

Passengers' Waiting Behavior at Bus Stops

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Abstract

Providing better environment that passengers can wait for bus comfortably is an important factor for promoting bus use. This paper investigates the relationships between passengers' waiting behavior at bus stops and their irritation levels to waiting for the bus. From the observation surveys on passengers' waiting behavior at bus stops, it was found that half of them were doing some activities while waiting but others were doing nothing and just waiting. We conducted questionnaire surveys for collecting information on their irritation levels and some attributes in addition to observation surveys. The results showed that irritation levels were affected by waiting time, activity engagement at the bus stop including spending time in a nearby convenience store, time constraints at destinations, and environment of the bus stops. Sitting on benches was very useful for mitigating the irritation levels especially for the elderly passengers, but some factors prevented them from sitting on the benches.

Keywords: bus stop, passenger, waiting behavior, activity

Introduction

The number of bus users in Japan has been decreasing since 1970's. One of the main reasons is rapid progress of motorization. As a result, level of bus service has been decreasing and this has caused further decrease of bus users, which is famous as a vicious circle. When traveling by bus as compared with traveling by car, out-of-vehicle time such as access, egress, waiting and transfer time occupies larger amount of travel time and is an important factor affecting the overall quality of bus

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services. As shown in case of Curitiba city, providing better environment of bus stops so that passengers can wait for the bus comfortably is one of the elements which contribute to increasing the number of bus users. On the other hand, in recent years, it should be paid attention to another noticeable revolution: spread of information and communications technologies (ICT) such as cellular phone and the Internet. People can communicate with friends and have access to websites by using cellular phone at any time and any place. This means that passengers can engage in additional activities by cellular phone while waiting at bus stops.

A lot of previous research has shown that the value of out-of-vehicle time savings is larger than that of in-vehicle time savings (e.g., Wardman (2001) reviewed British research). In most cases, these values of travel times have been measured by revealed preference surveys or stated preference surveys of travel choice. There has also been some research evaluating the value of waiting time by heart rate beats (Goodwin, 1976), by equivalent time coefficients (Nitta et al., 1995) and by observation surveys on bus choice at a bus stop (Hess, 2003). On the other hand, appropriate waiting area at bus stops tried to be evaluated by observation surveys of waiting passengers (Tanaka et al., 2002). Recently, bus users can get information on bus arrival from bus location systems at bus stops and it has been important to understand the relationships between their expected bus waiting time and information acquisition from bus location systems (Hall, 2001; Takami et al., 1995). The way how passengers are waiting at bus stops and what kind of activities they engage in while waiting can affect the value of waiting time at bus stops, but it has not been addressed by the previous studies. The value of waiting time could be reflected on perceived irritation levels to waiting for bus. This paper analyzes passengers' waiting behavior at bus stops and relationships between their waiting behavior and their irritation levels, using data collected by observation surveys at bus stops and questionnaire surveys for waiting passengers.

Observation Surveys on Passengers' Waiting Behavior at Bus Stops

We observed passengers' waiting behavior at six bus stops of a local bus operated by Bureau of Transportation, Tokyo Metropolitan Government, on weekdays in November 2001. A surveyor recorded all passengers' behavior (activities) every one minute, from the time they arrived at the bus stop to the time they boarded on the bus. Table 1 shows the characteristics of the six bus stops and the number of observations. About 50% of the total passengers were engaging in some activities while waiting for the bus, for example, reading books, smoking cigarettes, chatting with accompanied persons, talking and e-mailing by cellular phone, and spending time in a nearby convenience store. On the other hand, the rest of them were doing nothing and just waiting for the bus coming. Four of the six bus stops were equipped with benches. About 60% of the passengers were sitting on the bench at bus stops No.2 and No.4, while only 10% of them were sitting at bus stops No.3 and No.6. At the bus stops equipped with benches, the proportion of engaging in some activities was higher for passengers sitting on the benches (bench users) than for those standing (non-users, see Figure 1).

