Meeting appointment and waiting behavior with mobile communications

Nobuaki OHMORI*
Department of Urban Engineering, School of Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan
Tel.: +81-3-5841-6232
Fax: +81-3-5841-8527
E-mail: nobuaki@ut.t.u-tokyo.ac.jp

Takayuki HIRANO
Department of Urban Engineering, School of Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan
Tel.: +81-3-5841-6235
Fax: +81-3-5841-8527
E-mail: takayuki@ut.t.u-tokyo.ac.jp

Noboru HARATA
Department of Urban Engineering, School of Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan
Tel.: +81-3-5841-6233
Fax: +81-3-5841-8527
E-mail: nhara@ut.t.u-tokyo.ac.jp

*Corresponding author

Word count: 5,450 words, 6 tables, 2 figures, total 7,450 words

Submitted on August 1, 2005
Revised on November 21, 2005

Abstract. Information and communications technologies (ICT) have provided people with a lot of activity opportunities for communications in cyberspace. Mobile phones have made decisions about activity scheduling more flexible and changed our travel behavior dramatically. Among them, meeting and waiting behavior could be one of the most dramatically changed behaviors after the introduction of ICT. Mobile phones enable us to reschedule the appointment time and place without space-time constraints. Especially young people use mobile communications very frequently and cleverly. The objectives of this study are to investigate young people's decisions about meeting and waiting behaviors, and to analyze dynamic rescheduling behavior by mobile communications, in spatial and temporal dimensions. An on-site interviewing survey was conducted in Shinjuku, Tokyo, in December, 2003. Information on telecommunications relating to (re)scheduling the meeting time and place, and waiting behavior was obtained from 87 young pairs. Purposes of telecommunicating by mobile phones were classified into five categories: for making an appointment and deciding meeting time and place, rescheduling the meeting time, rescheduling the meeting place, informing of late arrival, and informing of the arrival and confirming current location. About half of the first persons to arrive participated in some activities not at the pre-decided meeting place but at other activity opportunities around the meeting place. The activity choice behavior of the first person while waiting was affected by the frequency of visiting the town, whether considering the possible opportunities around the meeting place or not, and the length of the expected waiting time and the additional expected waiting time.

INTRODUCTION

In recent years, rapid development and diffusion of information and communications technologies (ICT), such as mobile phones and the Internet, have provided people with a lot of activity opportunities for communications in cyberspace. The use of ICT affects individual activity-travel behavior and our lifestyles and activity-patterns have dramatically changed. Mobile phones have made people's scheduling decisions about activity-travel patterns more flexible. Especially young people use mobile communications by mobile phones, e.g. voice call and e-mail, very frequently and cleverly. Among various behaviors, meeting and waiting behavior could be among the most dramatically changed behaviors after the introduction of ICT. Approximately 10 years ago, when mobile phones were not so disseminated as nowadays, people had to decide beforehand the exact time and location when meeting outside, and it was difficult to alter the time and location thereafter. The person who arrived first at the pre-decided meeting place had to stay at the same location until the other person would show up. The first person to arrive was concerned about when the other was coming. The person being late was also concerned that the first person would be anxiously waiting. However, now that we can use mobile phones, the situation is completely different from that of 10 years ago. We need not decide in advance the exact time and location for meeting, because we can communicate with each other at anytime and anyplace, and, if needed, can reschedule the appointment time and place by mobile communications. Also we need not stay at the pre-decided location and can spend time elsewhere (e.g. bookstore, café, etc.), making use of our time by participating in other activities until the other person arrives. What enables this flexible scheduling is "virtual accessibility" provided by mobile phones and the Internet (*1*). On the other hand, from the viewpoint of designing urban space, how to evaluate the value of meeting space may have to be reconsidered, as the traditional meeting space may no longer be the actual space for waiting for people, but may have just become a common landmark or a temporary meeting spot.

In Japan, the number of subscription of mobile phones is 94 million and its penetration rate to the population is 73% in November, 2004 (*2*). Japan has also been by far the largest provider in the world of Internet connection services via mobile phones. About 80% of the total number of subscribers to mobile phones are mobile Internet subscribers (including i-mode, FOMA 3G, etc.), which is fairly high in comparison with other major countries and regions (*2*). Tokyo has the richest railway network in the world and a lot of railway stations are very densely located. Entrances and ticket gates of railway stations or spaces around the stations are very popular meeting places. There are many activity opportunities such as cafés and shops, around these stations, as well as within the station yards, where travelers can engage in activities.

Because people can make decisions on activity scheduling more dynamically, not only revealed activity-travel patterns but also activity scheduling processes have been of interest to transportation researchers. Some researchers have been developing computer software working on a PC or PDA for data collection of scheduling processes, e.g. CHASE (*3*), React! (*4*), Zhou and Golledge (*5*) and Doherty and Papinski (*6*). On the other hand, activity scheduling is often conducted by telecommunications. Among interactions between travel and telecommunications, which is substitution, complementation, modification and neutrality, proposed by Salomon (*7*), this activity scheduling by telecommunications could be related to modification. Recently, activity and telecommunications diary surveys for one or multiple days have been conducted for analyzing the effects of telecommunications on individual activity scheduling and travel patterns (*8−10*). These studies revealed that dynamic rescheduling is conducted by mobile communications. However, how the use of mobile phones affected the meeting and waiting

behavior has not been addressed in the previous research.

