Psychological Factors Influencing Intentions to Use Bus Rapid Transit (BRT) in Khon Kaen, Thailand

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Abstract: The psychological factors are important to understand the mode choice behavior. This paper utilizes psychological factors according to the Theory of Planned Behavior (TPB) to examine people's intentions to use BRT in Khon Kaen city, Thailand. A sample of 298 participants completed the survey questionnaires that measured a series of constructs based on TPB. Both standard direct measurement and control beliefs measurement were included. The results showed that the TPB factors accounted for a significant part of the variance in the intention to use BRT. Intention of using BRT was determined by subjective norm and perceived behavioral control. Moreover, the analysis of control factors revealed that the beliefs about "standard of service", "traffic congestion", and "accessibility to the station" strongly contribute to the perceived behavioral control and intention to use BRT. The outcomes of this study help to understand travelers' behavior and can be useful for BRT planning in other cities.

Keywords: Bus Rapid Transit, Psychological factors, Theory of Planned Behavior, Socioeconomic factors.

1. INTRODUCTION

The recent work in discrete choice models has emphasized the importance of the explicit treatment of psychological factors affecting decision-making. (See, for example, Koppelman and Hauser, 1979; McFadden, 1986a; Ben-Akiva and Boccara, 1987; Ben-Akiva, 1992; Ben-Akiva et al.,1994; Morikawa et al., 1996) (Ben A-kiva, 1997). A guiding philosophy in these developments is that the incorporation of psychological factors leads to a more behaviorally realistic representation of the choice process, and consequently, better explanatory power (Ben A-kiva, 1997).

The widely used behavioral decision theory is the Theory of Planned Behavior (TPB; Ajzen, 1988). The TPB has received good empirical support in applications to a variety of domains including mode choices researches (see, for example, Bamberg, Ajzen and Schmidt, 2003; Long, Choocharukul and Nakatsuji, 2010; Ching and Wei, 2011; Ching and Wen, 2011; Donald, Cooper and Conchie, 2014).

In Khon Kaen, Thailand, the Bus Rapid Transit System (BRT) is planned to operate to solve traffic problems in the city. It is a new system which has specific lanes, uses NGV energy that will provide environmental friendly, convenient and standard service. There are 5

routes of BRT run cover urban area of Khon Kaen City and has feeder system along BRT stations (show in Figure1.) (SATIENNAM, T. et al., 2013). In the figure 1, the red line of BRT is used as the main route transit service in the north-south of highway.
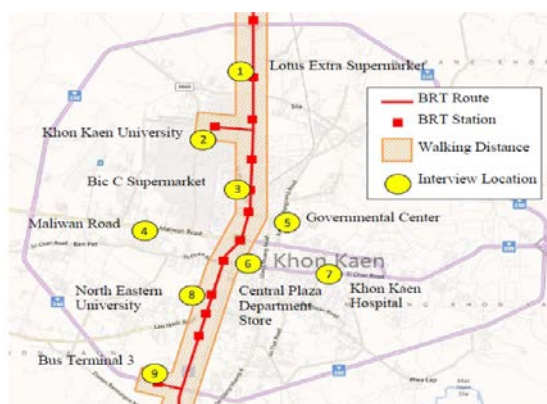

Figure 1. Bus Rapid Transit planning location in Khon Kaen City

This study, therefore, utilized the TPB to explain the intention of using BRT in the selected study area of Khon Kaen city, Thailand. It revealed the role of attitudes toward the behavior, subjective norms, perceptions of behavioral control, and beliefs control factors to predict people's intentions to use BRT. It is high expectation that it should be possible to influence intentions and behaviors of using BRT by designing an intervention that has significant effects on one or more of the preceding factors according to TPB.

2. LITERATURE REVIEWS

2.1 Psychological Factors Influencing Mode Choice Behavior.

From the literature reviews, it is obviously that TPB have been widely used and applied in the mode choice behavior research.

Table 1. Psychological factors influencing mode choice behavior

Name	Objective	Technique	Variables	Findings
Bamberg, Ajzen and Schmidt (2003)	investigate an intervention—introduction of a prepaid bus ticket—on increased bus use among college students	SP/RP	TPB and Past Behavior	PBC and past behavior were found to a strongly influence students' intentions to take the bus to the campus
Long, Choocharukul and Nakatsuji (2010)	Study to the motorcyclist's intentions to use future urban rail transport in Phnom Penh, Cambodia.	SP	TPB include Social and Economic factors	PBC and attitude were the factors to predict intention of using future sky train
Ching and Wei (2011)	Study the switching intentions toward public transit by private vehicle users (both car and motorcycle users).	RP	TPB, Technology Acceptance Model (TAM) and Habit	The habitual behavior of private vehicle use hinders an individual's intention to switch from a car or motorcycle to public transit.

