Safety Behavior for Cycling : Application Theory of Planned Behavior

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Abstract

Introduction: Cycling has been popular exercise but the high incidences of injuries were document since Thai cyclists shared the roads with other vehicles. The purposes were to determine the validity of the validation model of Theory of Planned Behavior (TPB), and examine the total, direct and indirect effects of causal variables on the TPB.

Methods: The samples were 475 recreational cyclists for exercise and non-athletes, answered the cycling's safety behavior (SB) questionnaires. The structural equation modeling analysis was employed to compare the relationship between SB and TPB.

Results: TPB was not accurate with respect to structural model. The total, direct and indirect effects of the causal variables indicated that variability of SB was 56.25%. Subjective norm was directly effect to SB but perceived behavioral control did not effect to intention and SB.

Conclusions: TPB could explain SB in terms of safety-related attitudes that correlated with intention. The variation in safety reference was related to SB without intention. The behavioral control variable is not related to the intentional behavior, nature and habit to SB. It can be concluded that TPB cannot explain the SB and TPB cannot be use in the SB.

Keywords: Cycling, Exercise, Safety, Theory of Planned Behavior

Introduction/Objective

Cycling, one of the most popular activities in Thailand recently, is beneficial for healthy aerobic exercisers. The cycling beginners have rapidly increased in the couple years [1]. Moreover, there have been several exercise events, both for competitions and charities such as “bike for mom”, “bike for dad”, “Bangkok bank cycling fest” [2]. Although the cycling has been supported from both government and private organizations, the statistics of accident in 2007-2014, there were 2,891 times of accident in cyclists [3]. This means that it’s still shortage of the specific areas for safety riding. The cyclists have to share the public roads with other vehicles and the drivers don’t pay much attention on the cyclists along the road sides. With these evidences, the great number of cycling participants require specific areas for safety riding. However, the riding area in the public has been increased slowly, the cyclists have to improve their safety behaviors instead of concerning about the safety areas.

In psychology aspect, there is a theory for predicting and developing safety behavior for cyclists, so called Theory of Planned Behavior (TPB), this TPB was invented by [4] and developed from Theory of Reason and Action which was invented by [5]. TPB can predict and explain human behavior from behavioral intention which consist of several components; attitude toward behavior, subjective norm and perceived behavioral control, in addition, the perceived behavioral control can directly predict the human behavior as well (Figure 1).

[6] studied the predictive activities of Canadian adults by applying the TPB and found that the physical activities of Canadian adults increased 29%, the interesting in physical activity increased 21%. [7] investigated the psychological and social factors in riders’ risk assessment (RRAM) which focus on behavior and intention for riders. The study was divided into 2 phases; 47 participants answered the questionnaires, modified from TPB, and were interviewed in 6 factors about safety-conscious behavior of the riders, motorcycle skill, riders’ awareness, body readiness, traffic rules understanding, and overtaking in the emergency areas. The reliability was analyzed in the first phase of investigation, then the questionnaire measurement for riders’ risk was invented for the second phase. In the second phase, 229 participants answered this RRAM questionnaires to predict about the safety behavior for riders. The results showed that the riders had awareness to increase safety behavior and other aspects of safety but self assessment report was unclear that the riders could improve their safety behaviors. Increasing new cyclists in Thailand, lack of evidences support and predict the safety behavior. Therefore, the researcher is interested in the topic of safety behavioral cycling by applied the theory of planned behavior. To find out which direction for cycling is practiced. The purposes of this study were 1) to determine the validity of the model validation model of Theory of Planned Behavior, 2) to examine the total effect, direct effect and indirect effect of causal variables on the TPB model.