This paper investigates young people's decisions about meeting and waiting behaviors, and analyzes dynamic rescheduling behavior by mobile communications, in spatial and temporal dimensions. A case study is conducted in Tokyo, at or around JR (Japan Railway) Shinjuku Station, where a lot of waiting places for meeting and opportunities for participating in a variety of activities exist. In this study, "meeting" means that a person meets with another person outside by making an appointment and two persons travel to the meeting place from different locations separately. "The first person" means the person who arrived at the meeting place first. "The second person" means the person who arrived at the meeting place second or later than the appointment time.

RESEARCH HYPOSESES ABOUT MEETING AND WAITING BEHAVIOR

Mobile phones alleviate space-time constraints on participating in activities in cyberspace, e.g. acquiring information from websites and communicating with people. "Virtual accessibility" has been a key concept for understanding the interaction between telecommunications, and human activity scheduling and travel behavior. Some researchers approach this issue from the concepts of space-time path and space-time prism. Kwan (*11*, *12*) represented an example of a space-time path including telecommunications at different spatial scales using 3-D GIS environments. Harvey and Macnab (*13*) discuss spatial and temporal constraints on communications system, especially spatial and temporal coincidence. Dijst (*14*) also discusses constraints on the use of ICT, based on Hägerstrand's space-time constraints (*15*), and proposes "digital boxes" within which individuals can use ICT under space-time and authority constraints. Janelle (*16*) represents space-time opportunity costs of a telephone call and a business meeting in a space-time diagram. There have been a lot of conceptual studies but empirical studies have not yet been conducted much.

In Japan, the most dominant purpose of telecommunications by mobile phones and also secondly by e-mail is "making an appointment and communications for meeting with people" (*17*). The author conducted focus group interviewing surveys for 5 different socio-economical groups (a total of 30 individuals) in December, 2001, asking the participants about changes in meeting behavior before and after using mobile phones and e-mail communications (*18*). The followings are major changes for the participants:

- need not decide the exact time and place for meeting,
- be able to reschedule the appointment time and place just before meeting,
- do not have to wait at the pre-decided place but can kill time at shops around the meeting place, and
- even when being late for the appointment time, both the person who arrives first and the person who arrives late do not feel any stress because they are able to communicate with each other at anytime and anyplace.

Moreover, in the survey questionnaires administered to people in their 20's, preliminarily conducted by the authors in 2003, it was discovered that the following factors were important for decisions about meeting locations. (*19*):

- Clarity: easy to find the partner; easy to understand the route to the meeting place
- Accessibility: close from the station; close to the destination
- Comfort: existence of activity opportunities/places for spending time around the meeting place; few people
- Familiarity: well-known to everybody

- Other: familiar to both persons; midpoint in-between the two persons' current locations

Figure 1 shows an example of the difference in meeting and waiting behavior between having and not having a mobile phone, representing "space-time path." The left-side figure shows the space-time path without mobile phones. Individual *A* called individual *B* by "landline phone" at time t_1 and they decided to meet at location *X* at time t_2. *A* left home and arrived at *X* just at t_2 but *B* was late. After waiting for a few minutes, at time t_3, *A* called *B*'s home from a "phone booth," but *B* was already out of home and could not communicate with each other. *B* arrived at *X* at t_4. *A* was waiting for time (t_4-t_2). *A* had to wait for *B* at *X* being worried about when *B* would arrive. *A* might have been so angry and they might not have been able to have a good time any more.

On the other hand, the right-side figure shows this behavior with mobile phones. In the same way, *A* calls *B* at time t_1 and they decide to meet at location *X* at time t_2. *A* arrives at *X* at t_2 but *B* is late. Immediately, *A* calls *B* by "mobile phone," and says to *B* "Where are you? If you are late, I will wait for you at shop *Y*, so come to see me there." *A* arrives at time t_5 at shop *Y*. *B* arrives at *Y* at t_6. Waiting time is (t_6-t_5) which is less than (t_4-t_2). As shown in this figure, now *A* can wait for *B* at anyplace and *A* can spend the waiting time participating in such activities that *A* likes while waiting for *B*. In the figure, bold lines in the time axis show "time windows" during which they can communicate with each other. "Non-digital boxes" might exist according to space-time and authority constraints, e.g. while being in trains between subway stations.

