

**Psychological and Behavioral Effects of Travel Feedback Program
for Travel Behavioral Modification**

by

Ayako TANIGUCHI
Department of Urban and Environmental Engineering,
Hokkaido University
& Hokkaido Development Engineering Center
11, South 1, East 2, Chuo-ku, Sapporo, Hokkaido, 060-0051
Japan
tel: +81-11-271-3028
fax: 11-271-5366
e-mail: taniguchi@decnet.or.jp

and

Fumihiro HARA¹, Shin'ei TAKANO², Sei'ichi KAGAYA³, Satoshi FUJII⁴
¹Hokkaido Development Engineering Center
²Associate Professor, Graduate School of Engineering, Hokkaido University
³Professor, Graduate School of Engineering, Hokkaido University
⁴Associate Professor, Department of Civil Engineering, Tokyo Institute of Technology

Psychological and Behavioral Effects of Travel Feedback Program for Travel Behavioral Modification

by

Ayako TANIGUCHI

Department of Urban and Environmental Engineering,
Hokkaido University, Japan

and

Fumihiro HARA¹, Shin'ei TAKANO², Sei'ichi KAGAYA³, Satoshi FUJII⁴

Abstract

This study investigated the effects of the Travel Feedback Program (TFP) on travel behaviors and psychological factors that may influence automobile use. TFP was proposed by Taniguchi et al. (2000) as a method of modifying travel behavior with automobile into that without automobile. In TFP, as in the Travel Blending Program (Ampt and Rooney, 1999) and Travel Smart (Department of Transport, Western Australia), participants were requested to report their activity-travel behavior, after which they received feedback on that behavior including information of the amount of CO₂ emission resulting from the behavior, and comments or suggestions from the program coordinators on how to reduce automobile use. The behavioral and psychological effects produced by TFP were theoretically investigated based on Norm Activation Theory (Schwarz, 1977), which describes psychological process of altruistic behavior proposed in Social Psychology. Based on the theory that automobile-use reduction or pro-environmental behavior is influenced by behavioral intention to reduce automobile use, we hypothesized that behavioral intention is in turn influenced by moral obligation, and moral obligation is in turn influenced by awareness of the negative environmental consequences of automobile use. The psychological and behavioral data confirmed the set of hypotheses of causal relations, and the data indicated that TFP has a significant positive effect on pro-environmental behavior even one year after participation in TFP.

Key words: behavioral modification processes, travel demand management (TDM), Travel Feedback Program (TFP), Norm Activation Theory, social psychological effects

Introduction

Toward easing traffic congestion in urban areas, transport policy makers who have tried to implement travel demand management (TDM) have focused on changing the transportation service level, for the purpose of travel behavior modification. TDM includes legal regulation of road pricing and traffic restrictions, installation of park-and-ride schemes, and the reduction of transportation fees. Fujii et al. call these "structural strategies" for behavioral modification, because they change the environment of travel behavior, e.g., the service levels of various travel modes or the system for regulating travel behaviors¹⁾. Those authors identified another type of strategy for behavioral modification, called "psychological and behavioral strategy," which works on individual psychological factors or awareness to encourage voluntary travel behavior change. Psychological and behavioral strategy includes the provision of specific information on public transport, travel campaigns, and travel education¹⁾. One such strategy is a feedback program for behavioral modification in which participants report their travel behavior to the program coordinator, and the processed report data including number of trips for each traffic mode and amount of CO₂ emissions resulting from the trips are fed back to the participants with hints or suggestions on behavioral modification. Such programs include the Travel Smart²⁾ and Travel Blending³⁾ programs in Australia, and the Travel Feedback Program (TFP)^{5), 6), 7), 8)}, which the authors have developed and implemented in Sapporo, Japan.

Although the effects of behavioral feedback strategies on travel behavior have been examined^{2),3), 5), 6), 7), 8)}, their effects on psychological factors, including attitude toward various travel modes and moral obligation to desist from automobile use, have not yet been well examined. This study reports the procedure and effects of TFP immediately after its implementation in greater Sapporo in 2000. We analyzed how TFP has affected program participants' psychological factors as well as their travel behavior. The analysis was based on Norm Activation Theory¹⁰⁾, which has been applied to describe psychological processes that induce pro-environmental behavior⁹⁾. Toward verifying the persistence of TFP effects, the behavioral psychology data collected in 2001, one year after TFP implementation, were analyzed.

Figure 1.

1. Outline of TFP in Sapporo

Figure 1 shows the flow of TFP, which was implemented from August to December 2000 with 599 participants in 219 households. The sample groups consisted of residents of two communities and an elementary homeroom class of fifth graders and their families. Figure 1 describes the TFP Community Participation Program, for all community members, and the TFP Education Curriculum Program, for the fifth graders and their families. The continuity of the program's effect was verified by a survey detailed in Section 4. The survey was conducted 1 year after program implementation. The TFP procedure for 2000 is outlined below.

(2) TFP Procedure

TFP in 2000 was conducted under two programs: the Community Program and the Education Curriculum Program. Procedures for both programs consist of the four steps in Figure 1. At the outset, the program coordinator used educational pamphlets to explain the purpose of TFP: reduction of CO₂ emissions by shifting anti-environmental travel behavior to pro-environmental travel behavior. Each family member kept a 7-day activity-travel diary (Diary 1), which was in the form of a questionnaire. After collecting Diary 1, we made diagnostic checklists to feed back the survey results to each participant's household. The diagnostic checklists consist of analysis results of the participant's activity-travel logs and comments on those logs from the viewpoint of reducing CO₂ emission. The Diary-2 survey followed, and we made final diagnostic checklists that compared Diary 1 and Diary 2 to analyze their difference. The feedback given to participants could be regarded as persuasive communication¹¹⁾ encouraging them to shift from car use to walking, cycling and public transport.

