Integrating Travellers' Heterogeneity in Subscription Choice Processes Through Hybrid Choice Modelling: An Application to the Swiss Railway Market

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Workshop on Discrete Choice Models, June 22-24 2017 Page 1



- 1. Research Idea
- 2. Study 1
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix





Research Idea

Research Idea

Public transportation companies often classify their customers into only two classes, i.e. first and second class. Such a rough segmentation largely ignores travellers' specific needs and habits and may thus leave significant heterogeneity within classes.

Do **dedicated train sections** that create separate spaces for people with different travel needs and habits provide value to travellers?

Study 1 (207 participants) with 2 different types of section access:

- 1. Common section access
- 2. Common + dedicated section access

Study 2 (505 participants) with 2 different types of section access (+ specification):

- 1. Common section only
- 2. Common + dedicated section dedicated section (business); dedicated section (silence); dedicated section (family); dedicated section (life-style).



1. Research Idea

- 2. Study 1
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix



Study 1 – Survey Design and Method

Choice Design	SP data, D-efficient design (D-error: 0.0499), 60 choice tasks, 5 blocks, 3 unlabeled alternatives + no choice option, 4 attributes per alternative
Data Collection	Stratified sample by age; 20-minutes surveys including demographics, choice experiment and latent variables
Analysis	 Discrete choice model (MNL with EC for panel data structure); Hybrid choice model (MNL with EC and latent variable)





Study 1 – Choice Experiment

<u>Train Section Access</u>

- 1. Common Section Access
- 2. Dedicated Section Access

• <u>Travel during rush hour</u> (7:00-8:30 and 17:00-18:30)

- 1. No
- 2. Yes

Geographical Access

- 1. Area Small (Zone)
- 2. Area Medium (Region, Canton)
- 3. Route (> 10 km)
- 4. Area Small (Zone) + Route (> 10 km)
- 5. Area Medium (Region, Canton) + Route (> 10 km)
- 6. Area Big (Country)

Price

- 1. CHF 1'000.-
- 2. CHF 2'500.-
- 3. CHF 4'000.-
- 4. CHF 5'500.-





Study 1 - Example Specification for Choice Situation of Consumer

If these were the travel card options offered to you, would you buy any of those and if yes which one?

Choose by clicking on one of the buttons below:

	Travel Card Nr. 1	Travel Card Nr. 2	Travel Card Nr. 3	None	
Train Section Access	Common Section Access	Common + Dedicated Section Access	Common Section Access	I would not choose any of	
Geographical Access	Area Small (Zone)	Area Small (Zone) + Route (> 10 km)	Area Medium (Region, Canton) + Route (> 10 km)	these.	
Travel during rush hour (7:00 – 8:30 and 17:00 – 18:30)	Yes	s No Yes			
Price	CHF 5'500	CHF 1'000	CHF 4'000		
	0	0	0	0	

LEGEND (Click on the attribute name to see the description)

- Train Section Access
- Geographical Access
- Travel during rush hour (7:00 8:30 and 17:00 18:30)
- Price



Study 1 - Main Latent Construct in the Survey

Out-group Derogation:

Out-group derogation describes the phenomenon of people having a tendency to evaluate people of their outgroup (people with different behaviors, opinions, characteristics) more negatively (Dasgupta, 2004). Group biases often influence people's judgments, decisions, and behaviors (Dasgupta, 2004).

- H1a: When choosing between travel card offerings, travelers have a higher utility for travelcards that offer additional access to dedicated sections (vs. access only to common section).
- H1b: When choosing between travel card offerings, travelers with a high (vs. low) tendency towards out-group derogation derive a higher utility from travel cards that offer additional access to dedicated sections (vs. access only to common section).