Ching and Wen (2011)	Explore the effects of rational and habitual factors on mode choice behaviors in a motorcycle dependent region.	RP	TPB include Social and Economic factors	Psychological (rational and habitual) factors have stronger influences on mode choice behaviors than socio-economic factors, and furthermore that habitual factors explain traveler mode choice behaviors better than rational ones.
Donald, Cooper and Conchie (2014)	Study (TPB) model within the domain of transport mode choice and identified the most important factors impacting on participants drove or used public transport to commute to work.	RP	TPB and habit	TPB variables (attitude, subjective norm and PBC) influenced use of both transport modes indirectly through their effects on intention and habit.

2.2 The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) was developed from the Theory of Reasoned Action (TRA) by Icek Ajzen, 1991. Principle of TPB is human behavior affected via their intention. The intention was affected from 3 factors including attitude towards the behavior, subject norm and perceived behavioral control as shown in Figure 2. **Attitude towards the behavior** is determined by behavior beliefs that are the overall person's general feeling to their behavior. **Subject norm** is determined by normative beliefs that are person's perceptions from people who are important to them think he should or should not perform behavior. **Perceived behavioral control (PBC)** is determined by Control beliefs that are feeling difficult or easy to perform behavior.
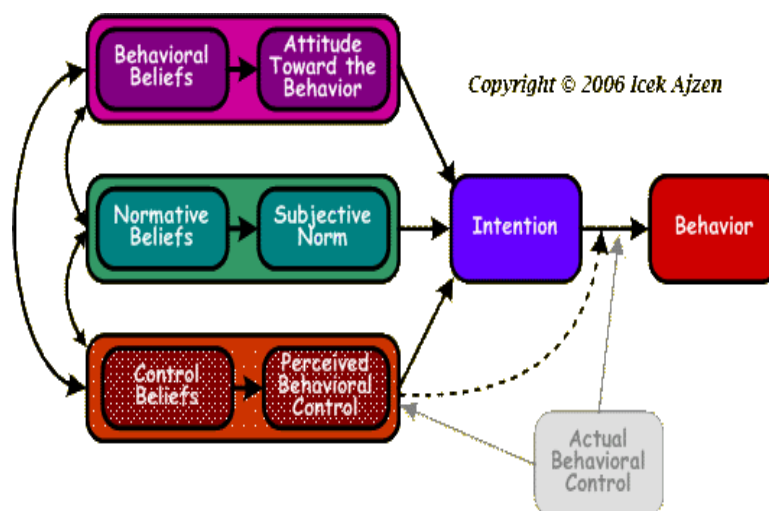

Figure 2. Framework of TPB

3. METHODOLOGY

3.1 Participants

Participants are the students group in Khon Kaen University (KKU) since KKU is a major origin and destination hub in Khon Kaen city where consists of 40,000 students. The target of study is to explore the opinion of students about the BRT major line—the Red Line. The introduction about the planed BRT system is carried out before asking the participants to complete the questionnaires. Finally, a total of 298 respondents were completed.

3.2 Design of the Questionnaire

The questionnaire contains two sections. The first part of the questionnaire asks the respondents' socioeconomic and travel information such gender, age, income and existing mode. The second part consists of items for psychological measures according to TPB. Standard direct measurement and indirect measurement according to Ajzen (2006) were utilized to examine the attitude, subjective norm, perceived behavioral control as well as control beliefs that influence an intention.

All psychological items are measured based on Likert scale. Direct measures scale is unipolar (1 to 5). In part of belief measurement, control beliefs strength and control beliefs power are scored in an unipolar fashion (1 to 5) and a bipolar fashion (-2 to 2), respectively.

3.2.1 Direct Measures

The TPB standard direct measurements according to Ajzen (2006) and Jillian J Francis et al.(2004) involve measuring of four constructs including attitude, subjective norm, and perceived behavior control and intention. There are total 16 items for the direct measurement as follow:

Attitude Attitude towards the behavior was measured by four items: ''For me to using BRT would be: bad/good, unpleasant/pleasant, support/unsupported and harmful/beneficial.'' Cronbach's alpha was 0.715.