Table 1.

(3) Kits for TFP

The kit developed for TFP in 2000 includes 1) an explanatory pamphlet, 2) diaries, 3) diagnostic checklists, and 4) the final diagnostic checklists.

1) Explanatory pamphlet

Psychological and behavioral strategies for behavioral modification need to start with an explanation of the background, goals, and procedure, for effective prompting of behavior change. Travel behavior change is not realized without the participants understanding the program's goals. We created a pamphlet that outlines the programs. In doing so, we tried to ensure that participants would understand that the programs did not intend for participants to cease all car use and that participants' independence would be respected.

2) Diary

The diary consists of three parts: lists of family members and cars, a travel-activity diary, and a car-use diary. Each participant was requested to fill in the lists for family members and cars. Family members of elementary school age or older recorded travel activities each day. The car-use diary was for recording the family's daily car use.

3) Diagnostic checklists

The diagnostic checklists for feedback to the participant were the most crucial component of TFP. The participant's motivation for behavior change was assumed to differ greatly depending on their activity-travel patterns. The diagnostic checklists, therefore, were made to ensure that the participant would review his or her activity-travel patterns from the viewpoint of CO₂ emissions, and to provide information on travel alternatives to car use. In the checklists, the 7-day activity-travel patterns were graphically presented as a diagram, to facilitate the participant's understanding (Figure 2), and comments including proposals resulting from evaluation of the participant's activity-travel patterns were made. The comments were systematically drafted under a system established by the authors⁶⁾. To

facilitate quantitative comparison between the results of one participant and those of others, the participant's frequency and duration of transportation use by mode were placed next to the group averages for these. In addition to the diagnostic checklists, materials including information on public transport discounts in Sapporo, bus route maps and timetables were handed out.

Figure 2

In the comments, praise for the subject's travel behavior came first and proposals followed. This was because it was thought that participants would be more receptive to comments that did not seek to ban their travel behaviors, including car use. Praise was expected to induce intrinsic motivation that would result in the participant's pro-environmental behavior. Examples of praise follow.

Example 1 (praise for subjects who routinely used public transport): Your travel behavior is ideal and helps reduce air pollution and traffic congestion. You usually use public transport. Please continue doing so. Please find the enclosed information on fee discounts for public transport. We hope it will be useful to you.

Example 2 (praise for subjects who routinely used Kiss & Ride): You are greatly contributing to the reduction of air pollution and traffic congestion by practicing Kiss & Ride. On day X you were driven to the nearby station by family member X on the family member list, where you transferred to public transport to your destination. Your travel behavior is excellent.

Example 3 (comments for subjects who commuted by car almost every day neither at very early hours nor at late hours. You might consider using public transport once a week on a sunny day. On day X you did not use a car on business except to commute. If small behavior changes of individuals prevail in the city, it will reduce air pollution. Also, walking is healthy.

Example 4 (comments for subjects who made frequent short (shorter than 10 minutes each) car trips except for commuting): On day X you made X short car trips. On a sunny day, you could replace these with cycling or walking. A 10-minute walk consumes 48 kcal (equivalent to two mandarin oranges) and can improve your health.

Example 5 (comments for subjects who made frequent car trips that took 10 minutes or more each): Please find the enclosed route maps for regularly scheduled buses. There will be bus routes that conveniently connect your home and workplace. Unlike stressful driving, the bus ride may provide you with an opportunity to relax and see new things from the window. You might want to give it a try.

Example 6 (comments for subjects who were driven routinely to work or school): Person X drove you to work every day. When you do not have many things to carry,

you could get a ride to the nearest station where you could transfer to public transport. Such commuting will reduce CO₂ emissions and might make a nice change.

4) *Final diagnostic checklists*

The final diagnostic checklists were made to enable the participants to identify their travel behavior change by comparing Diary 1 and Diary 2. CO₂ emissions in the Diary-1 survey and Diary-2 survey were graphed by travel mode to facilitate the participant's visual understanding.

(4) Subject groups

TFP in 2000 was conducted in three groups: a) residents of the Sanae district of Ebetsu City, b) residents of the Aino-sato district, and c) fifth-graders of Homeroom Class 1 at the elementary school associated with the Hokkaido University of Education, Sapporo. The groups and their collection rates of the survey and diary are outlined below (Table 2).

a) Residents of the Sanae district of Ebetsu City

Ebetsu City adjoins Sapporo to the east. The Sanae district is a flat residential district from which many people commute to Sapporo. There is a railway station in Ebetsu, and the bus system from the railway station is relatively well developed. In the Sanae district, there are few bus routes, so car use is frequent.

b) Residents of the Aino-sato district

The Aino-sato district is in northern Sapporo. It is a rather new, flat residential district. In the area there is the Aino-sato University of Education Railway Station on the Sassho Line. Buses on several routes including those bound for downtown Sapporo and for subway stations in the suburbs of Sapporo are available from the station.

c) Fifth-graders in Homeroom Class 1 at the elementary school associated with the Hokkaido University of Education, Sapporo

The elementary school stands in Aino-sato; however, students live throughout Sapporo and its environs because it is the only national elementary school in Sapporo and its students are not limited to the local school district. Students are not allowed to be driven to or from the school. In principle, the students commute by public transport.

