Route Choice Associated with the Provision of Public Transportation Information

Masatoshi KISAKA*, Yoongho AHN**, Hiroshi TSUKAGUCHI***

Abstract:

Public transportation in urban areas is a very convenient form of transportation because there are multiple bus and railway operators. In recent years, however, the number of automobiles on the road is increasing, and the resultant traffic congestion has resulted in the disruption of bus timetables, with buses arriving late at bus stops. This situation detracts from the convenience of public transportation from the viewpoint of reliability. Information on scheduled running times according to timetables can be easily obtained from various sources, but information about the actual running status of public transportation, taking into account traffic congestion, is not currently provided.

The objecitve of this study is to analyze route choice behavior in public transportation assuming that traffic information, including delays due to traffic congestion, is provided.

Kyoto is a prime tourist destination for visitors from other parts of Japan and abroad due to the presence of a great many temples and shrines that are registered in the world cultural heritage, such as the Temple of the Golden Pavilion, and Kiyomizu Temple. However, the large number of vehicles in the city results in heavy traffic congestion, which means buses do not run on time, with significant delays on many routes, which is a significant problem.

To provide real-time information on bus services, a route-information application called Arukumati Kyoto that takes into account actual traffic information has been provided for routes in Kyoto City since September 2013. The application has an “expected time of arrival” function that takes into account traffic congestion and the current locations of bus determined by a global positioning system on-board buses. Surveys of route choice behavior were conducted using this application. The results of the survey show that arrival time was influenced important by respondents to choose their routes.

Keywords: Public transportation information, Expected time of arrival, Route choice behavior

* :Graduated Student, Development of Civil Engineering, Ritsumeikan University, m.kisaka84@gmail.com

** :Assistant Professor, Development of Civil Engineering, Ritsumeikan University, ahnyh@fc.ritsumei.ac.jp

*** :Professor, Development of Civil Engineering, Ritsumeikan University, tsukaguc@se.ritsumei.ac.jp

* This is an abstract peer-reviewed by the International Affairs Committee of the City Planning Institute of Japan for ISCP2014.

1. Introduction

Today, transportation systems that have a low environmental load are desired, meaning that an increase in public transportation usage is desired. However, the usage rate of private transportation such as cars remains high, and Kyoto - the subject area of this paper - is no exception to this.

Kyoto's public transportation network includes municipal buses, a municipal subway, private bus operators, and JR (Japan Rail companies). In general, the transportation infrastructure in Japan is of a high level. However, in order to make public transportation services even more convenient, improved transfer connections between subway and bus, and bus and bus are required. It is also necessary to adjust the timetables of the different transportation service providers to better cooperate with each other. Furthermore, it is important to make public transportation easier and more convenient to use by providing up-to-date information to the user. Against this backdrop, Kyoto City has established a public transportation center called Arukumati Kyoto, and begun operation of a bus and railway transfer guidance application called Arukumati Kyoto, which is a traffic information system. This application can be accessed via the website of Arukumati Kyoto by PC, smart phone, and mobile phone and it enables users to search information about service conditions and transfer stations for 8 railway operators and 11 bus operators in Kyoto City. The key merit of this application is the “bus arrival prediction” function that enable arrival time to be estimated based on current real traveling time using the Global Positioning System (GPS) device fitted in municipal buses.

There are existing studies of route choice behavior in public transportation systems such as a study that evaluates the service level of public transportation systems and one about the provision of real-time transfer information for public transportation. Noguchi[1)] proposed a bus network of main roads and feeder roads, and a consideration of transfer based on a survey of residents about public transportation (e.g., buses, railways, and subways) in Kyoto City. Takada et al.[2)] evaluated the service level of routes including transfers and the extraction of transfer issues based on route analysis using a route-searching engine that uses timetable data of railways, buses, and ferries in Hiroshima Prefecture. Shimamoto[3)] evaluated the bus network in Hiroshima from the perspective of the efficiency of the entire system as a case study by using the output of the transportation network optimization model.

Research regarding information provision for public transportation has been studied in Japan and abroad. Nakao and Ishikawa[4)] proposed a route-guidance system that considers the service situation when an accident happens for users using multiple public transportation operators. Dziekan[5)] discussed changes in behavior when real-time information is provided in a case that was limited to the subway system in Sweden.

Route choice behavior based on the information provision system of railways considering the operation situation has been studied as mentioned above**.** However, it is difficult to find studies on information systems for public transportation that provide real-time information to users using multiple public transportation operators. Therefore, the objective of this study is to clarify the behavioral characteristics of users when real-time information is provided; to this end, we carried out a data Revealed Preference (RP) survey and Stated Preference (SP) survey by using the bus and railway transfer guidance application Arukumati Kyoto.

Figure 1 Location of Kyoto City

2. Public transportation in Kyoto City

Kyoto has a population of about 1.46 million and has a history of more than 1,200 years. It is located in the northern part of the Kyoto Basin, and on three sides, the south being the exception, it is surrounded by mountains. It is also a tourist city, because Kyoto is of historical interest and has many historical houses and other buildings. In addition, Kyoto City is well known as an academic city and as an industrial city. Because of these multivarious features, urban planning in Kyoto contains a number of basic policies such as "conservation" in the northern area, “urban regeneration” in the central area, and “creation” in the southern area to match the characteristics of each area. Kyoto City aims to be both an eco-friendly and a compact city.

Buses and subways are the main forms of public transportation in Kyoto City, and more than 300,000 people a day, both residents and visitors, use the services. Figure 2 shows both municipal transportation services and private transportation companies such as JR West, Hankyu Railway, and Keihan Railway, and we can see that the public transportation network in Kyoto is very dense. For this reason, Kyoto City has promoted a policy of residents and visitors being able to travel around almost all of the city on foot, a policy which is known as Arukumati Kyoto. Here, “aruku” means “to walk” and “mati” means “town” in Japanese.