Out-group Derogation Scale (Study 1 and 2)

Please indicate how much you agree with the following statements.									
When I am travelling alone on the train,	I strongly disagree. 1 I distance m	2 vself fro	3 m people .	4	5	6	I strongly agree. 7		
who have a different type of work than me.	0	0	0	0	0	\bigcirc	0		
who have a different family status than me.	0	\bigcirc	\odot	\bigcirc	\odot	\odot	0		
who are from a different social / economic class than me.	\odot	0	\odot	0	\bigcirc	\bigcirc	0		
who are culturally different from me.	\odot	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\odot	\odot		
When I am travelling alone, I separate fi	rom people								
who have different personal characteristics than me.	0	\bigcirc	\odot	\bigcirc	\odot	\odot			
who do not share my beliefs / values.	0	0	0	0	\bigcirc	0	\bigcirc		
who have different interests than me.	\odot	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\odot	0		
who behave differently than me.	0	0	0	0	0	0	\odot		
When I am travelling alone, I prefer not	to be on the	train wit	th people						
who have different travel needs than me.	0	\bigcirc	\bigcirc	0	\bigcirc	0	\bigcirc		
who have different purposes of travelling than me.	\odot	\bigcirc	\odot	\bigcirc	\odot	\odot			
who travel in different ways than me.	0	0	0	0	0	0	0		
who travel a distance different from mine	e. 🔘	0	0	0		\bigcirc			





- 1. Research Idea
- 2. Study 1
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix





Study 1 - Sample Description (I/II)

- 207 Swiss German respondents (101 female, 49 %).
- All respondents either want to buy a new subscription or renew an old one within the next year.
- All respondents will pay for their subscription by themselves.
- Stratified sampling by age.





Study 1 - Sample Description (II/II)



Main Purposes of Travelling by Train (Multiple Answers Possible)





Workshop on Discrete Choice Models, June 22-24 2017 Page 12



- 1. Research Idea
- 2. Study 1
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix



Study 1 – Discrete Choice Model

Parameter Description						coeff.	std. error	t-stat	p-value
Alternative Parameters									
Alternative constant						-3.45	.49	-6.99	.00 ***
Geographical access, area si	mall (zone))				-1.12	.19	-5.98	.00 ***
Geographical access, area si	mall (zone)) + route (> 10 km)				94	.16	-5.82	.00 ***
Geographical access, route	(> 10 km)					47	.14	-3.31	.00 ***
Geographical access, area n	nedium (re	gion, canton)				.28	.12	2.30	.02 **
Geographical access, area n	nedium (re	gion, canton) + route	e (> 10 km))		.31	.10	3.00	.00 ***
Travelling during rush hour	(7:00-8:	30 and 17:00 – 18:30))			1.84	.26	7.07	.00 ***
Train section access						.14	.09	1.43	.15
Price						00073	<.01	-6.92	.00 ***
Scale Parameters									
Scale effect, Lake Geneva r	egion					.70	.17	4.18	.00 ***
Scale effect, Swiss Plateau						.95	.14	6.63	.00 ***
Scale effect, North-west Sw	vitzerland					.93	.15	6.16	.00 ***
Scale effect, Eastern Switze	rland					.76	.15	4.93	.00 ***
Scale effect, Central Switze	rland					.73	.15	4.94	.00 ***
Scale effect, Ticino						1.78	.41	4.39	.00 ***
Error Component Paramo	eters								
Error component parameter	(panel dat	a)				2.43	.33	7.28	.00 ***
Summary Statistics									
$\mathcal{L}(eta_0)$	=	-2960.79	$ ho^2$	=	.402				
$\mathcal{L}(\hat{eta})$	=	-1770.89	$\overline{\rho}^2$	=	.396				
$-2[\mathcal{L}(\beta_0) - \mathcal{L}(\hat{\beta})]$	=	2379.80							
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Workshop on Discrete Choice Models, June 22-24 2017



Study 1 – Hybrid Choice Model (I/II)