Table 1. Characteristics of the bus stops and the number of observations

No.	Name of bus stops	Headway (min.)	Bench	Other characteristics	Number of observations
1	Komagome-fuji	8-10	No	Convenience store is located nearby	67
2	Kamifuji-mae	8-10	Yes	Convenience store is located nearby	27
3	Koishikawa-yonchōme	5-8	Yes	New facility and good environment	27
4	Ohtsuka-shako	5-8	Yes	Enclosed by a windbreak	37
5	Toshima-kuyakusho	3-5	No	—	58
6	Shikahama-sanchōme	8-10	Yes	—	58

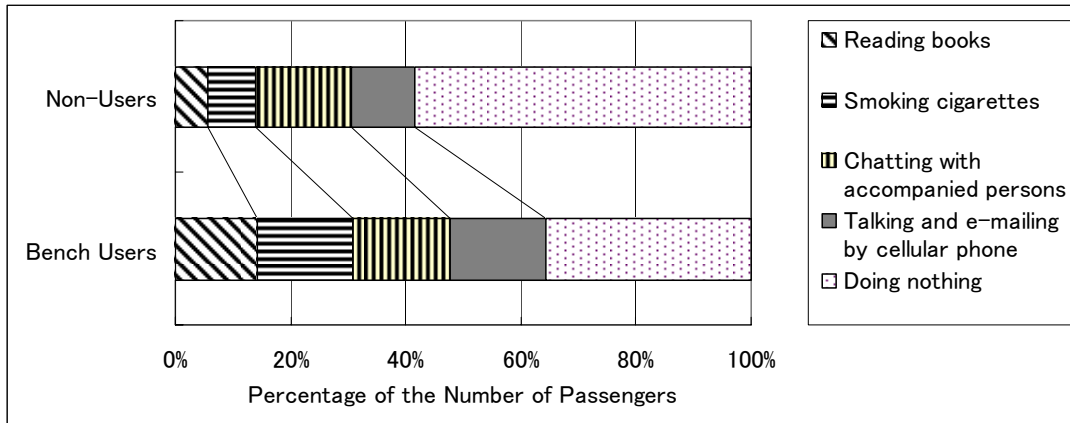


Figure 1. Comparison of activity engagement while waiting between bench users and non-users

Combined Observation and Questionnaire Surveys

Based on this preliminary observation survey results, we conducted questionnaire surveys for waiting passengers at four bus stops (No.1–4 in Table 1), from 9:00 to 18:00 on weekdays in January 2002. Three of the four bus stops were equipped with benches but were in different environment; one bus stop had a bus location system which gave information on bus approaching, and at two bus stops a convenience store was located in front of them. Bus headways were 5 to 10 minutes at all bus stops. Just before a bus arrived at the bus stop, surveyors had handed passengers a questionnaire postcard and a pen for answering it during boarding time. The respondents were required to answer the questions about their age, trip purpose, name of destination bus stop, arriving time constraints, frequency of daily bus use, amenities they wanted at bus stops and irritation level to waiting for the bus (5-point scale, from “not be irritated at all” to “extremely irritated”). The total number of responses was 228 and the response rate was 72% (see Table 2). This relatively high

response rate was considered to be achieved because the questionnaire postcard had simple questions and the respondents could answer it during boarding time and post it after getting off the bus. Simultaneously, as in the preliminary observation surveys, we observed each passenger's waiting behavior (activity engagement while waiting) every one minute and other characteristics: passenger's arrival time at the bus stop, sex, age group, accompanied persons, whether he checked a time table at the bus stop, whether he sat on the bench, and bus arrival time (see Table 3). Each observed passenger was coded an identification number and matched with the questionnaire survey postcard, so that we could combine both information collected by the observation surveys and the questionnaire surveys. More than half of the respondents were over 60 years old (proportion of 60's is 14%, 70's 31% and 80's 7%, respectively). Trip purposes were shopping (26%), business (26%), going to work or school (16%), going home (13%) and others (19%).

