TOPIC 18
ENVIRONMENT AND
SUSTAINABLE MOBILITY

VALUATIONS OF URBAN TRAVEL TIME AND INFORMATION AND THE ROLE OF TIMETABLE USE

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Abstract

The paper deals with local and regional public transport concerning (a) the passengers valuations of travel time components, where the valuations' depend on timetable information, (b) the passengers' valuations of various information sources. Special attention is given to the two situations where passengers use or do not use timetables.

INTRODUCTION

This project aims to achieve some further knowledge for local and regional public transport concerning (a) the passengers' valuations of travel time components, where the valuations depend on timetable information, (b) the passengers' valuations of various information sources.

An important aspect, which has often been ignored in practical public transport planning, is that passengers behave differently and value service frequency differently in the situation where they do use and do not use time tables respectively. Jansson [1991] shows the importance for cost-benefit analyses of making correct assumptions on whether the passengers use timetables or not. One aim of this study was therefore to try and find the magnitude of possible differences in values for these two situations.

The project commenced in 1993 and was finalized in early 1995. The method used was "stated preference" (SP), applied to three different groups in the Stockholm region: a) public transport users without car available for the journey, b) public transport users with car available for the journey, c) private motorists. Group a), which was the largest one, also permitted categorisation with respect to in-vehicle time, public transport mode, ticket type, journey purpose etc.

Most results of this study are provided in tables, showing valuations for various passenger groups. As a matter of course, any valuations obtained through empirical studies never provide the ultimate "truth". This is a fact which might be even more emphasized in SP studies, based on preferences for hypothetical alternatives, where the respondents may have difficulties to understand the "games" and find them realistic.

A side issue, which is important but which was originally not intended, is how to find the appropriate way to get the correct response from travel card holders. When some basic results of this study was presented at the 22nd European Transport Forum (PTRC), 12-16 September, 1994, we were not fully aware of a stupid mistake which we had made in the design of questions. That is, card holders were asked about variations of the price of their card (valid 1 month, 3 months or one year), while all travel time and information variables referred to their latest journey.

This study shows in brief:

- That the passengers valuation of interval between departures is substantially higher where timetables are not used compared to where they are.
- That car users have a much higher value of public transport riding time than public transport riders who use single tickets , who in turn, have higher values than public transport travel card users.
- That improved information seems to be socially justifiable.
- That a lesson has been learnt concerning how to ask travel card holders on price and travel times: respondents must clearly understand that improvements and worsening of travel tirnes refer to the same period as for which the card is valid.

The next section includes an outline of the study and defines the prerequisites. The following three sections give the results for the three passenger groups respectively. The final section discusses and summarizes the main conclusions. The study was financed by the Swedish Transport and Communications Research Board.

OUTLINE AND PREREQUISITES

Method

The method used was stated preference (SP), by use of computerized telephone interviews with pairwise choices.

The sampling was made in two steps. In step 1 respondents were approached on the public transport vehicle/station and on the parking place. Respondents were asked some basic questions concerning the actual journey: origin and destination, route numbers used (public transport passengers), ticket type, and in general: car ownership, name, address and telephone number. A folder including a "convincing" letter, the SP-games plus a picture post card was handed over to the respondent. Out of contacted persons in the defined age range etc. 74% of public transport passengers and 84% of private motorists potentially accepted to be interviewed by telephone.

In step 2, the telephone interview, 20% of both public transport passengers and private motorists were lost due to refusal, lost the folder, wrong number etc.

The number of respondents who actually played the SP-games in each group was:

- Public transport passengers without access to a car: 474
- Public transport passengers with access to a car: 128
- Car users: 286

Each respondent plays two "games", each including 8 choices between two separate alternatives, where each alternative includes a number of characteristics (variables) for a journey which is actually made.

Basically the respondents are separated into two groups who play different games:

A Public transport passengers who do not have access to a car for the actual journey made.

B Public transport passengers who do have access to a car for the actual journey made, plus motorists who used car for the actual journey.