Parameter Description						coeff.	std. error	t-stat	p-value
Alternative Parameters									
Alternative constant						-2.97	.41	-7.35	.00 ***
Geographical access, area s	mall (zon	e)				92	.15	-6.07	.00 ***
Geographical access, area s	mall (zon	e) + route (> 10 km)				70	.13	-5.57	.00 ***
Geographical access, route	(> 10 km))				46	.12	-3.76	.00 ***
Geographical access, area n	nedium (r	egion, canton)				.25	.11	2.34	.02 **
Geographical access, area n	nedium (r	egion, canton) + route	e (> 10 km)			.26	.09	2.90	.00 ***
Travelling during rush hour	(7:00-8)	8:30 and 17:00 – 18:30))			1.60	.21	7.55	.00 ***
Train section access						.10	.10	1.07	.28
Price						00064	< 0.01	-7.26	.00 ***
Latent Variables									
Out-group derogation on tra	ain section	n access				51	.17	-3.00	.00 ***
Scale Parameters									
Scale effect, Lake Geneva r	region					1.08	.27	4.02	.00 ***
Scale effect, Swiss Plateau						.91	.13	6.98	.00 ***
Scale effect, North-west Sw	vitzerland					1.04	.18	5.78	.00 ***
Scale effect, Eastern Switze	erland					.71	.16	4.46	.00 ***
Scale effect, Central Switze	rland					.70	.15	4.79	.00 ***
Scale effect, Ticino						.83	.40	2.06	.04 **
Error Component Param	eters								
Error component parameter	(panel da	nta)				.72	.23	3.09	.00 ***
Summary Statistics									
$\mathcal{L}(eta_0)$	=	-5912.77	$ ho^2$	=	.025				
$\mathcal{L}(\hat{oldsymbol{eta}})$	=	-5767.33	$\overline{\rho}^2$	=	.017				
$-2[\mathcal{L}(\beta_0) - \mathcal{L}(\hat{\beta})]$	=	290.87							
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Page 15

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Study 1 – Hybrid Choice Model (II/II)

Parameter Description	coeff.	std. error	t-stat	p-value
Structural Model (DV: Out-group derogation)				
Age – Young Adults (16-25)	.09	.57	.17	.87
Age – Adults (26-49)	.32	.28	1.15	.25
Age – Best Agers (50-64/50-63)	.98	.32	3.09	.00 ***
Age – Seniors (>64/>63)	1.05	.34	3.14	.00 ***
Gender (Male)	47	.16	-2.84	.00 ***
Commuters	.14	.19	.71	.48
Measurement Model (Impact of out-group derogation on indicators)				
Indicator1 (different work)	-1.35	.13	-10.29	.00 ***
Indicator2 (different family status)	-1.31	.13	-10.35	.00 ***
Indicator3 (different social / economic class)	-1.48	.12	-12.52	.00 ***
Indicator4 (culturally different)	-1.31	.15	-8.51	.00 ***
Indicator5 (different personal characteristics)	-1.55	.10	-15.19	.00 ***
Indicator6 (do not share same values / beliefs)	-1.52	.11	-14.26	.00 ***
Indicator7 (different interests)	-1.53	.11	-14.15	.00 ***
Indicator8 (different behavior)	-1.45	.12	-12.08	.00 ***
Indicator9 (different travel needs)	-1.53	.12	-12.57	.00 ***
Indicator10 (different purposes of travelling)	-1.49	.12	-12.32	.00 ***
Indicator11 (different ways to travel)	-1.46	.12	-12.08	.00 ***
Indicator12 (different travelling distance)	-1.35	.14	-9.95	.00 ***



- 1. Research Idea
- 2. Study 1
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix





Study 1 - Main Insights

- On average in the sample, a travel card with access both to the common section and additionally to the dedicated section does not provide higher utility compared to a travel card with access to the common section only. (H1a not supported)
- The higher an individual's out-group derogation (negative evaluation of individuals that are different from the self), the lower (and negative) the utility of travel cards that additionally provide access to the dedicated section. (H1b not supported)
- In the sample, the out-group derogation is higher for older (significant for both best agers and seniors) and female respondents (significant).