Subjective norm Subjective norm was measured by four items. This can be measured in 2 kinds. The first kind is descriptive norm which concerns perceptions of others' use of each transport mode. It was measured by 1 item: "Most of people who are important to me intend to use BRT". The second kind is injunctive norm which concerns the perceptions of important people want he to use each transport mode. It was measured by 3 items :"Most people who are important to me would support my using the BRT", "Most people in social expect me to use BRT" and "Most people who are important to me think that I should/should not use BRT." Cronbach's alpha was 0.817.

Perceived behavioral control (PBC) PBC was measured by four items. This can be measured in 2 kinds. The first kind of these measures is Self-efficacy. It was measure by 1 item: "I am confident that if I want to I could take BRT". The second kind measured Controllability. It was measured by 3 items: "For me, to take the BRT would be easy–difficult", "Whether or not I intend to take BRT is completely up to me", "My freedom to take the BRT is high–low." Cronbach's alpha was 0.689.

Intention Finally, intention was measured by four items. "My intention to use BRT is strong–weak," "I intend to use BRT: likely–unlikely," "I plan to use BRT: likely–unlikely," "I will make an effort to use BRT." Cronbach's alpha was 0.928.

3.2.2 Control Beliefs Measurement

3.2.2.1 Pilot Study

In order to identify the commuter beliefs about the control factors in using BRT, a pilot study was conducted. Two standard open-ended questions were used in the focus group of student. The questions were "What factors enable you to use BRT?" and "What factors make it difficult or impossible for you to use BRT?".

The results of pilot study together with results from literature reviews reveals 5 control factors including low accessibility to BRT station (CF1), congestion of passengers (CF2), number of baggage (CF3), traffic jams (CF4) and good standard of service (CF5). It should be noted that the first 3 control factors are impeding circumstances of using BRT and the remained 2 control factors are considered as facilitating circumstances of using BRT.

3.2.2.2 Indirect Measures

For each control factor, control belief composites were created by multiplying control belief strength (the presence of factors that may encourage or interrupt to use BRT, CBS) with control belief power (the perceived power of these factors, CBP). Example of questions to measure CF1: "low accessibility to BRT station" are "Accessibility to BRT station is difficult: agree/not agree"(CBS1), "I …more likely/less likely to use BRT if accessibility to BRT station is difficult"(CBP1). Control belief composites were then created for each control factor by multiplying their CBS with their CBP. Control belief composites were in a bipolar scales (-10 to 10). For the 5 factors, the control belief composites were measured by 10 items.

3.3 Statistical Analysis

To determine the predictors of intention to use a BRT, hierarchical regression analysis are employed. Besides, standard multiple regressions were used to identify the belief composites that contributed to the prediction of the indices, constructed with the direct measures of perceived behavioral control and intention.

4. RESULTS AND DISCUSSION

4.1 Respondent Profiles

The respondent profiles are shown in table 2. The percentages of participants are as follows: 43.6 percent are male and 56.4 percent are female. Their range age is 18-25 years. The participants who have distance from home to BRT station less than 400 meters is 17.1 percent and more than 400 meters is 82.6 percent. Their income averages range is 5,000-10,000 Bath/month, with participants use private car along BRT route is 79 percent more than public transport.
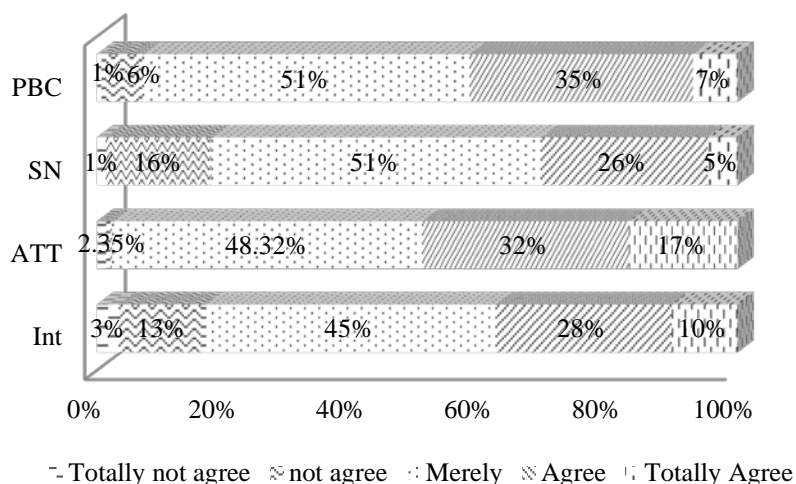
4.2 Direct Measurement

4.2.1 Descriptive

Figure 3 presents the descriptive of 4 psychological factors according to TPB. An intention factor founds that 38 percent of participants intend to use BRT. Attitude factor founds 49 percent have positive attitude to use BRT, also subjective norm founds 31 percent think that people who are important will support them to use BRT. The last PBC factor founds 42 percent feel confident that they can use BRT.