The price variable is related to the kind of ticket held by the respondent. For example, if the respondent uses monthly travel cards, the price of the card is varied, if the respondent uses a single ticket it is the price of the single journey which is varied.

Games and variables

Games A

The first games, A1:1 and A1:2, include variation in travel time components and price. The variation range of travel time components and price was around 10-20%, up and down.

Passengers who used time table for the journey play game A1:1, including the variables: in-vehicle time, price, interval and delay. Passengers who did not use time table for the journey play game A1:2, including the variables: in-vehicle time, price, interval. For the latter group delay is not a relevant concept since the passengers do not know when the bus or train is supposed to arrive.

The second game, A2, includes the variables price plus various information sources. The variation range of price was around 10-20%, up and down. The information variables was 0 or 1, except for telephone inquiry where the variable was waiting time minutes in telephone. The information variables are:

- Real time information ("count-down") at stops, i.e., a display showing number of minutes till arrival of each specific service,
- Stop timetable, i.e., a paper table showing the arrival times of each service,
- Digital answer, where the passengers make a telephone call and use the buttons to code departure stop, arrival stop and the wished departure or arrival time. The answer is given by a recorded digital voice, subsequently called digital answer.
- Home information means that timetables are sent home to the households whenever the times are changed and that new maps are sent home to the household once a year.
- Telephone information, which is the normal telephone inquiry at the public transport company.

The variables used in each game are summarized in the following table.

Game A1:1	Game A1:2	Game A2
interval	interval	real time, stop timetable
delay		digital answer, home info
in-vehicle time	in-vehicle time	telephone
price	price	price

Games B

The first game includes price, interval, in-vehicle time on a normal standard vehicle and a specific set of information variables. The second game includes price, interval, in-vehicle time on a high-standard vehicle and a specific set of information variables.

For car users the price for the public transport journey is based on the aggregate single ticket prices for all persons who used the car for the specific journey .

The variables used in each game are summarized below.

Game B1	Game B2
in-vehicle time, standard vehicle	in-vehicle time, high- standard vehicle
interval	interval
digital answer, digital answer + real time	home info, home info+stop timetable
price	price

Adaptation time

Public transport is characterised by a divergence between the passenger's ideal departure or arrival time and the actual departure or arrival time. This divergence is sometimes called frequency delay or schedule delay. Here we will refer to it as "adaptation time" in order to emphasize the effort of a time which is involved. On the average the adaptation time is half the interval between departures.

When passengers use timetables the adaptation time is taken at home, at work etc. before going to the stop. When passengers do not use timetables the adaptation time is taken at the stop—as waiting time. But, the passenger who use timetables perceives a few additional costs: a) find information about the departure time, b) having to check the watch every two minutes in order not to be late, c) a "margin" time at the stop in order not to miss the departure, where the latter cost in fact is waiting time at stop.

Problem related to travel card holders

Card holders were asked about variations of the price of their card (valid 1 month, 4 months or one year), while all travel time and information variable variation referred to their latest journey. Implicitly we thought that card holders would consider these changes in travel times and information should apply to all journeys over the valid card period. This thought was not very wise, we must admit. Some passengers probably have thought they would have to pay a substantial amount of money for a small improvement of one journey only. The problem is probably very small for the information variables, since it is difficult to perceive any kind of information being available for one single journey only. The problem may be worse for travel time components.

The way we subsequently tried to "solve" this problem is to test an alternative design, taking out all lexicographic price answers related to travel time components, that is, taking out all respondents who solely went for the cheapest card price. The number of lexicographic answers were about 25% of total answers for games A1:1 and A1:2, including variation in travel time components and price. The lexicographic part of answers in games B, including price, interval, in-vehicle time and information variables, was around 5% only. The definition of lexicographic

answer for these games was that price was the sole choice variable for both the standard vehicle *and* the high-standard vehicle cases. As a matter of course, to disqualify lexicographic answer is no perfect solution. Some persons are genuinely not willing to pay for improvements even if they have considered them to be valid for all journeys during the period. The results of this test may thus for this reason overvalue travel time components. And opposite, it may be that some persons actually are willing to pay the very high price for one journey improvements; while if we had formulated the question correctly, they would have been willing to pay even more. The results of the study, both with and without lexicographic answers, for this second reason would mean undervaluation of the travel time components. We are inclined to believe that the former case is more common, implying that the test result may overvalue travel time components. The test results in tables have the heading "Non-lexicographic".