Table 2. Response rate of the questionnaire surveys

No.	Name of bus stops	Number of distribution	Number of response	Response rate
1	Komagome-fuji	52	33	64%
2	Kamifuji-mae	46	33	72%
3	Koishikawa-yonchōme	153	119	78%
4	Ohtsuka-shako	60	38	63%
	Total	311	228	72%

Table 3. Information collected by the observation surveys and the questionnaire surveys

Observation surveys	Activity engagement while waiting Passenger's arrival time, Sex, Age group, Accompanied persons, Checking timetable, Bench use, Bus arrival time
Questionnaire surveys	<ul style="list-style-type: none"> - Age - Trip purpose (work and school, shop, business, home, recreation, others) - Name of the bus stop you are to get off - Arrival time constraint (be in hurry, be in time, no time constraints) - Frequency of daily bus use - Amenities you want at bus stops (roof, bench, ash tray, trees, bus location system, clock, route map, vendor machine, public telephone, dash box, convenience store) - Irritation level (1: not be irritated at all – 5: extremely irritated)

Relationships between Waiting Behavior and Irritation Level

Ordered probit models were calibrated for investigating factors to affect passengers' irritation levels to waiting at the bus stops. Probabilities of irritation level y are formulated as follows:

$$P(y=1) = \Phi(-\beta\mathbf{x})$$

$$P(y=2) = \Phi(\mu_1 - \beta\mathbf{x}) - \Phi(-\beta\mathbf{x})$$

$$P(y=3) = \Phi(\mu_2 - \beta\mathbf{x}) - \Phi(\mu_1 - \beta\mathbf{x})$$

$$P(y=4) = \Phi(\mu_3 - \beta\mathbf{x}) - \Phi(\mu_2 - \beta\mathbf{x})$$

$$P(y=5) = 1 - \Phi(\mu_3 - \beta\mathbf{x})$$

The μ 's are unknown threshold parameters to be estimated with β . Explanatory variables \mathbf{x} were identified by both the observation surveys and the questionnaire surveys. They were standing waiting time and sitting waiting time for the elderly and non-elderly respectively, whether engaging in some activities, whether spending time in a nearby convenience store, environment of the bus stop, bus delay time, bus boarding time and time constraint (see Table 4).

The final model estimation result showed a satisfactory goodness-of-fit and the significant coefficients for most of the explanatory variables. In Table 5, positive coefficients represent that an increase in the variables makes passengers more irritated. Longer waiting time increased the irritation level. Comparing the coefficients of the elderly with those of non-elderly, it was found that the elderly felt less irritation for the same amount of waiting time than non-elderly passengers. The ratio between the standing waiting time coefficient and the sitting waiting time coefficient was 1.87 for the elderly and 1.30 for non-elderly. This result showed that standing waiting time caused more irritation than sitting waiting time and the effect of benches on mitigation of irritation level was especially greater for the elderly than for non-elderly. Furthermore, engaging in some activities and spending time at a nearby convenience store contributed mitigation of irritation level. A significant

Table 4. Explanatory variables used in models

Type	Variable	Description
	Standing waiting time*** (min.)	Standing time of total waiting time
	Sitting waiting time*** (min.)	Sitting time of total waiting time
	Activity engagement	1: if engaging in some activities while waiting, 0: no activities
A*	Convenience store	1: if spending time in a nearby convenience store, 0: others
	Better bus stop environment	1: at bus stop No.3 (Koishikawa-yonchōme), 0: others
	Bus delay time (min.)	(time bus arrived) – (scheduled time of bus time table)
B**	Boarding time (min.)	Time to destination bus stop calculated by bus time table
	Time constraints	1: be in hurry, 0: others

* A: variables identified by the observation surveys

** B: variables identified by the questionnaire surveys

*** (total waiting time) = (standing waiting time) + (sitting waiting time)

= (time bus arrived at the bus stop) – (time passenger arrived at the bus stop)