Table 2

2. Short-term effects of TFP

(1) TFP's effectiveness for TDM

An index that most directly represents the effectiveness of TDM is the share change of transportation mode. The share for family car decreased by about 5%. That for public bus and railway became 15%, a 4% increase. CO₂ emissions yielded by travel behaviors as the

environmental load fell by 16.3% as the whole¹³). The amount of CO₂ emissions was calculated by multiplying unit emissions for that mode by trip time. Such calculations show TFP's effectiveness in TDM. In the share for each travel behavior, a large decrease was observed in private trips made by family car to give a ride or run errands.

(2) TFP's effectiveness in travel and environmental education

At the end of the program, great improvement was observed in the participants' awareness of their travel behavior. The awareness change was indicated by the student and their parents' comments given at a class or in the diary (Figure 3). They described their significant awareness change after receiving the diagnostic checklists and being told about TDM. This may support TFP's effectiveness.

Figure 3

3. Survey on persistence of TFP effects

TFP effects immediately after its implementation were explained in Section 2. To verify the persistence of these effects, a survey was conducted in 2001, one year after its implementation.

(1) Framework of the analysis

To analyze the continued psychological and behavioral effects of TFP, Norm Activation Theory was applied. Norm Activation Theory is used to describe psychological process of supportive or altruistic behaviors, such as rescuing a person who has fallen or is drowning. This type of behavior is characterized by significantly benefiting the party other than the behavior. Behaviors of desisting from car use, which are motivated by environmental concern, might benefit other community members by reducing environmentally harmful CO₂ emissions. Therefore, behaviors of desisting from car use resulting from TFP are expected to be theoretically described by Norm Activation Theory.

According to Norm Activation Theory, activation of the moral obligation to refrain from car use induces behavioral modification. "Moral obligation" refers to the behavior's intention of trying to bring his action into conformity with social norms of good and bad. To activate moral obligation, awareness of seriousness of the problem (e.g., car use is a major cause of environmental problems) is necessary. Such awareness is generally called "awareness of consequences." Figure 4 shows the psychological process leading to behavioral modification. Activation of the awareness of consequences further activates the moral obligation followed by behavioral intention which triggers actual behavior change.

Figure 4

This study considered that behavior change was induced by TFP's effect on psychological processes as explained by Norm Activation Theory. Among the multiple psychological factors (awareness of consequences, moral obligation and pro-environmental behavior), we investigated which one was affected by TFP. Further, attitude theory suggests "habit" as an important psychological hindrance to behavioral modification^{15), 16), 17)}. In addition to examining TFP effects, we analyzed how habit persistence affected the behavioral modification process (Figure 2).

(2) Subjects

Residents of the Aino-sato district and the elementary school students, two of the three subject groups for TFP in 2000, were surveyed one year later to verify the persistence of TFP effects. The subjects included both previously participating households (the TFP group) and newly participating households (the control group).

(3) Procedure

The survey was conducted from December 2001 to January 2002. Elementary students received the questionnaire at school and handed it out to their parents. The questionnaire was collected by post in an envelope distributed in advance with the questionnaire. In Aino-sato, both distribution and collection of the questionnaire for the TFP group was by post. For the control group around the households of the TFP group, the questionnaires were delivered by the surveyors and collected by post. Table 3 shows the survey collection rate. In each group, 50 to 80 samples were collected. The collection rate was higher for the TFP group than for the control group. This was probably because previous participants were more interested in the survey than were new participants.

Table 3

(4) Survey items

In the survey, psychological factors were those hypothesized by Norm Activation Theory, that is awareness of consequence with respect to automobile use, moral obligation to refrain from automobile use, behavioral intention to refrain from automobile, and behavioral indexes for refraining from automobile use. Table 4 lists the questions used in the questionnaire, and examples of questions are shown in Figure 5. Questions used for measuring psychological factors hypothesized by norm activation theory, i.e., awareness of consequence, moral obligation, and behavioral intention for pro-environmental travel behaviors, were developed in the current study by referring to questions used in Garling, et al.⁹⁾

Table 4

Figure 5

4. Results of the survey to verify the TFP effect continuity

(1) Reliability of the indexes

Reliability of the psychological factors was indicated by Cronback's α coefficient ¹⁸⁾ (a statistical value indicating how accurately multiple indexes measure a psychological factor). Cronback's α coefficients for individual psychological factors are shown in Table 5. In this study, each value of Cronback's α coefficient of the psychological factor reaches a reliable level. Therefore, the average score of answers to the multiple questions corresponds to the individual psychological factors excluding pro-environmental travel behavior.

Table 5

(2) Comparison of means of psychological factors between groups

The means and standard deviations for each psychological factor of households in Aino-sato and those of the elementary schoolers are shown in Table 6. The households included both previously participating ones, TFP group, and newly participating ones, the control group. The larger was the score (except for "habit"), the more pro-environmentally the subjects behaved. As for "habit," the larger was the value, the more habitually did the subjects use the car. On the whole, there were significant differences in the scores for pro-environmental behavior between TFP group and control group. In the results for the elementary school, a large difference was seen between scores for behavioral intention and pro-environmental behavior. In Aino-sato, the scores of newly participating households were high for awareness of consequences and for moral obligation. Table 7 shows *p* values of one-way analyses of variance (ANOVA) for TFP vs. control of measured psychological factors.

