

Do attitudes cause travel behavior or vice versa?

Results from a panel analysis.

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An alternative conceptualization of the attitude-behavior relationship in travel behavior modeling

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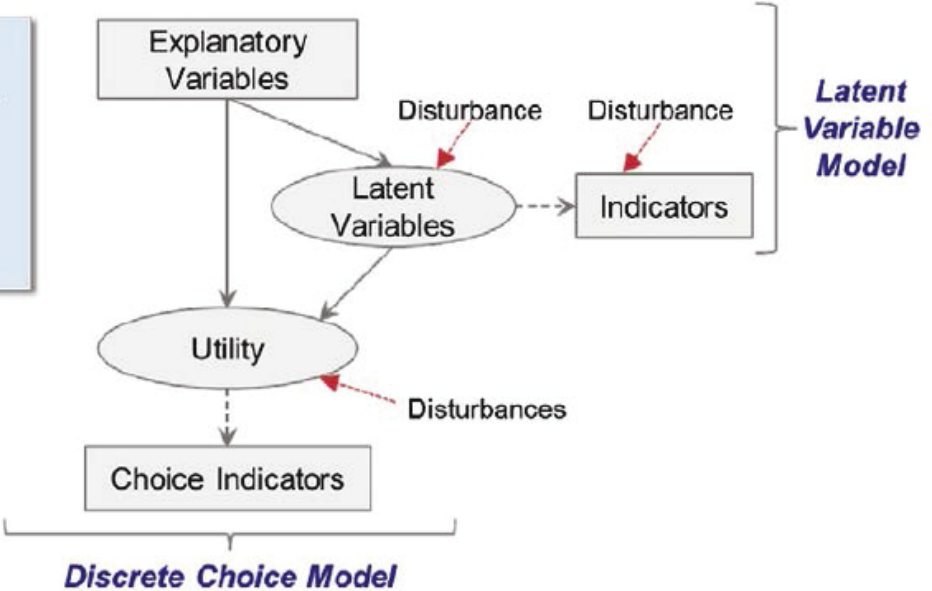
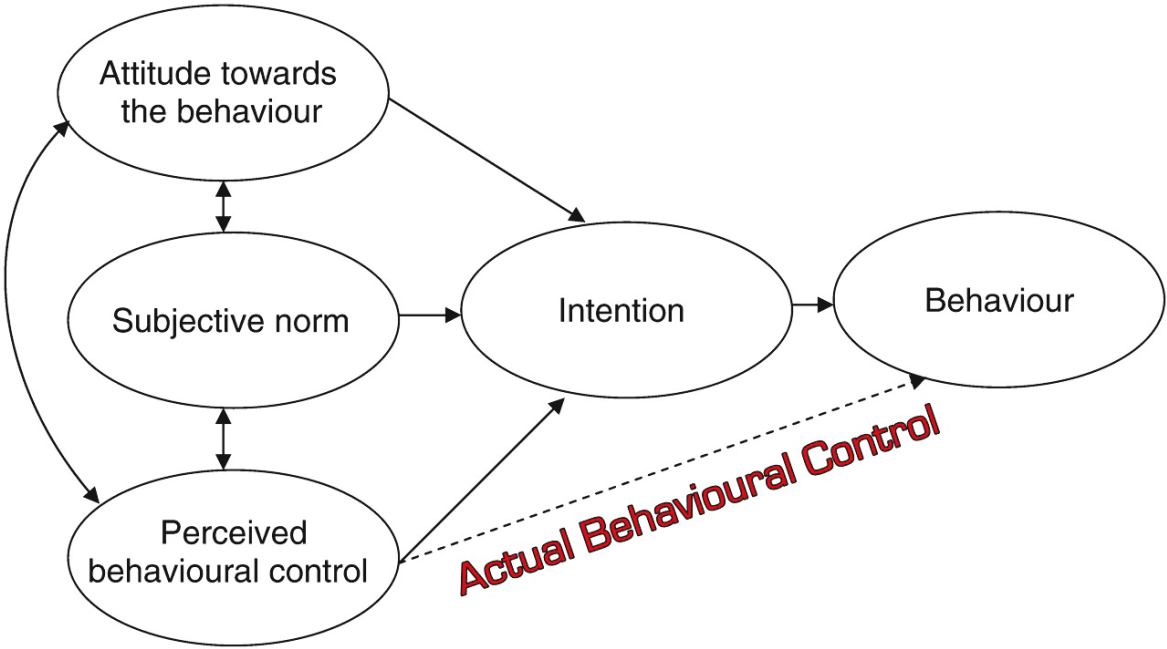
Caspar Chorus (Delft University of Technology)

# Role of attitudes

- Attitudes are relevant in the prediction of travel behavior:
  - In psychological models (e.g. theory of planned behavior)
  - In econometric models (e.g. hybrid choice models)
- Models are often applied in transport domain.

# Theory of planned behavior

# Hybrid choice model



# The role of attitudes revisited

- Attitudes precede behavior... but is this true?
- Empirically, effects have been found in both directions
  - Dobson et al. (1978); Tardiff, (1977), Tischer and Phillips (1979)
- Theoretically, such effects may be explained by Festinger's cognitive dissonance theory
  - Confronted with dissonance, people may adjust their behavior *or* their attitudes