Design of result tables

Valuations or travel time components are provided a) with a weight (W), where the weight for in-vehicle time is normalized to unity (1), b) with a value of time, in SEK per hour. GBP 1 is approximately SEK 12. Valuations of information are provided in Swedish "öre", (100 öre= SEK 1).

Variables which have not turned out as significant are marked "ns" (not significant).

For each table the number of respondents is given in parenthesis. Where we look at results for certain ranges of intervals and in-vehicle times, these ranges are marked as for example 11-20, which means that the column refers to passengers who have an interval between 11 and 20 minutes. 0 — means all intervals etc.

It occurs that in-vehicle time does not turn out as statistically significant for the situation where passengers do not use timetable. Weights marked with a star, weight 5.2* for adaptation time for example, means that this figure is synthetic, in the sense that the weight is based on the money value of adaptation time, divided by the money value of the in-vehicle time for the situation where passengers *use* timetable (assuming that the in-vehicle value of time is the same for the two situations).

Results of the original study including all respondents are headed "All", while results from the alternative design is headed "Non-lexicographic". When commenting on results we refer to these studies as A and N respectively.

RESULTS FOR PASSENGERS WITHOUT ACCESS TO CAR

Valuations with and without use of timetables

Comments on Table 1

In A the value of in-vehicle time was not significant for "no use of timetable". In N the value of in-vehicle time was significant for "no use of timetable". In N also all values of time are higher, something which is highly expected since persons who constantly chose lowest price irrespective of travel times are excluded.

In A we note that the synthetic value of adaptation time for passengers who do not use the timetable is twice the value of those who use the timetable. In N the value of adaptation time is however more than three times the value of in-vehicle time. That adaptation time is valued higher when timetables are not used is expected since adaptation time is spent as waiting time at the stop. It is however hard to believe in these very high values for adaptation time, both with and without use of timetable. We will elaborate this result for passengers who use timetables.

Table 1 Valuations with and without use of timetables

	Use of timetable			
	YES		NO	
All	(254)		(220)	
Travel times	W	SEK/h	W	SEK/h
In-vehicle time	1	8	ns	ns
Adaptation time	2.6	22	5.2*	45
Transfer time	2.4	20	1.8*	15
Delay, no shelter	14.2	117		
Delay, with shelter	10.5	87		
Delay, indoors	15.6	129		
Non-lexicographic	(200)		(175)	
Travel times	W	SEK/h	W	SEK/h
In-vehicle time	1	13	1	8
Adaptation time	2.6	34	8.7	70
Transfer time	2.5	33	4.1	33
Delay, no shelter	14.6	190		
Delay, with shelter	10.1	133		
Delay, indoors	14.9	195		
Information	Öre/journey		Öre/journey	
Stop timetable	434		550	
Real time	101		86	
Digital answer	61		77	
Home info	ns		ns	
Telephone (öre/min)	ns		0.19	

We have no good explanation for the result, in N, that the value of transfer time is higher for the passengers who do not use timetable than for those who do.

Stop timetable is more important for the passengers who did not use timetable before they walked to the stop. The result seems natural since they may feel they need the departure time which they did not know before going to the stop. Stop timetable is valued four to seven times higher than real time and digital answer.

Valuations for various intervals

Comments on Table 2

For passengers who use timetables there is a tendency that the weight for adaptation time decreases with the length of the interval, something which is even more pronounced in N. The explanation is probably that the longer the adaptation time is, the easier it is to use the time. For passengers who do not use timetables the tendency is that the weight for adaptation time increases with the length of the interval, but only in A. One would though expect that waiting is perceived worse the longer the waiting time is.

