

A new perspective on the role of attitudes in explaining travel behavior: A psychological network model.

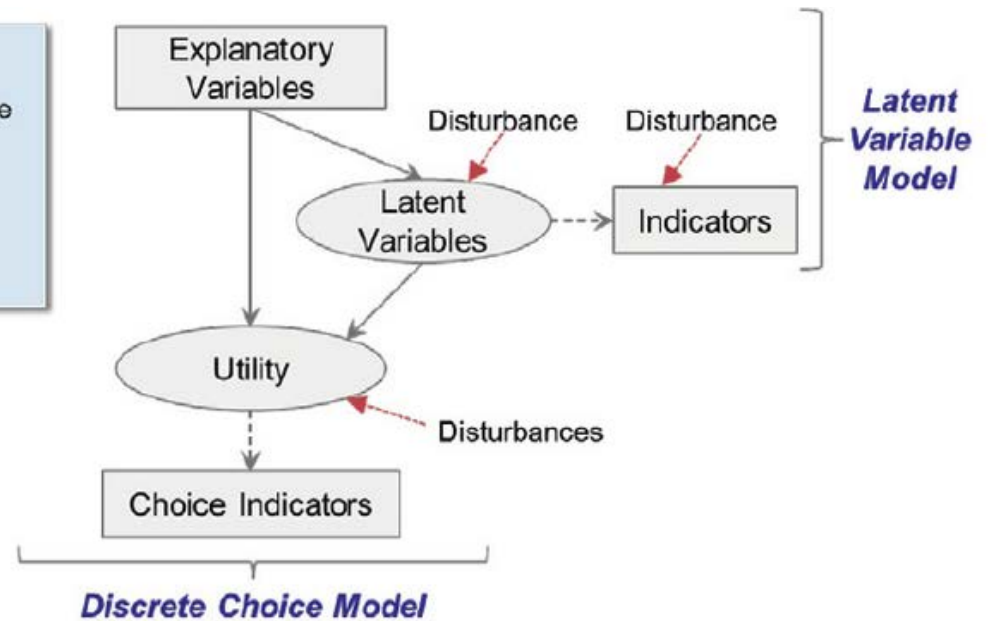
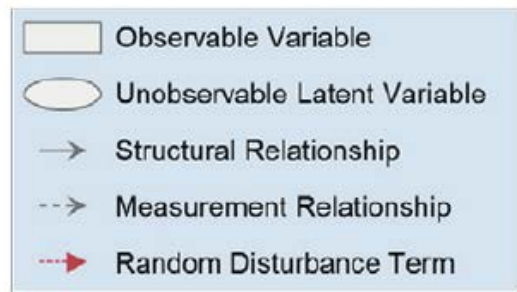
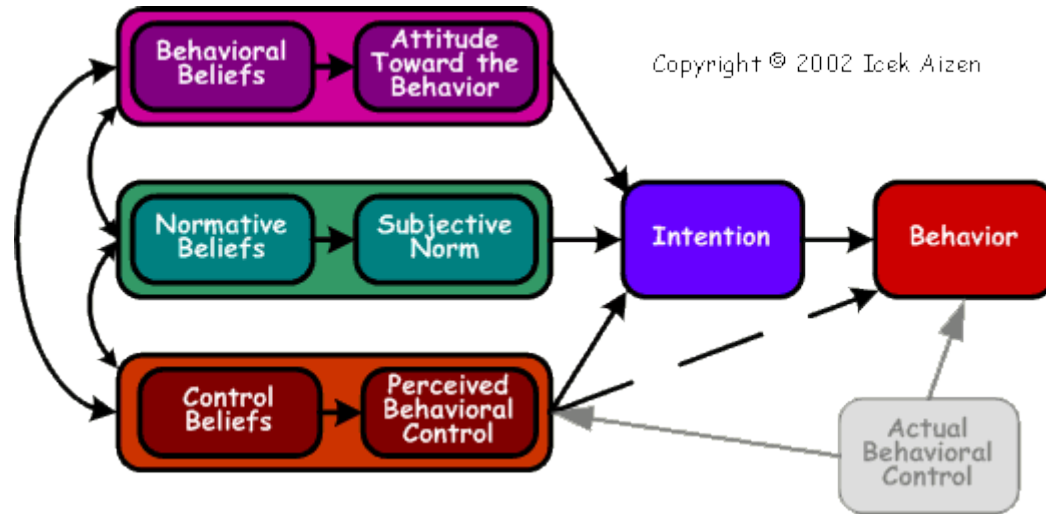
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Role of attitudes

- Attitudes (“feelings of favorability towards on object or behavior”) are relevant in the prediction of (travel) behavior:
 - In social-psychological models (e.g. theory of planned behavior)
 - In econometric models (e.g. hybrid choice models)



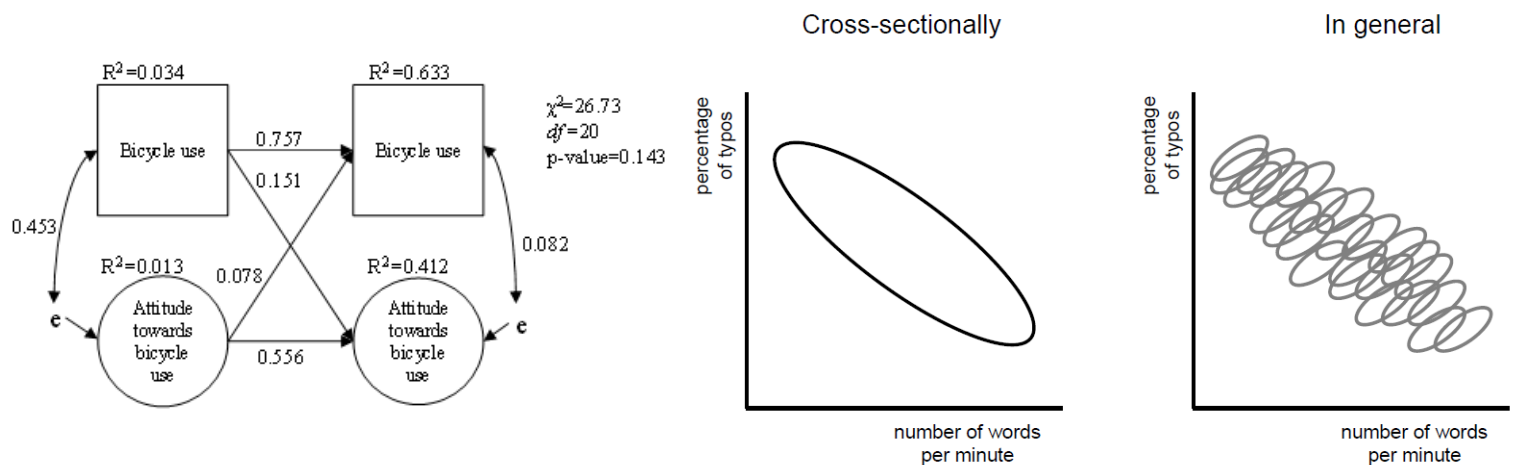
Key assumptions (3x)

