Stated Choice Experiments: survey design and performance

Empirical Transport Economics

Vincent van den Berg
v.a.c.vanden.berg@vu.nl
+31 20 598 2442

Objectives for today

- Learn about the basics of Stated Choice Experiments (SCE)
  - Assigned reading is needed background info on discrete choice
- Later lectures will continue with analysing the data and using the results in policy evaluation

Choice behaviour

- Continuous vs discrete choices
  - Continuous: how much is consumed of each good?
  - Discrete: which good is consumed?
- Q (in-class):
  - Examples of Discrete choices?
- Q: Experience with discrete choice?
  - Which master are you doing?

What is Stated Preference or Stated Choice?

- Techniques that use individuals' statements about their preferences for a set of hypothetical (transport) options to estimate utility functions
- The options are pre-specified in terms of their attribute levels
- **Discrete choice vs contingent valuation**
- **Q(in-class): SP vs RP?**
  - Hypothetical bias and misunderstanding
  - Lack of (uncorrelated) data

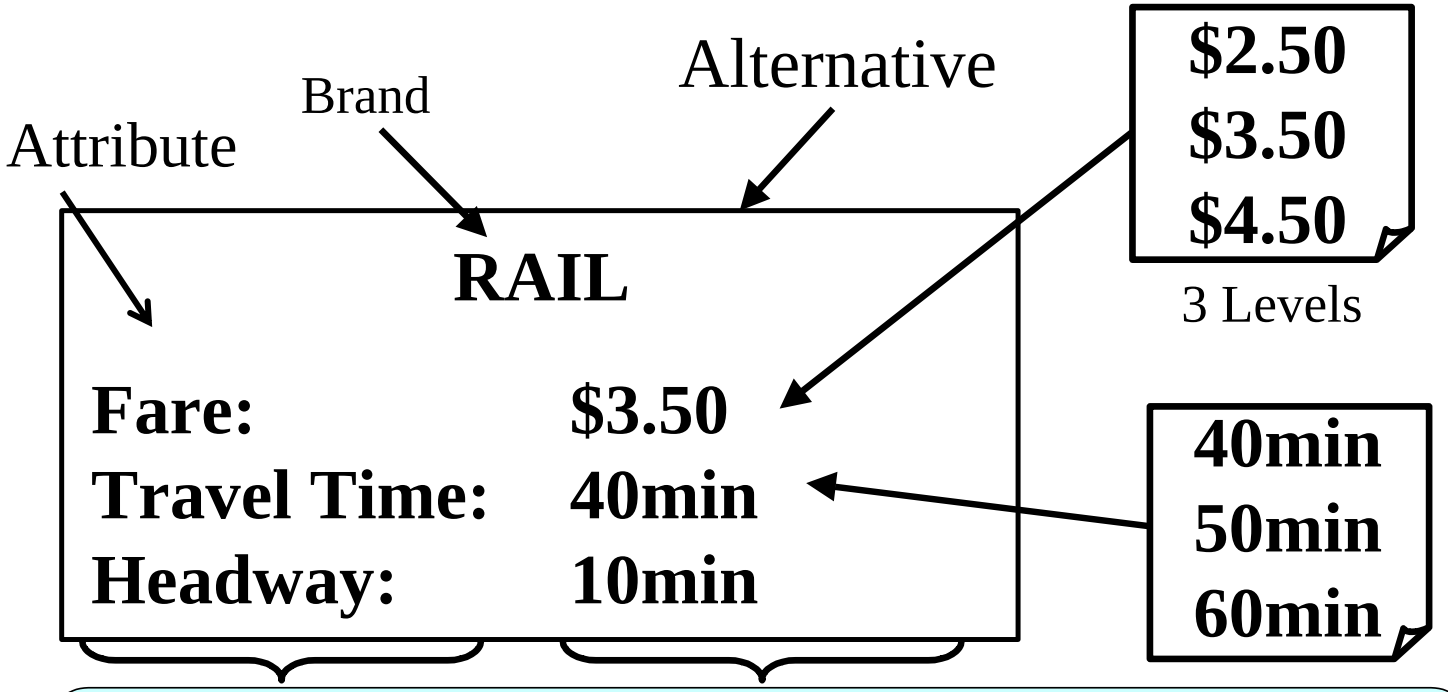
Specification of an experiment

- Attributes = variables
  - Levels = values of attributes
- Alternatives = choice options
- Choice context
- Reference levels
- Variation and correlation
- Interactions
  - Dutch VOT & VOR study