Table 2. Respondent profiles

Variables		Frequency	Percent
Gender	Male	130	43.6
	Female	168	56.4
Distance from home to BRT station	< 400 m.	51	17.1
	>400 m.	246	82.6
Incomes	<5000 Bath/month	88	29.5
	5000- 10,000 Bath/month	153	51.3
	10,000 -20,000 Bath/month	55	18.4
Existing Mode Use	Car	105	35.2
	Motorcycles	131	44.1
	Public Transport	61	20.5

- Totally not agree   not agree   Merely   Agree   Totally Agree

Note; Int = Intention, ATT= Attitude, SN= Subjective Norm, PBC= Perceive Behavior Control
Figure 3. Psychological factors base on TPB respondent

4.2.2 Correlations between Variables

Table 3 shows the standard deviations and correlations between study variables.

Table 3 Standard deviations and Correlations between study variables.

Variable	SD	1	2	3	4	5	6
Attitude	0.73	1					
Subjective Norm	0.74	0.392**	1				
Perceived behavioral control	0.67	0.493**	0.583**	1			
Intention	0.89	0.394**	0.727**	0.558**	1		
Sex	0.49	0.042**	0.067	0.076	0.127*	1	
Existing mode use	0.40	0.047	0.101	0.175	0.146*	0.079	1

** Correlation is significant at 1% level, * Correlation is significant at 5% level.

4.2.3 Intention Model

Regression model, incorporate TPB factors with socioeconomic factors, was estimated to examine intention to use BRT as shown Table 4. Model 1 only considers the TPB factors, which can explain 55.5 percent of the variance for intention. It should be noted that attitude is not statistically significant to intention to use BRT. The important factors are subjective norm and PBC, respectively. This study provides support for the predictive of the TPB factors in relation to transport mode choice (Donald, I. J et al., 2014). The results show that subjective norm is the strongest factor to predict intention of using public transport.

     Model 2 and 3 include socioeconomic as dummy variables, sex with value of 1 and 0, where 1 represents female, otherwise male and existing mode with value of 1 and 0, where 1 represents public transport, otherwise private car. The findings reveals that the data is fitted with the TPB since adding socioeconomic data could explain 0.04 percent more (from 55.5 to 55.9 percent) of the variance for intention.
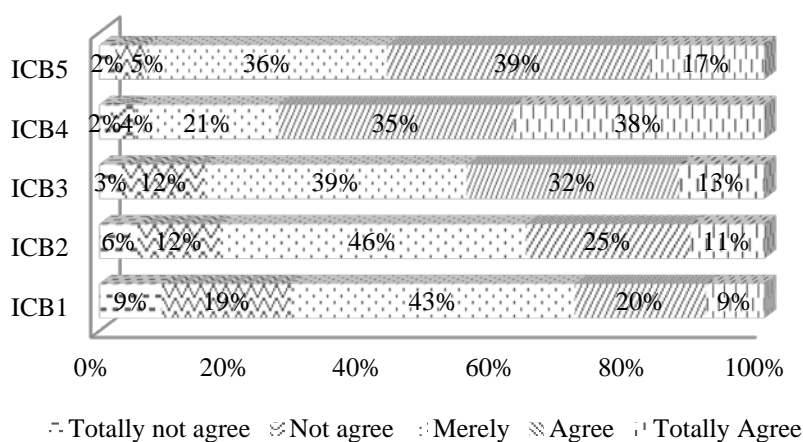
Table 4. Standard multiple regressions on intention of using BRT in Khon Kaen city.

TPB constructs	Intention			
	Model 1	Model 2	Model 3	Model 4
	β	β	β	β
Attitude	0.075	0.075	0.078	0.077
Subjective Norm	0.596**	0.594**	0.595**	0.593**
Perceived behavioral control	0.173**	0.169**	0.163**	0.160**
Sex	-	0.071	-	0.049
Existing mode use	-	-	0.053	0.068
Adjusted-R^2=	0.555	0.558	0.556	0.559