# Cognitive dissonance theory

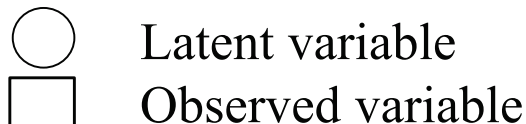
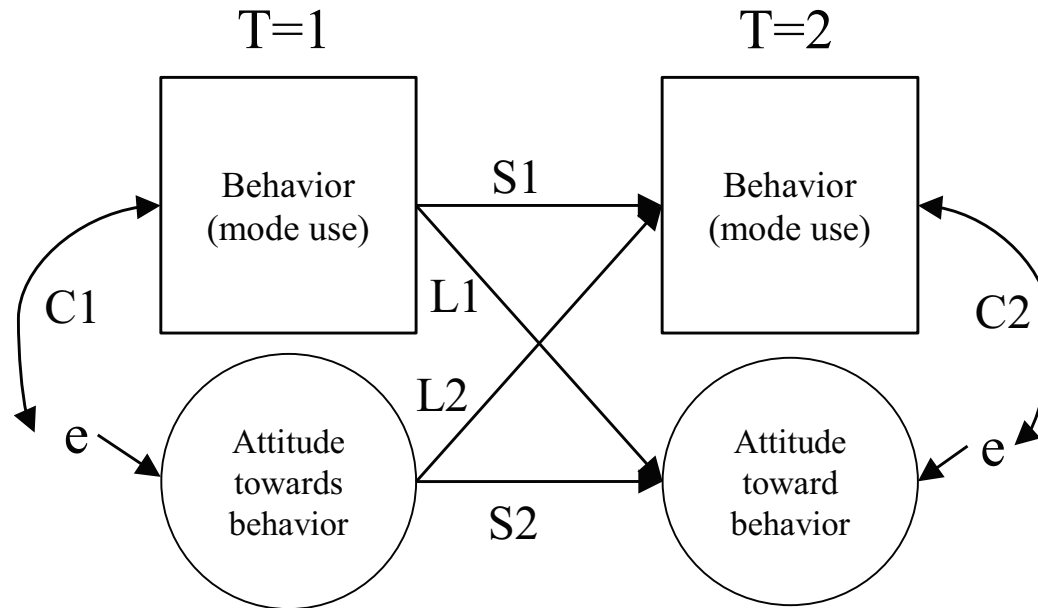
- Dissonance reduction strategies:
  - Alter the behavior ('I quit smoking'),
  - Alter the cognition ('smoking is not that bad for health')
  - Add new cognitions ('If I stop smoking I will gain weight, which is equally unhealthy').
- A priori, unknown which strategy is more likely to occur.
  - An influence from behavior towards attitudes is as likely as an influence from attitudes towards behavior.

# Study objectives:

1. To assess the direction of causation between attitudes and behavior *using panel data*
2. To develop and test a new framework to study attitude-behavior (in)consistency over time

# Conceptual model (1):

## Cross-lagged panel model



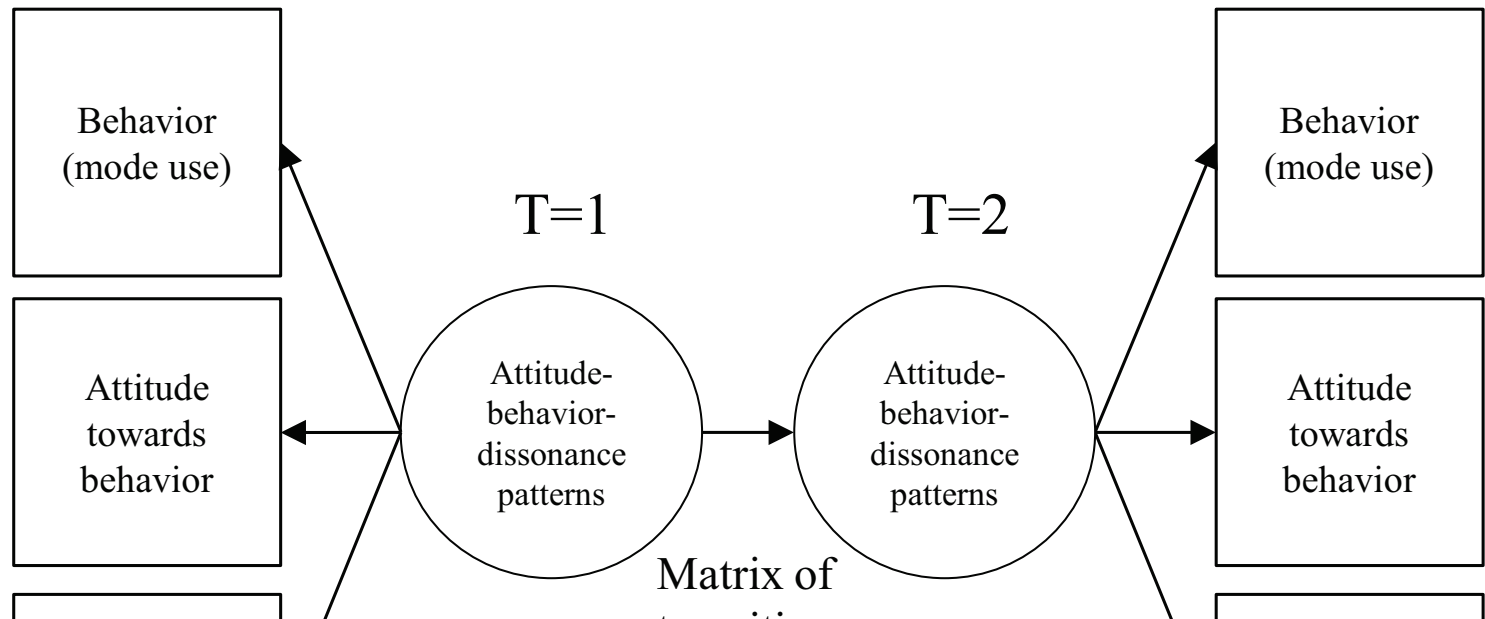
Does behavior influence attitudes and/or vice versa?

L (cross-)lagged relationship



# Conceptual model (2):

## Latent transition model



Are consonant travellers more inert than dissonant travellers? Do dissonant travellers adjust their attitudes or their behavior?

# Methods and data

- A mobility survey was administered twice among members of the LISS panel
  - Longitudinal Internet Studies for the Social sciences panel ([www.lissdata.nl](http://www.lissdata.nl))
- 1,376 members completed both waves (2013 and 2014)

# Sample distributions are consistent with population distributions

Variable	Category	
<b>Gender (%)</b>	Female	53
	Male	47
<b>Age</b>	Mean (SD)	52.1 (16.8)
<b>Primary occupation (%)</b>	Employed or self-employed	50
	Student	7
	Housekeeping	9
	Pensioner	23
	Other	11
<b>Level of education (%)</b>	Low	33
	Intermediate	35
	High	32
<b>Personal net monthly income in Euros (%)</b>	No income	9
	1-1000 Euro	24
	1001-2000 Euro	42
	2001-3000 Euro	19
	Over 3001 Euro	6