Among passengers who use timetable home information is significant only for those with the longest intervals. The reason is probably that the cost of missing a departure is the highest for those with the longest intervals.

Table 2 Valuations for various intervals

	With use of timetable							
	Interval, minutes							
All	0- (*254*)		0-10(*61*)		11- 20 (*83*)		21- (*110*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	8	1	9	1	8
Adaptation time	2.6	22	3.0	24	3.2	30	2.5	20
Transfer time	2.4	20	ns	ns	3.0	28	2.3	18
Delay, no shelter	14.2	117	8.8	70	ns	ns	17.9	142
Delay, with shelter	10.5	87	12.3	98	13.1	123	7.8	62
Delay, indoors	15.6	129	15.0	120	17.4	163	13.3	106
Non-lexicographic	0- (*200*)		0-10(*45*)		11- 20 (*69*)		21- (*86*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	13	1	11	1	14	1	13
Adaptation time	2.6	34	3.5	40	3.2	44	2.4	31
Transfer time	2.5	33	ns	ns	3.0	61	2.1	27
Delay, no shelter	14.6	190	9.1	103	ns	ns	19.9	255
Delay, with shelter	10.1	133	15.0	170	15.7	178	7.3	93
Delay, indoors	14.9	195	16.7	190	18.0	204	12.2	156
Information	Öre/journey		Öre/journey		Öre/journey		Öre/journey	
Stop timetable	434		421		450		413	
Real time	101		ns		ns		178	
Digital answer	61		ns		ns		123	
Home info	ns		ns		ns		146	
Telephone (öre/min)	ns		ns		ns		0.48	

	Without use of timetable					
	Interval, minutes					
	0- (*220*)		0-10 (*143*)		11- (*61*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	ns	ns	ns	ns	ns	ns
Adaptation time	5.2	45	4.2	36	7.6	66
Transfer time	1.8	15	3.4	28	ns	ns
Non-lexicographic	0- (*175*)		0-10 (*114*)		11- (*77*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	7	1	12
Adaptation time	8.7	70	8.5	56	8.4	99
Transfer time	4.1	33	6.8	45	2.5	29
Information	Öre/journey		Öre/journey		Öre/journey	
Stop timetable	550		448		701	
Real time	86		89		ns	
Digital answer	77		55		119	
Home info	ns		ns		ns	
Telephone (öre/min)	0.19		ns		0.40	

Valuations for various in-vehicle time intervals

Table 3 Valuations for various in-vehicle time intervals, with use of timetable

	With use of timetable							
	In- vehicle time, minutes							
All	0- (*254*)		0-15(*84*)		16- 30 (*112*)		31- (*58*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	15	1	4	1	8
Adaptation time	2.6	22	2.1	32	4.1	18	2.0	16
Transfer time	2.4	20	1.7	25	3.8	17	2.3	18
Delay, no shelter	14.3	117	15.2	231	18.0	80	12.4	95
Delay, with shelter	10.5	87	10.5	159	14.7	65	8.3	63
Delay, indoors	15.6	129	12.2	185	22.8	101	14.0	107
Non-lexicographic	0- (*254*)		0-15(*66*)		16- 30 (*85*)		31- (*49*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	13	1	22	1	8	1	10
Adaptation time	2.6	34	2.5	56	3.5	28	2.0	20
Transfer time	2.5	33	1.5	32	5.3	42	2.3	22
Delay, no shelter	14.6	190	13.9	309	18.5	148	13.4	132
Delay, with shelter	10.1	133	9.4	209	14.2	113	8.3	82
Delay, indoors	14.9	135	15.8	351	17.7	141	13.2	130
Information	Öre/journey		Öre/journey		Öre/journey		Öre/journey	
Stop timetable	434		992		276		170	
Real time	101		ns		77		81	
Digital answer	61		ns		49		ns	
Home info	ns		ns		55		ns	
Telephone (öre/min)	ns		ns		ns		ns	