Although Kyoto has a good public transportation network, in addition to a population of 1.46 million citizens, it also sees many tourists from abroad who use the public transportation

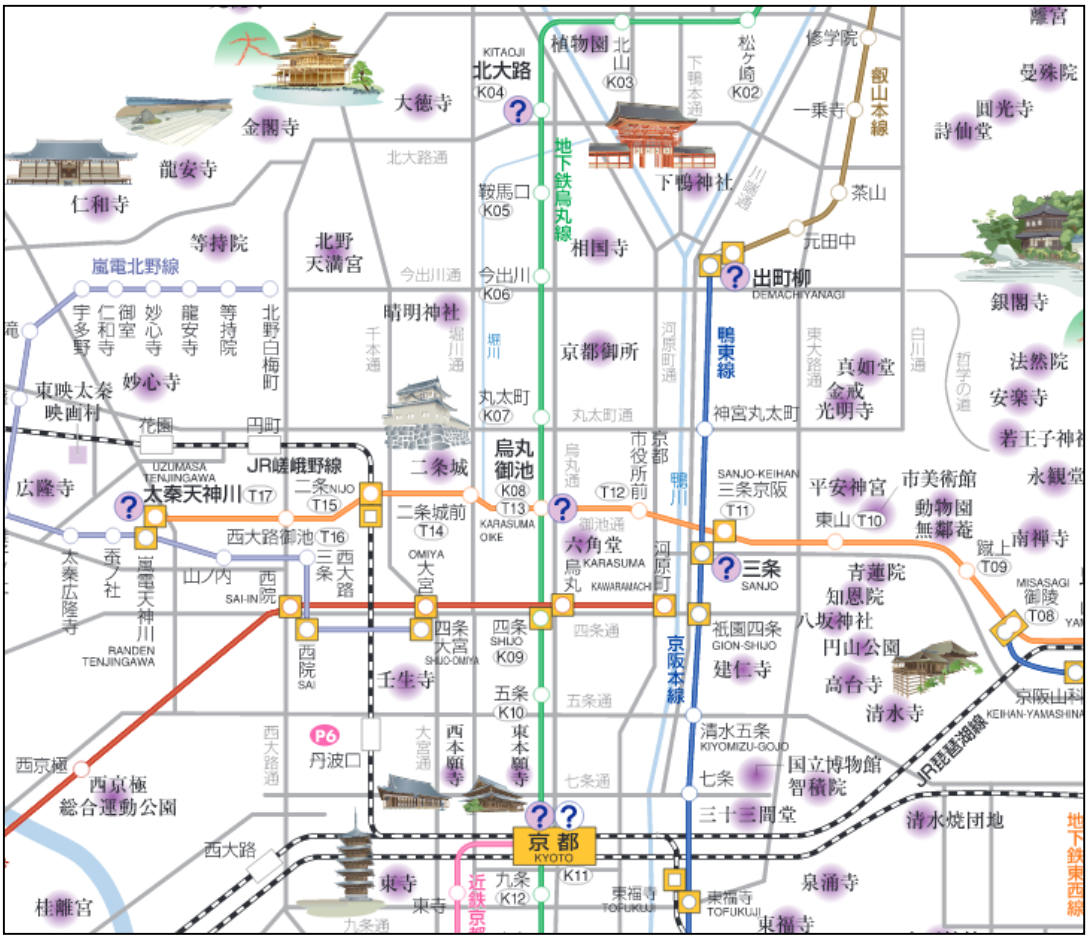

Figure 2 Public transportation network in Kyoto City
(from homepage of Arukumati Kyoto Policy)

system. In order to promote the Arukumati Kyoto policy, the system needs to provide an accurate guide to destinations for people unfamiliar with the geography of the city. The bus and railway transfer guidance application Arukumati Kyoto was created to provide effective usage of the transportation infrastructure as part of the Arukumati Kyoto policy.

3. Bus and railway transfer guidance application Arukumati Kyoto

The bus and railway transfer guidance application Arukumati Kyoto (hereinafter "Arukumati Kyoto app") is a system that can search routes and transfer stations for the 8 railway companies and 11 bus companies that operate in Kyoto City. The system has been in operation since August 30, 2013, and is accessible by PC, smart phone, and mobile phone. In particular, for municipal buses, it is possible to predict the arrival time to the destination and the bus stop input by the user input due to the GPS device installed in buses. The estimated time of arrival is calculated by a congestion-prediction engine that was customized for the Arukumati Kyoto app using GPS information on municipal buses. For tourists from overseas, a search can make in English. The system configuration of the Arukumati Kyoto app is shown in Figure 3.

The Arukumati Kyoto app displays routes in five orders: arrival time, travel time, cost, number of transfers, and walking time; and it includes details of transfer stations for railways and buses in Kyoto. The arrival order means that arranged routes are displayed in order of arrival time

Table 1 Bus and Railway Operators

Bus operators	Railway operators
Kyoto City Bus	Kyoto City Subway
Kyoto Bus	West Japan Railway(JR)
Keihan Bus	Kintetsu Corporation
Keihan City Bus	Keihan Corporation
Keihan Kyoto traffic	Hankyu Corporation
West JR Bus	Keifuku Corporation
Hankyu Bus	Eizan Corporation
Yasaka Bus	Sagano Scenic Railway
Daigo Community Bus	—
Kyoto Rakunan Bus	—
Kyoto Night Bus	—

when a user starts searching routes to a destination.The travel-time order means that routes are displayed in order of in-vehicle travel time on buses or subways or both, and the other factors are displayed in the same way.