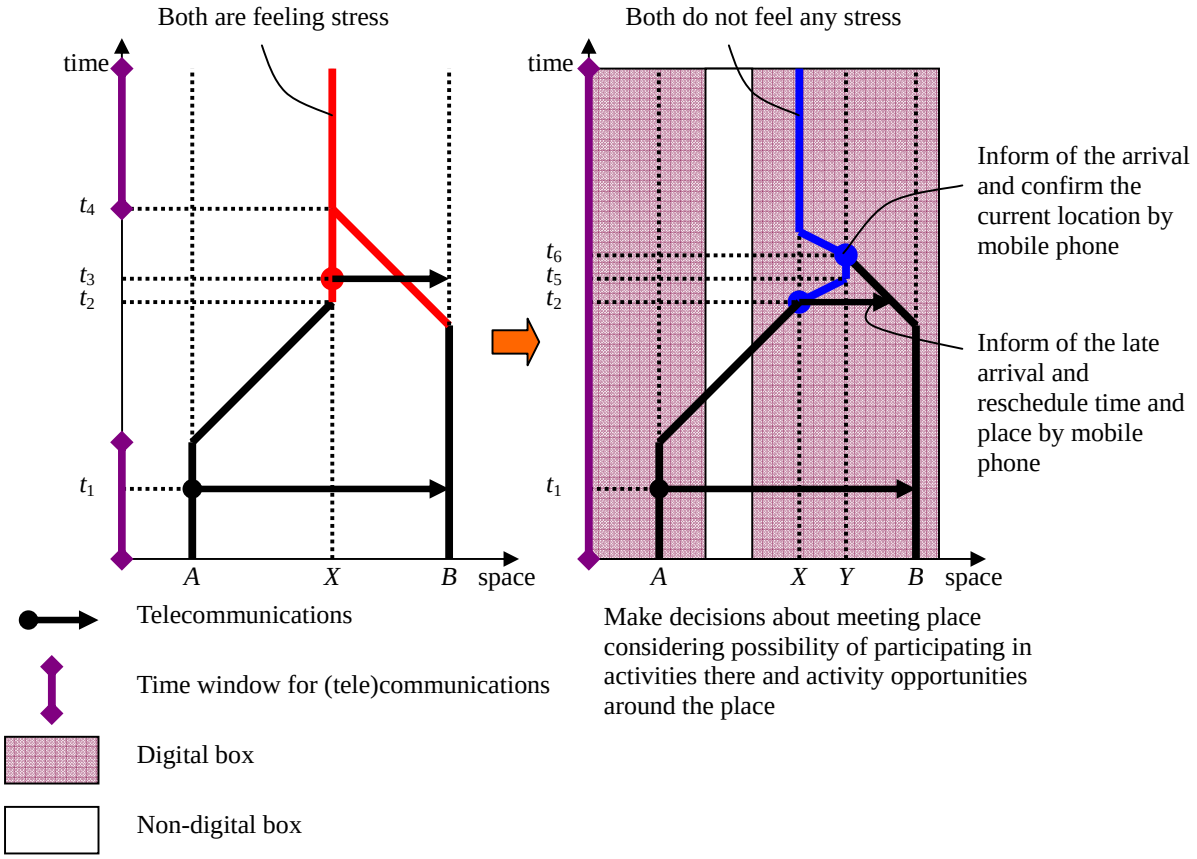


FIGURE 1 Example of Difference in Waiting Behavior between with and without Mobile Phones

As described above, people can reschedule the appointment time and place flexibly and dynamically by mobile communications. Space-time prisms also change dynamically depending on changes in activity-schedules and people make decisions about space-time paths within the space-time prism constraints. This is regarded as how people respond to the change of the prism by telecommunications and what activities they will participate in, and where, to spend the unplanned additional waiting time. Meeting behavior could be one of the most interesting subjects of dynamic rescheduling behavior by telecommunications and include many factors affecting human decision making. To analyze this dynamic scheduling behavior with mobile communications, the detailed information on both activity-travel patterns and telecommunications is needed and an on-site interviewing survey could be most appropriate at present. Another possible waiting behavior could be waiting for a public transit at stations. There have been several studies about this waiting behavior as well (e.g. *20*, *21*).

ON-SITE INTERVIEWING SURVEY

In December 19−21, 2003, Friday to Sunday, at 12:00−5:00 p.m., the authors conducted an on-site interviewing survey for young pairs (male and female, two females or two males) staying at or walking around JR Shinjuku Station. Shinjuku Station has a total of 9 railway lines and the largest number of passengers in Japan (more than 4 million passengers getting on and off at Shinjuku Station per day). A lot of people who made an appointment to meet with someone are waiting for their partners, in front of ticket gates, at famous meeting spots, etc. A pair of interviewers conducted an approx. 15-minute interview survey for each pair of respondents, in which a series of questions was structured and the answers were noted down. First the interviewers asked them if they made an appointment of meeting at or around Shinjuku Station and came to Shinjuku from different origins separately. The pairs coming to Shinjuku together were not interviewed. The respondents were a total of 87 young pairs of people. Information was collected regarding the time when making the first appointment to the time when the actual meeting took place at Shinjuku. Using a kind of activity diary format, information on both activity-travel patterns and the contents, date and time of telecommunications including mobile phones, and, if any, rescheduling of time and place by the telecommunications was also obtained from the respondents. The interviewers also asked the respondents to check the past record of telecommunicating time on their mobile phones to collect as accurate information as possible. Table 1 summarizes information obtained from the survey. All the interviewed people traveled to Shinjuku by train. If the interviewers interviewed people waiting at a specific meeting spot, it could be easier to ask some questions of them. In this case, however, the interviewers could not know all the activities until the final meeting with the partner and could not interview people spending time not at the meeting spot but at other activity opportunities while waiting. That's the reason why the authors selected people staying at or walking around Shinjuku Station as the sample.

Basic characteristics of the respondents are described below. 83 of the 87 pairs were teens and people in their 20's. 55% were male-female couples, and 36% were female-female pairs. 43% of the total pairs were both university students. The dominant relationships of the two persons were friends (61%) and couples (36%). 90% of the 174 individuals visited Shinjuku more than twice a month. 75% of the pairs met outside more than once a month.