Table 4 Valuations for various in-vehicle time intervals, without use of timetable

	Without use of timetable					
	In-vehicle time, minutes					
All	0- (*220*)		0-15 (*124*)		16- (*96*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	ns	ns	ns	ns	ns	ns
Adaptation time	5.6*	45	3.1*	46	5.8*	35
Transfer time	1.9*	15	4.0*	60	ns	ns
Non-lexicographic	0- (*220*)		0-15 (*99*)		16- (*76*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	ns	ns	1	9
Adaptation time	8.7	70	8.7*	72	7.0	60
Transfer time	4.1	33	8.2*	66	2.5	21
Information	Öre/journey		Öre/journey		Öre/journey	
Stop timetable	550		620		499	
Real time	86		136		ns	
Digital answer	77		ns		80	
Home info	ns		ns		ns	
Telephone (öre/min)	0.19		ns		ns	

Comments

The values of the travel time components in money terms tend to be higher for the short than for the long journeys. An explanation may be that the passengers value not only the absolute travel time change, but also the relative change.

Among the information variables only stop timetable permits interpretations. The valuation clearly decreases with the length of the journey.

Valuations for various public transport modes

We distinguish between BUS, METRO and TRAIN.

No significant differences in valuations of in-vehicle time between various modes was found. For passengers who use timetables the value of adaptation time and delay time (with shelter) was found to be lower for bus than for train.

Valuations for various purposes

We distinguish between work and school (WS) and other purposes (OTHER) respectively.

Passengers who use timetables value adaptation time and delay time higher for other journeys than for work and school journeys. The valuation of stop timetable is more or less the same for all purposes.

Valuations for various ticket types

We distinguish between travel cards (CARD) and single journey tickets (SINGLE).

Table 5 Valuations for various ticket types

	With use of timetable				No use of timetable			
	CARD		SINGLE		CARD		SINGLE	
All	(*220*)		(*34*)		(*162*)		(*58*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	6			1	2	1	29
Adaptation time	2.6	15			11.5	24	3.6	105
Transfer time	2.4	14			7.0	15	2.0	40
Delay, no shelter	15.0	89						
Delay, with shelter	9.3	55						
Delay, indoors	15.7	93						
Non-lexicographic	(*166*)		(*34*)		(*117*)		(*58*)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	9			1	5	1	29
Adaptation time	2.6	24			8.8	40	3.6	105
Transfer time	2.4	22			5.8	27	2.0	40
Delay, no shelter	15.3	140						
Delay, with shelter	9.1	83						
Delay, indoors	15.2	139						
Information	Öre/journ.		Öre/journ.		Öre/journ.		Öre/journ.	
Stop timetable	86				93		647	
Real time	29				25		117	
Digital answer	20				16		154	
Home info	23				15		ns	
Telephone (öre/min)	0.08				0.06		0.74	

Comments

For passengers who do not use timetables the valuations of travel time components are higher for single ticket than for travel card journeys. The explanations are probably: a) Card users are accustomed to daily travel and to the level of standard provided, implying a low willingness to pay for improvements, an explanation which may be called "self-selection". b) A costly improvement is more difficult to bear for card users who have to pay a large amount for all their journeys during a month, an explanation which may be called "budget constraint". c) Part of the passengers who use single journey tickets are normally (affluent) car users.

Among passengers who do not use timetables the single ticket riders value information 6-12 times higher than card users. An explanation may be that card users are more used to the public transport system, meaning that they do not need as much information as single ticket riders.

Valuations for various working hour rules

We distinguish between those who have flexible working hours (FLEX) and those who do not (NO FLEX).