Radom utility theory

- Choose the option with the highest utility
  - $U_i=V_i+\varepsilon_i$
  - ε_i: Unobeserved utility (by the analysisist)
  - V_i: observed utility
    - E.g. $V_i=B1\cdot TT_i + B2\cdot Cost_i + ASC_i$
    - Marginal utilities & Alternative specific constants
  - Value of time: B1 / B2
    - WTP for (an hour of) time savings
    - Monetary value of (an hour of) time savings
- For example: bus vs bike

SP/SC Alternatives, attributes, levels



Statistical Design:

Defines alternatives (and choices) for each respondent by combining attribute levels

Labelled vs unlabelled alternatives

- Generic vs alternative specific variables and coefficients
  - Generic: travel time, cost
  - Alternative specific: parking cost, access time to rail
- Within mode vs between mode experiment
  - Within mode: no label or Alternative Specific Constant?
  - Alternative specific: with label and ASC

Example within mode (unlabelled)

TRAIN A

- Travel time: 2h50
- Ticket: 30 euro
- On time: 80%
- 30 min delay: 12%
- 60 min delay: 8%

TRAIN B

- Travel time: 2h20
- Ticket: 40 euro
- On time: 90%
- 30 min delay: 8%
- 60 min delay: 2%

Example between mode (labelled)

CAR

- Travel time: 1h30
- Petrol: 20 euro
- Toll: 3.5 euro
- Parking: 10 euro
- Other car specific benefits => (ASC)

TRAIN

- Travel time: 2h10
- Ticket: 40 euro
- Access: 15 min
- Egress: 25 min

Do you have any questions?

Experimental Design

Why do a SC experiment?

- Aim is to estimate a discrete choice model and the coefficients of utility function
- These used for:
  - Estimating value of attributes (e.g. VOT)
  - Estimating demand elasticities
  - Estimating population market shares / volumes after policy changes

Experimental design - overview

- Design specified in terms of differences in attribute levels
  - Discrete choice -> only the difference in utility between alternatives matters
- Orthogonal versus correlated design
  - You want lot's of variation in attributes and little correlation between them
  - But this may entail unrealistic levels and many many choice situations
- Need to have trading
- Referencing and prospect theory

Orthogonal versus correlated design

- Orthogonal versus correlated design
  - More correlation in attributes means larger s.e.'s
  - But full orthogonal = respondents see all possible combination of the levels of the attributes
    - Respondents tire from such a long questionnaire
      - Quit or give random answers
    - E.g. 3 attributes with 4 levels: 4*4*4=64 choices
- Some correlation (say <0.50) is a small problem
- High correlation (say >0.90) leads to estimation failure (wrong sign, insignificant coefficients)

Full factorial design (differences)

		Attributes		
		$Fare_{B-A}$	$Time_{B-A}$	$Frequency_{B-A}$
Choices	1	0	0	0
	2	0	0	1
	3	0	1	0
	4	0	1	1
	5	1	0	0
	6	1	0	1
	7	1	1	0
	8	1	1	1

Fractional factorial design (diff.)

		Attributes		
		$Fare_{B-A}$	$Time_{B-A}$	$Frequency_{B-A}$
Choices	1	0	0	0
	2	0	0	1
	3	0	1	0
	4	0	1	1
	5	1	0	0
	6	1	0	1
	7	1	1	0
	8	1	1	1

You need to have trading

- If one alternative is better in all attributes we learn nothing about preferences
  - There is no trade-off / no trading
- Yet such dominant choice situations are often included in practice
  - See if people understand the problem

Dominant option B

TRAIN A		TRAIN B
Travel time: 2h50	>	Travel time: 2h00
Ticket price: 40 euro	>	Ticket price: 30 euro
Delayed: 20%	>	Delayed: 10%
30 min delay: 12%	>	30 min delay: 8%
60 min delay: 8%	>	60 min delay: 2%

With trading

TRAIN A		TRAIN B	
Travel time:	2h50	Travel time:	2h20
Ticket:	30 euro	Ticket:	40 euro
Delayed:	20%	Delayed:	10%
30 min delay:	20%	30 min delay:	8%
60 min delay:	0%	60 min delay:	2%