TABLE 1 On-Site Interviewing Survey Description

Survey dates	12:00 p.m. – 5:00 p.m., December 19 (Fri.) – 21 (Sun.), 2003
Respondents	87 pairs staying at or walking around JR Shinjuku station
Information obtained	Socio-economic characteristics - age, sex, job, nearest station from the origin, frequency of visiting Shinjuku Relationships of the pairs - relationship of two persons - frequency of meeting outside in daily life - the two persons' meeting experience in Shinjuku - the places at Shinjuku the two have met before, if any Travel - departure time traveling to Shinjuku - name of the origin railway station - arrival time at Shinjuku - travel mode to Shinjuku Meeting appointment and waiting behavior - date/time of making the first appointment - contents and date/time of telecommunications after the first appointment - activities while waiting for the partner*1 - whether pre-planned to go to activity opportunities or not*2 - whether the reason to go to activity opportunities is the partner's late arrival or not*2 - the final time and location the two met Others - factors in decision about choosing the waiting location*3 - whether the destination of where to go after the meeting was decided in advance or not

*1: Questions only for the first arrival person.
*2: Questions only for the person who went to activity opportunities while waiting for the partner
*3: List among total 9 factors about clarity, accessibility, comfort, familiarity and other

THE USE OF TELECOMMUNICATIONS IN MEETING AND WAITING BEHAVIOR

Communications are necessary for deciding the time and place for the meeting, and especially telecommunications by mobile phones play an important part. An average frequency of communications, including telecommunications and face-to-face conversations, directly relating to scheduling of the meeting is 2.4 times, and most cases are 2 (38%) and 3 (36%). Only 15% did no communications after the first appointment until the final meeting. Mobile communications (voice calls and e-mails by mobile phones) relating to the meeting is 95% of the total of 213 communications. These results suggest the importance of mobile communications in meeting behavior.

Then, the authors classified the purposes of mobile communications relating to the meeting into five categories: (1) to decide the appointment time and place before leaving the origin (home, workplace, etc.), (2) to decide or reschedule the appointment time after leaving the origin, (3) to decide or reschedule the appointment place after leaving the origin, (4) to inform the partner of their late arrival, and (5) to inform the arrival and confirm the partner's current location. Table 2 summarizes the number of pairs doing each telecommunication.

(1) *Decide the appointment time and place before leaving the origin*: 76% of the pairs decided both the appointment time and place before leaving the origin. The trend that the

appointment time was decided earlier than the place was observed, as the pairs who decided the time 1 hour before the meeting was 67% of them, whereas only 43% of the pairs decided the place 1 hour before the meeting. 38% of them decided the place by mobile communications after both persons arrived at Shinjuku.

(2) *Reschedule the appointment time after leaving the origin*: 17% of the pairs rescheduled the appointment time after leaving the origin. This includes cases in which one is late for the appointment time. 27% of the 17% communicated for rescheduling the appointment time while both persons were traveling to Shinjuku. In this case, one of the pair was late for the appointment time, so the first person to arrive was required to spend additional time at intermediate stations or around the meeting place until the second person arrived at Shinjuku. 20% of the 17% rescheduled the time after the first person arrived at the meeting place. Also in this case, the first person had to spend time until the second person arrived. The rest 53% rescheduled the time, when either of the pair was at the origin and could continue to participate in the activity at the origin.

(3) *Reschedule the appointment place after leaving the origin*: 11% of the pairs rescheduled the appointment place (within the Shinjuku area). 60% of the rescheduling occurred after the first person arrived at the meeting place, in which case the meeting place was changed to the place where the first person was located at the time of the phone call or to a more convenient place for both of them (e.g. an intermediate place between the two persons). The time when rescheduling the meeting place ranged from 20 minutes before the appointment time to 20 minutes after that.

(4) *Inform the partner of the late arrival*: 31% of the pairs communicated to inform the partner of their late arrival (the late arrival with rescheduling time is included in category (2) and not included in this category (4)). Although 30% of them informed of their late arrival more than 30 minutes before the appointment time, 41% informed of their late arrival after the appointment time. 67% of the second person informed of the late arrival while traveling, whereas 41% of the first person was informed of the late arrival after arriving at the meeting place.

(5) *Inform the arrival and confirm the partner's current location*: This communication finalizes the meeting behavior. 43% of the pairs communicated to inform the partner of their arrival. 49% of them were the case where the first person was spending time at activity opportunities while waiting, when the second person informed of their arrival. On the other hand, 35% of them were the case where both people were at the meeting place but could not find the partner, to confirm the partner's current location.

Table 2 also shows the patterns of combination of the above-mentioned 5 categories. As the most dominant pattern, 25% of the pairs decided the appointment time and place before leaving the origin and did no telecommunications after that until meeting at Shinjuku. This could have been a normal case for people without mobile phones about 10 years ago. The second dominant pattern (18%) was that two persons decided both the time and place before leaving the origin and the second person to arrive informed of the arrival at Shinjuku and confirmed the place of the first person.