- 1. Research Idea
- 2. Study 1
- 3. Study 2
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 4. Next Steps & Comments
- 5. Appendix



Study 2 – Survey Design and Method

Choice Design	SP data, D-efficient design (D-error: 0.0242), 60 choice tasks, 5 blocks, 3 unlabeled alternatives + no choice option, 4 attributes per alternative + 1 alternative-specific attribute (spec. of Common + Dedicated section)
Data Collection	Stratified sample by age; 20-minutes surveys including demographics, choice experiment and latent variables
Analysis	 Discrete choice model (MNL with EC for panel and choice set structure); Hybrid choice model (MNL with EC and latent variable)





Study 2 - Choice Experiment



- 1. Common Section (Access)
- 2. Common + Dedicated Section (Access)

Additional attribute

- 1. Business
- 2. Silence 3. Life-style
- 4. Family

• <u>Rush Hour Access</u> (7:00-8:00 and 17:00-18:00)

- 1. No (outside rush hour only)
- 2. Yes (24h access)

Geographical Access

- 1. Area Small (Zone)
- 2. Area Medium (Region, Canton)
- 3. Area Big (Country)

Price

- 1. CHF 1'500.-
- 2. CHF 3'000.-
- 3. CHF 4'500.-
- 4. CHF 6'000.-



Study 2 - Example Specification for Choice Situation of Consumer

If these were the travel card options offered to you, would you buy any of those and if yes which one?

Choose by clicking on one of the buttons below:

	Travel Card Nr. 1	Travel Card Nr. 2	Travel Card Nr. 3	None
Train Section Access	Common Section Only	Common Section + Dedicated Section (Business)	Common Section + Dedicated Section (Family)	l would not choose any of these.
Geographical Access	Area Small (Zone)	Area Small (Zone)	Area Medium (Region, Canton)	
Rush Hour Access (7:00 – 8:00 and 17:00 – 18:00)	Yes (no time restrictions)	No (outside rush hour only)	No (outside rush hour only)	
Price	CHF 3'000	CHF 4'500	CHF 3'000	

0

LEGEND (Click on the attribute name to see the description)

0

- Train Section Access
- Geographical Access
- Travel during rush hour (7:00 8:00 and 17:00 18:00)
- Price



0

0

Study 2 - Main Latent Construct in the Survey

Outgroup Derogation:

Out-group derogation describes the phenomenon of people having a tendency to evaluate people of their outgroup (people with different behaviors, opinions, characteristics) more negatively (Dasgupta, 2004). Group biases often influence people's judgments, decisions, and behaviors (Dasgupta, 2004).

- H1a: When choosing between travel card offerings, travelers have a higher utility for travelcards that offer additional access to dedicated sections (vs. access only to common section).
- H1b: When choosing between travel card offerings, travelers with a high (vs. low) tendency towards out-group derogation derive a higher utility from travel cards that offer additional access to dedicated sections (vs. access only to common section).





- 1. Research Idea
- 2. Study 1
- 3. Study 2
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 4. Next Steps & Comments
- 5. Appendix



Study 2 - Sample Description (I/II)

- 505 Swiss German respondents (192 female, 38 %).
- All respondents either want to buy a new subscription or renew an old one within the next year.
- All respondents will pay for their subscription by themselves.
- Stratified sampling by age.





Study 2 - Sample Description (II/II)



Type of Subscription Owned (Multiple Answers Possible)

Main Purposes of Travelling by Train (Multiple Answers Possible)

della Svizzera italiana



- 1. Research Idea
- 2. Study 1
- 3. Study 2
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 4. Next Steps & Comments
- 5. Appendix