# Measures: Travel behavior

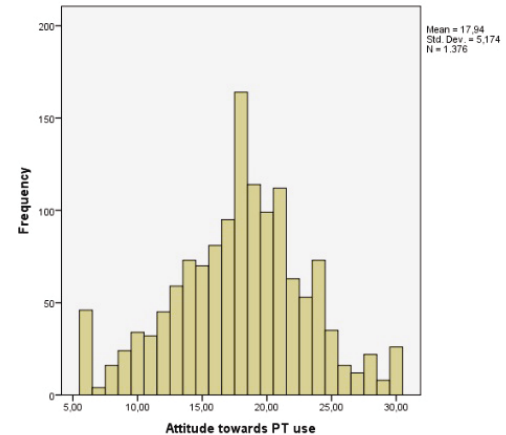
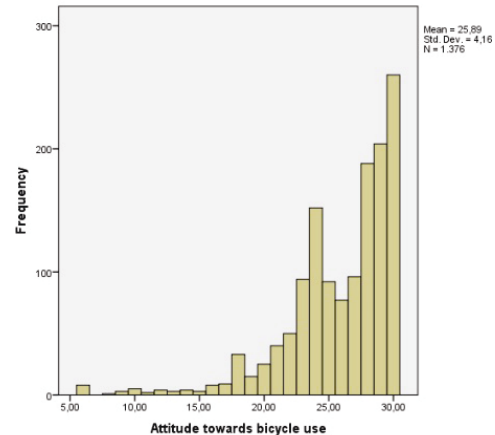
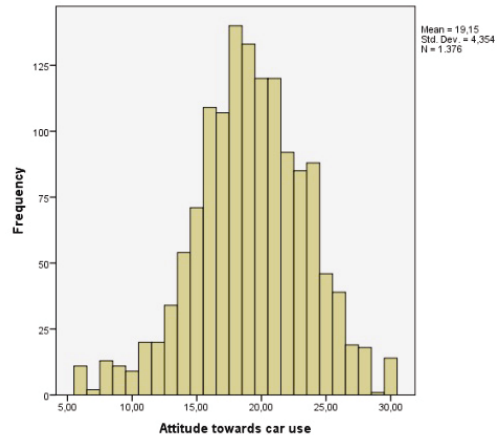
- Distance travelled by car, PT and bicycle in a 'regular week'
- Recoded to 5-point ordinal scale

	Car		Bicycle		Public transport	
<b>Kilometres in a regular week – wave 1 (%)</b>	0	21	0	19	0	77
	1-20	16	1-10	29	1-20	9
	21-50	15	11-20	15	21-50	4
	51-200	27	21-40	16	51-200	6
	>200	21	>40	21	>200	4

# Measures: Attitude towards behavior

- Six items measured on 5-point scales:
  - [Driving by car / Cycling / Using PT] is **easy**
  - [Driving by car / Cycling / Using PT] is **relaxing**
  - [Driving by car / Cycling / Using PT] is **fun**
  - [Driving by car / Cycling / Using PT] is **healthy**
  - [Driving by car / Cycling / Using PT] is **safe**
  - [Driving by car / Cycling / Using PT] is **environmental friendly**
- For each mode, the items converged on a single factor
- Composite measures were created and recoded to 5-point ordinal scales

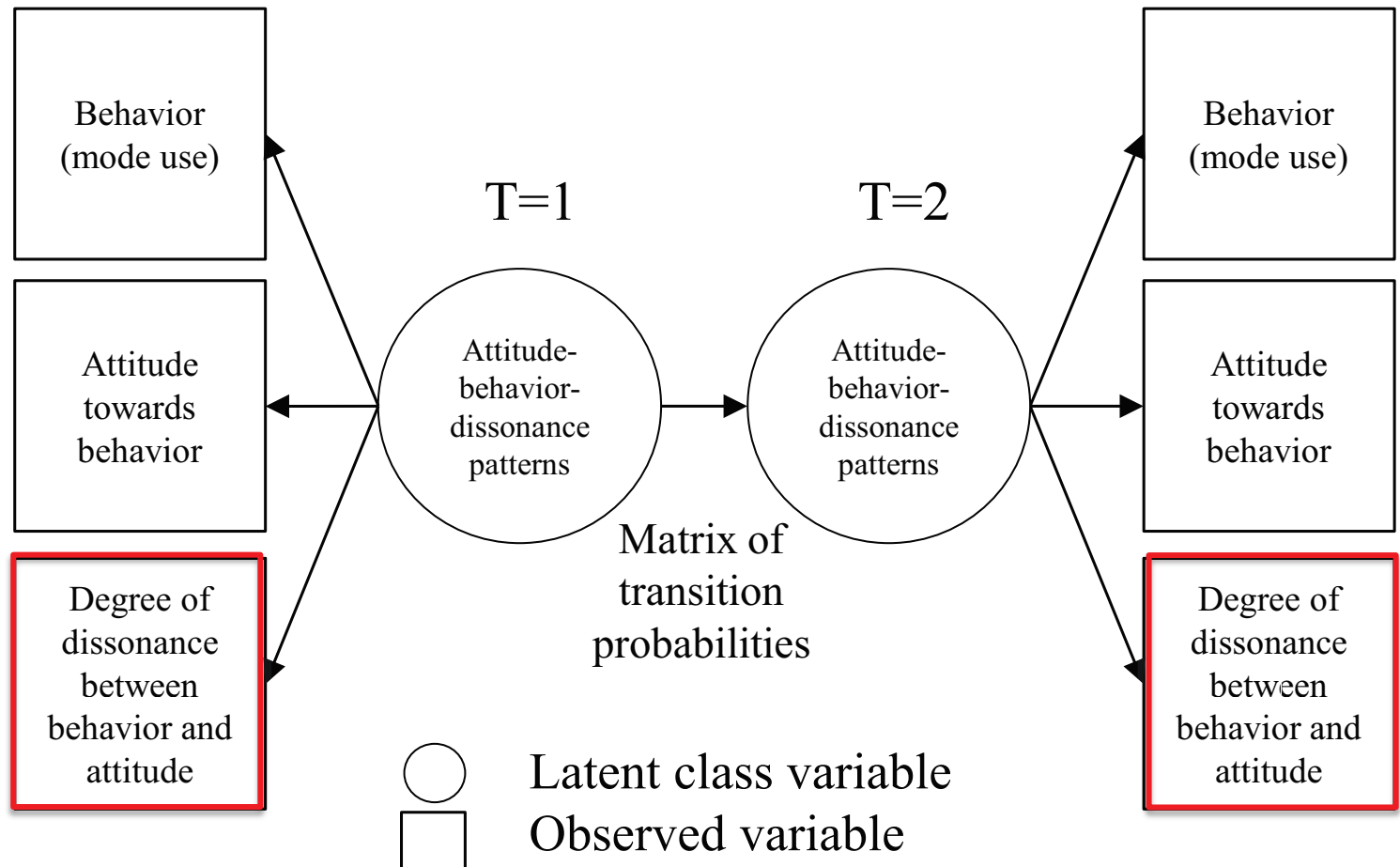
# Measures: Attitude towards behavior



	Car		Bicycle		Public transport	
<b>Attitude towards mode use – wave 1 (%)</b>	--	3	--	1	--	9
	-	15	-	1	-	20
	0	44	0	7	0	40
	+	31	+	31	+	24
	++	7	++	60	++	6