TABLE 2 Purposes and Patterns of Communications Relating to Meeting Behavior

Pattern	Decide the appointment time and place before leaving the origin	Reschedule the appointment time after leaving the origin	Reschedule the appointment place after leaving the origin	Inform the partner of the late arrival	Inform of the arrival and confirm the partner's current location	Number of observations
1	X					22 (25%)
2	X				X	16 (18%)
3	X			X		8 (9%)
4	X			X	X	6 (7%)
5		X				5 (6%)
Other 14 patterns	(X)	(X)	(X)	(X)	(X)	30 (34%)
Total	66 (76%)	15 (17%)	10 (11%)	27 (31%)	37 (43%)	87 (100%)

ANALYSIS OF THE FIRST PERSON'S WAITING BEHAVIOR

In this section, the first person's waiting behavior until the second person arrives at the meeting place is analyzed. The first person's activities while waiting are classified into two types: activities at the meeting place (talking, e-mailing and gaming by mobile phone, reading books, smoking, etc.) and activities at other activity opportunities (i.e. participating in some activities at various shops, e.g. relaxing at cafés, window shopping at bookstores and fashion boutiques, etc.). Table 3 shows the patterns of their waiting behavior. 47% of the first persons were staying at the pre-decided meeting place from the arrival until the second person arrived there. Whereas, 51% of the first persons were spending the waiting time at other activity opportunities around the meeting place. Average "expected waiting time" is 26.0 minutes for the first persons spending time at activity opportunities and 10.3 minutes for the first persons staying at the meeting place ("expected waiting time" is described in detail in the next section).

The time of staying at the meeting place was zero minute for 34% of the first persons, who met together on time, or met at the pre-decided or the rescheduled new meeting place, after having been informed of the late arrival and spending time at other activity opportunities. For them, the meeting place is not for "waiting" but just "meeting" for that particular moment. Excluding the persons whose waiting time was zero, average time of staying at the meeting place was 13.5 minutes for persons doing activities, 7.5 minutes for persons not doing any activities. For all the interviewed pairs, the total travel time (on foot) which the first person spent for participating in some activities at activity opportunities was less than 10 minutes. Therefore, the first person spent the waiting time at relatively near activity opportunities from the meeting place. If disutility for waiting for the partner could be alleviated by participating in some activities, the essential waiting time could be very short.

Table 4 shows the types of activity opportunities where the first persons spent time for waiting. 33 of the total of 44 never pre-planned to go to the activity opportunities but went there to kill the "waiting time." Fashion boutiques and music/bookstores are frequently visited, but cafés are less frequently visited. At the former shops, window shopping is possible, whereas paying some money is required for spending time at the latter shops. For killing a comparatively short waiting time, people would be reluctant to paying money. Average time of staying is longest in cafés excluding a special case in amusement shops. The ratio of the average time of staying to the "expected waiting time" is very high. The results also show that the first person

spends time at activity opportunities very close to the meeting place and spends most of the waiting time there.

When being informed of the late arrival at the origin or while traveling to Shinjuku, more than half of the first persons did not go to the pre-decided waiting place but went to some activity opportunities directly around there. Timing to know the partner's late arrival could affect the subsequent decisions, going to the meeting place or spending time at other activity opportunities. When the first person to arrive knew the second person's late arrival, time length which the first person had to wait was extended. The increase mainly ranged from 10-25 minutes.

TABLE 3 Patterns of Waiting Behavior of the First Person to Arrive

Patterns of waiting behavior	Number of observations
Staying at the meeting place	41 (47%)
The meeting place → the new meeting place	2 (2%)
Subtotal (Spending waiting time not at activity opportunities)	43 (49%)
The meeting place → activity opportunities → the meeting place	8 (9%)
The meeting place → activity opportunities → the new meeting place	3 (3%)
Activity opportunities → the meeting place	27 (31%)
Activity opportunities and meet there	6 (7%)
Subtotal (Spending waiting time at activity opportunities)	44 (51%)
Total	87 (100%)

TABLE 4 Types of Activity Opportunities Visited while Waiting

Type of activity opportunities	Number of the total visitors	Unplanned visitors	Average staying time of the unplanned visitors (minutes)	Expected waiting time of the unplanned visitors (minutes)	Ratio of the staying time to the expected waiting time
Fashion boutiques	15	13	16.3	19.5	84%
Music/bookstores	11	6	22.5	29.2	93%
Convenience stores	5	5	12.8	15.0	85%
Cafés	5	4	36.3	46.3	78%
Appliance shops	4	2	24.5	30.0	82%
Amusement shops	1	1	80.0	90.0	89%
Others	3	2	5.0	10.0	50%
Total	44	33	21.1	26.0	81%

ACTIVITY CHOICE MODELS WHILE WAITING

In this section, activity choice behavior (spending time at activity opportunities or not) of the first person to arrive while waiting for the second person to arrive is modeled based on the results in the previous sections. Since 11 of the first persons pre-planned to visit activity opportunities, the choice behaviors of 76 of the first persons were modeled. This behavior is considered an activity choice under a space-time prism constraint constructed by the expected waiting time. Longer expected time, more available opportunities and information about opportunities could induce additional activities at other activity opportunities than the meeting place. The first persons are classified into three cases according to timing being informed of late

arrival:
(a) without information about late arrival: 28 cases
(b) being informed of the late arrival after arriving at the pre-decided meeting place: 12 cases
(c) being informed of the late arrival before arriving at the pre-decided meeting place: 36 cases