Table 6

Table 7

On the whole, there was a 1% difference between TFP group and control group for pro-environmental behavior. This indicates that the previously participating households were more pro-environment than the newly participating ones. According to ANOVAs for

Aino-Sato and for the elementary school, although there was a difference at a 1 % significant level between groups for pro-environmental behavior in elementary school, there was no significant difference in Aino-Sato. As for the scores for awareness of consequences, moral obligation, behavioral modification, and habit, there was no significant difference between TFP group and control group overall or within households in Aino-Sato and the elementary school.

(3) Hypothetical tests

To examine how TFP acted the subjects' psychological processes to induce them to take pro-environmental behavior, samples of the Aino-sato group and of the elementary school were analyzed using Norm Activation Theory. For the analysis, whether Norm Activation Theory could be applied to a model of behavioral modification was examined by a set of regression analyses. Which phase of the psychological process supposed by the Norm Activation Theory, TFP would affect was examined in the same way. The effects of habitual car use also was analyzed. The results are listed in Table 8 and diagramed in Figure 6.

Table 8

Figure 6

The table shows that there was a statistically significant positive effect of moral obligation on behavioral intention, and of behavioral intention on pro-environmental behavior. It is also shown that awareness of consequences has a marginally significant positive effect on moral obligation. These results supported the hypotheses that pro-environmental travel behavior resulted from the psychological process stated in Norm Activation Theory.

Although Norm Activation Theory has assumed that only behavioral intention influences pro-environmental behavior, it has been indicated that moral obligation and awareness of consequences also directly influence it. It was also indicated that awareness of consequences influenced behavioral intention directly (Figure 6.). Further, significantly negative influence of habitual car use not only on pro-environmental behavior but also on behavioral intention was proved.

The table indicates that TFP did not influence moral obligation, awareness of consequences, or behavioral intention. However, it is shown that TFP had a significant positive influence on pro-environmental behavior. Since the variable used in the analysis as pro-environmental behavior was obtained from the survey conducted one year after the implementation of TFP, this result suggests that TFP continues to promote pro-environmental travel behavior even one year after implementation.

5. Conclusion

This study explained the procedure of TFP, a psychological and behavioral strategy for

TDM, and verified its effects immediately after implementation. The persistence of TFP effects was surveyed one year after implementation under the framework of Norm Activation Theory.

According to one-way ANOVA (TFP group vs. control group) of each psychological factor (Table 7), and the set of regression analyses of the psychological processes toward pro-environmental travel behavior (Table 8), it was statistically shown that TFP induced pro-environmental behavior even one year after implementation. Previous studies had proved that TFP triggers temporary behavioral modification. This study verified the persistence of TFP effect and suggested that TFP may be useful as a measure of TDM aiming at restraining car use.

However, the results of the set of regression analysis in Table 8 indicated that TFP did not significantly influence other pro-environmental factors, including moral obligation and awareness of consequences. Although the reason was not clear, it may be possible to interpret the results as showing that the participant's environmental awareness was high before the survey but lack of suitable information hindered this from manifesting as pro-environmental behavior. TFP might have provided the lacking information, thereby leading to pro-environmental behavior.

As hypothesized, the set of regression analyses proved that pro-environmental behavior could be described by using Norm Activation Theory. The results of this study suggest that to induce pro-environmental behavior, structural strategies activating egoistic motivation may not be sufficient, and psychological measures that work on awareness of negative consequences of anti-environmental behavior or moral obligation to desist from anti-environmental behavior may be necessary.

The results of the set of regression analyses in Table 8 identified significant negative influences of habitual car use both on behavioral intention and on pro-environmental travel behavior. This implies that people who heavily use car tend to be less restrained in car use. As other studies have pointed out^{15), 16), 17)}, the strength of habitual behavior needs to be considered when measures for behavioral modification are implemented. Since this study shows that TFP has a positive effect on pro-environmental travel behavior, TFP may be a way to break the habit¹⁾ of car use.

Although further research is called for, including further psychological analyses investigating TFP's effects that consider individuals' socioeconomic attributes and psychological predispositions, and the development of a simpler automated program that is applicable in many places and of educational kits, this study suggests that TFP may be used as a practical TDM measure for behavioral modification from anti-environmental travel behavior, e.g., car use, to pro-environmental travel behavior, e.g., public transport use.

References

- 1) Fujii, S., Gärling, T., Kitamura, R. (2001) Breaking habitual defecting by a temporary structural change, presented at *Ninth International Conference on Social Dilemmas*, June 29 - July 3, 2001, Chicago, IL, U.S.A.
- 2) Department of Transport, Western Australia: *Travel Smart: A cost-effective contribution to transport infrastructure*, 2000.