Table 6 Valuations for various working hour rules

	With use of timetable			
	FLEX		NOFLEX	
All	*(49)*		*(70)*	
Travel times	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	8
Adaptation time	2.5	21	2.4	18
Transfer time	2.2	19	2.8	21
Delay, no shelter	8.9	75	11.3	85
Delay, with shelter	8.4	70	11.6	87
Delay, indoors	7.4	62	15.9	120
Non-lexicographic	*(36)*		*(58)*	
Travel times	W	SEK/h	W	SEK/h
In-vehicle time	1	12	1	10
Adaptation time	2.4	30	2.5	26
Transfer time	3.1	38	2.8	29
Delay, no shelter	7.1	86	11.5	120
Delay, with shelter	9.7	117	10.8	113
Delay, indoors	7.7	93	15.1	159
Information	Öre/journ		Öre/journ	
Stop timetable	134		478	
Real time	ns		193	
Digital answer	ns		ns	
Home info	ns		ns	
Telephone (öre/min)	ns		ns	

Comments

Delays are valued higher by passengers who do not have flexible working hours. This seems natural since the cost of arriving late is higher for this group than for passengers with flexible hours.

Stop time table is valued 3-4 times higher by passengers without flexible hours, something which may be explained so that these passengers are more "obsessed" by exact times and timetables.

RESULTS FOR PASSENGERS WITH ACCESS TO CAR

In order to facilitate comparisons between the group with access to car (WITH CAR) and the group without access to car (NO CAR), we will here show certain results in the same table.

Table 7 Valuations of passengers with access to car

With use of time table

	NO CAR		WITH CAR			
			Normal standard		High standard	
All	(254)		(76)		(76)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	11	1	7
Adaptation time	2.6	22	1.9	20	1.6	12
Transfer time	2.4	20	0.9	10	2.2	16
Non-lexicographic	(200)		(73)		(73)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	13	1	14	1	8
Adaptation time	2.6	34	1.8	25	1.6	13
Transfer time	2.5	33	0.9	12	2.3	19
All (Non-lexicographic)						
Information	Öre/journey		Öre/journey		Öre/journey	
Real time	101		ns		-	
Digital answer	61		ns		-	
Stop timetable	434		-		ns	
Home info	ns		-		36(43)	

Without use of time table

	NO CAR		WITH CAR			
			Normal Standard		High Standard	
All	(220)		(52)		(52)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	ns	ns	1	11	ns	ns
Adaptation time	5.2	45	5.3	58	-	40
Transfer time	1.8	15	2.4	27	ns	ns
Non-lexicographic	(175)		(52)		(52)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	8	1	14	ns	ns
Adaptation time	8.7	70	4.9	68	-	51
Transfer time	4.1	33	2.1	29	ns	ns
Information	Öre/journey		Öre/journey		Öre/journey	
Real time	86		ns		-	
Digital answer	77		ns		-	
Stop timetable	550		-		ns	
Home info	-		-		ns	

Comments

For passengers who use timetables it seems as if those in the group with access to car have lower valuations of adaptation time and transfer time than the passengers in the group without access to car. We can see no reasonable explanation to this. We would rather have expected the opposite result.

Passengers who use timetables have a lower valuation of in-vehicle time for high standard vehicles than for normal standard vehicles, something which seems reasonable.

RESULTS FOR CAR USERS

We distinguish between work and school (WS) and other purposes (OTHER) respectively.

Table 8 Valuations of car users

	Normal standard				High standard			
	WS (160)		OTHER (126)		WS (160)		OTHER (126)	
Travel times	W	SEK/h	W	SEK/h	W	SEK/h	W	SEK/h
In-vehicle time	1	50	1	55	1	50	1	48
Adaptation time	1.5	76	1.7	94	1.2	63	1.4	69
Information	Öre/journey		Öre/journey		Öre/journey		Öre/journey	
Real time	ns		ns		-		-	
Digital answer	168		334		-		-	
Stop timetable	-		-		ns		ns	
Home info	-		-		284		526	

Comments

Car users value in-vehicle time (in public transport) 1.5-2 times higher than public transport passengers who use single tickets and around 4 times higher than public transport passengers who use travel cards. One reason is probably that car users earn more. Another reason is probably "self-selection", that is, those who choose public transport have lower valuations than those who choose the car.