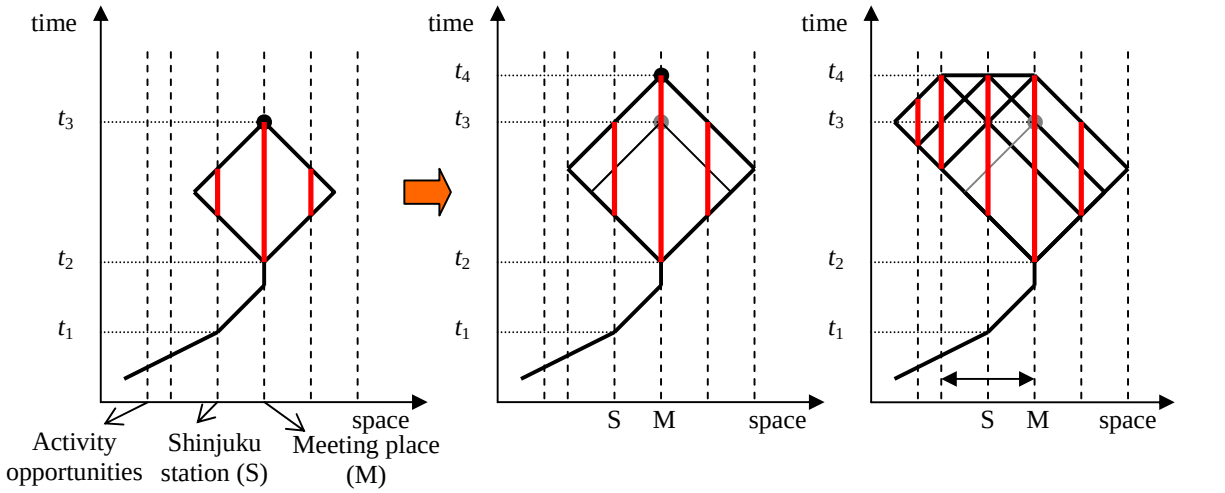
In case (a), the first person normally expects that the partner will arrive on time and the expected waiting time is defined as duration between the appointment time and the arrived time. Whereas, when the first person arrives after the appointment time, the expected waiting time is defined as zero. When the second person to arrive informs the first person of the late arrival, two cases are considered. In case (b), the expected waiting time is defined as duration between the new appointment time and the time being informed of the late arrival. On the other hand, in case (c), the expected waiting time is defined as the time between the new appointment time and the arrival time at Shinjuku. Based on the above-mentioned definitions, the expected waiting time is defined as Table 5.

Table 5 Definition of the Expected Waiting Time

	Total expected waiting time	The expected waiting time without information about late arrival	The additional expected waiting time after being informed of late arrival
(a) without information about late arrival	0 (if $t_3 \leq t_1$) $t_3 - t_1$ (if $t_3 > t_1$)	0 (if $t_3 \leq t_1$) $t_3 - t_1$ (if $t_3 > t_1$)	0
(b) being informed after arriving at the pre-decided meeting place (if $t_1 \leq t_2$)	$t_4 - t_2$	$t_3 - t_2$	$t_4 - t_3$
(c) being informed before arriving at the pre-decided meeting place (if $t_1 > t_2$)	$t_4 - t_1$	$t_3 - t_1$	$t_4 - t_3$

t_1: time the first person arrived at Shinjuku
t_2: time the first person was informed of the late arrival by mobile phone
t_3: pre-decided appointment time
t_4: rescheduled new appointment time
(Total expected waiting time) = (The expected waiting time without information about late arrival) + (The additional expected waiting time after being informed of late arrival)

Pairs classified into case (b) are considered that they have made decisions twice: (1) when they arrived at the pre-decided meeting place, (2) when they were informed of the late arrival by mobile phone. The independent variable “expected waiting time” is introduced as a space-time prism vertex. Figure 2 represents dynamic changes of space-time prisms and potential opportunities, according to the difference of timing of being informed of late arrival and rescheduling patterns of the new appointment time and place. Binary logit models are applied to explaining choice behavior of staying at the meeting place or spending time at other activity opportunities under space-time prism constraints.

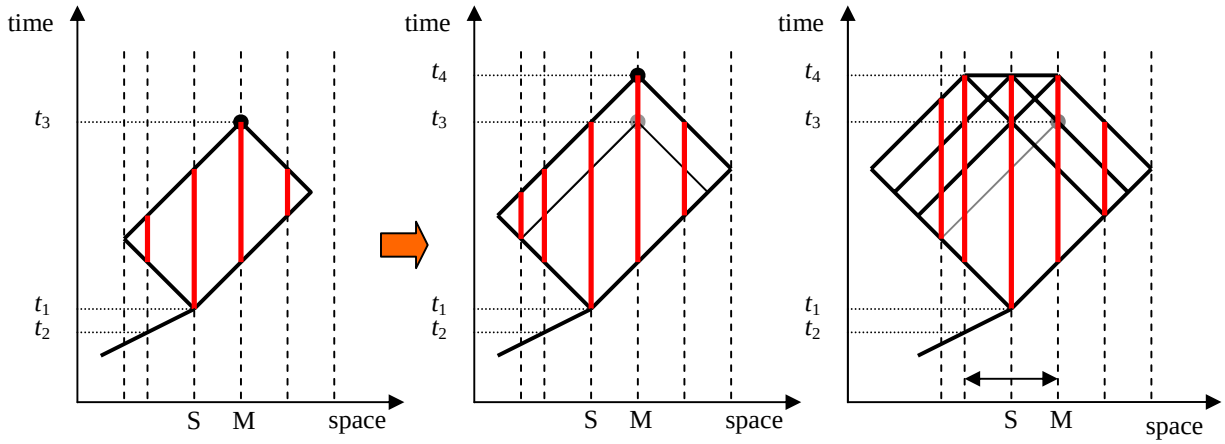


(a-1) Before informed of late arrival

(a-2) Time and place is decided

(a-3) Only time is decided and place is within a distance from the station

(a) In case being informed of late arrival after arriving at the pre-decided meeting place ($t_1 \leq t_2$)



