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Abstract:
The design of a Stated Preference survey can affect the results in many ways. The aim of this paper is to show whether the ordering of attributes has any influence in a self-completion questionnaire with a Stated Choice experiment about quality in public transport. Each scenario is described with four attributes. The attributes are presented in four different orderings, and for each interviewee a specific ordering of the attributes is randomly chosen. Response rate, lexicographical answers, parameter estimation, scale factors and value of time from the four segments of questionnaires are compared. A special analysis concerns less experienced respondents.
The ordering has no statistically significant effect. This result is positive because, when using paper questionnaires, resources can be saved if the same ordering can be used for all respondents. Attributes in scenarios can be presented in the ordering that seems most understandable to the respondents.

Keywords: Stated Preferences, attribute ordering, mail questionnaire

Method of Presentation:
(1) OHP

1 . INTRODUCTION

Stated Preference methods are now widely used as an accepted tool in transport research. The most frequently used Stated Preference methods can be divided into contingent valuation methods, CVM, and conjoint analysis, CA. In CVM, a scenario is described and the respondent is asked to state her/his maximum willingness to pay to get improvement, or how much she/he at a minimum must be compensated to accept deterioration. In CA, several alternatives are described and the respondent's preferences are shown either as choices between alternatives or as rating or ranking of alternatives.

The advantages with Stated Preference methods are many, but several studies have shown how vulnerable the estimated results can be and how important the design of the survey is for the conclusion. There is a consensus in the literature that the design affects the results. The results are affected both by the experimental design and by the layout. Respondents can be tempted to leave their true preferences. A bad experimental design may prevent respondents from expressing their real preferences.

For instance, Bradley (1988) discusses ways in which the experimental design of the survey may affect the results in a conjoint analysis. To increase the internal and external validity, the choice context has to be realistic and relevant to the respondent. Therefore, the adaptation of choice context to individual conditions is essential (Bradley, 1988).

Also, Widlert (1994) gives examples of how the design of a Stated Preference experiment affects the result in a conjoint analysis. There were significant differences in how the value of time was assessed when different questionnaire types and computer interviews were used in the same study. In the questionnaires, the scenarios were to be either rated, ranked, or chosen; the number of given scenarios varied; and the attribute levels were either absolute or relatively expressed. Also in Widlert's study the adaptation of the alternatives, to agree with respondents' recognition, showed considerable advantages.

Sjöstrand (1999) shows how the layout of the questionnaires in a mail-back survey can influence a mail-back survey's validity and reliability. For instance, either one or six binary choices were printed on each paper sheet in otherwise similar sets of questionnaires. In two other sets of questionnaires, tested in the same study, the endpoints on the scales in two otherwise similar rating experiments were differently labelled. These aspects of the layout proved to have decisive influence on how the questionnaires worked in terms of quality of estimates, response rate, etc.

The combination of attribute levels in presented scenarios also affects the result, according to Toner *et al.* (1999). Simulations were made to compare five experimental designs, which differed in orthogonality and realism. The results indicated dependency on the stimuli presented, even if the underlying preferences of the respondents were identical.

The literature is not as developed concerning more detailed design, for example, such as the ordering of questions or the ordering of attributes within scenarios. The information found is partly contradictory.

Halvorsen (1996) has shown significant effects of ordering of scenarios in a contingent valuation survey. The expressed value of a particular good depends on when in the valuation procedure the good is valued. The reason is assumed to be that the respondents have imperfect information about the valuation problem during the valuation sequence.

Another contingent valuation study by Boyle *et al.* (1993) showed that the ordering of scenarios had significant effects only under certain circumstances. Respondents who had less experience with the assessed utility were affected by the ordering of questions, while the ordering effect was absent among more experienced respondents.

According to Farrar and Ryan (1999), little work is done on the methodological issue of response ordering effects. The authors have made a binary choice experiment in which they have ordered the five attributes, within each alternative, in two different ways in otherwise similar questionnaires. The conclusion drawn from this test was that the ordering did not have any statistically significant effect on the importance respondents attached to attributes.

However, one of the advantages often mentioned when using computer assisted interviews is the possibility to randomise the vertical ordering of attributes (MINT, 1994). The randomisation is done to avoid possible bias caused by always presenting the same attribute as the first one. The manual (MINT, 1994) claims that there is a risk that respondents will tend to place more importance on the top variable.