Car users seem to value travel time components equally for all journey purposes.

Car users value waiting time lower in relation to in-vehicle time than public transport users do. The reason may be that for car users it is the total travel time that matters more than each individual component.

It may be thought remarkable that car users do not seem to value in-vehicle time different for high standard vehicles and normal standard vehicles.

Information which is consumed at home, that is home information and digital answer, are the only significant sources of information for car users. The reason may be that car users who are not used to public transport do not find it worthwhile to walk to a stop and find out when a bus may arrive. If they would consider to use a bus they must get the information at home.

The study also collected information about some perceptions and opinions of car users. 80 percent of the car users claimed that they knew the public transport services which they could have used instead of their car for the actual journey made. 78 percent claimed that they also knew the service frequency or departure time. We have not been able to check the truth of their statements.

We also asked for their reasons to choose car instead of public transport. Since they were allowed to give more than one reason the sum of percentages in the table below exceeds 100 percent.

Note that the percentage for quality of public transport is very low. The fact that travel time is the most important factor is interesting in the sense that it is this factor which the public transport company can affect most.

Table 9 Reasons for choosing car over public transport

Reasons for choosing car	
Travel time	40%
Convenience (baggage, children, transfers etc.)	26%
Use in work	14%
Flexibility (freedom, several travel purposes etc.)	12%
Price of public transport	7%
Poor quality of public transport (crowded, dirty, violence etc.)	2%
Poor knowledge of the public transport system	2%
By habit	2%
Miscellaneous (fun to drive, return from repair shop etc.)	7%

DISCUSSION AND CONCLUSIONS

Travel time components

Travel card holders

A lesson has been learnt concerning how to ask travel card holders on price and travel times: respondents must clearly understand that improvements and worsening of travel times refer to the same period as for which the card is valid.

In-vehicle time

According to this study the average value of in-vehicle time in local and regional public transport is SEK 9 -14 per hour (dependent on exclusion of lexicographic answers or not). (The value is lower for travel card holders and higher for single ticket journeys.) This average value is substantially lower than the value normally used in cost-benefit analyses for transport investments in Sweden, around SEK 30 per hour. This latter value is however based on studies including a mix of car users and public transport passengers. Several studies apart from this one shows that public transport passengers have lower values of time than car users. Whether one should use a lower value for public transport riders than for car users is thus a matter of distributional policy. In this report we do not discuss this matter. We will only present the weights obtained.

Delays

We have found that the value of delay time is around 12 times the value of in-vehicle time. Widlert (1990) makes references to a few results concerning delays. In his own study the delay weight is 9-19. In Bates and Copley (1988) the weight for British commuter trains was 8.5 for long delays and 14.4 for short delays. These studies, like our, were concerned with the risk for delays. Studies which have been concerned with actual delays have shown lower values. However, the risk for delays seems more relevant for practical use since the risk itself may force the passenger to use a security margin in order not to miss a departure. Our conclusion is that the weight 12 seems reasonable for practical use. But note that this weight should only be used where the intervals are so long that most people use timetables. Where timetables are not used the concept delay is not relevant, but should be replaced by the concept prolonged expected interval.

Another conclusion is that it may be worthwhile to examine whether it is beneficial to extend the round trip times of the services, and consequently also the in-vehicle times, in order to reduce the risk for delays.

Adaptation time

We have already mentioned that adaptation time is here defined as the time between the passenger's ideal departure time and the actual departure time. In practice this time has to be calculated as half the interval between departures.

An important point of departure in this study is that we distinguish between the situation where passengers use and not use timetables respectively. We have found that most passengers use timetables if the interval exceeds 12 minutes.

The average value of adaptation time when timetables are used has been found to be 2.6. Since the passengers who use timetable perceive additional costs, the consequence is that the weight for adaptation time for passengers who use timetable in fact is a weight which takes into account all these costs. The weight for the actual adaptation time for those who use timetable is therefore lower than the number 2.6.