(b-1) Before informed of late arrival

(b-2) Time and place is decided

(b-3) Only time is decided and place is within a distance from the station

(b) In case being informed of late arrival before arriving at the pre-decided meeting place ($t_1 > t_2$)

Potential available activity opportunities in space-time

Space-time prism

FIGURE 2 Dynamic Changes of Space-Time Prisms and Potential Available Activity Opportunities When Being Informed of Late Arrival by Mobile Communications

Table 6 shows model estimation results. The number of observations of decision making was 88. In Model 1, the total expected waiting time was introduced as an independent variable. In Model 2, the expected waiting time without information about the late arrival and the additional waiting time after being informed of late arrival were introduced separately, and the additional waiting time was introduced to each pair according to the timing of being informed of

the late arrival. Parameters with a positive sign show an increase in utility of activities participated in activity opportunities around the meeting place. In both models, the parameter "frequency visiting Shinjuku" is significant and shows a positive sign. This means persons who visit more frequently Shinjuku spend time at some activity opportunities more while waiting. Persons more frequently visiting Shinjuku could have more information on activity opportunities in Shinjuku. If so, this behavior relates to the amount of information on activity opportunities around the pre-decided meeting place. The parameter "Meeting place evaluation" is also significant and shows a positive sign, which means persons who consider the existence of opportunities around the meeting place when deciding the meeting place spend time at activity opportunities more. In Model 1, the "total expected waiting time" is a significant variable. The longer total expected time induces more visiting activity opportunities. In Model 2, the parameter "the expected waiting time without information about late arrival" is significant. When not being informed of late arrival, persons who have the longer expected waiting time visits other opportunities more. As for "the additional waiting time after being informed of late arrival," when being informed before arriving at the pre-decided meeting place, the longer additional waiting time promotes the first person's activities at other opportunities. Since the value of the parameter of the additional time is larger than that of the expected waiting time without information about late arrival, the additional time induced by information of the late arrival has more impact on activity choice behavior while waiting. However, after arriving at the pre-decided meeting place, the additional waiting time does not have significant effects.

TABLE 6 Model Estimation Results

Explanatory variables	Model 1		Model 2	
	coefficient	t-statistic	coefficient	t-statistic
Sex (1:male, 0:female)	-0.722	-1.059	-0.770	-1.092
Frequency visiting Shinjuku (1:more than twice a week, 0:others)	1.681	2.458	1.815	2.502
Meeting place evaluation (1:considering existence of opportunities around the meeting place, 0:others)	1.660	2.158	1.796	2.305
Destination constraint (1:destinations was pre-planned, 0:others)	-1.003	-1.524	-0.866	-1.257
Total expected waiting time (minutes)	0.143	3.954		
The expected waiting time without information about late arrival (minutes)			0.127	3.235
The additional expected waiting time by being informed of late arrival after arriving at the pre-decided meeting place (minutes)			0.093	1.785
The additional expected waiting time by being informed of late arrival before arriving at the pre-decided meeting place (minutes)			0.190	3.460
Constant (1: for spending time at activity opportunities)	-2.894	-3.567	-3.029	-3.575
Number of observations	88		88	
Log likelihood at zero	-60.997		-60.997	
Log likelihood at convergence	-33.346		-32.134	
ρ^2 corrected for the number of the parameters	0.355		0.342	

CONCLUSIONS

In this paper, young people's meeting appointment and waiting behavior with mobile communications was investigated using information from an on-site interviewing survey around one of the largest railway stations in Tokyo. Mobile phones have provided the options of rescheduling the meeting time and place after leaving the origin. Purposes of telecommunicating by mobile phones were classified into five categories: for making an appointment and deciding meeting time and place, rescheduling the meeting time, rescheduling the meeting place, informing of late arrival, and informing of the arrival and confirming current location. About half of the first persons to arrive participated in some activities not at the pre-decided meeting place but at other activity opportunities, such as cafés, bookstores and fashion boutiques around the meeting place. The activity opportunities where the first persons spent the waiting time were close to the meeting place and the ratio of the staying time to the expected waiting time was very high. The activity choice behavior of the first person while waiting was affected by the frequency of visiting the town, whether considering the possible opportunities around the meeting place or not, and the length of the expected waiting time. The impact of the length of the additional expected waiting time by being informed of late arrival before arriving at the pre-decided meeting place was larger than that of the time without information about the late arrival.

Meeting behavior is one of the most dynamic rescheduling behaviors by mobile communications. The results of this empirical study suggest that evaluation methods of meeting spaces should be reconsidered. Available activity opportunities around the meeting place are more important than environment of the meeting place itself, because, for many people, a meeting place is not for "waiting" but just "meeting."