When a user inputs the name of a tourist attraction, bus stop, or station name, the optimal route from the search point to the destination is given. In addition, it is possible to search by the names of attractions if users do not know the names of a station or bus stop near the destination. Moreover, when a user inputs just a fragment of the destination name, a candidate destination name list is

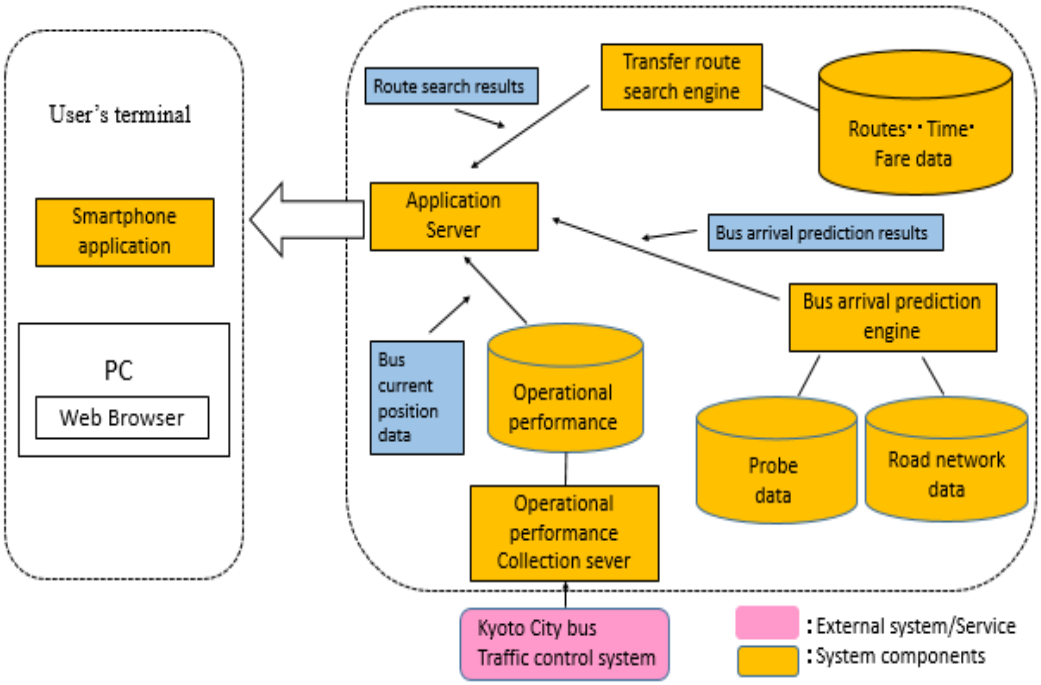

Figure 3 System structure of Arukumati Kyoto app

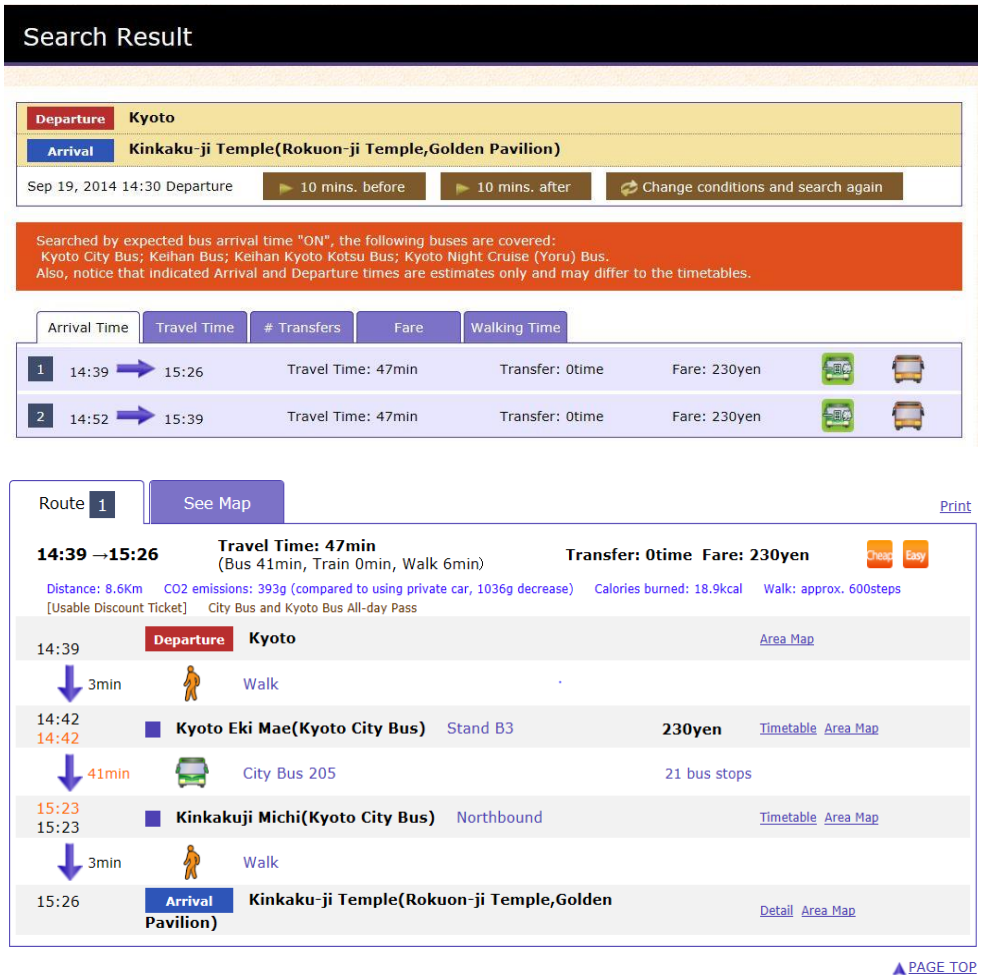

Figure 4 Example of a search results page

displayed, so searching is possible even if the user is not entirely sure of the name. Furthermore, the departure and destination point can be searched for on a map. Figure 4 shows an example of a search results page.

As mentioned above, the Arukumati Kyoto app can calculate the expected time of arrival of a bus or bus and train at a destination. This is possible because the current position of all buses is tracked by the GPS device installed in municipal buses and this information is stored for analysis**.** The bus arrival prediction is an application of the technology of congestion prediction and is calculated by predicting the travel time between bus stops.

Users can select two options for bus arrival-prediction: “None” and “Apply”. If “None” is selected, the information is provided based on the timetable. If “Apply” is selected, the expected results for the in-vehicle travel time, departure time and arrival time at the bus stop are displayed. The expected results are displayed in red; the results displayed in black are the arrival and departure times according to the timetable. An example of an expected arrival result is shown in Figure 5.

However, sometimes errors in GPS positioning occur and the wireless reception between the

Figure 5 Bus arrival prediction

bus and the system center, shown as Figure 3, is interrupted so that the current position of the bus is not known exactly. In that case, it is not possible to predict the arrival time. Also, errors regarding departure time and arrival time to destination, and errors in the general travel time prediction system may occur because the expectation is calculated according to the current traffic situation when the user starts searching and by historical travel time data from the past.