- 3) Ampt, E., Rooney, A. (1999) Reducing the Impact of the Car – A Sustainable Approach Travel Smart Adelaide, 23rd Australasian Transport Forum, Perth, September 29 - October 1.
- 4) Rose, G., Ampt, E.: Travel blending: an Australian travel awareness initiative, *Transportation Research*, **6D**, pp. 95-110, 2001.
- 5) Taniguchi, A., Hara, F. Murakami, Y., Takano, S.: Implementation of a traffic survey and feedback program in Sapporo as a measure of TDM. *Proceedings of Papers and Reports of the Infrastructure Planning Committee, Japan Society of Civil Engineers*, Vol. 23, pp. 783-786, 2000.
- 6) Taniguchi, A., Hara, F., Murakami, Y., Takano, S.: Implementation of a traffic survey and feedback program in Sapporo as a measure of TDM. *Journal of Infrastructure Planning and Management*, **18**, pp. 895-902, 2001 (in Japanese with English abstract).
- 7) Taniguchi, A., Hara F., Shimbo, M., Takano, S., Kagaya, S.: A demonstrative study of the meaning and effects of the Program to Consider Wise Way of Using Cars as a measure of environment-oriented traffic education at an elementary school. *Environment System Study*, **29**, pp. 159-169, November 2001 (in Japanese with English abstract).
- 8) Taniguchi, A., Hara, F., Takano, S., Kagaya, S.: Study of Traffic Environment Awareness among Elementary Schoolers in Japan, and a Program to Raise It, Traffic and Transportation Studys, Proceedings of International Conference of Traffic and Transportation Study (ICTTS) (ed. by K.C.P.Wang, G.Xiao, L.Nie, H.Yang) Vol.1, pp.9-16, 2002.
- 9) Gärling, T., Fujii, S., Gärling, A., Jacobsson, C.: Moderating effects of social value orientation on determinants of pro-environmental behavior intention, *Journal of Environmental Psychology* (in press), 2002.
- 10) Schwarz, S.H.: Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in Experimental Psychology*, Vol. 10. New York: Academic Press. pp. 222-280, 1977.
- 11) Fujii, S., Kitamura, R.: Preventing inappropriate bicycle parking through persuasive communications, prepared for *Transportation Research Board 83rd Annual Meeting*, Washington, D.C., USA, 2003.
- 12) Deci, E. L.: *Intrinsic motivation*. Plenum Press, 1975.
- 13) Taniguchi, A., Hara, F., Takano, S., Kagaya, S.: Procedure and Effectiveness of TFP, a Psychological Strategy for TDM. *Proceedings of Papers and Reports of the Infrastructure Planning Committee, Japan Society of Civil Engineers*, Vol. 24, June 2002.
- 14) Taniguchi, A., Takano, S., Kagaya, S.: Continuous Effects of a Psychological TDM Program “TFP” as a Transportation-Environmental-Education Program. *37th Papers on City Planning, City Planning Review Special Issue*, November 2002, (submitted) (in Japanese with English abstract).
- 15) Fujii, S. and Gärling, T.: Effects of Forced Behavioral Change on Script-Based Travel Mode Choice, on CD-ROM of proceedings of *Transportation Research Board 82nd Annual Meeting*, Washington, D.C., U.S.A, 2002.
- 16) Fujii, S., Kitamura, R.: What does a one-month free bus ticket do to habitual drivers? An experimental analysis of habit and attitude change in travel mode choice, on CD-ROM of *Proceedings of Transportation Research Board 82nd Annual Meeting*, Washington, D.C, U.S.A., 2002.
- 17) Gärling, T., Fujii, S., Boe, O.: Empirical tests of a model of determinants of script-based driving choice, *Transportation Research F: Traffic Psychology and Behavior*, **4**, pp. 89-102, 2001.
- 18) American Psychological Association : *Standards for Educational and Psychological Testing*, Amer. Psychological Assn. 1985.

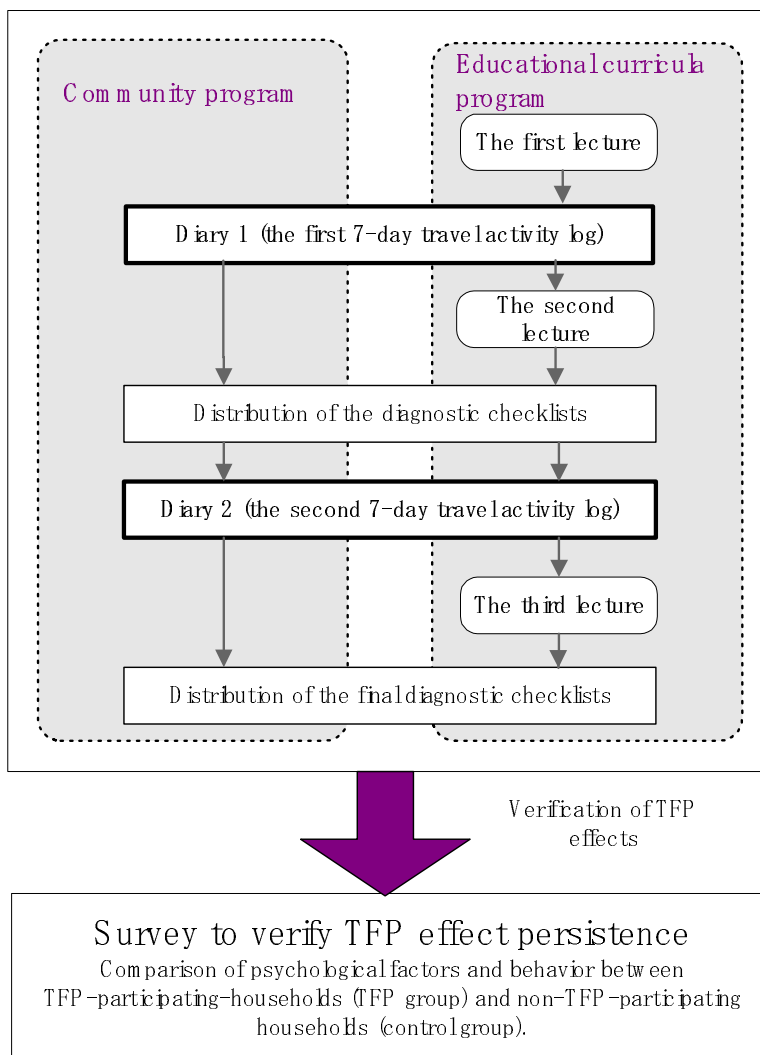


Figure 1. Flow of the TFP procedure implemented in Sapporo

Table 1. Procedure of TFP implemented in Sapporo

Step	Item	Material
1	7-day diary survey	Diary 1
2	Feedback	Diagnostic checklists
3	7-day diary survey	Diary 2
4	Feedback	Final diagnostic checklists

