

Persuasive communication aimed at public transportation-oriented residential choice and the promotion of public transport

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Abstract In this study, we developed a persuasive communication program to induce public-transport-oriented residential (PTOR) choice. We implemented an experiment that targeted students from the University of Tsukuba, Japan, who were in the process of changing their residential location. These students were randomly assigned to four groups: the first group was a control group; the second group received an information brochure about apartment flats typically used by students in Tsukuba city; the third group received a brochure identical to the one given to the second group, except that it also included information about the level of bus service for every flat; and the fourth group was provided with a leaflet that provided motivation for PTOR choice, in addition to the brochure used for the third group. The residential locations were investigated 5 months after the intervention. There was a significant difference between the control group and the third and fourth groups. The ratio of PTOR choice in the group with the information was twice as high as that for the control group. Furthermore, the persuasive message also increased PTOR choice. Additionally, the target groups' frequency of bus use from home or the university was significantly high compared with the control group.

Keywords Residential choice · Public-transport-oriented residential (PTOR) choice · Mobility management · Persuasive communication · Contingent focus model

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Introduction

Recently, the concept of a “compact city” that offers public transportation options for residents living close to the city centre has been proposed as a potential solution to the various traffic and environmental problems in urban areas (e.g., CEC 1990; Jenks et al. 1996). The realization of a compact city would require land-use regulations and infrastructure development, in addition to measures to induce people to live or work in areas close to public transportation. However, measures to regulate residence choice may be difficult to introduce because they may be viewed as reducing people’s free choice regarding their living arrangements. Thus, soft measures to voluntarily induce behaviour change regarding residential choice, combined with regulatory measures and infrastructure development, may provide the needed results.

In Japan, the number of public transportation users in rural areas is decreasing. The promotion of public transportation has become an important issue for local governments in Japan to secure travel options for people who are unable to drive themselves. To promote public transportation, it is essential to not only offer a high level of service (e.g., high-frequency service and low fares) but also to locate people’s homes or workplaces close to public transportation.

A compact city with an integrated transportation system would be feasible if people lived close to the city centre or near railway stations or bus stops, lessening their reliance on car use. Persuasive communication to induce people to choose to live in such locations could aid in developing a compact city and solving various types of urban transportation problems. The objective of this study was to develop a persuasive communication program to induce public-transport-oriented residential choice (PTOR choice).

Theoretical background

Literature

Numerous studies have examined residential choice, with many focusing the development of models to quantitatively determine the factors influence residential choices or preferences. Lerman (1976), Louviere (1979), McFadden (1978), White (1988), and Young (1984) formulated discrete residential location choice approaches, and Timmermans et al. (1992), Sermons and Koppelman (2001), and Zhang and Fujiwara (2009) further developed such work. As a state-of-the-art on this topic, Pagliara et al. (2010) represented a range of approaches used to model residential locations within the context of developing land-use and transport models. However, these studies did not use a proactive approach to influencing choice of living arrangements.

As a measure to actually induce PTOR choice, in the city of Toyama, Japan, the local government gave apartment owners a subsidy if their apartment complex was located close to public transportation (see website: <http://www.city.toyama.toyama.jp/english/English.html>). If the apartment was located close to a railway station, a maximum one-time subsidy of 1,200,000 yen (~ 12,000 Euros) was allotted per apartment. For apartment buildings with four or more units located close to the central zone, a maximum of 1 million yen (~ 10,000 Euros) per apartment was given to the owner (Takami and Hatoyama 2008). Moreover, Toyama citizens received a subsidy of as much as 500,000 yen (~ 5000 Euros) per household for purchasing a residence in the central zone. These measures may aid in developing a “compact

city,” but it would still take a long time to realize a compact city. Soft measures of persuasion, in addition to subsidies, are required to induce changes in behaviour regarding PTOR choice.