1. attitudes → (choice) behavior

- Actually: attitudes ↔ (choice) behavior (Kroesen et al., 2017)

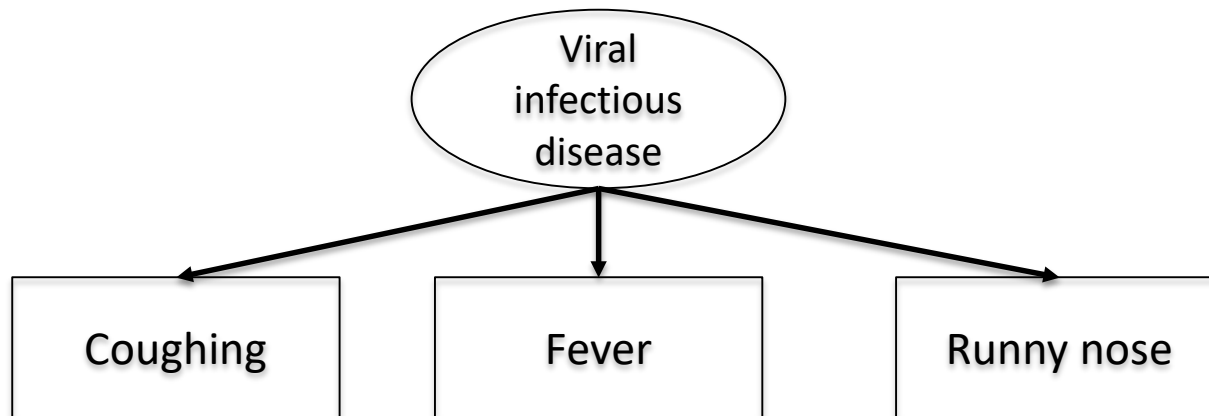
2. between-person = within-person

- between-person ≠ within-person (Chorus & Kroesen, 2014)
- E.g. typing speed and typos (Hamaker, 2012)
- Attitude-behavior relationship may not exist at within-person level



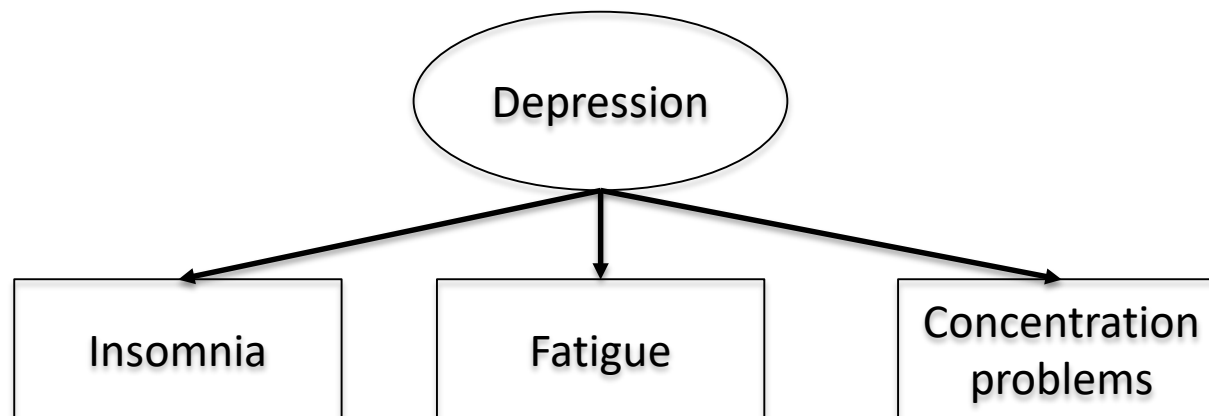
3. Local independence assumption

- Items are reflective of latent construct and thus
 - conditionally independent (after controlling for the latent variable)
 - interchangeable
- 'Common cause' model
- Makes sense for physical/biological diseases, e.g. a cold:



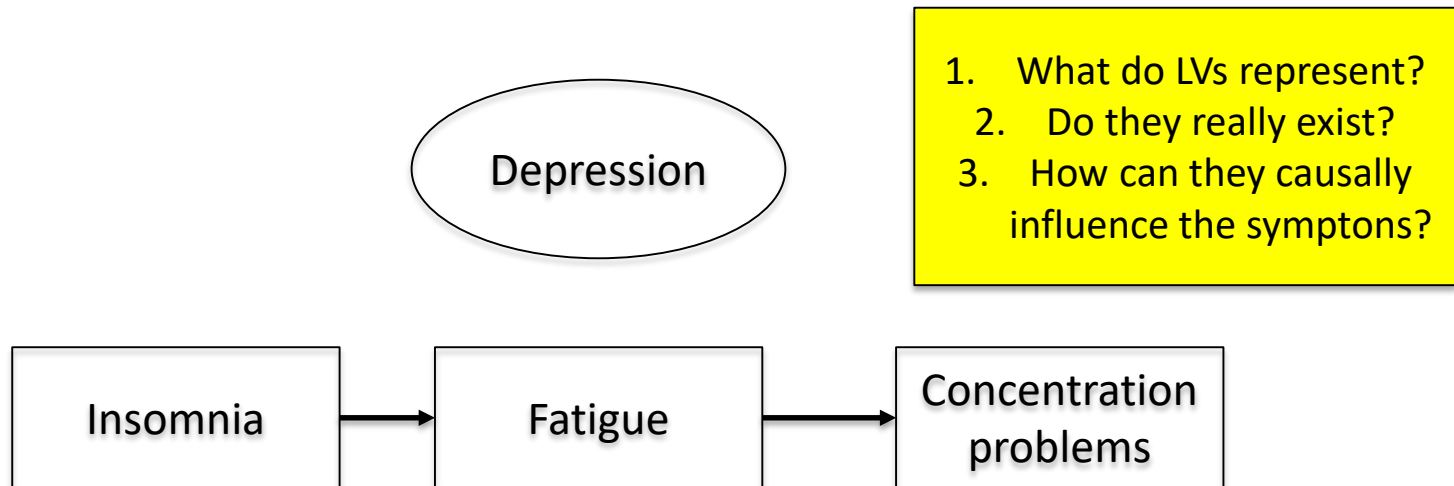
3. Local independence assumption

- But this does not make sense for psychological constructs, e.g. depression (Borsboom et al., 2013):