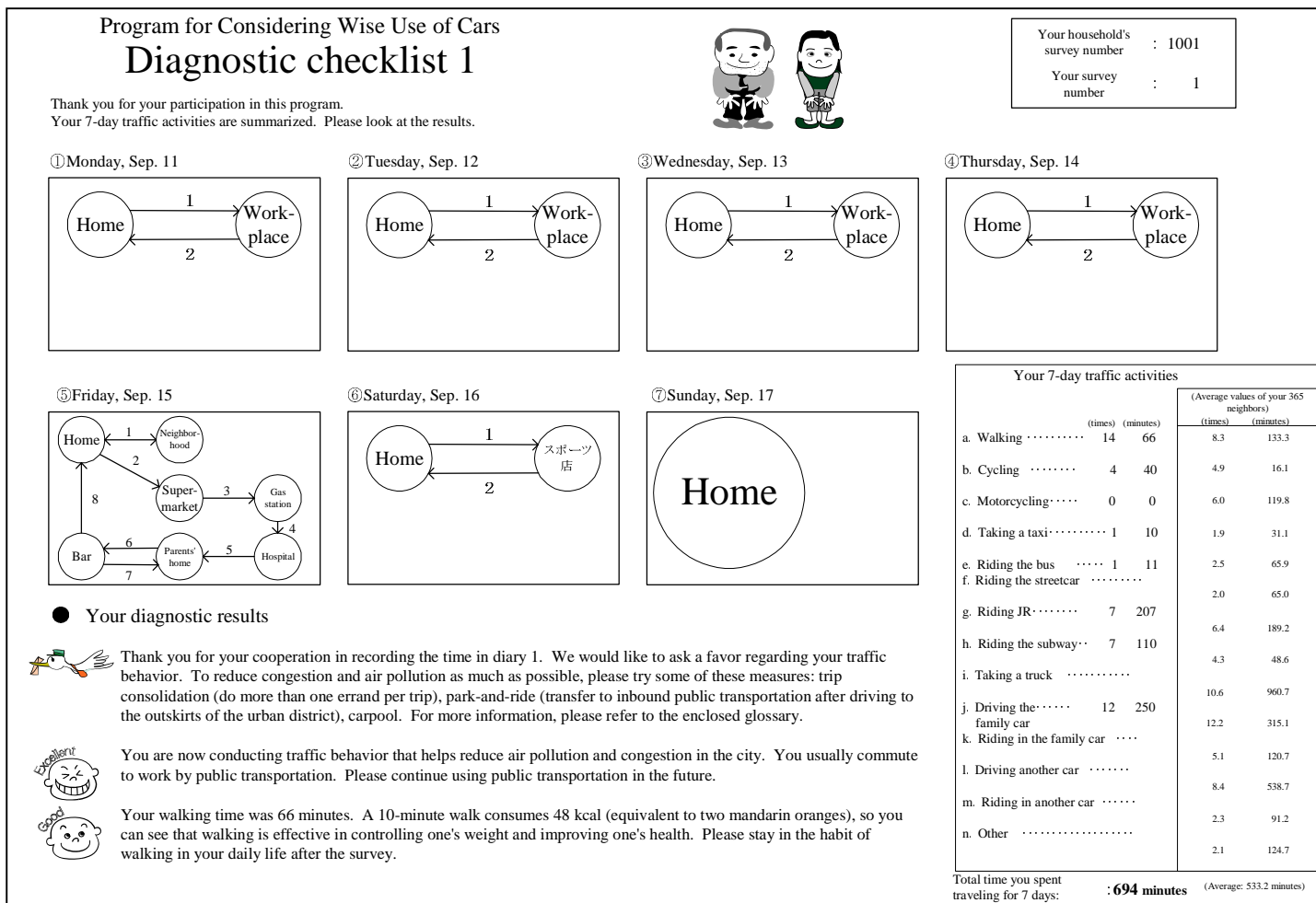


Figure 2. Example of diagnostic checklists

Table 2. Response rate of diary survey in TFP in 2000

	Diary	Recipients individuals (households)	Collected diaries individuals (households)	Response rate of individuals
Sanae, Ebetsu	1	496 (155)	365 (149)	71.0%
	2	365 (149)	352 (142)	
Aino-sato	1	147 (44)	124 (41)	81.6%
	2	124 (41)	120 (40)	
Elementary school	1	154 (41)	142 (39)	82.5%
	2	142 (39)	127 (37)	