Some psychological studies have examined the use of soft measures to induce voluntary behavioural change (VBC) to a more sustainable lifestyle (e.g., Stern et al. 1986, 1993; Fransson and Gärling 1999; Gärling and Fujii 2002). The major characteristic of VBC is to induce voluntary behaviour change by providing information and motivation rather than monetary incentives or restrictions. These communications to motivate people are typically called “persuasive communications” in academic psychological research (cf. Ajzen 1992). Mobility management may be a practical measure for inducing voluntary travel behaviour change, as shown by various studies (Jones 2003; Cairns et al. 2004; Brög 1998; Ampt and Rooney 1999; Rose and Ampt 2001; James 2002; Fujii and Taniguchi 2005; Taniguchi et al. 2007; Enoch 2012). The EU has supported several such projects, as listed on the European Platform on Mobility Management website (<http://www.epomm.eu/index.php>). We referred to these projects when developing and implementing our experiment.

Overview of the contingent focus model

We also referred to the contingent focus model when developing our persuasive communication program for PTOR (Takemura 1994; Fujii and Takemura 2001, 2003). Here, we briefly describe this model.

Identical decision problems in form may yield different outcomes. The outcome depends on the subjective decision framing as a function of how the situation is described. This is called the framing effect (Tversky and Kahneman 1981). Tversky and Kahneman (1981) conducted experiments on the framing effect and found that different phrasing affected participants’ responses to a question about disease prevention strategy. In their study involving 600 participants, they offered two alternative solutions to the participants afflicted with a hypothetical deadly disease. One solution was offered in a positive frame that emphasized “lives gained”; the second was presented in a negative frame that emphasized “lives lost”. The choice of the participants was more likely to be based on the discrepancy between “gained” and “lost”. This demonstrates the essence of the framing effect: the two groups favoured different options because the options were expressed employing different language. In the first problem, a positive frame emphasized lives gained; in the second, a negative frame emphasized lives lost. A slight alteration in the language underlies the differences in the preferences.

The contingent focus model (Takemura 1994) can theoretically explain why the framing effect emerges. This model hypothesizes that risk attitude depends on how one focuses on the possible outcome (focusing hypothesis). The ability to focus on the outcome is, in turn, contingent on the decision-making situation (contingent focus hypothesis).

According to contingent focus model, the decision-making frame would be affected by differences in the message and communication approach. As a result, behaviour would also be expected to be different. For example, for the case of residential choice, if people receive information that emphasizes the level of bus service, then they would be expected to choose based on the bus service level. If this is true, then we could induce PTOR choice.

Two methods can be used to emphasize a particular attribute: cognitive and motivational. “Cognitive” emphasis means that the attribute displays more merit after one obtains and processes information on the attribute in an organized, rational manner, carefully weighing the choices before making a final decision. For example, specific text is displayed larger or more distinct colour than the others. It was indicated by past cognitive decision-making research that this method was effective to change people’s decision making.

“Motivational” emphasis refers to the ability to induce a decision by explaining the importance of the attribute, using various data and examples. This approach is often used in actual persuasive communication. For example, a salesman emphasizes the merits and importance of the goods which he wants to sell.

In this study, on the basis of the theoretical discussion above, we conducted a persuasive communication program to induce PTOR choice using both cognitive and motivational emphasis methods.

Overview of the target

In this project, the target population was students from the University of Tsukuba, Japan. The University of Tsukuba is located in northern Tokyo and has approximately 12,000 students and 6,000 faculty. It takes approximately 1 h to get to the university from the centre of Tokyo by train. In August 2005, a new bus system was introduced for the students and faculty, in addition to a new railway line, the “Tsukuba Express” which runs from Akihabara (at the centre of Tokyo) to Tsukuba. The price of an annual commuter pass for the new bus service is only 4,200 yen (about 42 Euros) per year for students and 8,400 yen for faculty. This annual commuter pass is sold to students at a 97 % discount. During rush hours, the bus frequency is one bus every 5 min. In non-rush hours, buses arrive every 6–10 min.

Although the new bus system offers a high level of service, as mentioned above, only 3,000 passes (2,300 for the student population) were sold during the first year. In the second year of service (2006), we implemented a promotion that provided easy but detailed information on transportation pass purchases and transportation system use to students and faculty. This promotion was successful, resulting in 5,700 passes sold (4,800 to students).