Study 2 – Discrete Choice Model

Parameter Description	coeff.	std. error	t-stat	p-value
Common Parameters				
Geographical Access, area small (zone)	-1.04	.10	-10.39	.00 ***
Geographical Access, area medium (region, canton)	.15	.05	-3.16	.00 ***
Rush Hour Access (7:00 – 8:00 and 17:00 – 18:00)	1.32	.15	8.92	.00 ***
Price	000663	<.01	-11.00	.00 ***
Alternative Parameters (Common Section Only)				
Common Section Only – alternative-specific constant	37	.19	-1.90	.06 *
Alternative Parameters (Common Section + Dedicated Section)				
Common Section + Dedicated Section - alternative-specific constant	58	.17	-3.39	.00 ***
Dedicated section (business)	.05	.07	.76	.44
Dedicated section (life-style)	06	.06	96	.34
Dedicated section (silence)	.16	.06	2.93	.00 ***
Scale Parameters				
Scale effect, Lake Geneva region	3.37	1.29	2.62	.01 ***
Scale effect, Swiss Plateau	1.32	.15	9.05	.00 ***
Scale effect, North-west Switzerland	.95	.14	7.07	.00 ***
Scale effect, Eastern Switzerland	.91	.13	6.76	.00 ***
Scale effect, Central Switzerland	1.31	.16	8.01	.00 ***
Scale effect, Ticino	.81	.33	2.47	.01 ***
Error Component Parameters				
Error component parameter (paned data)	1.88	.18	10.40	.00 ***
Error component parameter (common section only)	26	1.03	25	.80
Error component parameter (dedicated section)	1.12	.24	4.68	.00 ***
Summary Statistics				
$\mathcal{L}(\beta_0)$ = -8258.53 $ ho^2$ =	.471			
$\mathcal{L}(\hat{\beta}) = -4366.96 \overline{\rho}^2 =$.469			
$-2[\mathcal{L}(\beta_0) - \mathcal{L}(\hat{\beta})] = 7783.14$				



Workshop on Discrete Choice Models, June 22-24 2017



Study 2 – Hybrid Choice Model (I/II)

Parameter Description	coeff.	std. error	t-stat	p-value
Common Parameters				
Geographical Access, area small (zone)	95	.09	-10.23	.00 ***
Geographical Access, area medium (region, canton)	13	.05	-3.06	.00 ***
Rush Hour Access (7:00 – 8:00 and 17:00 – 18:00)	1.21	.13	8.73	.00 ***
Price	000608	<.01	-10.54	.00 ***
Alternative Parameters (Common Section Only)				
Common Section Only – alternative-specific constant	86	.20	-4.33	.00 ***
Alternative Parameters (Common Section + Dedicated Section)				
Common Section + Dedicated Section - alternative-specific constant	79	.17	-4.72	.00 ***
Dedicated section (business)	.06	.06	.97	.33
Dedicated section (life-style)	06	.05	-1.15	.25
Dedicated section (silence)	.15	.05	2.96	.00 ***
Scale Parameters				
Scale effect, Lake Geneva region	3.57	1.21	2.96	.00 ***
Scale effect, Swiss Plateau	1.42	.16	9.04	.00 ***
Scale effect, North-west Switzerland	.99	.14	7.06	.00 ***
Scale effect, Eastern Switzerland	.94	.14	6.71	.00 ***
Scale effect, Central Switzerland	1.35	.18	7.63	.00 ***
Scale effect, Ticino	.88	.30	2.90	.00 ***
Error Component Parameters				
Error component parameter (paned data)	1.99	.19	10.21	.00 ***
Error component parameter (common section only)	85	.23	-3.65	.00 ***
Error component parameter (dedicated section)	06	.09	66	.51
Summary Statistics				
$\mathcal{L}(\beta_0) = -17597.03 \qquad \rho^2 =$.203			
$\mathcal{L}(\hat{\beta}) = -14023.76 \qquad \overline{\rho}^2 =$.200			
$-2[\mathcal{L}(\beta_0) - \mathcal{L}(\hat{\beta})] = 7146.55$				
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Workshop on Discrete Choice Models, June 22-24 2017



Study 1 – Hybrid Choice Model (II/II)