The weight of the actual adaptation time for those who do not use timetable is on the average between 5 and 9. These weights certainly seem too "high". The weight 8 would mean that passengers would be indifferent between the alternatives waiting at a bus stop for 5 minutes and riding the bus for 40 minutes. So, this result is certainly not reliable, and demonstrates the weaknesses of SP-studies and/or the weaknesses of the designers of this particular study.

Interestingly enough, however, it is shown to be the a difference between the value of adaptation time with and without use of timetable respectively. This is something which we believe should be taken into consideration for practical planning purposes, where traditionally often a common weight is used (2 or 3 for example) for both situations. This consideration of separate weights is also related to the fact that passengers behave differently when they do use and do not use timetables respectively. In the former case there is a reason to take into account more routes and more stops for the decision of travel path.

Since we believe that both adaptation time weights are too high, what can be done about it? Well, concerning the situation where timetables are not used we can only claim that the value should be lower. Let us assume that the weight is 3. This assumption can then be used to elaborate on the weight for the situation where timetables are used.

In the study we actually asked passengers who used timetable for the "margin" time, that is how many minutes before announced departure time they arrived at the stop, which on the average was 3.4 minutes. We then made a guess about the information cost. Since we know that for the interval 12 minutes the cost for using and not using timetable respectively must be the same, we calculated the actual adaptation weight, which was found to be slightly over 1.

Our recommendation is therefore to use the weight 1 for adaptation time for intervals over 12 minutes and the weight 3 for intervals below 12 minutes. In order to get the same cost for timetable use and no timetable use at the interval 12 minutes, the extra costs when time tables are used is 12 minutes. Note then that these 12 minutes include the weight for waiting the "margin" time at the stop. The 12 minutes are thus seen in the following expressions:

Without use of timetable	With use of time table
3 x adaptation time 6 = 18	1 x adaptation time 6 + 12 = 18

Transfer time

The average weight for transfer time seem to be between 2 and 4. We assume a value in between, 3. One other argument for this value is to make it the same as the value for adaptation time when timetables are not used, since waiting without knowing the timetable in advance and waiting at a stop when transferring can be regarded as similar situations.

Conclusions on travel time components

The following values are recommended on the basis of this study:

Table 10 Conclusions on weights for travel time components

Travel time components	Weight
In-vehicle time	1
Adaptation time with use of time table interval ≥ 12 minutes	1 (+12 minutes extra cost)
Adaptation time with use of time table interval < 12 minutes	3
Transfer time	3
Delay time with use of timetable	12

Information

We have tried to calculate the cost for each information source on a yearly basis, thereby comparing the cost with the value of information for all journeys made during a year. For the telephone service we have tried to estimate the value and the cost for a reducing by 2 minutes the waiting time for the answer.

Table 11 Calculation of benefits and costs of information sources

	Benefits and costs per year, in SEK millions					
	Stop time table	Real time	Digital answer	Home info	Telephone -2 minutes	Sum
Benefits						
Card journeys	192	54	32	43	26	347
Single journeys	345	61	80	0	76	562
Sum benefits	537	115	112	43	102	909
Costs	7	51	1	14	11	84
Benefits-costs	+530	+64	+111	+21	+91	+817

Observe that the value of improvement of each information source should be reduced when other sources are improved simultaneously. The sum of benefits is therefore not relevant.

Conclusions concerning information

Stop timetable is very beneficial compared to the cost.

Digital answer is achieved at a very low cost compared to the benefits. Since the passengers have to accept a "book" with codes for each stop, it has to be investigated whether a full system, covering all services is practically feasible. The system is already implemented in Stockholm, but so far limited to the commuter railway, the metro and the airport bus services.

Improvement of the telephone inquire system seems worthwhile.

A real time display system seems worthwhile to implement for the commuter rail system, the metro and the 150 "biggest" (most used) bus stops.

Home information is not worthwhile in a full scale. It should be limited to the areas that have the worst travel standard and to the areas with a high percentage of car use.

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