However, university officials felt that there was more potential demand for the new bus system. To investigate this further, we interviewed several students to learn why they did not use the new bus system or purchase the pass. The interview results indicated that some students did not use the new bus system because they lived too far from a bus stop. People living far from a bus stop or rail station were less likely to use public transportation. Our results also suggest that if people do not consider public transportation accessibility when choosing their residence, sprawl will continue, leading to an inefficient, underutilized city. Considering these issues, we examined the use of persuasive communication for encouraging residency closer to public transportation.

We implemented our study with freshmen students at the University of Tsukuba, many of whom live on the campus in dormitories. Freshmen are given priority regarding dormitory residency. However, because of limited dormitory space, many sophomores are not awarded dorms and have to move into apartments around the university. We thus focused on freshmen students who were planning to move from the dormitory to an apartment in their sophomore year.

Method

Experimental groups and materials distributed

As mentioned above, we targeted students at the University of Tsukuba who were about to change their residency. These students were randomly assigned into four groups (Fig. 1):

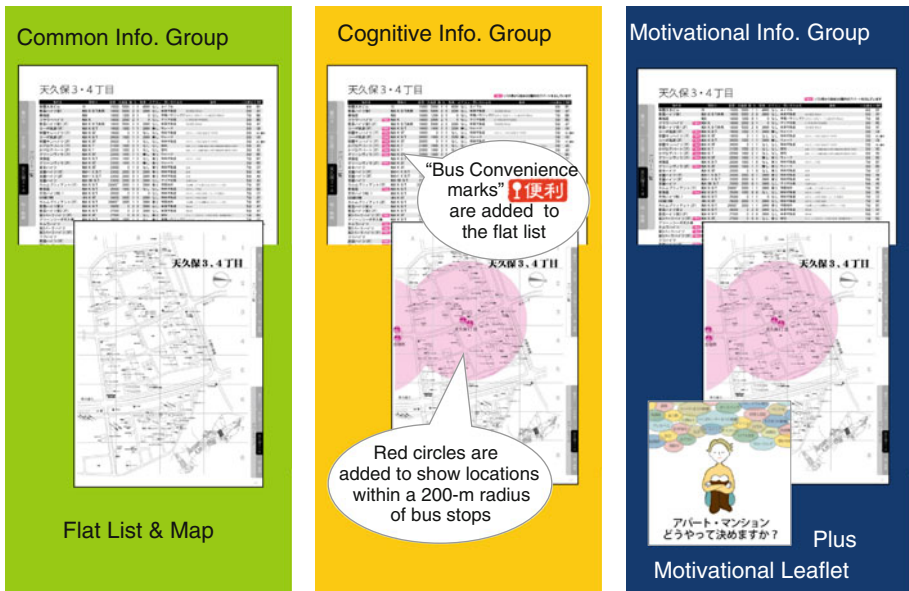


Fig. 1 Experimental groups and materials distributed

the first group was a control group; the second group (the common information group) was provided with an information brochure about typical apartments used by students in Tsukuba City; the third group (the cognitive information group) was provided with a brochure that was identical to the one used for the second group, except that it also included information about the level of bus service for every apartment; the fourth group (the motivational information group) was provided with a leaflet to motivate PTOR choice in addition to the brochure used for the third group. The information brochure distributed to the common group, cognitive group, and motivational group consisted of two components: a list of each apartment’s attributes (such as rent, room size, age of the building) and location maps of the apartments.

For the cognitive group, we attached “bus convenience marks” (in red) to the apartments listed in the brochure, if the apartment was located less than 200 m from the bus stop (within a 3-min walk). Moreover, to increase the appeal of apartments conveniently located for bus use, we attached location maps with red circles around the apartments located within a 200-m radius of a bus stop. The cognitive group did not receive any motivational information.

For the motivational group, a motivational leaflet was added to the brochure used by the cognitive group discussed above. The motivational leaflet consisted of three parts: advantages to living close to the bus stop (such as health, all-weather mode of transportation, environmentally friendly), an overview of the new bus system at the University of Tsukuba, and how to look for an apartment around bus stops (Fig. 2).