The Arukumati Kyoto app's homepage has been in service since August 2012 and, as shown in Figure 6, access numbers to the site total 1500-3500 per month. Accesses to the website and visits to the public transportation center are included in this access count. It seems that this system is being used continuously as a system to improve the convenience of public transportation including transfers.

4. Route choice behavior survey on providing public traffic information

4-1 Overview of route choice behavior survey

We refer to observed preference data as SP data in real or virtual situations, and observed behavior data as RP data in actual situations**.** The RP survey can obtain reliable data because the survey is performed in real situations, while it is difficult using a survey to measure and analyze demands of transportation facilities that do not exist. The SP survey can obtain a lot of data

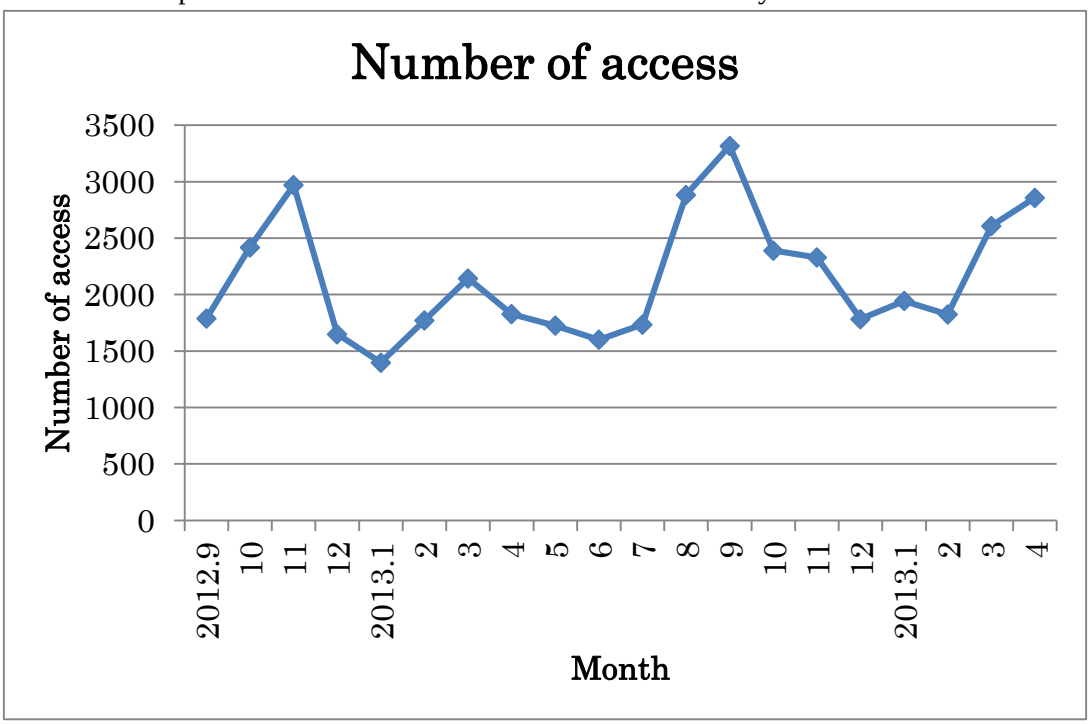

Figure 6 Number of accesses to the Arukumati Kyoto app

from the same respondent easily because the survey can measure preferences by an attribute change of the choices existing in a real or virtual situation, and controls the experimental factors

In this study, we performed both RP and SP surveys. As mentioned above, generally, an SP survey is used to examine preferences in a virtual situation, but the choice conditions displayed are conditions actually displayed in the Arukumati Kyoto app, and the routes displayed are routes existing in a real network. For this reason, we can obtain enough data by using the RP survey. However, in the SP survey conducted in this study, at first we did not understand the Arukumati Kyoto app well enough, although we could control various condition of the survey by using the SP survey, so it was possible to obtain a choice intention close to realistic choice behavior results.

It was not easy to obtain all data on choice behavior by means of an RP survey only; however, we could understand the choice behavior trend of some respondents using the Arukumati Kyoto app by means of an RP survey because they reported which routes they actually used and those data are highly reliable. Therefore, an RP survey was conducted in this study in order to compare the results of the RP survey and the SP survey.

4-2 SP survey using the Arukumati Kyoto app

(1) Outline of the survey

Information on public transportation is needed not only when people travel around but also when people are checking travel plans at home. People obtain such information by Internet searches and select their routes based on the search results. The SP survey in this study was conducted to examine route choice behavior based not on a real situation but on a controlled situation.

In this study, a survey of 33 students of Ritsumeikan University (31 men and 2 women, aged

Table 2 OD set in SP survey

OD number	Origin	Destination
1	Kyoto Station	Ryoan Temple
2	Ryoan Temple	Kyoto Station
3	Kyoto Station	Kifune Shrine
4	Kifune Shrine	Kyoto Station
5	Yamashina Station	Kinkaku Temple
6	Kinkaku Temple	Yamashina Station
7	Yamashina Station	Shijo-Kawaramati
8	Shijo-Kawaramati	Yamashina Station
9	Shijo Station	Kitano Shrine
10	Kitano Shrine	Shijo Station

20-27 years) was carried out on December 5 and 6, 2013. The survey was conducted in an information exercise room on campus, and the respondents gave information on their route choices when routes and transportation modes were displayed on their monitors using the Arukumati Kyoto app. The routes and transportation modes are related to origin - destination pairs (ODs) which are set in advance. The ODs are shown in Table 2.

Each respondent was provided with a PC and they searched route plans using the Arukumati Kyoto app. They considered and chose a route based on displayed multiple route information when they chose a route in an actual real situation.

The ODs for the SP survey consist of five pairs, but as the information on the return direction is different, the OD set consist of 10 pairs, as shown in Table 2. In addition, in the Arukumati Kyoto app, there are bus arrival time expectation options: “Apply“ or “None.“ In both cases, there are 10 ODs and the traffic situations are different. Therefore, we performed the route choice SP survey 20 times per respondent. The SP survey proceeded in the order of OD number as shown Table 2, and options “Apply” and “None”.