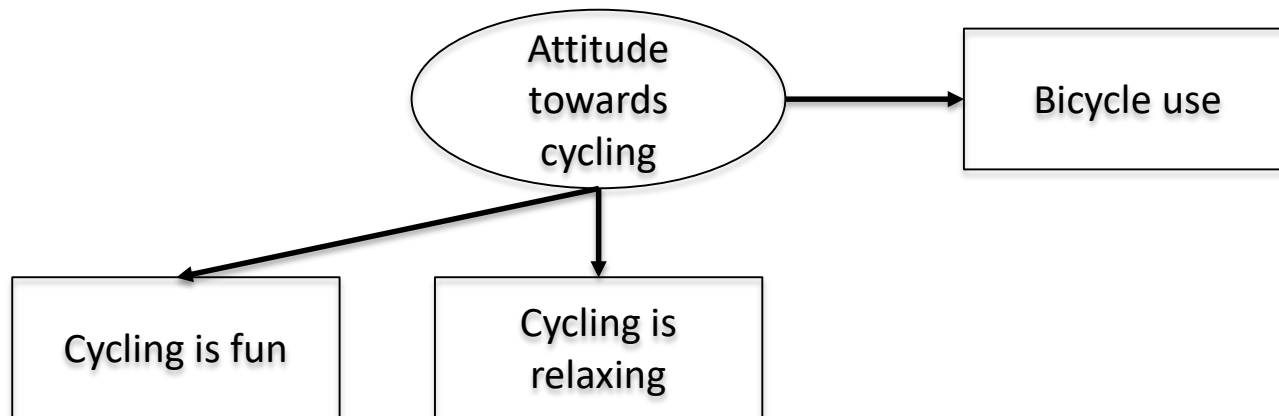
3. Local independence assumption

- But this does not make sense for psychological constructs, e.g. depression (Borsboom et al., 2013)
- Here, direct effects are actually more intuitive / plausible
- Moreover, conceptualization of LVs also raises unanswerable theoretical questions



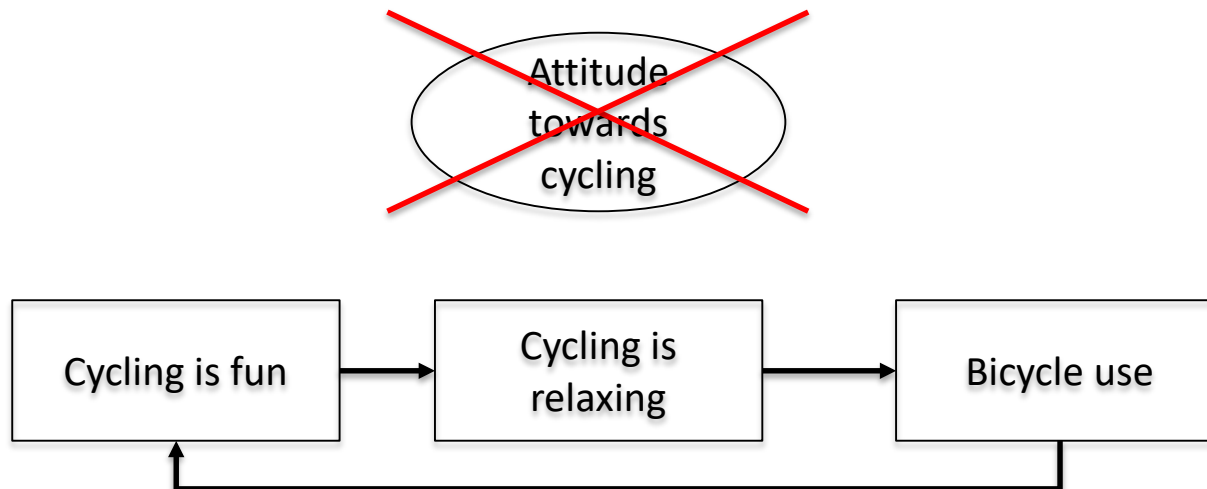
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- The same holds for (travel-related) attitudes and behaviors
- So instead of assuming an underlying LV and an effect of the LV on (choice) behavior



3. Local independence assumption

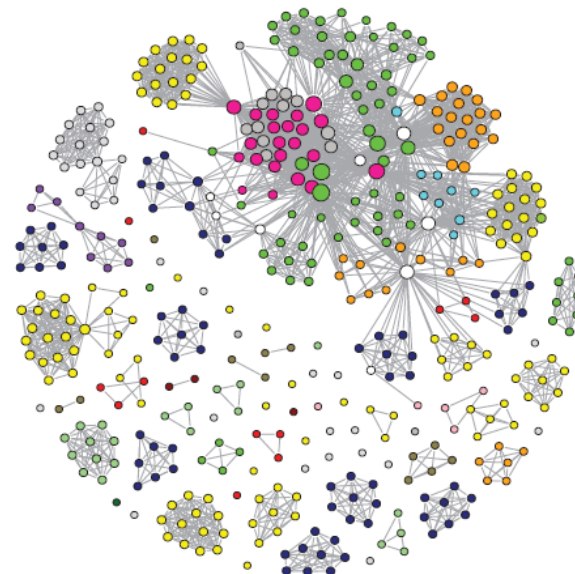
- The same holds for (travel-related) attitudes and behaviors
- So instead of assuming an underlying LV and an effect of the LV on (choice) behavior
- Empirical associations arise from direct effects (operating in multiple directions)



Network psychometrics

- Items (beliefs, feelings, behaviors) are conceived of as mutually reinforcing nodes within a network
 - Structure? Clustering?
 - Node centrality? Bridging symptoms / nodes?

- Disorders usually first diagnosed in infancy, childhood, or adolescence
- Delirium, dementia, and amnesia and other cognitive disorders
- Mental disorders due to a general medical condition
- Substance-related disorders
- Schizophrenia and other psychotic disorders
- Mood disorders
- Anxiety disorders
- Somatoform disorders
- Factitious disorders
- Dissociative disorders
- Sexual and gender identity disorders
- Eating disorders
- Sleep disorders
- Impulse control disorders not elsewhere classified
- Adjustment disorders
- Personality disorders
- Symptom is featured equally in multiple chapters



Estimating psychological networks

- Cross-sectional data (1 wave)
 - Between-person network based on individual scores (***undirected*** relationships)
 - Partial correlation coefficients with LASSO regularization
- Panel data (2-10 waves)
 - Within-person network based on deviation scores from individual means (synchronous ***undirected*** relationships)
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- Panel data (>10 waves)
 - Within and between-person temporal network (lagged ***directed*** relationships)
 - (multilevel) vector autoregressive (VAR) models

PCC's provide strongest evidence of possible causal links

Empirical illustration

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)
- 1,376 members completed both waves (2013 and 2014)

Sample distributions are consistent with population distributions

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

Representative of Dutch population

Measures: Travel behavior

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

	Car		Bicycle		Public transport	
Kilometres in a regular week – wave 1 (%)	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 **convenient**
 - [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**
- Note: for each mode, the items converged on a single factor (“attitude towards mode”)