Experimental procedure

In November and December of 2007, we distributed the materials randomly at two places: freshmen lecture halls and the venue for the “dormitory lottery” event revealing which

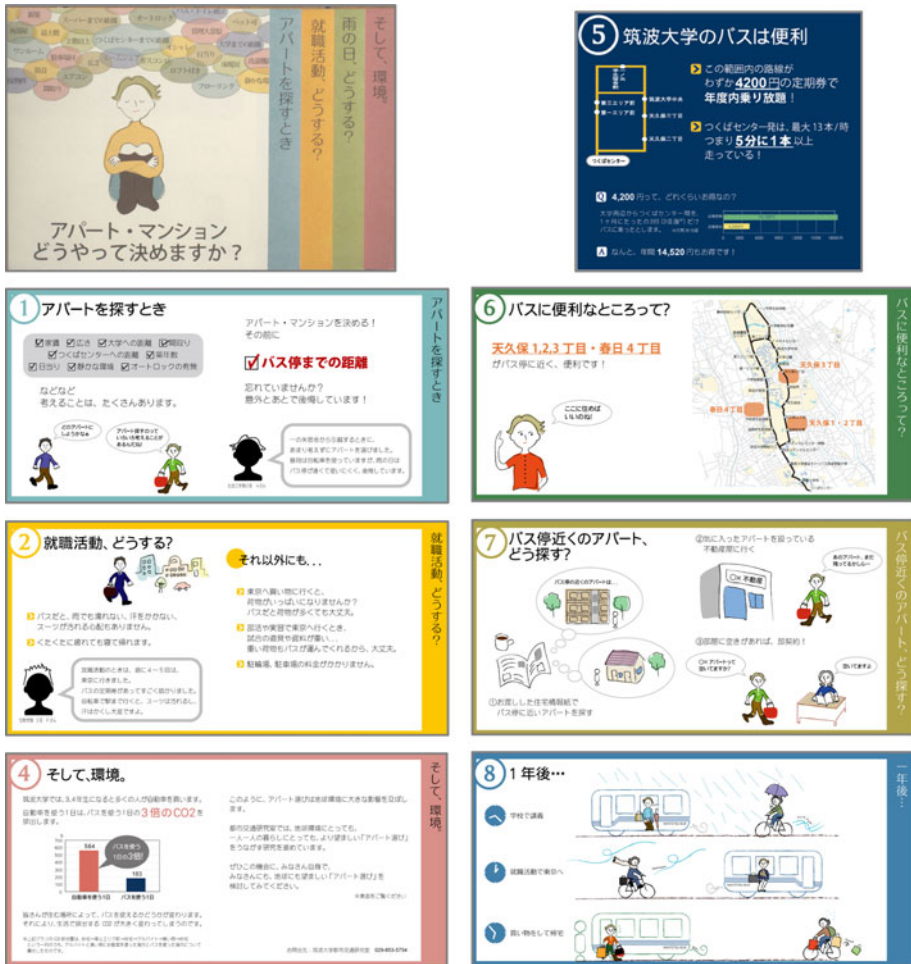


Fig. 2 Example of the motivational leaflet

non-freshmen have been awarded dormitory rooms for the upcoming year. The participants were asked to read the materials carefully and to fill out a form using their name and student ID number.

In April 2008, 5 months after the intervention (material distribution and dormitory lottery), we conducted a questionnaire survey to measure the effects of the interventions, targeting all of the sophomores who had completed their freshmen year at the university (Fig. 3). (Note that in Japan, the new academic/fiscal year begins in April.) For the survey, we requested that the participants fill in their name, student ID number, and home address, in addition to other pertinent information. We then verified the name and student ID number and identified the participants who had received the intervention materials. For the control group, we selected 77 students from the 2,714 participants that received the first questionnaire survey in April 2008. Of these, 47 completed the first questionnaire in April 2008, among which 37 were identified as having moved to apartments in Tsukuba. These 37 students comprised the control group.