The choice results of each respondent and the search results pages were saved on each respondent’s PC. In addition, the respondents wrote the reference factors (arrival time, travel time, cost, number of transfers, walking time), departure time, in-vehicle travel time, number of transfers, total cost, and transportation mode down in the survey paper to enable an examination to be made of the route choice criteria of the participants.

The results from the 33 respondents yielded valid 329 datasets of “Apply” and 323 valid datasets of “None”, meaning a total of 654 valid datasets were obtained.

(2) Survey results

Figure 7 shows the factor rate considered important when respondents choose their routes. In both the “Apply” case and the “None” case, about 60% of respondents chose a route displaying information in order of arrival.

Comparing “Apply” and “None”, there was not much difference between the proportions of the order factors. The arrival factor is bigger for “Apply” case than for “None”, but conversely, the cost factor is bigger for the “None” case. In both cases, the travel time factor is not a large consideration, because travel time is related to arrival time. When respondents input their destination, information is displayed in order of arrival time. Therefore, it seems that arrival time is considered important.

Arrival time and cost were both important factors in this survey. Others of factors seemed not to be so important, with travel time and the number of transfers constituting a small

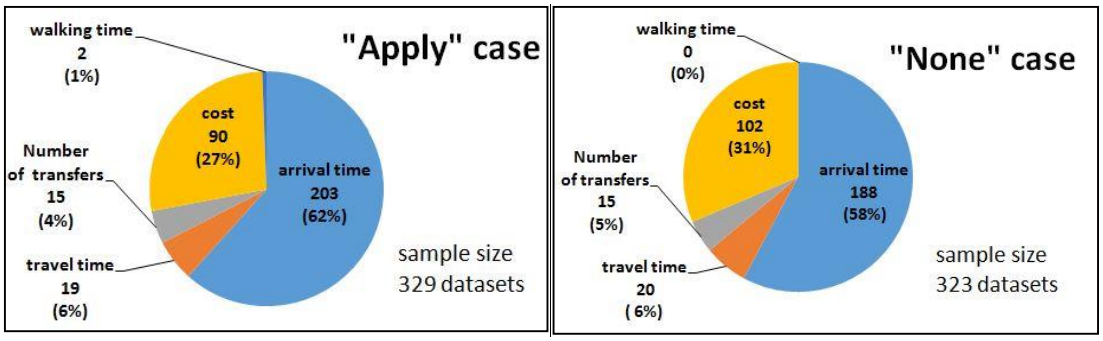

Figure 7 Factor considered important in route choice (SP survey)

proportion. Generally, these factors should be treated as factors that should be considered when examining the route choice behavior of public transportation, rather than as factors that can be ignored. In addition, walking time is not considered to be important. But as respondents do not interact in an actual real network in the SP survey, it is considered that they cannot have a realistic feeling for the walk loading. For this reason, the walking time results from the SP survey should be given limited importance in terms of their significance.

Next, we examined the relationship between the respondents who referenced only the arrival order and those who used other factors according to progression of the survey. Table 3 shows that respondents checked and considered other factors in addition to arrival order. Generally, respondents get used to survey on progressing in the SP survey. However, as the results shown in Table 3, this trend is not seen. The reason for this is that this survey was not performed in a real network. Therefore, respondents were not nervous about their choice results and they had enough time to check other factors. In the 8th OD, the number of respondents who looked at other factors is small because only two routes are displayed, which may be due to the need to compare routes by choosing fewer other factors.

Table 3 Check factors relating to choice policy

Case	“Apply” case		“None” case	
OD number	arrival order	Other factors	arrival order	Other factors
1	12	21	11	22
2	9	24	11	22
3	11	22	11	22
4	16	17	15	18
5	13	20	12	21
6	16	17	13	20
7	12	21	14	19
8	24	9	15	18
9	14	19	17	16
10	16	17	17	16

Figure 8 shows the route choice rate for Route 1 regarding difference between travel time of Route 1 and that of Route 2. In the “None” case, when the travel time of Route 1 is short, the route choice rate is high and when the travel time is long, the route choice rate is low on the contrary**.** When the travel time of Route 1 is faster by more than 20 minutes, the route choice rate of Route 1 is more than 40%. We considered the reason is that Route 1 has the earlier arrival time when information is displayed in order of arrival time and that there are few cases of the in-vehicle travel time of Route 1 being longer than that of Route 2.

On the other hand, in the “Apply” case, it seems that the choice rate is 50% whatever the travel time of Route 1 is. This means that respondents choose their route irrespective of the travel time of Route 1.

Because route information is displayed in order of arrival time in this survey, the probability of respondents choosing Route 1 is high. However, a situation in which other routes are chosen irrespective of the travel time of Route 1 suggests that the correlation between arrival time and travel time is low. A case where the arrival time is later when the travel time of Route 1 is