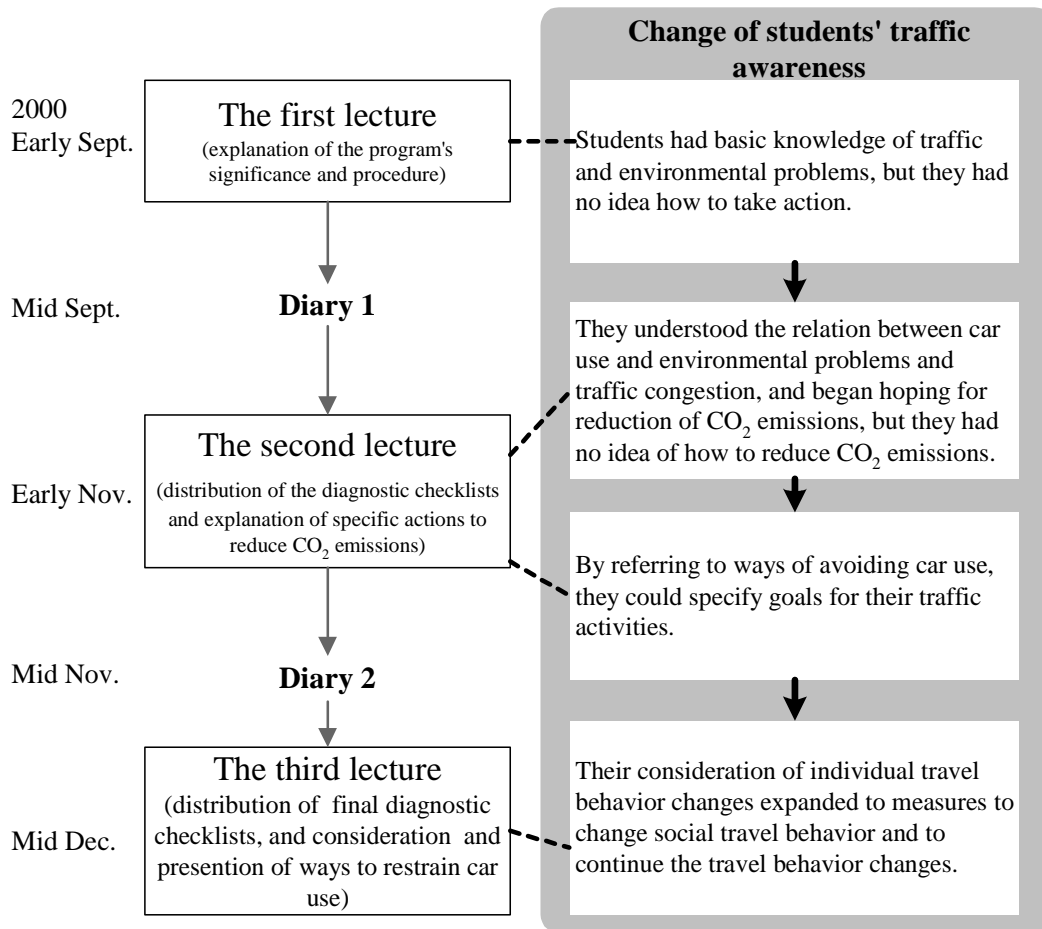


Figure 3. Change of students' traffic awareness

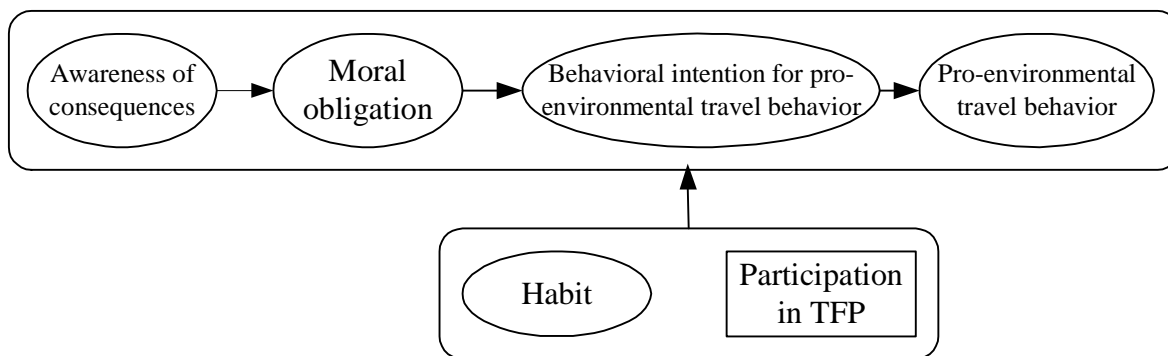


Figure 4. Hypothesis of psychological process of behavioral modification to pro-environmental behavior (i.e., restraining car use) on the basis of Norm Activation Theory and the hypothesis concerning TFP effects on this process.

Table 3. Number of recipients, number of respondents, and response rate in survey for investigation of TFP effect persistence in 2001

		Recipients		individuals respondents	response rate
		households	individuals		
Elementary school	TFP group	37	127	78	61.4%
	control group	40	160	53	33.1%
Aino-Sato	TFP group	40	120	61	50.8%
	control group	150	450	80	17.8%

Table 4. Questions to measure the participant’s psychological factors and the endpoints of measures' scales

Index	NO.	Question	Scale antipodes
awareness of consequences	(1)	Do you think car use contributes to environmental pollution?	No / Yes
	(2)	Do you think car use contributes to global environmental problems?	No / Yes
moral obligation	(1)	How do you evaluate car use in terms of morality?	Morally unproblematic/ morally problematic
	(2)	Do you think cars should be used frequently?	No / Yes
behavioral intention for pro-environmental travel behaviors	(1)	Do you sometimes think about refraining from using a car?	No / Yes
	(2)	Do you sometimes think to stop completely using a car?	No / Yes
pro-environmental travel behavior	(1)	Do you think your traffic behavior is sometimes pro-environmental?	No / Yes
habit	—	Which transportation do you use to visit a friend? to shop for clothes? to go to the movies? to go for lunch? to go back home? to go out for dinner? to go for a picnic barbecue? to go swimming? to go skiing? to commute to work or school? to go to the hospital? to go to the convenience store? to go to the bookstore?	Family car, Railway, Subway, Streetcar, Bus, Bicycle, Walking, Motorcycle, Other

Note: As the score for “habit”, out of the answers to the 13 questions, only those who chose “car” were counted.