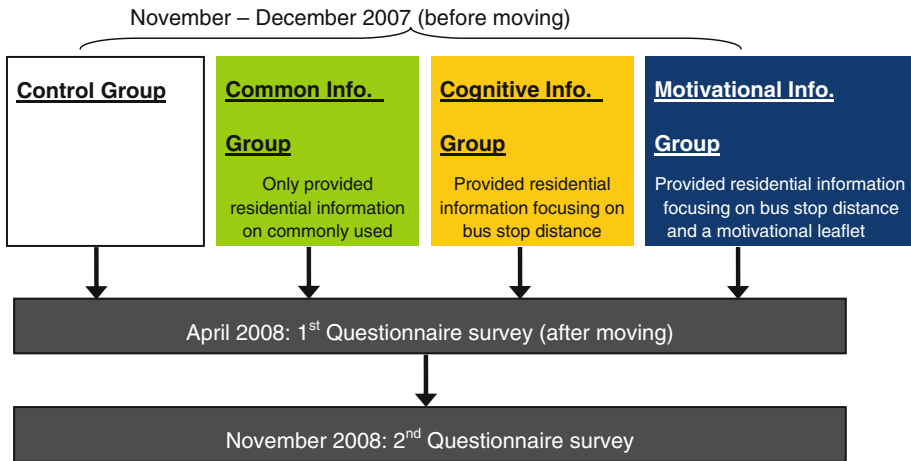


Fig. 3 Flow of the experiment

In November 2008, approximately 11–12 months after the intervention, we conducted a second survey. With the cooperation of the university’s administrative office, we compiled a list of students who were given intervention materials in 2007. This list, displayed on a bulletin board at the university, asked the students to contact the university so that they could receive the second questionnaire for our study.

Table 1 indicates the number of materials distributed and the number of materials and questionnaires collected.

Measures and indexes

To analyse the effects of the experiment, we asked the participants several questions, using two separate questionnaires, and calculated the measures and indices, as shown in Table 2.

Table 1 Number of materials distributed and questionnaire respondents

		Control group	Common info. group	Cognitive info. group	Motivational info. group
Nov.–Dec. 2007	# Receiving the distributed materials	(77)	72	78	53
April 2008	1st questionnaire respondents	47	30	48	35
	# Of respondents who had moved to an apartment in Tsukuba City	37	18	34	20
	# Of students participating in the analysis	37	18	34	20
November 2008	2nd questionnaire respondents	35	26	31	16
	# Of respondents who had moved to an apartment in Tsukuba City	16	22	22	9
	# Of students participating in the analysis	16	22	22	9

Table 2 Questionnaire responses and indices

1st questionnaire	2nd questionnaire	Index	Questions used in survey calculation	Scale
X		(1) Cognition of level of bus service	Q. Do you think your apartment is convenient for bus use?	No/yes (seven-point scale ^a)
X		(2) Intention to move closer to bus transportation for the next residence	Q. The next time you move, will you likely choose an apartment convenient to bus transportation?	No/yes (seven-point scale)
X		(3) Self-assessment of time/distance from home to the nearest bus stop	Q. How many minutes does it take you to get from your home to the nearest bus stop?	Minute (s)
X		(4) Calculated time/distance from home to the nearest bus stop	Q. Please list your address and block number Calculate time distances from the apartment to the nearest bus stop using a GIS system, in which the average walking speed is defined as 80 m/s	
X		(5) Living within 3 min from bus stop	Participants who live within 3 min from the bus stop by walking = 1, otherwise = 0	
X	X	(6) Ownership of annual bus commuter pass	Q. Do you have an annual bus commuter pass for this year?	Yes/no
X		(7) Frequency of bus use (for April)	Q. How many times did you recently use the campus bus in 1 week?	Times/week
	X	(8) Frequency of bus use from home (for November)	Q. How many times did you recently use the campus bus from your home in 1 month?	Times/month
	X	(9) Frequency of bus use from university (for November)	Q. How many times did you recently use the campus bus from the university in 1 month?	Times/month

^a The 7-point scale rankings: “0” means that respondent do not think it at all, and “7” means that respondent think it strongly

Results

We analysed the data of the two questionnaire surveys from three viewpoints: (1) cognition, intention, and self-assessment of the participant’s residential choice, (2) residential choice, (3) ownership of the annual commuter pass and (4) frequency of bus use.

Cognition, intention, and self-assessment

Table 3 shows the mean and standard deviation for each of the experimental groups regarding their cognition and intention towards residential choice, self-assessment, and calculated time distance. Table 4 shows the results of a one-tailed *t* test of paired comparisons for the groups.