In many studies, the ordering of attributes is varied randomly to control for the ordering effect, but the effect is not investigated, (f.i. Trawén *et al.*, 1999).

As stated above, the design of a survey affects the results in many ways. It is therefore likely that the ordering of the attributes within scenarios also has some influence on the results. As few have investigated this effect, I find a need to study whether there is an ordering effect in the often used binary choice method in a context where this method is used often, i.e., assessing quality in public transport.

The aim of this study is to see whether the ordering of attributes within an alternative has any effect on the estimated assessments. A special investigation will show whether the ordering effect is present only among respondents who are inexperienced in the subject in question, as launched by Boyle *et al.* (1993).

Reasons for paying more attention to any of the attributes because of the ordering of the attributes may be that

- the respondent focuses on one of the attributes only because of the attribute's place
- the respondent does not read all the attributes, but maybe only the first or the last attribute
- some orderings seem more natural, and thus make the choice task easier to understand

One may first expect that the attribute presented at the top would have received too much attention (MINT, 1994). The reason for that is that the top attribute is seen first if the respondent reads in the common way, from top bottom. Due to its place, the top attribute may look like it is the most important. Another possible problem may occur when an attribute is placed as the last in the row of four. The attribute may be underestimated because it was seen last, or it may be overestimated if many persons have read the attributes in the reverse order. It may also be suspected that an attribute is easier to see when placed either first or last than if it is placed in between other factors. These three possibilities will be analysed.

2 . DATA COLLECTION

2.1 Respondents

The subject of the study was assessments of quality in local public transport, and the population was bus passengers in the city of Gothenburg, Sweden. Bus passengers were contacted on board buses and invited to participate in a study on quality in public transport. Almost 2000 people said they were interested, and the participation rate was 85%. Questionnaires were handed out directly after a short contact interview, which made it possible to customise the stated preference experiments regarding travelling time for this trip and ticket type used. The questionnaire consisted of background questions and six binary choices. Each respondent was supposed to choose the one alternative among the two described bus trips in each choice which she or he liked the most. The questionnaires were to be mailed back. The response rate was 56% among those agreeing to participate. Considering that it was not possible to send out reminders, the response rate was considered acceptable. The study is more fully described in Sjöstrand (2000) and Sjöstrand (2001).

2.2 Stated Preference design

Each Stated Preference alternative described a bus trip with four attributes: cost, walking time to bus stop, in-vehicle time and bus frequency. Each of the attributes had three levels. The cost was described either per trip or per month, depending on what kind of ticket the person was using. The alternatives were created and paired at random. Pairs containing a dominant alternative, however, were rejected. Each questionnaire thus had its own design and probably none looked exactly the same.

For each interviewee a specific ordering of the attributes was randomly chosen. Thus, similar, but not identical, numbers of each type of questionnaire were distributed for all ordering types. The internal order of the four attributes was always the same, but it was varied among the questionnaire types which attribute was placed first, see table 1 and figure 1.

Table 1. Ordering of attributes in the four different ordering types

Ordering type	first attribute	second attribute	third attribute	fourth attribute
c	cost	walking time	in-vehicle time	bus frequency
w	walking time	in-vehicle time	bus frequency	cost
v	in-vehicle time	bus frequency	cost	walking time
f	bus frequency	cost	walking time	in-vehicle time

To make the differences and similarities between the four questionnaire types even clearer, figure 1 shows examples of possible choice tasks.

Choose one of the alternatives in each pair, please!	
type c:	
Your bus trip costs 13 SEK It takes you 2 minutes to walk to bus stop Your bus trip takes 30 minutes Buses leave every 30 minutes I choose ☐	Your bus trip costs 10 SEK It takes you 7 minutes to walk to bus stop Your bus trip takes 25 minutes Buses leave every 10 minutes ☐
type w:	
It takes you 2 minutes to walk to bus stop Your bus trip takes 30 minutes Buses leave every 30 minutes Your bus trip costs 13 SEK I choose ☐	It takes you 7 minutes to walk to bus stop Your bus trip takes 25 minutes Buses leave every 10 minutes Your bus trip costs 10 SEK ☐

Figure 1. Examples of choice task in questionnaire type c and type w

The passenger groups that answered these four different sets of questionnaires were compared to ensure that differences in estimated assessments would not actually depend on differences in group-characteristics. As table 2 shows, differences between the groups are small. Each of the four groups that answered the four ordering types are relatively homogeneous with respect to gender, age, ticket type, travelling type on bus for this trip, and number of bus transfers during this trip.