# Conceptual model (2):

## Latent transition model



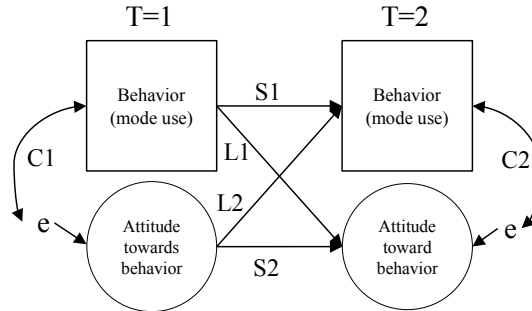
# Measures: Degree of dissonance

- The absolute differences between the 5-point behavioural and the 5-point attitudinal scale

	Car		Bicycle		Public transport	
Degree of dissonance – wave 1 (%)	0	3	0	1	0	9
	1	15	1	1	1	20
	2	44	2	7	2	40
	3	31	3	31	3	24
	4	7	4	60	4	6

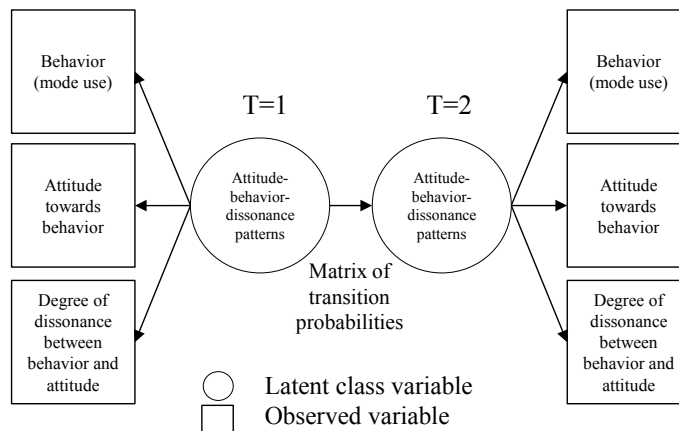


# Model estimation



- Latent variable
- Observed variable
- e Error term
- C Correlation
- S Stability relationship
- L (cross-)lagged relationship

- 3 Structural Equation Models (one for each mode)
- Attitudes specified as LV's
- Mplus 7.2



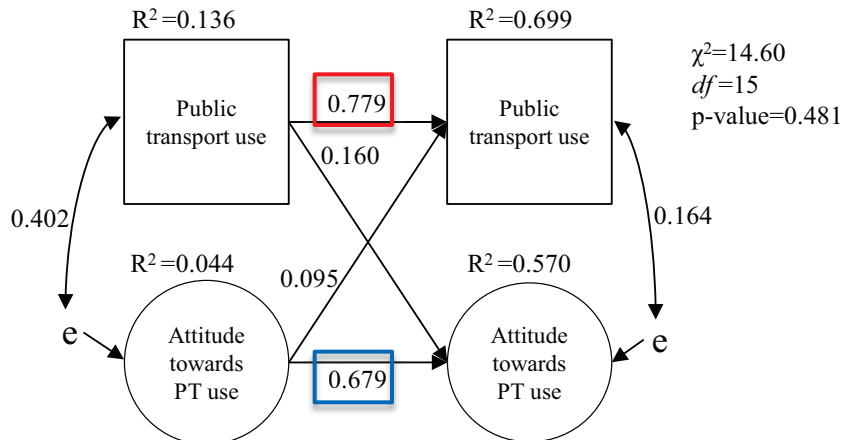
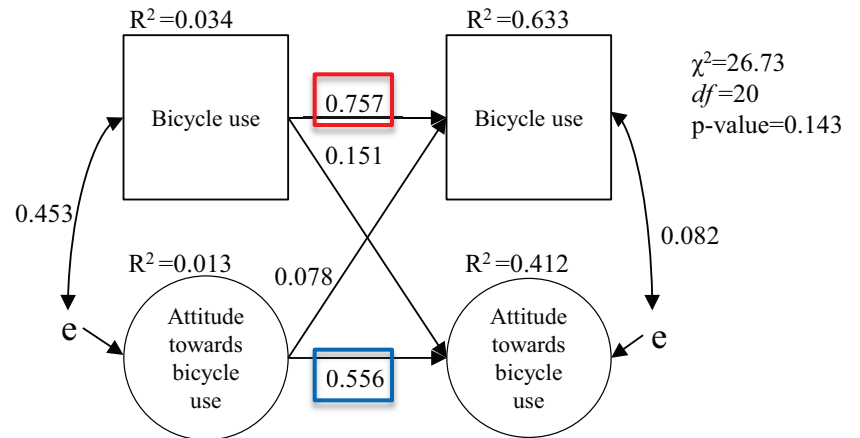
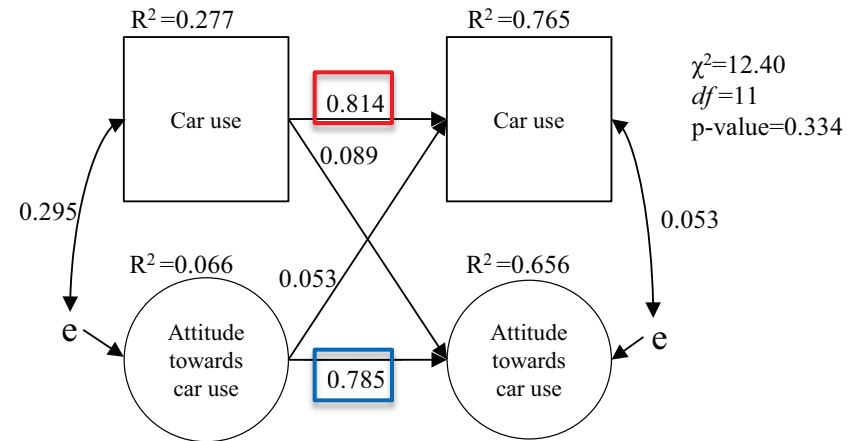
- 3 latent transition models (one for each mode)
- 4 classes optimal for car and bicycle, 5 for PT
- Latent Gold 5.0