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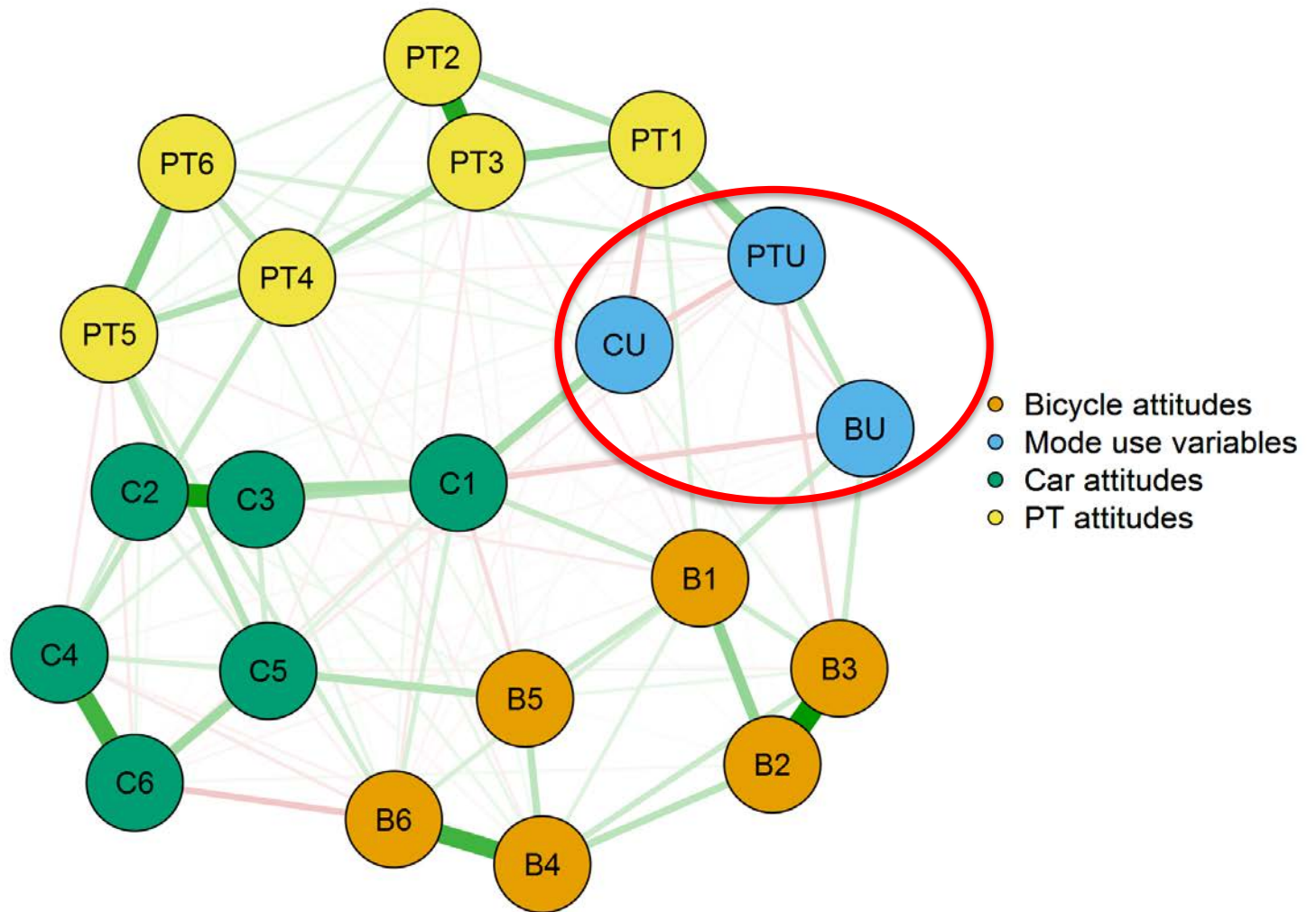
EBIC graphical LASSO procedure based on the polychoric correlation matrix (ordinal scales)