Table 2. Comparison of background variables within each ordering type.

		Ordering type			
variable	group	c	w	v	f
gender	female	67%	66%	68%	68%
	male	33%	34%	32%	32%
age	young	34%	35%	29%	32%
	middle	53%	58%	63%	54%
	old	13%	7%	8%	14%
ticket	period	65%	59%	54%	54%
	per trip	35%	41%	46%	46%
time	10 min	15%	15%	16%	15%
	20 min	25%	24%	19%	25%
	30 min	23%	22%	26%	25%
	40 min	20%	21%	22%	18%
	60 min	17%	18%	17%	17%
transfers	0	37%	39%	35%	40%
	1	52%	50%	55%	50%
	2 or more	10%	11%	10%	10%

The small differences can be seen as a background to the coming comparisons.

3 . COMPARISON OF THE FOUR DIFFERENT ORDERINGS

3.1 Response rate

One comparison that can give information about how interesting the respondents have found the questionnaire is to look at the response rates, table 3. If the response rate is lower within a specific questionnaire type, it can be a sign of less seriousness shown by the respondents.

Table 3. Response rate in the four different ordering types

Ordering	Response rate
c (w,v,f)	58%
w (v,f,c)	53%
v (f,c,w)	57%
f (c,w,v)	55%

There is no significant difference in answering frequency depending on the order in which the attributes are presented. This indicates that the ordering of attributes has not had any effect on the respondents' willingness to participate in the study.

3.2 Rate of lexicographical answers

One way to find out whether too much attention has been paid to any of the attributes is to compare the share of lexicographically sorted answers. This means that the alternatives have been sorted according to only one attribute, e.g., the cost. Lexicography is often mentioned as a common way to simplify the sometimes demanding Stated Preference task. Such lexicographical choices contribute to a larger variance in Stated Choice data compared to other, less demanding, valuation methods (Saelensminde, 1999).

Lexicographical answers are not always wrong (Widlert, 1992), though. One parameter, for example the cost, could be extremely important to the respondent. The alternatives could be lexicographically sorted at random. Furthermore, the design of the game could be unbalanced so that one factor dominates the others. Saelensminde (1999) also writes that one reason for lexicographic choices is a result of study designs with too large differences between the alternatives. When this is the case, less information about the preferences is given, but this is normally not a modelling problem.

Share of lexicography is still to be tested in a quality test because the assessment of the factor according to which respondents have sorted will be wrong in relation to the preferences. For example, Bates (1994) claims that as a minimum the data should always be checked for possible lexicographic effects.

The question investigated in this section is whether any of the attribute places in the sequence has an overrepresentation among the lexicographical answers.

Lexicographic responses were identified and counted in Excel. Chi-2 test was then applied to test whether there was a significant difference in the rate of lexicographic responses between ordering types.

Table 4. Share of lexicographically sorted answers in the four different ordering types, per attribute

	Share of answers lexicographically sorted according to			
Ordering	cost	walking time	in-vehicle time	bus frequency
c (w,v,f)	15%	5%	9%	20%
w (v,f,c)	17%	6%	10%	22%
v (f,c,w)	17%	6%	11%	23%
f (c,w,v)	20%	7%	10%	23%

As can be seen from table 4 there is no significant difference in rate of lexicographical answers depending on ordering. Thus, there is no evidence that respondents pay "too much" attention to the attribute placed at any special place in the list, according to this comparison of share of lexicographical answers.

3.3 Parameter estimation

The discrete choice data was analysed through the estimation of a binary logit model. Since the material contains responses of more than 1000 people who have done 6 choices each, there are 6180 observations to analyse. Alogit (1992) was used in these estimations.