Table 3 Mean and standard deviation of each experimental group

	Control			Common info			Cognitive info.			Motivational info.		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
(1) Cognition of level of bus service	37	2.27	1.84	18	3.17	1.42	33	2.94	2.28	20	4.05	2.09
(2) Intention to move to a location convenient to bus service next time	37	2.62	2.03	17	2.59	1.80	33	3.30	2.05	20	3.35	2.13
(3) Self-assessed time/distance from home to the nearest bus stop	36	6.00	3.56	18	4.72	2.40	34	4.88	3.61	19	4.16	3.20
(4) Calculated time/distance from home to the nearest bus stop	37	6.93	4.51	18	5.80	3.84	34	5.84	4.85	20	4.63	3.68

N sample size, *M* mean, *SD* standard deviation

Table 4 Results of one-tailed *t* test of paired comparisons of each group

Results of one-tailed <i>t</i> test	Control vs. common info. <i>t</i>	Control vs. cognitive info. <i>t</i>	Control vs. motivational info. <i>t</i>	Common info. vs. cognitive info. <i>t</i>	Common info. vs. motivational info. <i>t</i>	Cognitive info. vs. motivational info. <i>t</i>
(1) Cognition of level of bus service	-1.819**	-1.360*	-3.328***	0.384	-1.505*	-1.774**
(2) Intention to move to a location convenient to bus service for the next move	0.058	-1.393*	-1.269	-1.213	-1.160	-0.080
(3) Self-assessed time/distance from home to the nearest bus stop	1.372	1.304*	1.886**	-0.169	0.604	0.729
(4) Calculated time/distance from home to the nearest bus stop	0.915	0.977	1.954**	-0.035	0.957	0.965

t: *t* value

* $0.05 < p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4 shows that the control group tended to have low cognition of the level of bus service compared with the other groups. The motivational group exhibited a particularly high cognition of the bus service available, compared with the common and cognitive groups.

The intention to move to a location convenient to bus service for the next move tended to be high for the cognitive group, compared with the control group; there was no significant difference between the other groups. However, the *p* value between the

motivational and control groups was 0.1048, close to a 90 % significance level. The average for the motivational group, shown in Table 4, was high compared with other groups.

The self-assessed time/distance from home to the nearest bus stop tended to be smaller for the cognitive group than for the control group and was even smaller in motivational group.

These results suggest that the cognitive group, who were focused on the level of bus service, tended to see their residential location as convenient to bus service, and that they intended to live close to a bus stop for their next move, compared with the other groups. The motivational group, which had a motivational leaflet added to their cognitively focused materials, was also more likely to consider that their residential location convenient for bus use.

Residential choice

The last lines of Tables 3 and 4 show the mean, standard deviation, and the results of the *t* tests of calculated time/distance from home to the nearest bus stop for each group. The calculated time/distance for the motivational group was significantly small compared with that for the control group.

Table 5 shows the frequency of living in an area within/outside 3 min from a bus stop for each group, and the results of χ^2 tests. Figure 4 shows the percentage of students living within a 3-min walk from the bus stop. The cognitive group (32.4 %) was twice as likely as the control group (13.5 %) to live within a 3-min walk to a bus stop, a significant difference, and the motivational group (45.0 %) was three times more likely than the control group. The cognitive group tended to live close to a bus stop, even without the motivational material.

Ownership of the annual commuter pass

The last two sections of Table 5 show the frequency of ownership of an annual bus commuter pass (for April and November 2008) and the results of the χ^2 test divided by living within a 3-min walk. There was no significant difference of ownership in April 2008; however in November 2008, ownership in the motivational group (66.7 %) was twice that in the control group (31.3 %) (Fig. 5).

Frequency of bus use

Table 6 shows the mean and standard deviation of bus use frequency for each of the experimental groups. Table 7 lists the results of the one-tailed *t* test of paired comparisons of the groups. Figure 6 shows the frequency of bus use per week (for April and November of 2008) for each group.