Partial correlation (weight) matrix

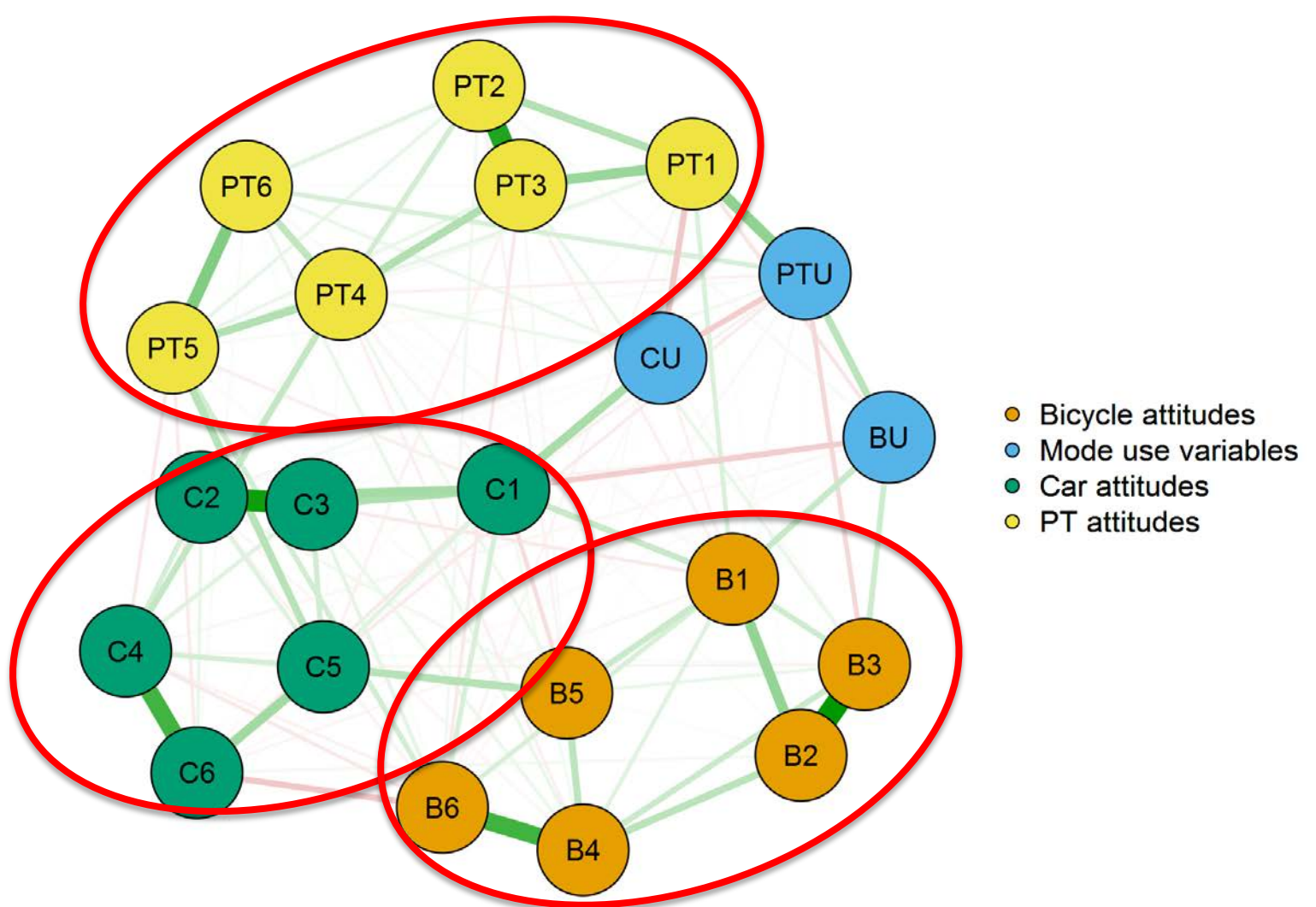
Weights matrix																					
Variable	Network																				
	B1	B2	B3	B4	B5	B6	BU	C1	C2	C3	C4	C5	C6	CU	PT1	PT2	PT3	PT4	PT5	PT6	PTU
B1	0.000	0.282	0.125	0.079	0.139	0.101	0.144	0.144	0.000	-0.056	0.000	0.000	-0.026	-0.036	0.095	0.000	-0.038	0.000	0.000	-0.019	0.025
B2	0.282	0.000	0.683	0.182	0.015	7.395e -4	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.000	0.011	0.000	0.000	0.000	0.000	-0.016	-0.005
B3	0.125	0.683	0.000	0.139	0.052	0.000	0.129	0.000	0.000	0.000	0.023	-0.033	0.000	-0.019	0.000	0.000	0.056	0.013	0.000	-0.004	-0.102
B4	0.079	0.182	0.139	0.000	0.173	0.509	0.000	0.032	-0.026	0.050	-0.035	0.000	0.000	0.000	0.000	0.000	0.000	-0.041	0.000	0.053	0.000
B5	0.139	0.015	0.052	0.173	0.000	0.000	0.000	-0.086	0.038	-0.008	0.043	0.194	7.305e -4	-0.005	0.022	-0.032	0.024	0.045	0.018	0.007	0.009
B6	0.101	7.395e -4	0.000	0.509	0.000	0.000	-0.006	0.102	-0.031	0.067	-0.059	0.000	-0.146	-0.017	-0.030	0.038	-0.055	-0.002	0.117	0.015	-0.022
BU	0.144	0.000	0.129	0.000	0.000	-0.006	0.000	-0.130	0.000	-0.031	-0.023	-0.009	-0.016	0.000	-0.067	0.024	0.000	-0.003	0.000	0.000	0.179
C1	0.144	0.000	0.000	0.032	-0.086	0.102	-0.130	0.000	0.239	0.213	0.000	0.077	-0.058	0.227	0.000	0.000	0.000	-0.014	-0.042	-0.028	-0.038
C2	0.000	0.000	0.000	-0.026	0.038	-0.031	0.000	0.239	0.000	0.642	0.111	0.082	0.053	0.018	0.000	-0.013	0.000	-0.010	0.000	0.000	0.034
C3	-0.056	0.000	0.000	0.050	-0.008	0.067	-0.031	0.213	0.642	0.000	0.079	0.118	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C4	0.000	0.000	0.023	-0.035	0.043	-0.059	-0.023	0.000	0.111	0.079	0.000	0.111	0.505	0.000	0.000	-0.012	0.000	0.157	-0.058	0.000	0.000
C5	0.000	0.000	-0.033	0.000	0.194	0.000	-0.009	0.077	0.082	0.118	0.111	0.000	0.248	0.017	0.000	0.000	-0.035	-0.013	0.187	0.000	-0.050
C6	-0.026	0.031	0.000	0.000	7.305e -4	-0.146	-0.016	-0.058	0.053	0.000	0.505	0.248	0.000	0.014	-0.012	0.000	0.011	0.000	-0.052	0.020	0.000
CU	-0.036	0.000	-0.019	0.000	-0.005	-0.017	0.000	0.227	0.018	0.015	0.000	0.017	0.014	0.000	-0.146	0.000	0.000	0.049	0.000	0.052	-0.132
PT1	0.095	0.011	0.000	0.000	0.022	-0.030	-0.067	0.000	0.000	0.000	0.000	0.000	-0.012	-0.146	0.000	0.199	0.268	0.026	0.059	0.000	0.293
PT2	0.000	0.000	0.000	0.000	-0.032	0.038	0.024	0.000	-0.013	0.000	-0.012	0.000	0.000	0.000	0.199	0.000	0.594	0.118	0.059	0.079	0.000
PT3	-0.038	0.000	0.056	0.000	0.024	-0.055	0.000	0.000	0.000	0.000	-0.035	0.011	0.000	0.268	0.594	0.000	0.207	0.055	0.014	0.000	0.000
PT4	0.000	0.000	0.013	-0.041	0.045	-0.002	-0.003	-0.014	-0.010	0.000	0.157	-0.013	0.000	0.049	0.026	0.118	0.207	0.000	0.203	0.169	-0.037
PT5	0.000	0.000	0.000	0.000	0.018	0.117	0.000	-0.042	0.000	0.000	-0.058	0.187	-0.052	0.000	0.059	0.059	0.055	0.203	0.000	0.332	0.021
PT6	-0.019	-0.016	-0.004	0.053	0.007	0.015	0.000	-0.028	0.000	0.000	0.000	0.000	0.020	0.052	0.000	0.079	0.014	0.169	0.332	0.000	0.103
PTU	0.025	-0.005	-0.102	0.000	0.009	-0.022	0.179	-0.038	0.034	0.000	0.000	-0.050	0.000	-0.132	0.293	0.000	0.000	-0.037	0.021	0.103	0.000

135 significant edges (our of 210)

