8				−1009.3			
Model improvement (χ^2)	318.0				615.0			
Likelihood ratio index (model system)	0.121				0.234			
Likelihood ratio index (selection model estimated separately)	0.285				0.354			

[a] Variable known to influence the extent of residential neighborhood type mismatch (see Schwanen and Mokhtarian, 2004).
[b] Estimate for a regular tobit model without selection equation (see Footnote 3 to the text).

Estimation Results
推定結果

- **バス選択モデル**
- 不一致都市生活者 （－）
- 不一致郊外生活者 （＋）
- フールモデルで効果が小さくなる

- **バス走行距離**
- 不一致都市生活者 （＋）

Tobit model system for distance traveled by bus

	Baseline model				Full model			
	Selection (use)		Regression (distance)		Selection (use)		Regression (distance)	
	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value
Neighborhood type dissonance								
MM2 for NSF resident	−0.558	−6.89			−0.234	−2.24	0.200	2.06
MM5 for PH resident	0.621	3.28			0.452	2.07		
Residential location and vehicle ownership								
NSF resident	2.256	19.04			1.667	10.87		
PH resident			−0.928	−2.80			−0.805	−2.50
Ratio of vehicles to valid driver's licenses[a]					−0.783	−7.94		
Mobility constraints								
Driving on a freeway					0.896	2.56		
Using public transit[a]					−0.590	−2.19		
Sociodemographics								
Household income (1000 US$)[a,b]					−0.009	−5.28		
Occupation in sales[a]					−0.387	−1.97		
Occupation in production/construction/crafts					−0.708	−3.06		
Two-worker couple[a]					0.310	3.01	−0.301	−2.54
One-worker family							−3.566	−2.50
Female in one-worker family							2.448	5.35
Age (in years)[b]					−0.015	−3.56		
Personality and lifestyle factors								
Status seeker factor[a]							0.200	3.00
Workaholic factor							−0.185	−2.41
Travel attitudes								
Travel freedom factor					−0.249	−3.79		
Pro-env. solutions factor					0.187	2.99		
Liking for traveling by bus					0.231	4.32		
Constant	−1.764	−25.14	2.894	20.74	−0.542	−1.08	3.128	25.90
σ			1.064	28.72			1.015	19.87
ρ			−0.057	−0.40			−0.310	−3.29
N observations	1325				1325			
Log likelihood (constant only)[c]	−1461.9				−1461.9			
Log likelihood (convergence)	−1080.2				−882.9			
Model improvement (χ^2)	763.4				1158.0			
Likelihood ratio index (model system)	0.261				0.396			
Likelihood ratio index (selection model estimated separately, equally likely model as base)	0.400				0.522			

[a] Variable known to influence the extent of residential neighborhood type mismatch (see Schwanen and Mokhtarian, 2004).
[b] Category midpoint used as estimate of true value.
[c] Estimate for a regular tobit model without selection equation (see Footnote 3 to the text).

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Estimation Results
推定結果

- **徒歩・自転車選択モデル**
- フールモデルで効果がなくなる
- 手段に対して意識の効果のほうが大きい。

- **徒歩・自転車走行距離**
- フールモデルで効果がなくなる
- 手段に対して意識の効果のほうが大きい。

Table 8
Tobit model system for distance traveled by walking/jogging/bicycling

	Baseline model				Full model			
	Selection (use)		Regression (distance)		Selection (use)		Regression (distance)	
	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value	Coef.	*t*-Value
Neighborhood type dissonance								
MM2 for NSF resident			−0.149	−2.66				
Residential location								
NSF resident	0.536	3.56	0.441	5.05	0.468	3.59		
CON resident	−0.279	−2.10	−0.261	−3.16				
Sociodemographics								
Professional/technical occupation							0.100	2.14
Household income (1000 US$)[a,b]							−0.002	−2.79
Female in multiple-worker family							−0.323	−4.56
'Other' household[b]					−0.385	−1.92		
Personality and lifestyle factors								
Adventure seeker factor[b]							0.102	3.92
Frustrated factor							−0.060	−2.12
Travel attitudes								
Pro-env. solutions factor							0.082	2.82
Liking for traveling by personal vehicle							−0.049	−1.92
Liking for traveling by bus					−0.123	−1.90		
Liking for walking/cycling/jogging					0.664	10.60	0.348	10.54
Liking for traveling to eat out							−0.074	−2.17
Constant	0.838	8.18	1.905	30.56	−1.213	−6.51	1.304	6.45
σ			0.910	33.61			0.795	34.90
ρ			0.850	16.18			0.713	8.39
N observations	1303				1303			
Log likelihood (constant only)[c]	−2085.4				−2085.4			
Log likelihood (convergence)	−1819.3				−1650.1			
Model improvement (χ^2)	532.2				870.6			
Likelihood ratio index (model system)	0.128				0.209			
Likelihood ratio index (selection model estimated separately, equally likely model as base)	0.399				0.489			

[a] Category midpoint used as estimate of true value.
[b] Variable known to influence the extent of residential neighborhood type mismatch (see Schwanen and Mokhtarian, 2004).
[c] Estimate for a regular tobit model without selection equation (see Footnote 2 to the text).

Conclusions
結論

Overall weekly distance traveled and traveled distances by private car are shortest among true urbanites and longest among consonant and dissonant suburban dwellers.
真都市生活者は総合走行距離と自動車走行距離が最短である。一方、不一致の組が最長の距離である。

The probability of using rail is itself ordered as hypothesized, with the highest probability among true urbanites, followed by mismatched urban dwellers, and lowest among true suburbanites.
鉄道の利用について、仮説通り、真都市生活者が最高の確率である。その次は不一致郊外生活者であって、真郊外生活者が最低の確率である。

Urban residents are more likely to travel by these modes but, the conditional distances are more related to modal preference than mismatch.
徒歩や自転車利用について、真都市生活者が最高の確率であるが、走行距離は地区一致より手段に対して意識によることが明らかにした。

In short, if you prefer a suburban lifestyle but live in the “wrong” neighborhood you are better capable of realizing your preferred type of travel than if you prefer urban life but reside in the “wrong” type of place.
つまり、もし郊外生活の方が好きであるが間違ってる近隣地区に住む場合は、間違っている郊外地区に住む場合より、好きな手段を利用できること可能性の方が高い。