Prospect theory and referencing

- Kahneman and Tverski (1979) developed theory about how people choose between probabilistic alternatives and evaluate gains and losses
- Evaluation relative to reference point
- Asymmetrical value function: losses hurt more than gains feel good

Referencing

- Ask questions in context of *actual choice situation* known to respondent
- Create attribute levels of SP experiment as *variations of existing choice situation*:
  - Existing travel time = 30 min
  - SP travel times are: 30 min, 33 min, 36 min
  - or: “Same as now”, “3 min longer”, “6 min longer”
  - Same for all other attributes

Referencing

- Basing the question on an actual choice setting (e.g. trip) gives better answers
  - Less hypothetical
  - People can understand what is going on
    - Asking someone who has never flown about their WTP for reliable luggage handling may give less accurate results
    - Just giving people the difference in attribute levels will result in confused respondents
- Different design for different references?
- Can allow for asymmetric marginal utilities

Prospect theory

- Referencing allows for asymmetric marginal utilities
  - E.g. a travel time that is 1 min. longer than the reference gives more disutility than the utility you gain from a 1 min. quicker trip
    - $U = \alpha 1 * (TT_i - TT_{reff}) + \alpha_{loss} * IF[TT_i > TT_{reff}, TT_i - TT_{reff}, 0]$
    - Or $U = IF[TT_i > TT_{reff}, \alpha_{loss}, \alpha_{gain}] * (TT_i - TT_{reff})$

Do you have any questions?

- Would you add a constant to the utility function of an unlabelled alternative (e.g. road A vs Road B)?
- In a stated choice survey, would you include a question with a dominated alternative ?
  - e.g. road A vs road B, where road A is cheaper and quicker
  - What would you learn from the answer to such a question?
- Generic variables
  - Should we use a different travel time and/or cost coefficient for bus, train and car? Or should they be generic?
  - Should we use a different travel time and/or cost coefficient for flying first-class or economy class?

Examples of SP questions

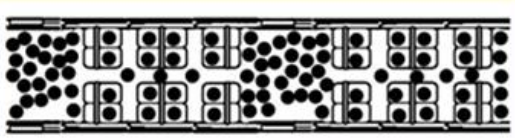
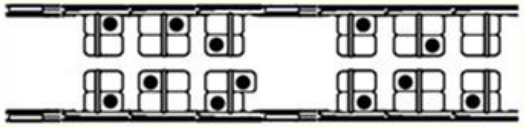
Example 1: Crowding experiment

- Study for Syndicat des Transports Ile de France
- Passengers' value of Crowding in vehicles
  - Unpleasant if the metro is really busy
  - Seated vs standing
- Results are used in Cost Benefit Analysis and a demand model