Tables 6 and 7 indicate that there was no significant difference in bus use for April 2008; however, in November 2008, the frequency of bus use from home for the cognitive and motivational groups was significantly high in comparison to the control group. The frequency of use for the cognitive group tended to be high compared with that of the common group. Furthermore, the frequency of bus use from the university tended to be high in the motivational group in comparison to the control group. The higher use in the motivational group can be attributed to the motivational leaflet, which included messages

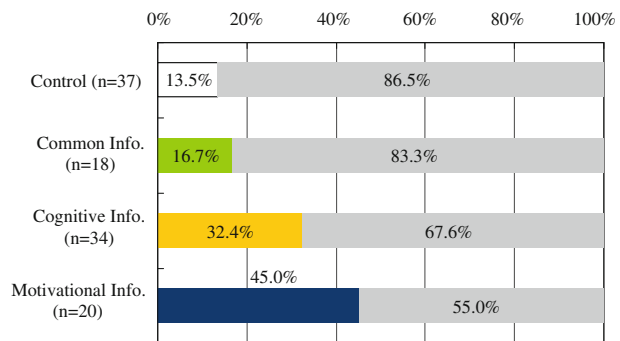
Table 5 Frequency of living within/outside a 3-min area from a bus stop for each group, owning an annual bus commuter pass (April and November 2008), and χ^2 test results

			Control	Common	Cognitive	Motivational	χ^2	DoF	<i>p</i>
Living within an area 3 min from a bus stop	Out	Frequency	32	15	23	11	8.34	3	0.040**
		Expected frequency	27.5	13.4	25.3	14.9			
		%	86.5 %	83.3 %	67.6 %	55.0 %			
	Within	Frequency	5	3	11	9			
		Expected frequency	9.5	4.6	8.7	5.1			
		%	13.5 %	16.7 %	32.4 %	45.0 %			
Ownership of bus annual commuter pass (April 2008)	Out	Frequency	23	14	20	11	2.47	3	0.481
		Expected frequency	23.1	11.2	21.2	12.5			
		%	62.2 %	77.8 %	58.8 %	55.0 %			
	Within	Frequency	14	4	14	9			
		Expected frequency	13.9	6.8	12.8	7.5			
		%	37.8 %	22.2 %	41.2 %	45.0 %			
Ownership of bus annual commuter pass (November 2008)	Out	Frequency	11	18	13	3	7.16	3	0.067*
		Expected frequency	10.4	14.3	14.3	5.9			
		%	68.8 %	81.8 %	59.1 %	33.3 %			
	Within	Frequency	5	4	9	6			
		Expected frequency	5.6	7.7	7.7	3.1			
		%	31.3 %	18.2 %	40.9 %	66.7 %			

DoF degree of freedom, *p* significance probability

* 0.05 < *p* < 0.1; ** *p* < 0.05

Fig. 4 Percentage living within an area 3-min walking distance from a bus stop



recommending bus use from the university for various objectives such as job hunting or commuting on a wet day.

These results indicate that the participant’s travel behaviour was not stabilized initially after they moved. Instead, achieving stability in bus use frequency required some time. The persuasive PTOR communication program conducted in this study appeared to influence the students’ choices, as indicated by the results from the motivational group.

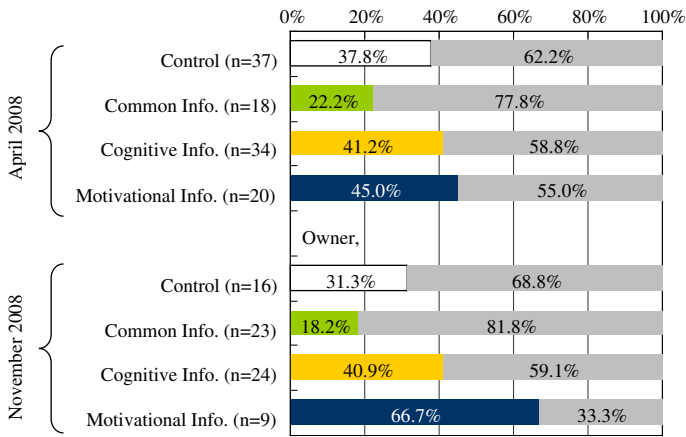


Fig. 5 Percentage of ownership of a new annual commuter pass in April and November of 2008

Table 6 Mean and standard deviation of bus use frequency for each experimental group