Three models were formulated to make it possible to show if the attribute placed first, last or at either of the edges had greater influence on the binary choice than the other attributes had.

$$U= a_c*c + \Delta a_{c1}*c_1 + a_w*w + \Delta a_{w1}*w_1 + a_v*v + \Delta a_{v1}*v_1 + a_f*f + \Delta a_{f1}*f_1 + \varepsilon \qquad (1)$$
$$U= a_c*c + \Delta a_{c4}*c_4 + a_w*w + \Delta a_{w4}*w_4 + a_v*v + \Delta a_{v4}*v_4 + a_f*f + \Delta a_{f4}*f_4 + \varepsilon \qquad (2)$$
$$U= a_c*c + \Delta a_{ce}*c_e + a_w*w + \Delta a_{we}*w_e + a_v*v + \Delta a_{ve}*v_e + a_f*f + \Delta a_{fe}*f_e + \varepsilon \qquad (3)$$

where

a_i are the parameters for cost, walking time, in-vehicle time, and bus frequency

Δa_{i1} , Δa_{i4} and Δa_{ie} are the presumed extra contribution to the parameter when the specific attribute is presented first, last or at the edges in the row of the four attributes

c, w, v, and f are the cost, walking time, in-vehicle time, and frequency actually presented in the alternatives

c_1, w_1, v_1, f_1 are the extra contributions to cost, walking time, in-vehicle time and frequency when respective attribute is presented first, otherwise zero

c_4, w_4, v_4, f_4 are the extra contributions to cost, walking time, in-vehicle time and frequency when respective attribute is presented last, otherwise zero

c_e, w_e, v_e, f_e are the extra contributions to cost, walking time, in-vehicle time and frequency when respective attribute is presented at the edges, otherwise zero

ε is the random or unobservable error effects associated with the utility of an alternative

The parameters, a_i, and $\Delta a_{ij,}$ were estimated using computer package Alogit, the equations 1-3 above, and all 6180 observations from the study.

Table 5. Estimate of parameters with additional contribution if placed as the first attribute (equation 1), the last attribute (equation 2) or at the edges (equation 3) and respective t-value

		Equation 1		Equation 2		Equation 3	
		estimate	t-value	estimate	t-value	estimate	t-value
cost	a_c	-0.345	(-23.8)	-0.353	(-24.2)	-0.361	(-21.0)
	Δa_{c1}	0.002	(0.1)				
	Δa_{c4}			0.039	(1.6)		
	Δa_{ce}					0.036	(1.7)
walking time	a_w	-0.110	(-9.0)	-0.10	(-8.2)	-0.108	(-7.5)
	Δa_{w1}	0.033	(1.4)				
	Δa_{w4}			-0.010	(-0.4)		
	Δa_{we}					0.015	(0.7)
in-vehicle time	a_v	-0.093	(-21.6)	-0.087	(-20.7)	-0.088	(-17.4)
	Δa_{v1}	0.010	(1.4)				
	Δa_{v4}			-0.016	(-2.1)		
	Δa_{ve}					-0.005	(-0.8)
frequency	a_f	-0.105	(-29.8)	-0.106	(-30.1)	-0.107	(-25.6)
	Δa_{f1}	0.002	(0.3)				
	Δa_{f4}			0.005	(0.8)		
	Δa_{fe}					0.005	(1.0)

The results show no clear pattern. The Δa_{i1}–parameters were separated from 0 (sign 80%) for two attributes; walking time to bus stop, w, and for in-vehicle time, v. Both of these delta-parameters have the opposite sign as their corresponding a-parameters, meaning that less attention was paid to the attribute if placed as the first one. This result was unexpected, since the hypothesis was that more attention should be paid to the first attribute. It did not make any significant difference, however, for the corresponding parameters of travel cost and bus frequency if the respective attributes were placed at the first place or not. All Δa_{i1}–parameters were positive, though. Thus, there is a weak tendency for the first attribute to get less attention.

More attention has been paid to in-vehicle time when this attribute was placed as the last attribute. The additional Δ a_{v4} is separated from 0 (sign 95%). Contradictory to this result is that the cost attribute has been considered less important when placed at the bottom (sign 80%). Neither of the corresponding parameters for walking time to bus stop nor bus frequency showed any significant difference depending on whether this attribute was placed as the last one or not.