Gare de l'Est

Example 1: Crowding experiment

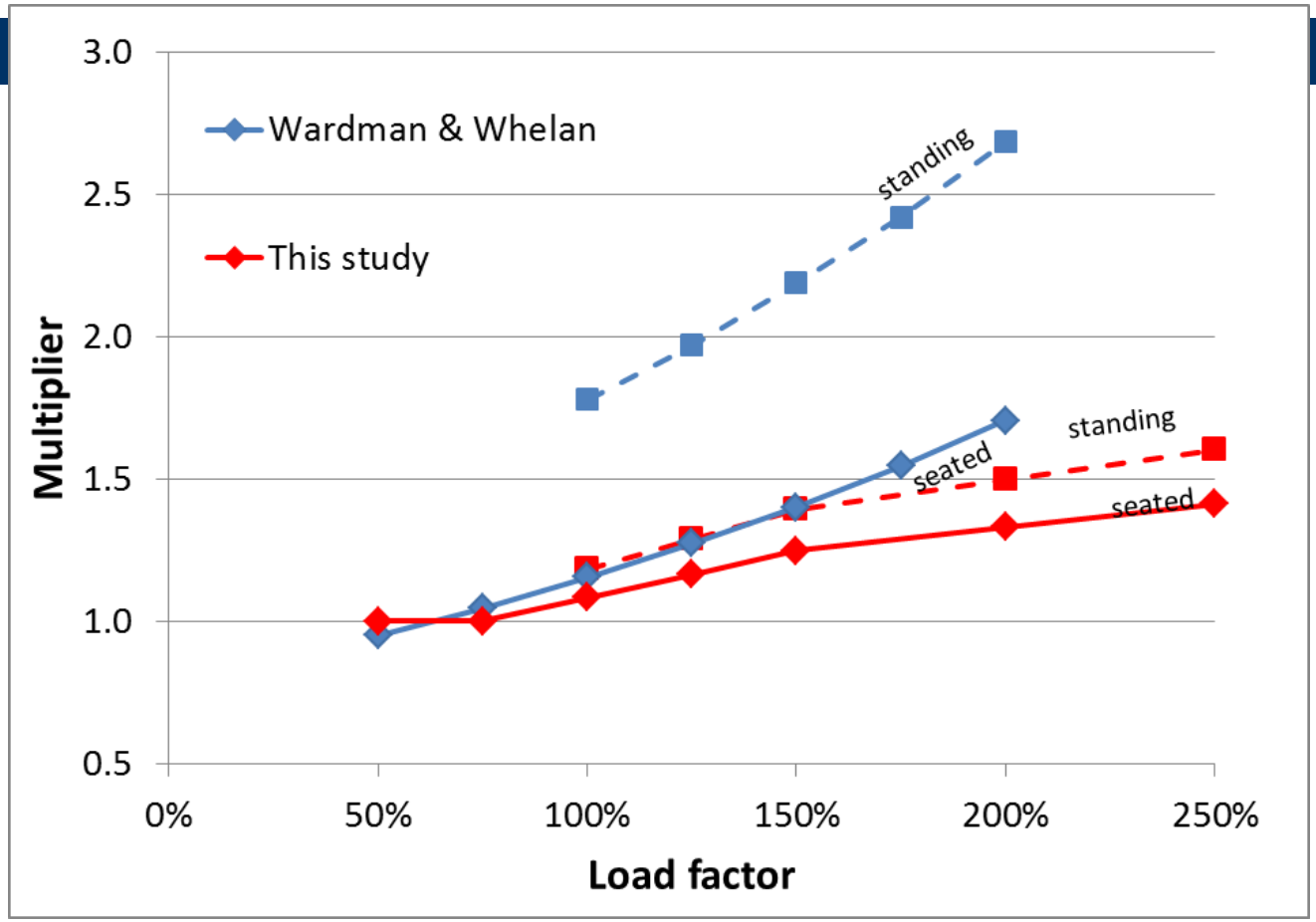
Pensez à votre déplacement de Tolbiac à Châtelet.
Imaginez que vous ayez le choix
entre les deux conditions de déplacement décrites ci-dessous.
Dans laquelle de ces deux conditions de durée, d'affluence et de position
préférez-vous effectuer votre déplacement ?
On suppose que la durée totale du trajet, le niveau d'affluence et votre position ne changeront pas pendant tout le trajet.

	Métro voie 1	Métro voie 2
Durée du trajet:	14 minutes	15 minutes
Affluence dans le véhicule:	 *100 % des sièges occupés, des voyageurs debout autour des portes et partout dans le véhicule*	 *25 % des sièges occupés, et personne debout*

No cost variable was used, as may be difficult for people to imagine that this would differ on the same metro line in Paris

Wardman & Whelan = overview article of crowding studies

Travel time multipliers
(multiplying existing VOT's)



Example 2: Mode Choice

Think about your journey from Tolbiac to Chatelet.
Which mode would you choose?

Pensez à votre déplacement de Tolbiac à Châtelet.
Quel mode choisiriez-vous ?

	Métro	Bus	Tzen
			
Durée du trajet:	15 minutes	17 minutes	15 minutes
Fréquence:	Toutes les 10 minutes	Toutes les 5 minutes	Toutes les 3 minutes
Temps pour rejoindre le mode:	10 minutes	10 minutes	5 minutes
Design de l'interieur:			
	○	○	◉

Example 3: Dutch VOT and VOR

- Kouwhoven et al. (2014):
  - we will study the paper in debt later in the course
- New values of time (VOT) & of travel time reliability (VOR) for The Netherlands
  - VOT: Value in euros of lowering travel time by 1 hour
  - VOR: Value in euros of lowering the standard deviation of travel time by one unit
  - Previous VOT was old (1997)
    - Updated for income growth & inflation
    - But this can only do so much
  - No VOR