	Control			Common info			Cognitive info.			Motivational info.		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Frequency of bus use per week (April 2008)	37	0.57	1.48	18	0.94	1.51	34	0.74	1.19	20	0.90	1.45
Frequency of bus use from home per month (November 2008)	16	0.44	1.09	22	0.91	3.01	22	2.45	3.83	9	2.00	1.94
Frequency of bus use from the university per month (November 2008)	16	0.19	0.54	22	0.27	0.94	22	0.45	1.18	9	0.89	1.76

N sample size, *M* mean, *SD* standard deviation

Table 7 Results of one-tailed *t*-test of paired comparisons for each group

	Control vs. common <i>t</i>	Control vs. cognitive <i>t</i>	Control vs. motivational <i>t</i>	Common vs. cognitive <i>t</i>	Common vs. motivational <i>t</i>	Cognitive vs. motivational <i>t</i>
Frequency of bus use per week (April 2008)	-0.879	-0.523	-0.815	0.549	0.092	-0.453
Frequency of bus use from home per month (November 2008)	-0.597	-2.042**	-2.598**	-1.490*	-1.001	0.337
Frequency of bus use from the university per month (November 2008)	-0.326	-0.838	-1.491*	-0.565	-1.275	-0.802

t: *t* value

* $0.05 < p < 0.1$; ** $p < 0.05$

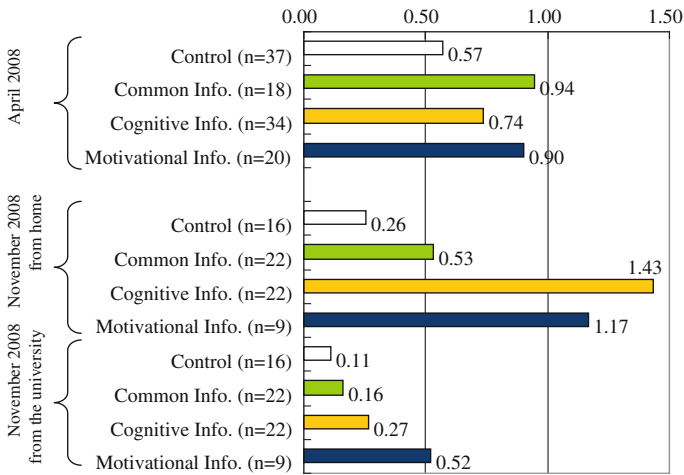


Fig. 6 Frequency of bus use per week (for April and November of 2008) for each group

Conclusion

In this study, we conducted a persuasive communication program to induce PTOR choice using both cognitive and motivational emphasis methods. We then implemented an experiment that targeted freshmen students at the University of Tsukuba to study their decisions regarding residency and the availability of bus service close to their residence location.

The results indicate that providing information about the level of bus service for every apartment complex can induce PTOR choice. The ratio of PTOR choice for the cognitive group was twice as high as that of the control group. The persuasive message to induce PTOR choice in the motivational group also contributed to an increase in PTOR choice. These results imply that simple intervention, like the inclusion of information about the level of public transportation availability for each residence, can effectively induce PTOR choice. Additionally, ownership of an annual commuter pass for the motivational group was double that of the control group. Furthermore, frequency of bus use from home and from the university was significantly higher in the cognitive and motivational groups than in control group. The cost of these interventions was low, and thus the PTOR choice approach could be implemented at any university, workplace, or housing agency, leading to less car use.

The effect of the program developed in this study depends on the balance of supply and demand for apartments in the target area. From the point of view of free competition, if PTOR-choice became more generalized for the population as a whole, people may prefer the convenience of apartment living close to public transportation. This would cause the rental prices in areas near transportation to increase. For example, in a metropolitan area like Tokyo, apartments close to public transportation often command higher rents. In these cities, it can be said that the supply and demand are balanced.

Nevertheless, if the program we suggest is widely implemented as a practical policy, people will change their attitudes and behaviours towards PTOR choices. Then, urban developers in a local region might start developing areas in line with attitudes towards PTOR choices. For example, public transportation-oriented urban development might occur over the long run in the area. Furthermore, public acceptance of regulatory policies

to promote compact cities might be increased through attitude changes towards PTOR choices. To realize a compact city, it would be necessary to combine the soft communication measures studied in our research and regulatory policy, such as zoning restrictions. The PTOR choice approach proposed by this research should be effective for a variety of different scenarios and areas.

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