** Correlation is significant at 1% level, * Correlation is significant at 5% level.
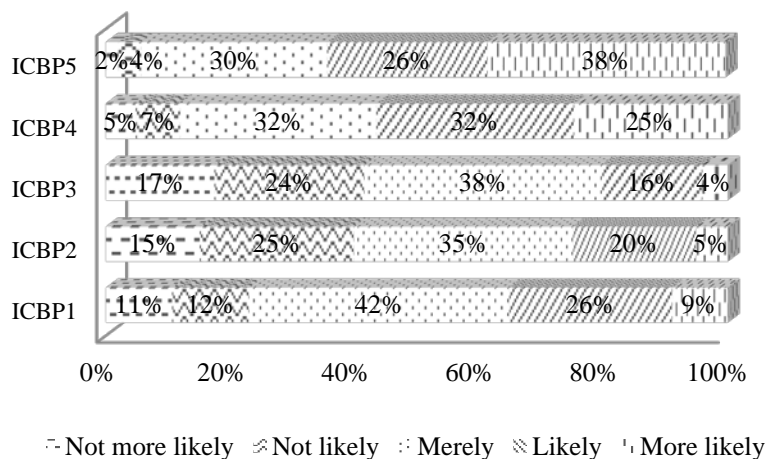
4.3 Control Beliefs Measurement

Figure 4 and 5 present the distribution of the 5 control factors for their control beliefs strength and control belief power, respectively.

Note: ICB1=low accessibility to BRT station, ICB2=congestion of passengers, ICB3=number of baggage, ICB4=traffic jams and ICB5=standard of service

Figure 4. Control beliefs strength

- Not more likely ⚡Not likely ∷ Merely ⚲ Likely '' More likely

Note: ICB1=low accessibility to BRT station, ICB2=congestion of passengers, ICB3=number of baggage, ICB4=traffic jams and ICB5=standard of service

Figure 5. Control belief power

Table 5 shows that the participants agreed most with "traffic jams" (M= 4.04, SD= 0.95) and estimated "low accessibility to BRT station" as least frequency (M= 2.99, SD= 1.06). They estimated "standard of service" as making it the easiest for them to use BRT (M= 0.95, SD= 1.01) and "number of baggage" as making it the hardest for them to use BRT (M= -0.35, SD= 1.07). Taken together "standard of service" got the highest rating (M= 3.65, SD= 3.85) while "number of baggage" got the lowest (M= -1.42, SD= 4.01).

Moreover, the model of all control belief composites could explain 36% of the variance in PBC (direct measures) and 42% of the variance in the intention. The composite factor "standard of service" made significant contribution to both the prediction of PBC (β=0.45, ρ<0.001) and intention (β=0.39, ρ<0.001) to use BRT.

Table 5. The mean and standard deviation of control belief strength, control belief power and belief composite of these two variables.

Variables	N	Belief strength (5=Totally agree; 1=Totally not agree)	Belief power (2=More likely; -2=Not more likely)	Belief composite (-10 to 10)	PBC, r	I, r
accessibility to BRT station	282	2.99 (1.06)	0.10 (1.08)	0.07 (3.35)	0.303**	0.492**
congestion of passengers	298	3.23 (0.99)	-0.25 (1.09)	-0.89 (3.85)	0.013	0.199**
number of baggage	297	3.38 (0.97)	-0.35 (1.07)	-1.42 (4.01)	0.089	0.292**
traffic jams	291	4.04 (0.95)	0.64 (1.08)	3.12 (4.48)	0.427**	0.409**
standard of service	296	3.63 (0.92)	0.95 (1.01)	3.65 (3.85)	0.573**	0.513**

The two last columns show correlation between the belief composite and PBC and intention, respectively.
** Correlation is significant at 1% level.

From the results, the beliefs about "standard of service", "traffic congestion", and "accessibility to the station" strongly contribute to the perceived behavioral control and intention to use BRT. These outcomes help to understand travelers' behavior and can be useful for BRT planning. This suggests that in order to succeed BRT planning in Khon Kaen

city, the policy for encourage students group to use BRT should regard the 3 control factor because these factors have the high contribution to perceived behavioral control and intention to use BRT.

5. CONCLUSIONS

This study utilized the TPB to explain the intention of using BRT in Khon Kaen city, Thailand. This study explored the opinion of students group about the BRT major line—the Red Line with the survey questionnaires that measured a series TPB factors, including both standard direct measurement and control beliefs measurement. Hierarchical regression analysis is employed to determine the predictors of intention to use a BRT. Besides, standard multiple regressions were used to identify the belief composites that contributed to the perceived behavioral control and intention to use BRT.

The results showed that the TPB factors accounted for a significant part of the variance in the intention to use BRT. Intention of using BRT was determined by subjective norm and perceived behavioral control. Moreover, the analysis of control factors revealed that the beliefs about "standard of service", "traffic congestion", and "accessibility to the station" strongly contribute to the perceived behavioral control and intention to use BRT. The outcomes of this study help to understand travelers' behavior and can be useful for BRT planning in other cities.

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