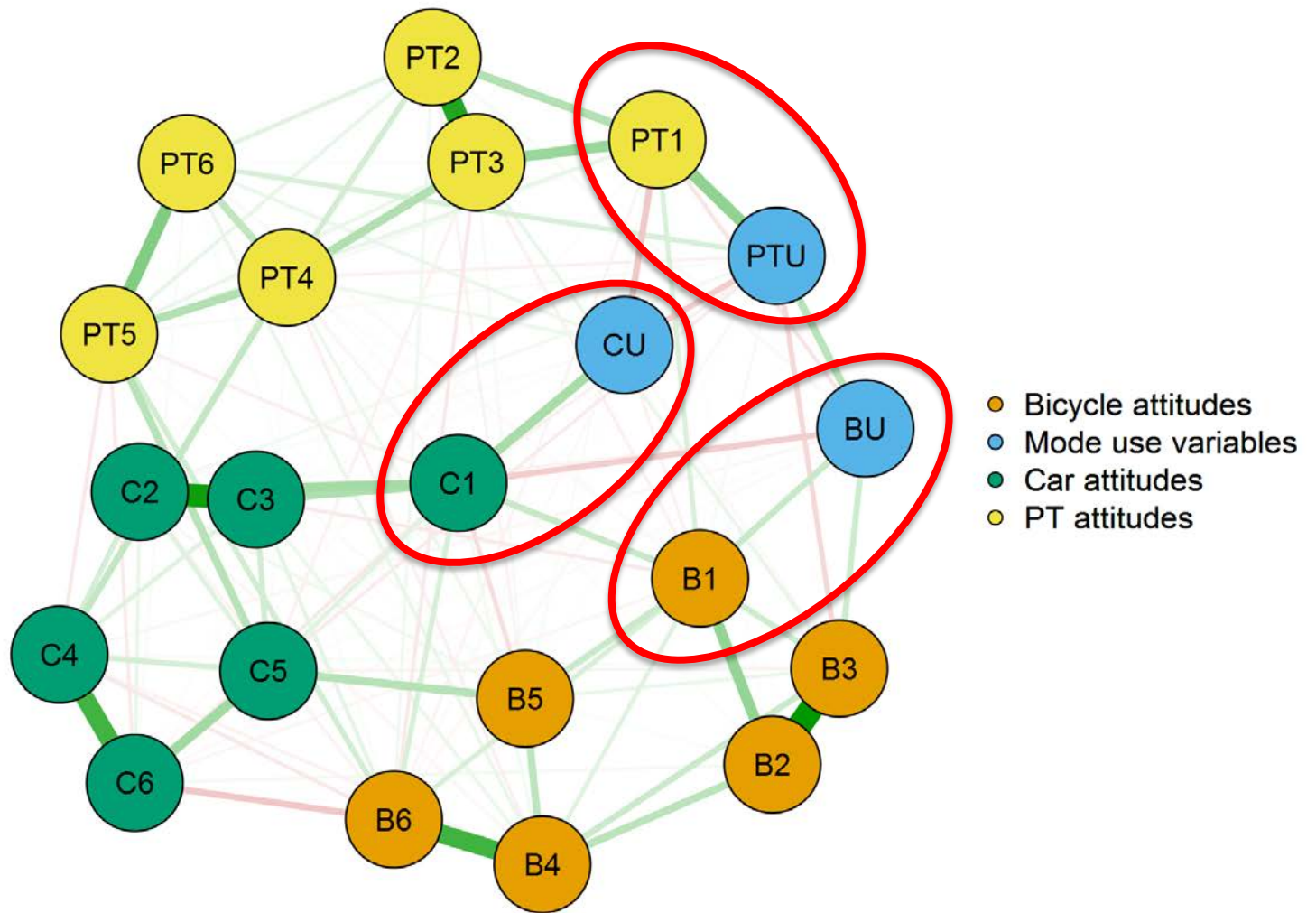
Visualization via Fruchterman–
Reingold algorithm



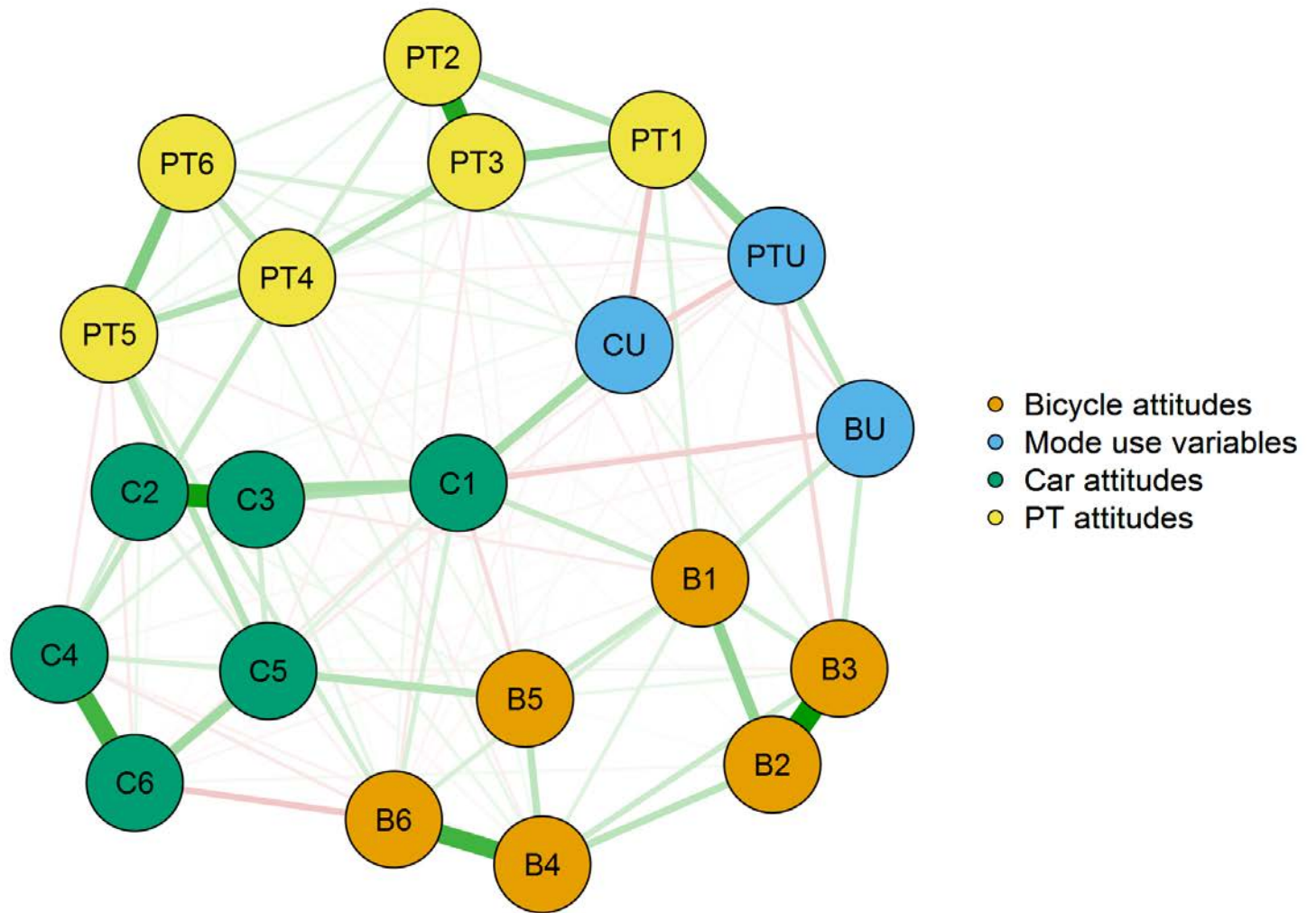
CU	Car use	BU	Bicycle Use	PTU	PT use
C1	Driving by car is convenient	B1	Cycling is convenient	PT1	Using PT is convenient
C2	Driving by car is relaxing	B2	Cycling is relaxing	PT2	Using PT is relaxing
C3	Driving by car is fun	B3	Cycling is fun	PT3	Using PT is fun
C4	Driving by car is healthy	B4	Cycling is healthy	PT4	Using PT is healthy
C5	Driving by car is safe	B5	Cycling is safe	PT5	Using PT is safe
C6	Driving by car is environmental friendly	B6	Cycling is environmental friendly	PT6	Using PT is environmental friendly