# Results

Standardized coefficients

Across all three modes:

- **Behavior** is relatively more stable
- **Attitudes** are relatively less stable

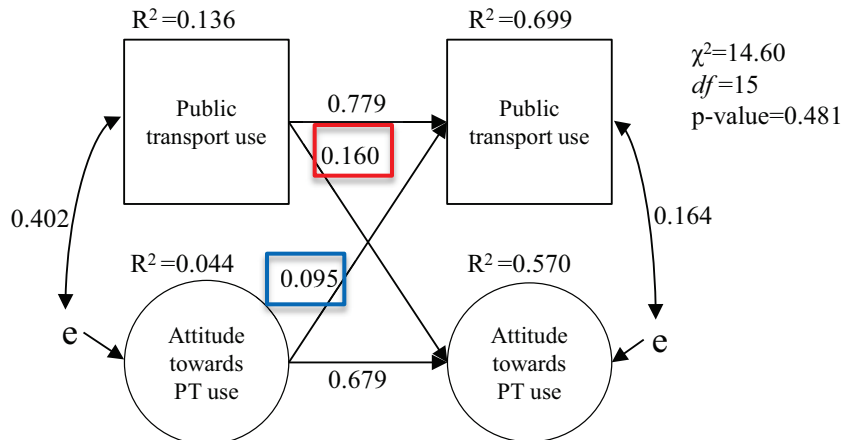
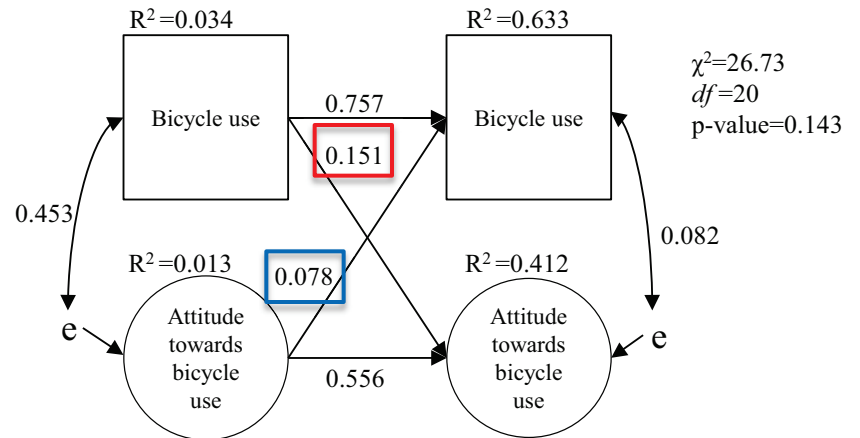
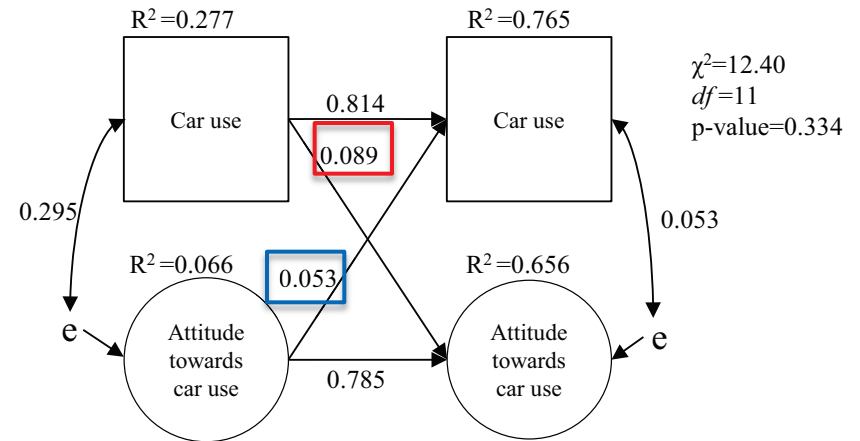


# Results

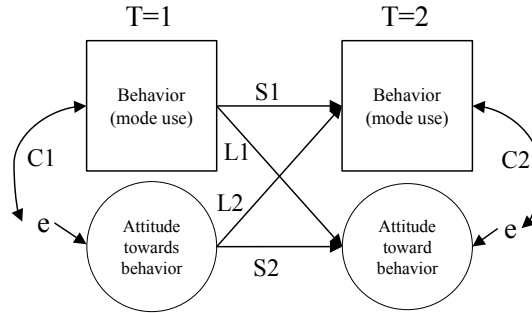
Standardized coefficients

Across all three modes:

- Effects of **behavior on attitudes...**
- ...stronger than **vice versa**

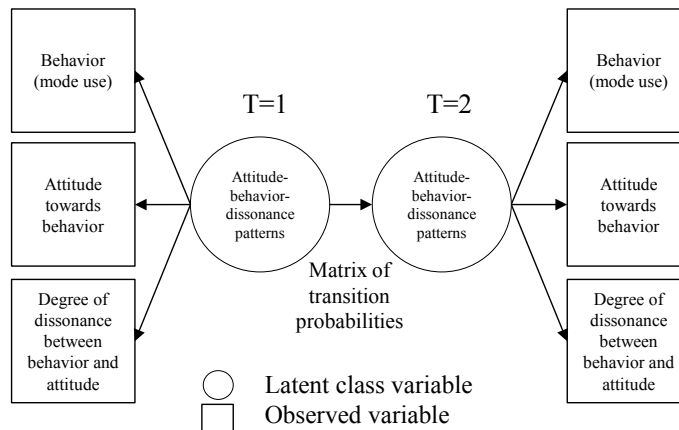


# Model estimation



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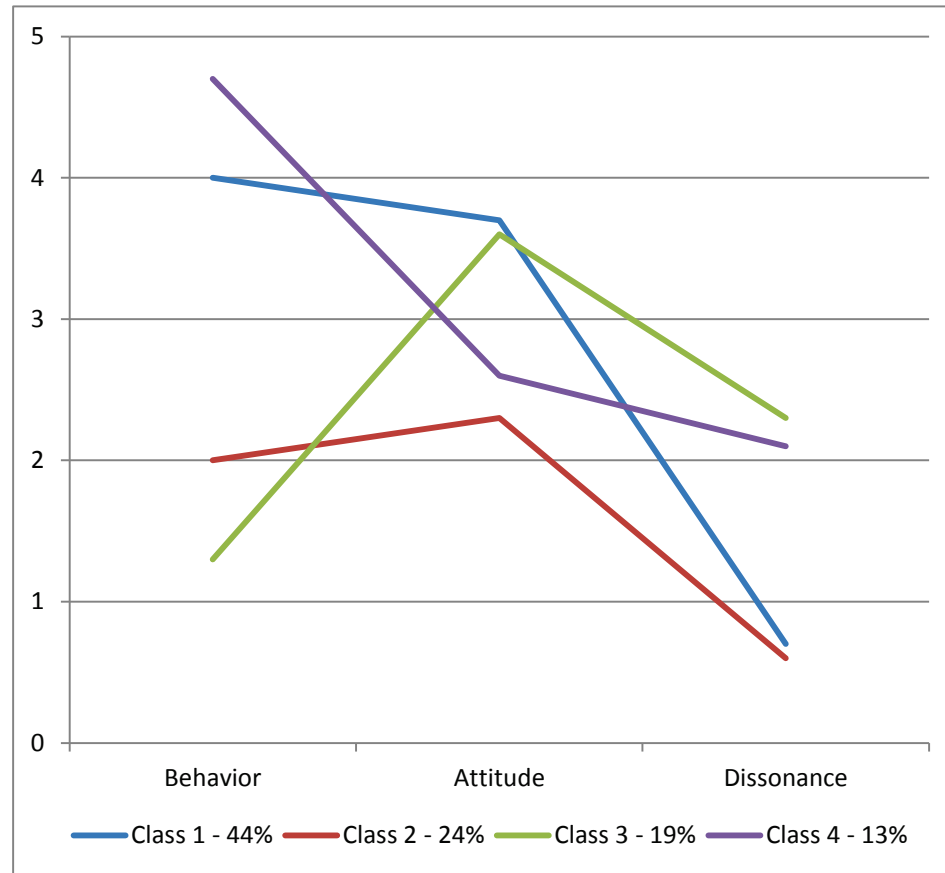


- 3 latent transition models (one for each mode)
- 4 classes optimal for car and bicycle, 5 for PT
- Latent Gold 5.0

# Car

4 classes:  
 2 consonant (1 & 2)  
 2 dissonant (3 & 4)

Transition probability matrix  
**Consonant** more inert than **dissonant** travellers

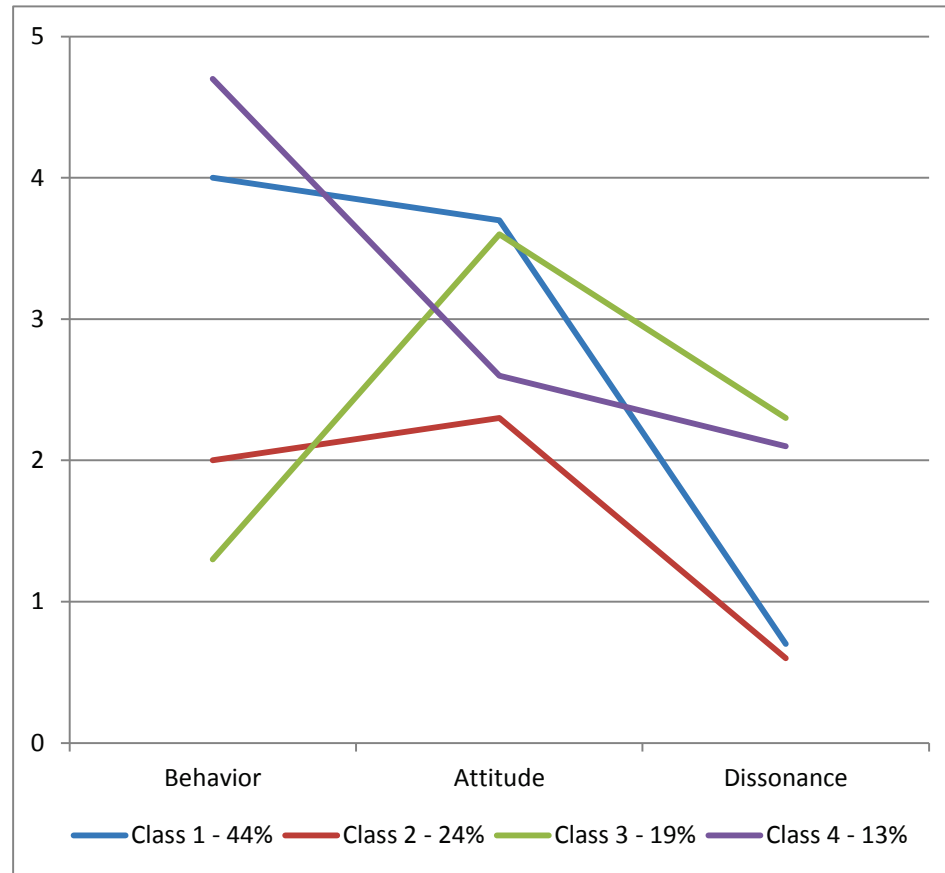


		Class membership probability at t=1			
		1	2	3	4
Class membership probability at t=2	1	0.77	0.07	0.11	0.42
	2	0.04	0.69	0.27	0.09
	3	0.05	0.21	0.60	0.01
	4	0.14	0.03	0.01	0.47

# Car

4 classes:  
 2 consonant (1 & 2)  
 2 dissonant (3 & 4)

Transition  
 probability matrix  
 dissonant travellers  
 adjust their attitudes