<p>Do you think car use contributes to environmental pollution?</p> <p>No Don't know Yes</p> <p>←—————→</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p>
<p>Do you think your traffic behavior is sometimes pro-environmental?</p> <p>No Don't know Yes</p> <p>←—————→</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p>

Figure 5. Examples of 7-points scales to measure psychological factors

Table 5. Reliability indexes of sets of measures for psychological factors

Index	Cronback's α
Awareness of consequences	0.86
Moral obligation	0.65
Behavioral intention	0.68
Pro-environmental behavior	—
Habit	0.84

Table 6. Mean (M) and standard deviation (STD) for each psychological factor

	Overall		Elementary school		Aino-Sato	
	TFP group M (STD)	control group M (STD)	TFP group M (STD)	control group M (STD)	TFP group M (STD)	control group M (STD)
Awareness of consequence	5.83 (1.12)	5.97 (1.24)	5.75 (1.37)	5.72 (1.65)	5.93 (1.33)	6.14 (1.13)
Moral obligation	4.32 (1.02)	4.19 (1.14)	3.04 (1.18)	2.99 (1.14)	2.97 (1.09)	3.01 (1.20)
Behavioral intention to decrease car use	4.15 (1.61)	3.86 (1.68)	4.09 (1.67)	3.62 (1.62)	4.24 (1.55)	4.02 (1.71)
Proenvironmental traffic activity	5.17 (1.57)	4.55 (1.72)	5.18 (1.35)	4.33 (1.28)	5.16 (1.51)	4.71 (1.38)
Habit	8.01 (3.25)	8.48 (3.46)	8.39 (3.16)	8.92 (2.97)	7.51 (3.32)	8.18 (3.75)

Table 7. *p* values for one-way analysis of variance (TFP group vs. control group) of psychological factors hypothesized in Norm Activation Theory and habit

	Overall	Elementary School	Aino-S ato
Awareness of consequences	0.388	0.901	0.307
Moral obligation	0.327	0.819	0.670
Behavioral intention	0.143	0.114	0.439
Pro-environmental travel behavior	0.002***	0.004***	0.110
Habit	0.245	0.328	0.273

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 8. Estimation results of a set of regression analysis

	Pro-environmental travel Behavior	Behavioral intention	Moral obligation
	<i>b</i> (<i>t</i>)	<i>b</i> (<i>t</i>)	<i>b</i> (<i>t</i>)
Behavioral intention	0.23 (3.84) ***		
Moral obligation	0.16 (2.74) ***	0.22 (3.67) ***	
Awareness of consequences	0.11 (1.93) *	0.19 (3.21) ***	0.10 (1.66) *
Participation in TFP	0.15 (2.69) ***	0.06 (1.10)	0.04(0.64)
Habit	-0.20 (-3.51) ***	-0.12 (-2.09) **	0.07(1.05)
R ²	.23	.12	.02
sample size	263	263	264

b: Standardized coefficients

(*t*): t-statistics * $p < .10$, ** $p < .05$ *** $p < .001$

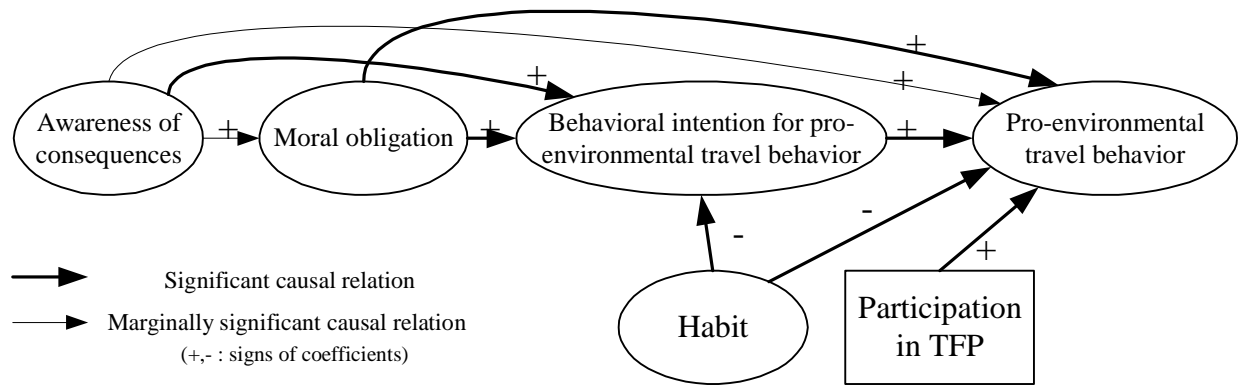


Figure 6. Causal relations indicated by regression analyses