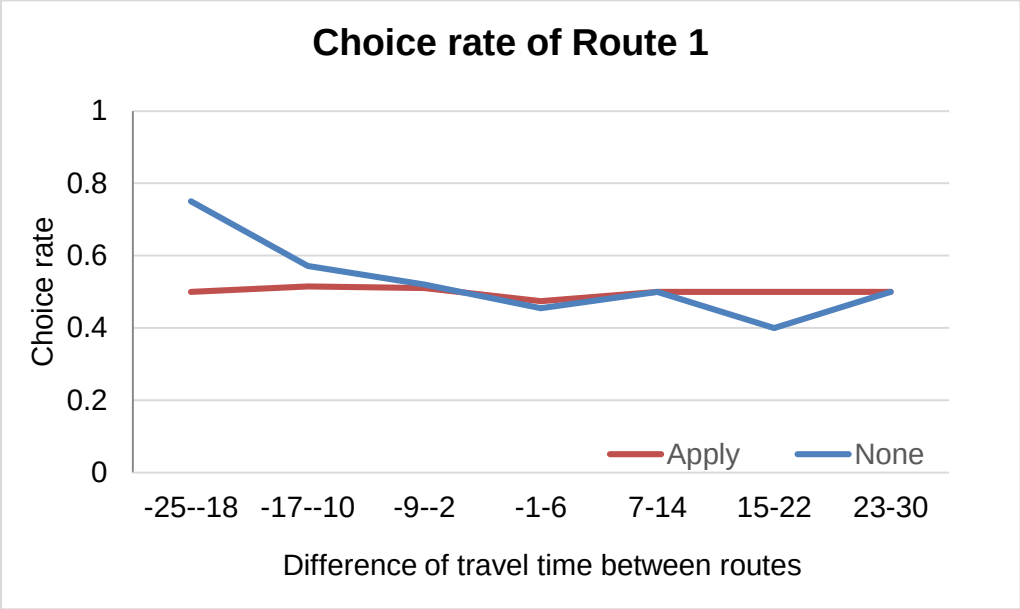

Figure 8 Choice rate of Route 1

shorter exists in this survey and a case where the arrival time is earlier when the travel time of Route 1 is longer also exists on the contrary.

Although these results are considered carefully, we only suppose that multiple situations are provided more in the "Apply" case than in the "None" case. In other words, travel time is calculated by arrival time in a timetable, and travel time and arrival time are related to each other in the "None" case. For this reason, respondents are choosing their routes considering arrival time, not in-vehicle travel time.

4-3 RP survey using bus and railway guidance application Arukumati Kyoto

(1) Outline of the survey

In this survey, 14 students (all men in their 20s) from Ritsumeikan University took part in an RP survey on July 5 and 12, 2014. We divided the target area into the three zones shown in Figure 9 as the survey area range before the RP survey was carried out.

In this RP survey, it was possible to choose as public transportation only the Kyoto Municipal subway and buses. Zoning was set in consideration of these conditions. We instructed the respondents to start at Kyoto Station, visit at least one tourist area included in the three zones, and return to Kyoto Station. The respondents were instructed to capture images of the result screens for search route choices with smart phone and to send the images to an Internet site set up in advance for saving data. Finally, the respondents wrote their chosen route down on in the survey paper.

Generally, public transportation fares are important factors in route choice behavior, as mentioned in the previous section. However, as it was difficult to set the fares in advance, the respondents used a one-day ticket available for the Kyoto Municipal subway and bus services. For this reason, it was difficult to examine the effect of fares from the RP survey.

(2) Survey results

Similar to the SP survey results, we described the aggregation analysis for the RP survey

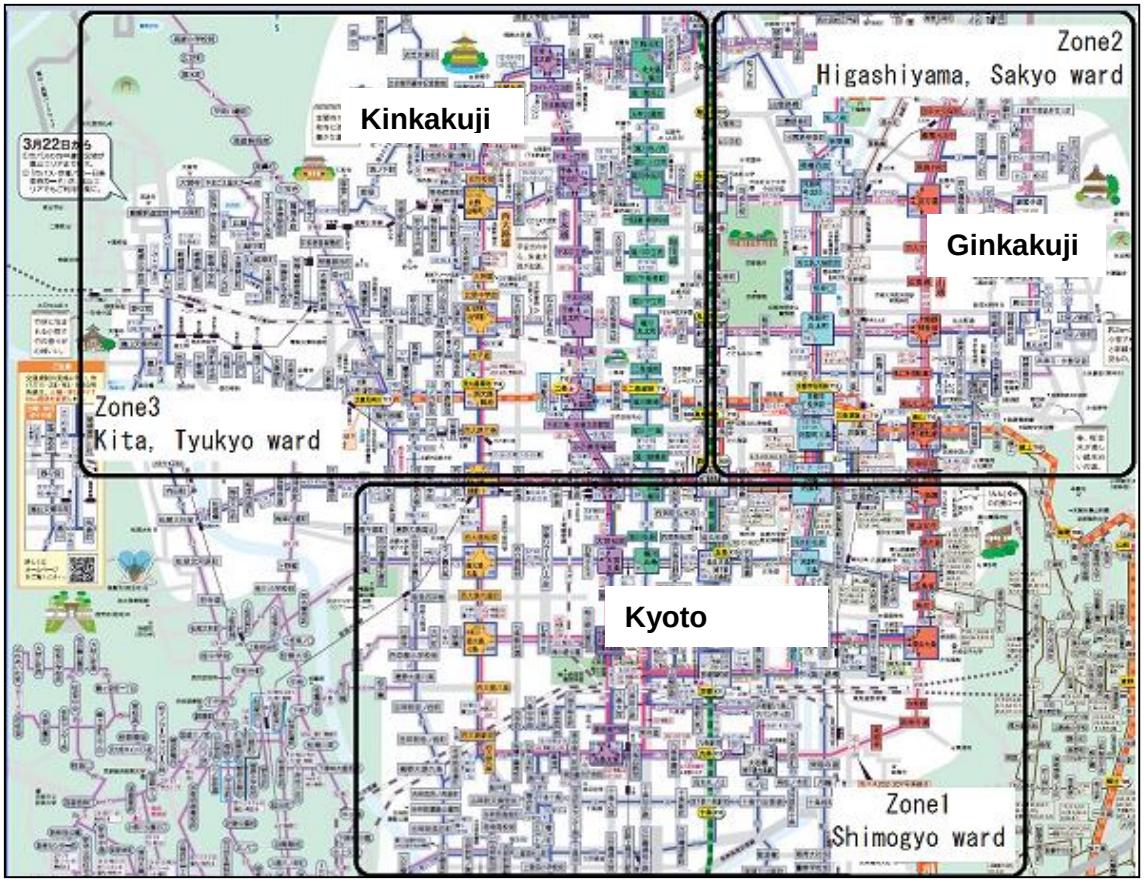

Figure 9 Zoning of Kyoto City

data before explaining the findings of the route choice model. Figure 10 shows which factors (arrival time, travel time, cost, number of transfers, walking time) were deemed important by the respondents. Arrival time accounted for about 94%, as shown in the figure. It is considered that this result was influenced by the arrival time being described at the beginning as a result of a route search. In the SP survey, which was conducted using a PC, the presented information could be changed by switching the order factors. However, as the RP survey was performed using a smartphone, the respondents could not switch order factors and they chose their route based on arrival time without switching to other order factors. In point of fact, the respondents knew all the routes from the results without switching order factors, but did not know which route was first for the other orders.