Parameter Description	coeff.	std. error	t-stat	p-value
Latent variables				
Out-group derogation on Common Section Only	.94	.24	3.92	.00 ***
Out-group derogation on Common Section + Dedicated Section	.53	.14	3.69	.00 ***
Out-group derogation on Dedicated section (business)	<.01	.08	.10	.92
Out-group derogation on Dedicated section (life-style)	02	.07	24	.81
Out-group derogation on Dedicated section (silence)	<.01	.06	.02	.98
Structural Model (DV: Out-group derogation)				
Age – Young Adults (16-25)	25	.16	-1.54	.12
Age – Adults (26-49)	21	.21	-1.00	.32
Age – Best Agers (50-64/50-63)	16	.22	75	.46
Age – Seniors (>64/>63)	27	.26	-1.02	.31
Gender (Male)	.08	.11	.74	.46
Commuters	.24	.11	2.24	.03 ***
Measurement Model (Impact of out-group derogation on indicators)				
Indicator1 (different work)	1.50	.10	14.56	.00 ***
Indicator2 (different family status)	1.70	.10	17.41	.00 ***
Indicator3 (different social / economic class)	1.63	.10	16.95	.00 ***
Indicator4 (culturally different)	1.57	.10	15.67	.00 ***
Indicator5 (different personal characteristics)	1.67	.09	18.28	.00 ***
Indicator6 (do not share same values / beliefs)	1.75	.09	19.80	.00 ***
Indicator7 (different interests)	1.63	.10	17.15	.00 ***
Indicator8 (different behavior)	1.53	.09	16.27	.00 ***
Indicator9 (different travel needs)	1.57	.12	12.61	.00 ***
Indicator10 (different purposes of travelling)	1.51	.11	13.12	.00 ***
Indicator11 (different ways to travel)	1.57	.11	13.84	.00 ***
Indicator12 (different travelling distance)	1.37	.11	12.02	.00 ***



Workshop on Discrete Choice Models, June 22-24 2017

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Page 30

- 1. Research Idea
- 2. Study 1
- 3. Study 2
 - 1. Survey Design and Method
 - 2. Sample Description
 - 3. Choice Model
 - 4. Main Insights
- 4. Next Steps & Comments
- 5. Appendix





- Overall in the sample, the travel cards with access to one of the dedicated sections in addition to the common section provide higher utility than the travel cards with access to common section only, introducing in the model the out-group derogation variable. (H1b partially supported)
- In both models, the travel cards with access to the dedicated section "silence" are the only ones that provide higher utility than travel cards with access to the dedicated section "family" (reference level for this attribute).
- The higher an individual's out-group derogation (negative evaluation of individuals that are different from the self), the lower the utility gain of travel cards that additionally provide access to the dedicated section. (H1b not supported)
- In the sample, the out-group derogation is higher for commuters (vs non-commuters).



- 1. Research Idea
- 2. Study 1
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix



Next Steps

- Factor analysis on out-group derogation;
- (already done) Interactions of attributes with sociodemographics;

• ...





Comments





- 1. Research Idea
- 2. Study 1
- 3. Study 2
- 4. Next Steps & Comments
- 5. Appendix



Out-Group Derogation Scale (Study 1 and 2)

Please indicate how much you agree with the following statements.									
When I am travelling alone on the train,	I strongly disagree. 1 I distance m	2 yself fro	3 m people	4	5	6	I strongly agree. 7		
who have a different type of work than me.	0	0	0	0	0	0	0		
who have a different family status than me.	0	\bigcirc	0	0	\odot	\bigcirc	0		
who are from a different social / economic class than me.	0	\bigcirc	0	0	\bigcirc	\bigcirc	0		
who are culturally different from me.	\odot	\bigcirc	\bigcirc	\odot	\bigcirc	\odot	\odot		
When I am travelling alone, I separate fr	om people								
who have different personal characteristics than me.		\bigcirc	\bigcirc	\bigcirc	\odot	\odot			
who do not share my beliefs / values.	0	0	0	0	0	0	\odot		
who have different interests than me.	\bigcirc	\bigcirc	0	\bigcirc	\bigcirc	\odot	0		
who behave differently than me.	0	\bigcirc	0	0	\bigcirc	0	0		
When I am travelling alone, I prefer not	to be on the f	train wit	th people						
who have different travel needs than me.	0	\bigcirc	0	\bigcirc	\bigcirc	0	\bigcirc		
who have different purposes of travelling than me.	\odot	\bigcirc	\bigcirc	\bigcirc	\odot	\odot			
who travel in different ways than me.	0	\bigcirc	0	0	0	0	0		
who travel a distance different from mine	e. 🔘	\bigcirc	\odot			\bigcirc			

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