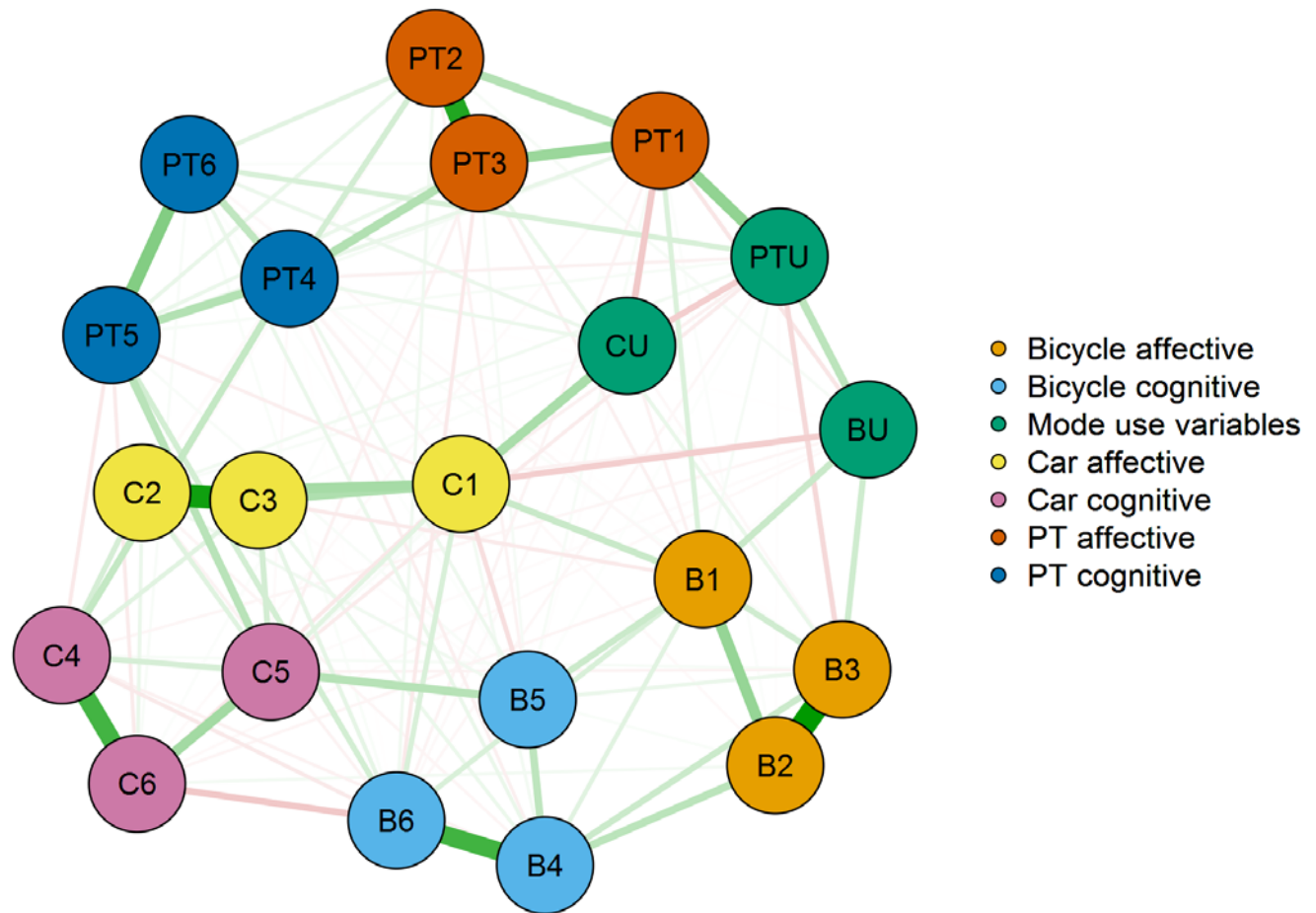
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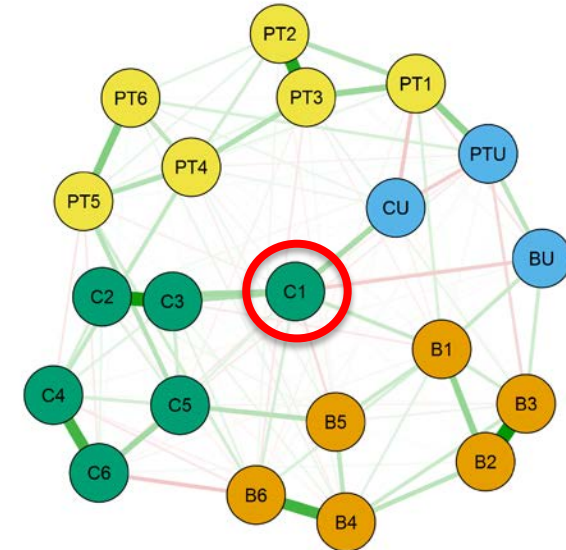
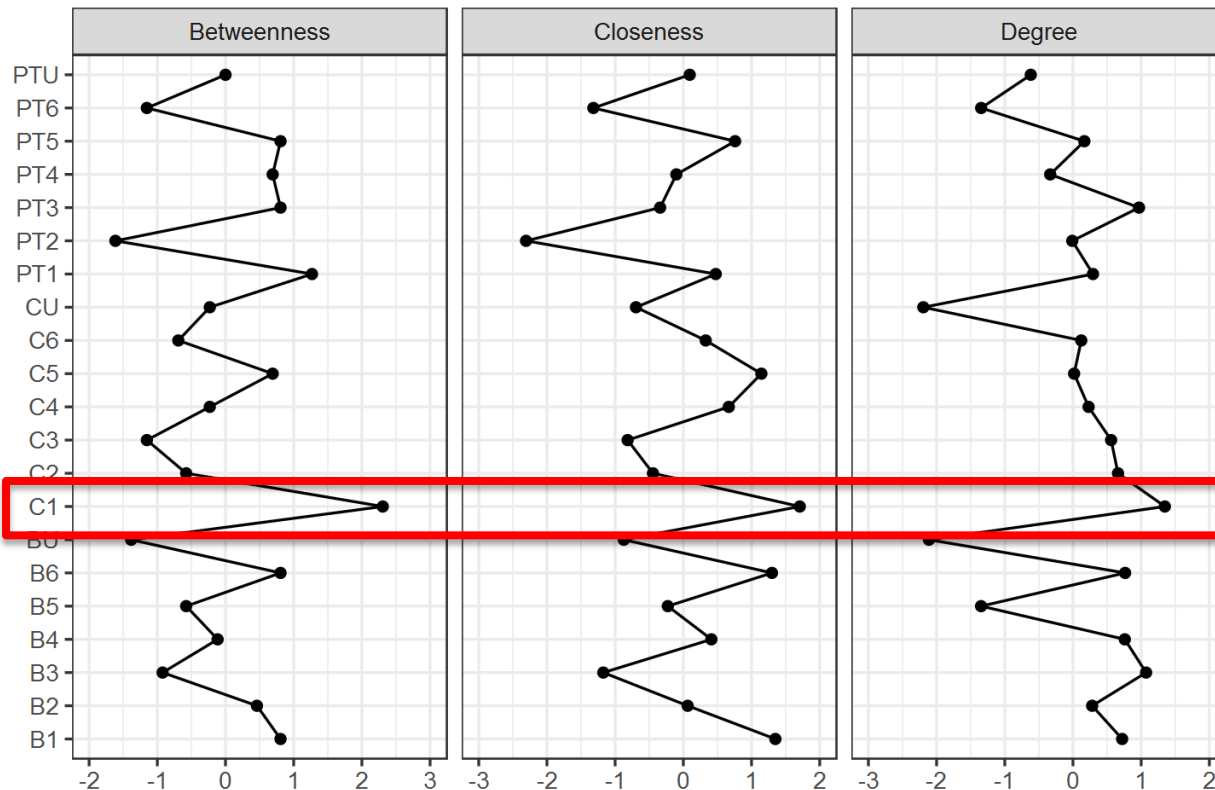
Interpretations