Only one of the Δa_{ie}-parameters was found being separated from 0 (sign 90%). The cost attribute was less important when placed at the edges. Thus, more attention was paid to cost when this attribute was placed in the middle. The remaining three attributes did not show any difference in estimated parameters depending on whether it was placed at the edges or in the middle.

3.3.1 Parameter estimation among less experienced respondents

Since Boyle *et al.* (1993) found ordering effects only among respondents inexperienced with the assessed utility, a corresponding comparison will be made in this study. The respondents were divided into two groups. The first group consisted of passengers travelling with tickets valid for an unlimited number of trips during a specific period, i.e., period tickets. The second group consisted of passengers who paid for each trip separately. Passengers with period tickets use public transport more often. Their average number of trips per month is 50, compared to 27 trips per month for passengers paying per trip. Because of this difference in travel frequency, this test corresponds to Boyle *et al.* (1993). The group with "experienced" travellers contains more passengers than the "inexperienced" group, 590 persons compared to 440 persons.

The three equations 1-3 above were used again, but now for the two ticket-type groups separately. However, no obvious ordering effect was discovered, either among inexperienced nor among experienced respondents. The results are shown in tables in the appendix.

3.4 Scale factors

The relative size of a model's estimated parameter values can give information about the model's scale factor (Brundell-Freij, 1995). The scale factor indicates the degree to which the choices are based on the predictors included in the model, and, conversely, the degree to which they are based on other "random" factors. The higher the scale factor, the more the choices made are influenced by the included predictors. When Revealed Preference data is used to estimate logit models, for example, the scale factors are normally smaller than for SP data, since peoples' real choices are based upon factors and restrictions that are not included in the model.

To make the comparison of scale factors in this study, four separate models were estimated, one per questionnaire type respectively. The number of observations used to create each model were only about one-fourth of the total material from 6180 observations. Each of the four models was estimated in Alogit with utility-formulations according to equation 4 below.

$$U = a_c * c + a_w * w + a_v * v + a_f * f + \varepsilon \qquad (4)$$

where

a_i are the parameters for cost, walking time, in-vehicle time, and bus frequency

c, w, v, and f are the cost, walking time, in-vehicle time, and frequency actually presented in the alternatives

ε is the random or unobservable error effects associated with the utility of an alternative

Four analyses in Alogit estimated four parameters each. The average of respective models' four parameters is shown in table 6, representing an average, relative scale factor.

Table 6. Scale factor for the four different ordering types

Ordering	scale factor
c (w,v,f)	-0.145
w (v,f,c)	-0.156
v (f,c,w)	-0.167
f (c,w,v)	-0.175

As table 6 shows, the scale factors of the four models are fairly similar. Probably, the ordering of attributes in scenarios has no effect on the extent to which the choices are explained by the included characteristics.

Another means of describing what the scale factors indicate is how obvious the respondent found the choices. The scale factors get higher when the choices are easy to understand. Hence, one possible hypothesis is that the scale factor should have higher values when cost is placed either first or last. The reason is that all time attributes are then placed together in one sequence, and the cost is either before or after the time attributes, which all have the same unit. But, as can be seen in table 6, the scale factor has its highest value when cost is placed in the middle, ordering v or ordering f.

3.5 The values of time

The previous sections investigated whether the sizes of the parameters a_i were affected by each attribute's place. However, it is not the a-parameters that we are ultimately interested in, but the relationship between one of the time-parameters and the cost-parameter. By dividing one of the time-parameters by the cost-parameter we can estimate the corresponding value of time. These ratios are affected both by the place of the time-parameter and the place of the cost-parameter.

As stated above, the variation of the ordering was rotated such that the internal ordering of the four attributes was always the same. This means that the place of the cost-attribute is dependent on the place of the time-attribute currently being analysed. For example, the cost is always placed as the last attribute when walking time is at the top. Thus, when comparing the values of time calculated from the four subsets of data, the present position of the cost attribute must also be considered.

To calculate the assessments of walking time, in-vehicle time, and bus frequency in table 7, equation (4) above has been used once for each of the four sub-samples. Each orderings' assessments have consequently been estimated separately.