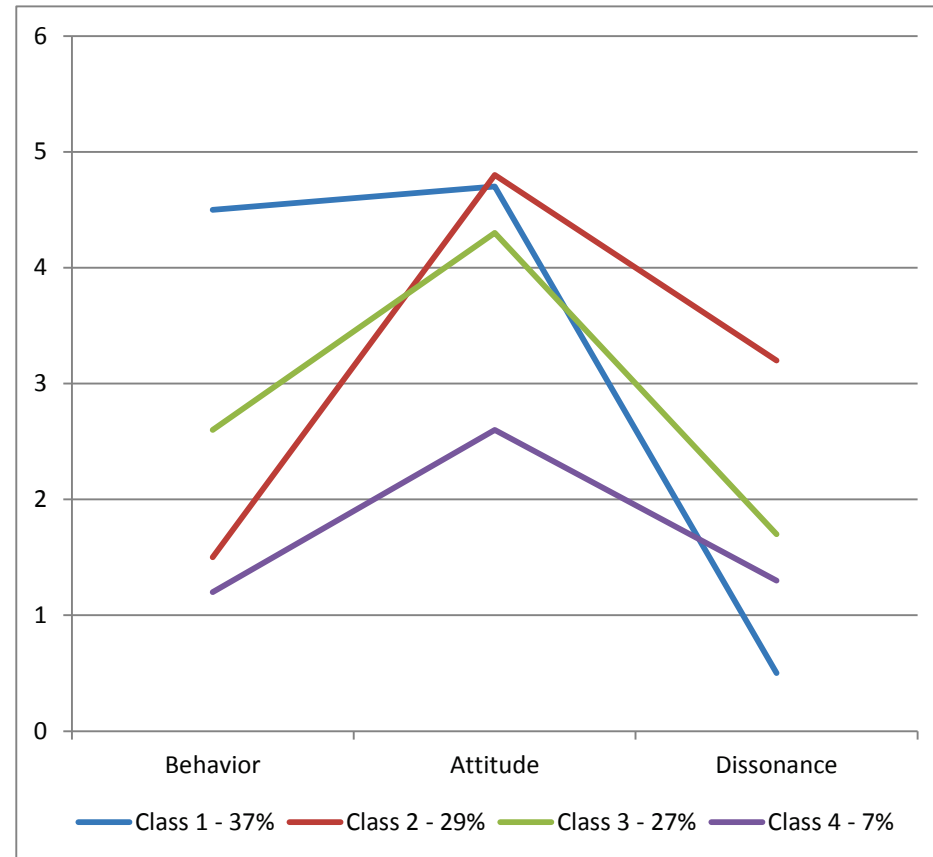
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	2	0.04	0.09	0.27	0.09
	3	0.05	0.21	0.60	0.01
	4	0.14	0.03	0.01	0.47

# Bicycle

4 classes:

1 consonant (1)

3 dissonant (2, 3 & 4)



Transition probability matrix

Consonant more inert than dissonant travellers

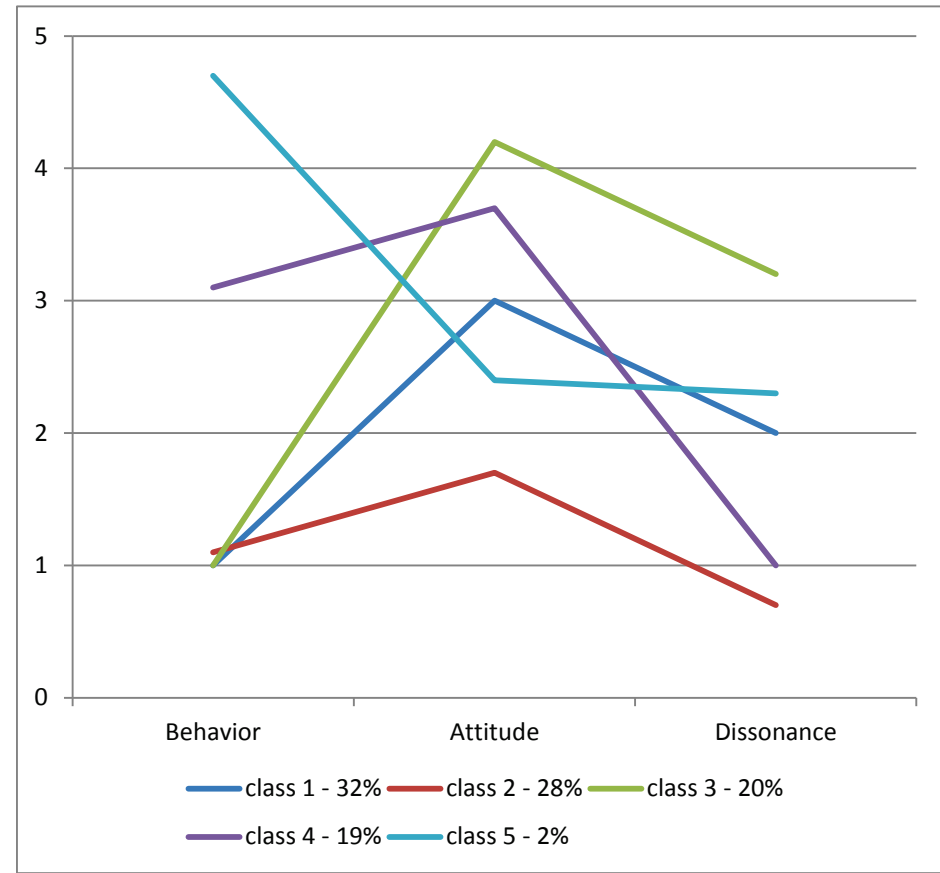
		Class membership probability at t=1			
		1	2	3	4
Class membership probability at t=2	1	0.75	0.10	0.24	0.00
	2	0.06	0.57	0.26	0.26
	3	0.18	0.25	0.48	0.13
	4	0.01	0.08	0.02	0.61

# Bicycle

4 classes:  
 2 consonant (2 & 4)  
 3 dissonant (1, 3 & 5)