The reason cost is not shown in the figure is that the respondents all used one-day tickets as described above, therefore, they did not act in consideration of the fare.

Figure 11 shows the route choice rate of Route 1 regarding the difference between the travel time for Route 1 and that for Route 2. When the travel time of Route 1 was shorter, the choice rate for Route 1 is high as shown in Figure 11, and it seems the trend of a decreasing choice rate according to the difference in travel time between routes is smaller. However, the choice rate is very high when comparing the results of the “Apply” case in the SP survey.

Few samples were obtained, unlike the multiple situation sample in the SP survey, because samples were obtained while the respondents were actually moving around a real network in the RP survey. Therefore, it seems that a correlation between arrival time and travel time exists,

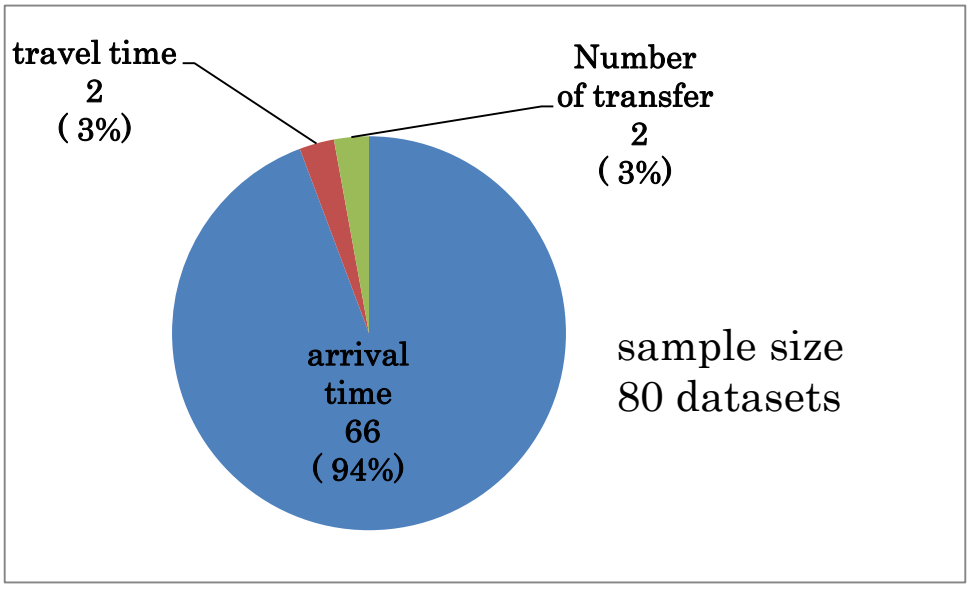

Figure 10 Factors considered important in route choice (RP survey)

which is opposite to the results of the SP survey in the "Apply" case. Moreover, there were only a few cases where the travel time for Route 1 is longer. In the 4-8 minute section, the difference in travel time between routes had a 100% route choice rate because that situation occurred only once.

It is considered that the reason a various situation sample was not obtained was the difficulty in setting ODs. We did not know where the respondents were going to visit so we could not obtain OD data in advance. In contrast, as various ODs were set in advance in the SP survey, various samples could be obtained.

If we suppose that this result can be regarded as route choice behavior of the respondents, as mentioned for Figure 10, the respondents chose their route based on information that displayed only arrival time because they could not consider other factors, as was the case in the SP survey. When information was provided, they believed the information and they chose the quickest route from the displayed information in order of arrival time first. It is considered that this is why the choice rate of Route 1 is so high.

5. Analysis of route choice behavior when using public transportation based on provided information

5-1 Overview of discrete-choice models

A disaggregate model assumes that an individual acting on reasonable rules chooses the best option from among the available choice set, and a model is developed generally based on this assumption. In this study, we developed route choice models using a logit model to examine route choice behavior when information on public transportation is provided. In general, a logit model is expressed by following equation:

$$P_i = \frac{exp(V_i)}{\sum_j exp(V_j)}$$

Pi : Probability of choice of route i

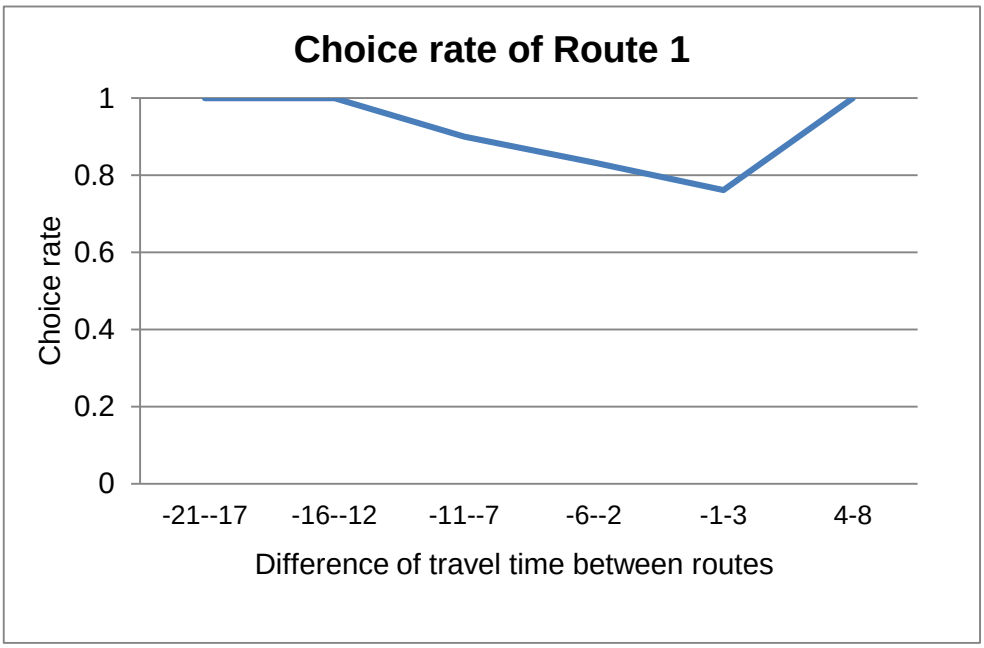

Figure 11 Selection rate of Route 1

where the utility function is expressed by the equation

$$V_i = \sum_{k=1}^{K} \beta_k \cdot Z_{ik}$$

β_k : Unknown parameters

Z_{ik} : The explanatory variables

For a statistical test of the estimated model, the following tests were used. A T-test was used to test the significance of the parameters, and the fitness of the model was determined by using the likelihood ratio, which takes the form ρ^2 and satisfies $0 < \rho^2 < 1$.