This study proposes analyzing waiting behavior under dynamic changes in space-time prism constraints by mobile communications, but does not consider the location and opening hours of each activity opportunity in detail. More detailed analysis explicitly considering "space-time accessibility" measures (*22*, *23*) to available activity opportunities is an issue for future research. For getting information from more respondents, survey methods should be reconsidered. Studies in local cities, where railway stations are not a major meeting place, the number of opportunities is smaller and a main travel mode is not train but car, could provide interesting results and more implications to researchers. Analyzing how participating in activities while waiting for people can mitigate the disutility of waiting time, e.g. irritation level (*20*), could be important for evaluating a meeting place. Also analyzing relationships between information on activity opportunities available at websites by mobile phones and waiting behavior could be important.

REFERENCES

1. Golob, T. F. Travel Behavior.Com: Activity Approaches to Modeling the Effects of Information Technology on Personal Travel Behavior, In: Hensher, D. A. (ed.), *Travel Behaviour Research: The Leading Edge*, Pergamon, Oxford, 2001, pp.145-183.
2. Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan. *Information and Communications in Japan: White Paper 2004*, 2004.
3. Doherty, S.T. and E.J. Miller: A Computerized Household Activity Scheduling Survey, *Transportation*, Vol.27, 2000, pp.75-97.
4. Lee, M. and M. McNally. Experiments with a Computerized Self-Administered Activity Survey, *Transportation Research Record 1752*, 2001, pp.91-99.
5. Zhou, J. and R. Golledge. Real-Time Tracking of Activity Scheduling/Schedule Execution within Unified Data Collection Framework, *TRB 2004 Annual Meeting CD-ROM*, 2004.
6. Salomon, I. Telecommunications and Travel: Substitution or Modified Mobility?, *Journal of Transport Economics and Policy*, Vol.19, No.3, 1985, pp.219-235.
7. Doherty, S. T. and D. Papinski. Is It Possible to Automatically Trace Activity Scheduling Decisions?, *paper presented at Conference on Progress in Activity-Based Analysis*, Maastricht, the Netherlands, May 2004.
8. Senbil, M. and R. Kitamura. The Use of Telecommunications Devices and Individual Activities Relationships, *TRB 82nd Annual Meeting CD-ROM*, 2003.
9. Nishii, K., K. Sasaki, R. Kitamura and K. Kondo. Recent Developments in Activity Diary-Based Surveys and Analysis: Some Japanese Case Studies, In: Timmermans, H. (ed.), *Progress in Activity-Based Analysis*, Elsevier, Oxford, 2005, pp.335-354.
10. Ohmori, N., Y. Muromachi, N. Harata and K. Ohta. The Effects of Using Telecommunications on Individual Activity Schedule, *Infrastructure Planning Review*, Vol.18, No.4, 2001, pp.587-594. (in Japanese)
11. Kwan, M.-P. GIS Methods in Time-Geographic Research: Geocomputation and Geovisualization of Human Activity Patterns, *Geografiska Annaler*, Vol.86B, No.4, 2004, pp.267-280.
12. Kwan, M.-P. Human Extensibility and Individual Hybrid-Accessibility in Space-time: A Multi-Scale Representation Using GIS, In: Janelle, D.G. and D.C. Hodge (eds.), *Information, Place, and Cyberspace: Issues in Accessibility*, Springer, Berlin, 2000, pp.241-256.
13. Harvey, A.S. and P.A. Macnab. Who's Up? Global Interpersonal Temporal Accessibility, In: Janelle, D.G. and D.C. Hodge (eds.), *Information, Place, and Cyberspace: Issues in Accessibility*, Springer, Berlin, 2000, pp.147-170.
14. Dijst, M. ICTs and Accessibility: An Action Space Perspective on the Impact of New Information and Communication Technologies, In: Beuthe, M., V. Himanen and A. Reggiani (eds.), *Travel Demand and Organization in an Evolving World*, Springer, Berlin, 2004, pp.27-46.
15. Hägerstrand, T. What about People in Regional Science?, *Papers of the Regional Science Association*, Vol.24, 1970, pp.7-21.
16. Janelle, D.G. Impact of Information Technologies, In: Hanson, S. and G. Giuliano (eds.), *The Geography of Urban Transportation, 3rd ed.*, Guilford Press, New York, 2004, pp.86-112.
17. Institute of Socio-Information and Communication Studies, The University of Tokyo. *Information Behavior 2000 in Japan*, University of Tokyo Press, Tokyo, 2001.
18. Ohmori, N. Change of Travel Behavior after Introduction of ICT–Results from Focus Group Interviews–, *Proceedings of Infrastructure Planning*, Vol.27, 2003, CD-ROM. (in Japanese)

19. Hirano, T., N. Ohmori and N. Harata. Choice of Meeting Spots around a Station, *Proceedings of Infrastructure Planning*, Vol.28, 2003, CD-ROM. (in Japanese)
20. Ohmori, N., T. Hirano and N. Harata. Passengers' Waiting Behavior at Bus Stop, *Traffic and Transportation Studies: Proceedings of ICTTS 2004*, 2004, pp.157-164.
21. Hess, D.B., J. Brown and D. Shoup. Waiting for the Bus, *TRB 2003 Annual Meeting CD-ROM*, 2003.
22. Kwan, M.-P. Space-Time and Integral Measures of Individual Accessibility: A Comparative Analysis Using a Point-Based Framework, *Geographical Analysis*, Vol.30, 1998, pp.191-216.
23. Miller, H.J. Measuring Space-time Accessibility Benefits within Transportation Networks: Basic Theory and Computational Procedures, *Geographical Analysis*, Vol.31, 1999, pp.187-212.