Transition probability matrix

**Consonant** more inert than **dissonant** travellers

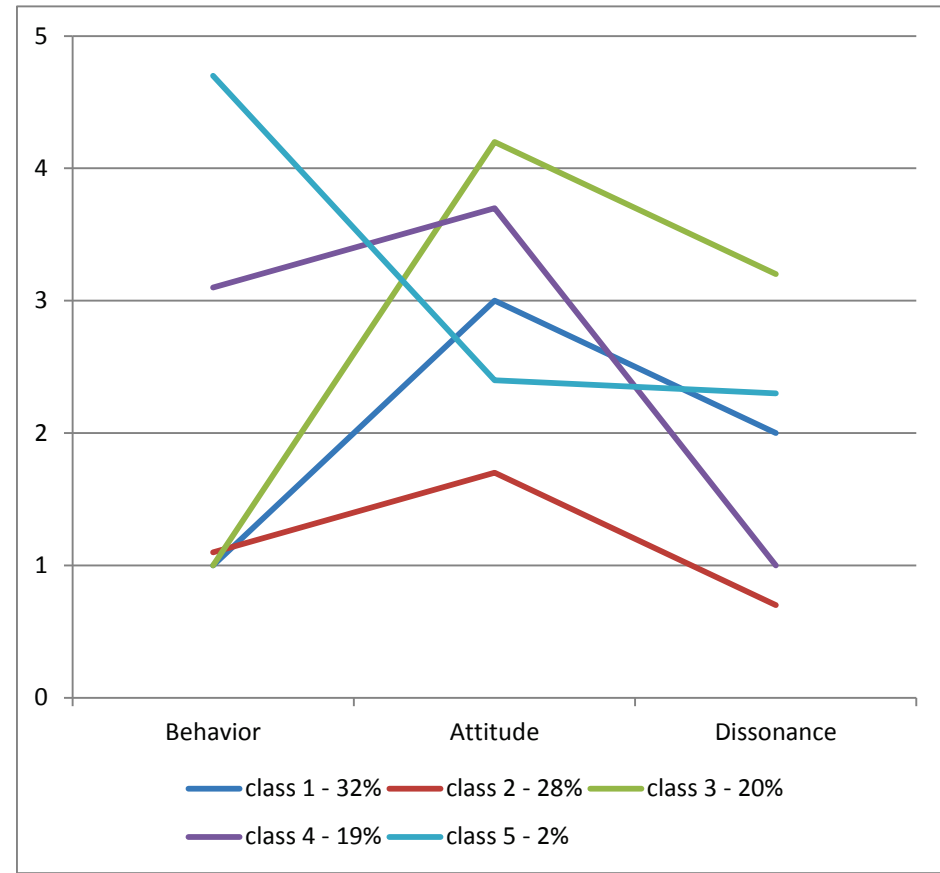


		Class membership probability at t=1				
		1	2	3	4	5
Class membership probability at t=2	1	0.49	0.28	0.35	0.12	0.08
	2	0.23	0.62	0.06	0.06	0.14
	3	0.20	0.04	0.43	0.12	0.00
	4	0.07	0.04	0.15	0.69	0.50
	5	0.00	0.01	0.00	0.02	0.28



# Bicycle

4 classes:  
 2 consonant (2 & 4)  
 3 dissonant (1, 3 & 5)



Transition  
 probability matrix  
 Students

		Class membership probability at t=1				
		1	2	3	4	5
Class membership probability at t=2	1	0.49	0.28	0.35	0.12	0.08
	2	0.23	0.62	0.06	0.06	0.14
	3	0.20	0.04	0.43	0.12	0.00
	4	0.07	0.04	0.15	0.50	0.00
	5	0.00	0.01	0.00	0.02	0.28

	Car				Bicycle				Public transport					
	1	2	3	4	1	2	3	4	1	2	3	4	5	
<b>Gender</b>														
<b>Female</b>	0.40	0.72	0.70	0.34	0.50	0.56	0.53	0.59	0.55	0.52	0.52	0.50	0.68	
<b>Male</b>	0.60	0.28	0.30	0.66	0.50	0.44	0.47	0.41	0.45	0.48	0.48	0.50	0.32	
<b>Age</b>														
<b>15 - 34</b>	0.15	0.16	0.30	0.15	0.17	0.17	0.22	0.16	0.15	0.18	0.10	0.27	0.74	
<b>35 - 54</b>	0.39	0.28	0.20	0.37	0.29	0.37	0.33	0.28	0.35	0.39	0.31	0.21	0.17	
<b>55 or older</b>	0.46	0.57	0.50	0.48	0.54	0.46	0.45	0.56	0.50	0.42	0.60	0.52	0.08	
<b>Primary occupation</b>														
<b>(self-) Employed</b>	0.61	0.34	0.32	0.71	0.44	0.59	0.51	0.41	0.53	0.56	0.50	0.39	0.34	
<b>Student</b>	0.03	0.09	0.19	0.01	0.10	0.04	0.08	0.03	0.04	0.03	0.03	0.16	0.56	
<b>Housekeeping</b>	0.04	0.17	0.13	0.02	0.07	0.08	0.10	0.14	0.12	0.09	0.07	0.05	0.04	
<b>Pensioner</b>	0.24	0.25	0.23	0.21	0.29	0.19	0.21	0.23	0.23	0.17	0.30	0.28	0.02	
<b>Other</b>	0.08	0.16	0.14	0.05	0.10	0.10	0.10	0.19	0.09	0.14	0.10	0.11	0.06	
<b>Level of education</b>														
<b>Low</b>	0.29	0.34	0.50	0.22	0.33	0.35	0.30	0.44	0.34	0.36	0.36	0.27	0.23	
<b>Intermediate</b>	0.37	0.36	0.30	0.31	0.34	0.34	0.34	0.39	0.34	0.39	0.31	0.33	0.40	
<b>High</b>	0.34	0.30	0.20	0.47	0.33	0.31	0.36	0.17	0.32	0.26	0.32	0.40	0.37	
<b>Income</b>														
<b>No income</b>	0.04	0.14	0.21	0.03	0.11	0.07	0.11	0.09	0.10	0.09	0.05	0.12	0.26	
<b>1-2000 Euro</b>	0.64	0.74	0.69	0.55	0.66	0.70	0.62	0.72	0.67	0.67	0.72	0.62	0.52	
<b>Over 2001 Euro</b>	0.32	0.12	0.10	0.42	0.23	0.24	0.28	0.19	0.23	0.24	0.24	0.26	0.22	

# Conclusions & implications

- Travel attitudes and behaviors mutually influence each other over time.
- Contrary to assumptions in most models, behavior influences attitudes more than vice versa.
  - Present models (strongly) overestimate the effects of attitudes (because they do not account for reverse causation)
  - Changing people's attitudes may not be effective as typically assumed
- Dissonant travelers are more likely to switch to another attitude-behavior pattern.
- Dissonant travelers are more likely to adjust their attitudes than their behavior.
  - E.g. if policy makers do not act on dissonance with respect to public transit, people will generally adjust their attitudes towards this mode downwards.

# Future work

- Combine approach with mobility biographies approach (life events)
- Qualitative research
- More waves

# Questions