5-2 Explanatory variable of route-selection model

When people use public transportation in general, multiple factors such as travel time, fare, and number of transfers are considered, and they choose a route by making a decision using the most reasonable judgment.This survey deals with the procedures used in making a decision, such as searching among routes and transfer stations to the destination by train or by bus.

Five explanatory variables of the route choice model are considered below, which are the main factors that influence route choice behavior.

Arrival time: time from starting a search to arriving,
that is to say, sum of IVTT and waiting time

IVTT (in-vehicle travel time): time spent on public transportation to arrival.

Fare: total fares for all transportation used.

Number of transfers: number of times to transfer bus to bus, subway to subway,
bus to subway, vice versa.

Waiting time: time from starting a search to riding public transportation.
Because users do not always have to search at a station, walking time to the station is included in waiting time.

An alternative set of this model is assigned by order of route describing information of public transportation in order of arrival time. For example, Route 1 means the earliest arrival route. The result by which respondents choose a route in order of other factors is adjusted to the order of route describing information on public transportation in order of arrival time. If respondents choose the cheapest route described in information showing cost, we check what rank the route has in describing information in order of arrival and a route number is assigned to that rank.

5-3 Parameter estimation results in SP survey

Table 5 shows the estimated parameters of results. These results are selected results of changing the combination of explanatory variables. The results in Table 5 are better than other results. As ODs and search times differ between respondents, the number of routes displayed is different. In the SP survey conducted using a PC, a maximum of four routes are displayed at a time.

We know that arrival time influences route choice behavior as shown in the survey results in the previous section. As mentioned above, the arrival time is the sum of IVTT and waiting time, so we cannot analyze a model that includes three variables. As arrival time and IVTT may be correlated with each other, IVTT is not included in these models.

Arrival time and cost are significant in all cases and all route numbers.

Table 5 Route choice model and estimated results

Case	“Apply” case			“None” case	
Number of routes	2	3	4	3	4
Arrival time	-0.131 (-2.733) **	-0.135 (-4.997) **	-0.359 (-5.416) **	-0.719 (-2.189) *	-0.171 (-3.056) **
Fare	-	-0.0097 (-3.450) **	-0.107 (-2.426) *	-	-0.0129 (-2.716) **
Number of transfers	-3.205 (-2.733) **	0.202 (0.635)	-0.1306 (-0.1918)	-	-1.541 (-2.268) *
Waiting time	-	0.115 (1.941)	-0.0996 (1.085)	0.437 (1.7119	0.0906 (1.492)
Number of Sample	41	62	71	24	35
Correction rate of expectation	80.49%	67.74%	63.38%	91.67%	57.14%

* : 5% signficance level ** : 1% significance level

5-4 Parameter estimation results in RP survey

Table 6 shows the estimated parameters of results in the RP survey. Like the SP survey, these results are selected results obtained by changing the combination of explanatory variables. Arrival time is significant at the 5% level in all route numbers. Other factors are not significant except the number of transfers in four cases. Increasing the number of routes, alternative routes become a various situation and a need to transfer may occur**.** With respect to fares, as the respondents used a one-day ticket, it is difficult to analyze the impact of fares in this study.

Table 6 Route choice model and estimated results

Number of routes	2	3	4
Arrival time	-0.391 (-2.130)*	-0.645 (-2.271) *	-0.486 (-2.282) *
IVTT	-	-0.0276 (-0.1979)	-
Fare	-1.693 (-0.0123)	-0.0131 (-0.693)	-
Number of transfer	50.540 (0.0122)	-	-6.747 (-1.970) *
Waiting time	-	-	0.170 (0.860)
Number of Sample	23	18	13
Correction rate of expectation	86.95%	83.33%	69.23%

* : 5% signficance level ** : 1% significance level

6. Conclusion

In this study, a preference survey and actual behavior research was performed using the bus and railway transfer-guidance application Arukumati Kyoto, which is an information provision system for public transportation users providing real-time public transportation information. This system has been in service since August 2013. It is a unique system. It has been used by the residents of an urban area, as well as by many tourists, and it is operated by multiple public transportation operators and companies.

The Arukumati Kyoto app has become important in promoting the Arukumati Kyoto policy of Kyoto City, because the application is a system that provides real-time information to public transportation users and a valuable system to obtain actual data on the route choice behavior of public transportation users.

The RP and SP surveys conducted in this study were carried out with several viewpoints in mind, as noted below. The SP survey was performed to provide information in a real situation, but the respondents did not physically interact with an actual real network. In the SP survey, the conditions of the survey could be set in advance, but it is impossible to set the conditions in full detail. For its part, the RP survey could obtain data from actual behavior, but could obtain various situations

As results of the aggregation analysis in the SP survey, the factors of arrival order and cost order influenced route choice behavior. In all models, arrival time is significant at the 5% level.

Cost and number of transfers is significant in some cases.

In the RP survey, most respondents were influenced by arrival time as shown the results of the aggregation analysis, with arrival time significant at the 5% level as in the SP survey for all models. Other variables were not significant except the number of transfers in the case of four routes. In particular, cost was not significant in any of the cases, because the respondents used a one-day ticket in the RP survey.

These surveys were carried out with students in their 20s in this study. In the future, we need to evaluate route choice behavior using participants with various attributes. In addition, in order to reflect the effects of cost, we need to develop a survey that can consider fares when public transportation information is provided.

Acknowledgement

As we proceed with this study, we used information of Arukumachi Kyoto app. We appropriate very much “Arukumachi Kyoto” committee and Kyoto City.

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