Example 3: Modes

- Passenger travel: train, car, bus/metro/tram & airplane
- Freight: water, road & rail
- Recreational navigation
  - (Water users complained before that cost-benefits studies ignored the effect on them)

Example 3: Experiments

- 1 Only cost & time (same set-up as in 1997)

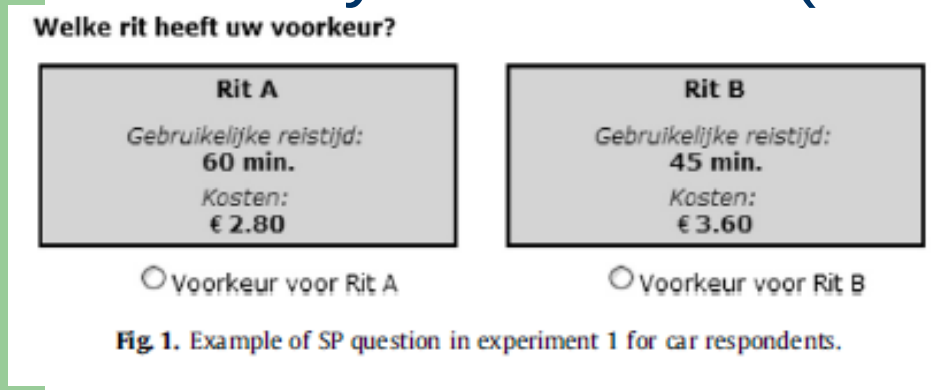


Fig. 1. Example of SP question in experiment 1 for car respondents.

- 2 cost, time & unreliability

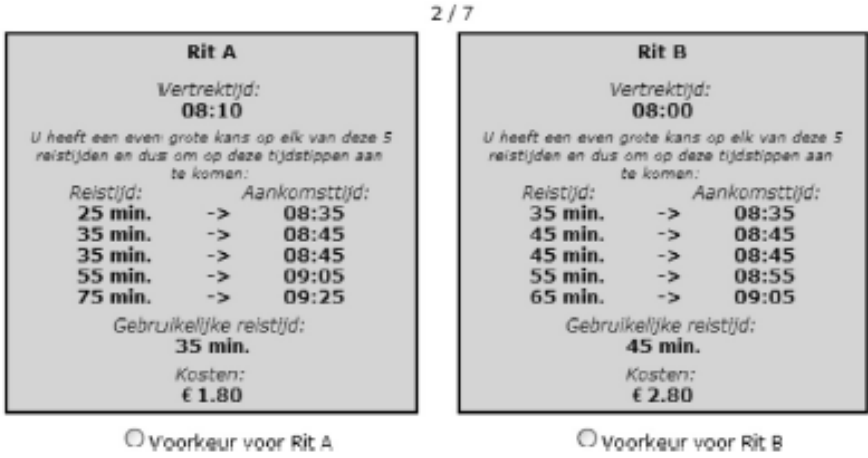


Fig. 3. Example of SP question in experiment 2b for car respondents.

Example 3: Importance design

- Nobody would understand a survey where you just give the standard deviation
  - Questions with 5 equally possible outcomes
  - Statistical design, so as to have the lowest correlation between cost, mean travel time and its standard deviation
  - => It was impossible to estimate a scheduling model, as used in the bottleneck model

Example 3: Importance design

- Statistical design is optimized to estimate your aimed utility function
  - So we could not estimate different models such as
    - Reliability based on the different possible outcomes
      - Only as standard deviation
    - Schedule delay model
      - Highly correlated early and late values

Example 3: other modes

- We also studied the VOT and VOR for recreational navigation
  - But in the trial respondents found questions about shorter trips odd
    - It is a hobby activity
  - So changed to waiting at bridges and locks, which is annoying

Example 3: Referencing

- The final model allowed for referencing
  - By making the value of the attributes cost and travel time relative to their reference levels
    - So $\Delta TT_i=0$ would mean same travel time as the respondent said was their last/normal trip
  - And by allowing the marginal utility of positive values to be different from negative ones

Conclusion

- Design matters
  - Statistical and looks
  - Design specified in terms of differences
  - Orthogonal versus correlated design
  - Dominant options versus trade-offs
  - Referencing and prospect theory
- Labled vs unlabled alternatives
- Q: Should we use a different travel time and/or cost coefficient for bus, train and car?
- Q: Should we use a different travel time and/or cost coefficient for flying first-class or economy class?