- Beliefs → feelings → behaviors?
- Clustering of beliefs and feelings can be interpreted as a means to reduce cognitive dissonance, while maintaining (belief) accuracy (Delege, 2016)
 - E.g. consider the following items:
 - ‘Driving by car is convenient/fun (feeling)’
 - ‘Driving by car is environmentally friendly (belief)’
 - By keeping these in separate clusters the belief that car use is not environmentally friendly (=accuracy) can be maintained, while cognitive dissonance can (mostly) be avoided.

Centrality indices

- Betweenness
 - Number of the shortest paths between two nodes that go through the node in question
- Closeness
 - Inverse of the sum of all the shortest paths between one node and all other nodes
- Strength (degree)
 - sum of absolute partial correlation coefficients between node and all other nodes

Centrality indices

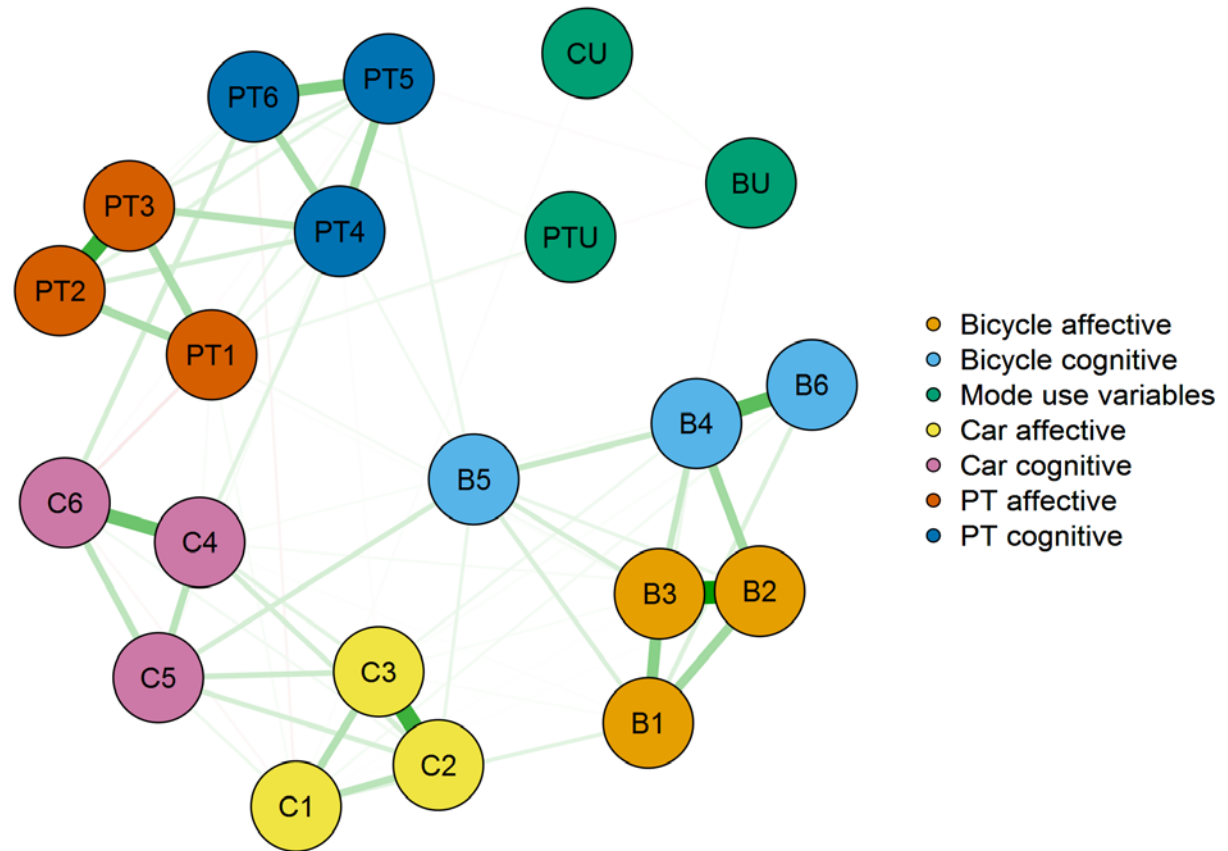


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- Only 76 significant edges (instead of 135)
- No edges connection attitudes and behaviors!



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Conclusions

- Psychological network models seem promising avenue to better understand attitude-behavior links
- Cognitions, feelings and behaviors cluster together
 - Strategy to increase both consistency and accuracy
- Convenience of the car most relevant / central
- Between-person network \neq within-person network!
 - Between-person network not reflective of within-person processes

Implications

- Results suggest that current theoretical models are overly restrictive in their assumptions
 1. Attitude → behavior
 2. Within-person = between-person
 3. Local independence
- And form a weak basis for policy interventions.

Questions