Table 5. Model estimation result

Variable	Coefficient	t statistic
Standing waiting time (for the elderly)	0.2622	7.556
Standing waiting time (for non-elderly)	0.2785	7.620
Sitting waiting time (for the elderly)	0.1402	4.063
Sitting waiting time (for non-elderly)	0.2147	5.256
Activity engagement	-0.9731	-5.659
Convenience store	-1.2509	-3.725
Better bus stop environment	-0.3515	-2.125
Bus delay time	0.1085	1.862
Boarding time	0.0244	1.417
Time constraints	1.0941	4.596
Constant	-0.4023	-1.548
μ_1	1.0919	9.448
μ_2	2.2690	12.397
μ_3	3.7103	12.409
$L(c)$	-321.79	
$L(\beta)$	-241.91	
Sample size	228	

dummy variable of better bus stop environment at bus stop No.3, which was newer and better maintained than other bus stops, indicated that better environment was able to mitigate bus waiting resistance. The positive time constraints coefficient showed that passengers who had an appointment and were in hurry felt more irritation. The coefficients of both bus delay time and bus boarding time showed positive effects on irritation level but were not significant at 95% level of confidence.

From the analysis of passengers' bench use and their demand for benches, it was found that proportion of the passengers who wanted benches as one of the amenities at bus stops was very high, even though they did not use the bench (see Table 6). Especially the situation is not desirable that 70% of the elderly passengers who did not use benches wanted benches at bus stops. There could be two reasons why the passenger did not use but wanted benches: (1) there was enough space to sit on but s/he did not feel like sitting, (2) there was little space because other passengers had already used the bench. For distinguishing these two reasons, we analyzed the number of passengers sitting on the bench at two bus stops (No.1 and No.3), when each passenger who did not use but wanted benches arrived at the bus stop. Both benches at the two bus stops had three seats. At bus stop No.3, dominant was the situation that when each passenger arrived at the bus stop, some passengers had already been sitting on the bench so there was not enough space for her/him to sit on. On the other hand, at bus stop No.1, more than 90% of them did not sit on the bench, whereas nobody had been sitting on. The results suggest that the number of seats was insufficient at bus stop No.3, while most of passengers waiting at bus stop No.1 did not feel like sitting on the bench and wanted benches because there were some problems in design or condition of the bench, or environment of the bus stop.

Table 6. Percentage of the passengers who wanted benches

	Bench users	Non-users
The elderly	78%	72%
Non-elderly	85%	68%

Table 7. Number of the passengers who did not use but wanted benches by the number of bench users when they arrived at bus stops

Bus stop	Number of bench users			
	0	1	2	3
No.1 Komagome-fuji	13	1	0	0
No.3 Koishikawa-yonchōme	13	17	11	4

Conclusions

This study investigated relationships between passengers' bus waiting behavior and their irritation levels to waiting at bus stops. About half of passengers were doing nothing while waiting at bus stops, while another half of them were engaging in some activities; reading books, smoking cigarettes, talking with accompanied persons, talking and e-mailing by cellular phone and spending time in a nearby convenience store. Longer waiting time increased passengers' irritation levels, but sitting on benches mitigated their irritation levels and the effects were greater for the elderly than for non-elderly passengers. Engaging in some activities including spending time in a nearby convenience store while waiting contributed mitigation of irritation levels. Environment of bus stops affected irritation levels. There were many passengers who did not use benches but wanted benches, even if benches were available for them while waiting at the bus stop. The proportion of such passengers differed between bus stops, depending on bench design and bus stop environment.

Further research should be directed at analyzing passengers' waiting behavior during morning peak periods, on weekends and in suburban/rural areas where bus headways are much longer. These analyses enable us to better understand the relationships between waiting behavior and their socio-demographic and trip characteristics. Introducing new survey methods for collecting activities while waiting is very important regarding this issue (Harvey (2003) has summarized traditional time-space diaries and mentioned some alternatives for more useful data collection). In addition, good design of benches and comfortable environment of bus stops need to be investigated so that passengers can use the bench willingly and wait for bus without feeling irritation.

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