Table 7. Estimated values of time for the four different ordering types, SEK per hour

Ordering	walking time	in-vehicle time	bus frequency
c (w,v,f)	19	15	18
w (v,f,c)	15	18	21
v (f,c,w)	18	14	17
f (c,w,v)	20	17	18

As table 7 shows, the assessment of walking time, in-vehicle time, and bus frequency, respectively, are very much the same independent of ordering type. There is no general pattern. None of these values can be significantly separated from the other values. The differences are small and cannot even be seen as tendencies.

4 . CONCLUSION

The aim of this study was to see whether the ordering of attributes in SP-alternatives had any influence on the estimated assessments in a study of quality in public transport. There were three hypotheses about ordering effects: the respondent focuses on some of the attributes only because of their place; the respondent does not read all attributes; and some orderings seem more understandable than others.

The ordering of attributes had no significant effect. Even among respondents less experienced with the assessed utility, a bus trip, no ordering effect was found. Neither the share of lexicographically sorted answers according to respective attribute nor the overall scale factor was affected by the ordering of attributes.

This is a positive result because it allows ordering of attributes in ways that are most clear and intuitive to respondents. In public transport quality studies, for example, it seems natural to first present walking time to bus stop, then waiting time or bus frequency, followed by time in the bus, with fare either at the top or the bottom.

This result was drawn from a self-completion survey where respondents can read the attributes in the ordering they want. In an interviewer-administered survey, where the interviewer reads or points out the attributes from top to bottom, one might find more of an ordering effect.

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APPENDIX

Estimates of parameters with additional contribution if placed as the first attribute (equation 1), the last attribute (equation 2) or at the edges (equation 3) for **experienced** travellers (period tickets) and respective t-value

		Equation 1		Equation 2		Equation 3	
		estimate	t-value	estimate	t-value	estimate	t-value
cost	a_c	-0.405	(-18.9)	-0.386	(-18.9)	-0.417	(-16.5)
	Δa_{c1}	0.066	(2.0)				
	Δa_{c4}			0.010	(0.3)		
	Δa_{ce}					0.063	(2.0)
walking time	a_w	-0.090	(-5.6)	-0.097	(-6.0)	-0.101	(-5.3)
	Δa_{w1}	-0.003	(-0.1)				
	Δa_{w4}			0.034	(1.0)		
	Δa_{we}					0.024	(0.9)
in-vehicle time	a_v	-0.096	(-17.1)	-0.083	(-15.5)	-0.088	(-13.7)
	Δa_{v1}	0.024	(2.5)				
	Δa_{v4}			-0.027	(-2.6)		
	Δa_{ve}					-0.004	(-0.4)
frequency	a_f	-0.107	(-22.9)	-0.107	(-22.2)	-0.106	(-18.8)
	Δa_{f1}	-0.004	(-0.5)				
	Δa_{f4}			-0.002	(-0.3)		
	Δa_{fe}					-0.004	(-0.6)

Estimates of parameters with additional contribution if placed as the first attribute (equation 1), the last attribute (equation 2) or at the edges (equation 3) for **inexperienced** travellers (paying per trip) and respective t-value

		Equation 1		Equation 2		Equation 3	
		estimate	t-value	estimate	t-value	estimate	t-value
cost	a_c	-0.293	(-14.6)	-0.321	(-15.2)	-0.311	(-13.2)
	Δa_{c1}	-0.061	(-1.6)				
	Δa_{c4}			0.060	(1.7)		
	Δa_{ce}					0.017	(0.5)
walking time	a_w	-0.137	(-7.4)	-0.106	(-5.7)	-0.122	(-5.5)
	Δa_{w1}	0.078	(2.2)				
	Δa_{w4}			-0.050	(-1.5)		
	Δa_{we}					0.008	(0.3)
in-vehicle time	a_v	-0.091	(-13.2)	-0.093	(-13.7)	-0.089	(-10.7)
	Δa_{v1}	-0.010	(-0.9)				
	Δa_{v4}			-0.001	(-0.1)		
	Δa_{ve}					-0.007	(-0.7)
frequency	a_f	-0.105	(-19.3)	-0.106	(-20.2)	-0.110	(-17.5)
	Δa_{f1}	0.008	(1.0)				
	Δa_{f4}			0.016	(1.7)		
	Δa_{fe}					0.017	(2.2)