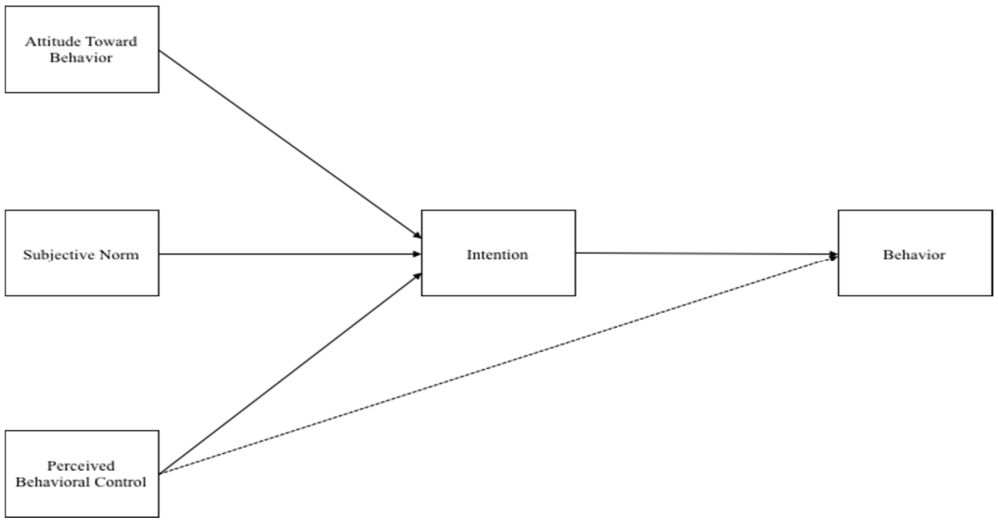

Figure 1 The Theory of Planned Behavior model (4).

Methods/Methodology

Participants

The participants in the study were healthy persons who regularly exercise by cycling at least 30 minutes of cycling per day, 3-5 days per week, with 3-month experience of cycling. The average age was 42.79±10.79 years old, experience of cycling was 3.83±1.35 years.

Measurement

The 149-item questionnaires with 7-likert scale for safety behavior measurement were invented by modifying from TPB. It was divided into 2 parts; 1) the general information such as age, sex, cycling experience and experiences of accident, and 2) the safety behavior for cycling such as the attitude, subjective norm, perceived behavioral control, intention and safety behavior. The item objective conguence indices (IOC) were analyzed and the 63 items which IOC score was lower than 0.5, were excluded from the questionnaires. The rest 86 items were analyzed and grouped into TPB, then, the final questionnaires consisted of 33 items in 5 aspects of safety behavior.

Data Collection and Analysis

This research was divided into 2 phases; in the first phase, author was in depth interview with two groups of cyclists, a group of people (n=6) who have experienced in cycling accidents and other group (n=6) has never experienced in cycling accident previously, for finding about beliefs associated with the factors of accident. They were analyzed to find out the apparent beliefs of questionnaires about safety behavior for cycling. In the second phase, author used multistage random sampling to random participants who exercise in 7 areas in Chonburi and Bangkok. Five hundred and twenty participants answered the questionnaires. The erroneous or incomplete data were removed. The 475 complete data were used for analyzed by structural equation modeling (SEM) to compare the relationship between the safety behavioral cycling model and TPB, total, direct and indirect effects of the casual variables in the model.

Results

This study was to determine the validity of the model validation model of TPB, and to examine the total effect, direct effect and indirect effect of causal variables on the TPB model. The general information of the participants (n=475) was presented in the Table 1.

Table 1 General information of the participants

Data	Gender		Missing	$\bar{X}$		SD.	
	Male (n=375)	Female (n=100)		Male	Female	Male	Female
Age (years)	370	100	5	43.546	40.020	11.064	9.245
Bike experience (years)	374	100	1	3.944 (1-2 years)	3.434 (1-2 years)	1.314	1.416
Bike accident (times)	375	99	1	0.597 (never)	0.343 (never)	0.491	0.477
Wound in the hospital (times)	375	99	1	0.392 (never)	0.343 (never)	0.883	0.673
Rest in the hospital (times)	374	100	1	0.144 (never)	0.110 (never)	0.492	0.490

The means and standard deviations of safety behavior for cycling were presented in the Table 2. The results showed that the participants had the safety behavioral beliefs, perceived power of control factor in safety, and belief in control of safety behavior for cycling in high level, the evaluation of safety behavior, normative beliefs, motivation to comply, and control beliefs for safety behavior in very high level.

Table 2 Mean and standard deviation of safety behavior for cycling.

Variables	$\bar{X}$	SD.
Safety Behavioral beliefs (b_i)	5.94	0.75
Subjective Evaluation for safety behavior cycling (c_i)	6.49	0.56
Normative beliefs (NB_i)	6.34	0.81
Motivation to Comply (MC_i)	6.33	0.80
Perceived power of control factor of safety (P_i)	5.49	1.06
Control Beliefs for safety behavior cycling (C_i)	5.71	0.89
Intention behavior of safety cycling (I)	6.50	1.52
Safety Behavior for Cycling (B)	4.05	0.70

The results of correlation matrix between observation variables in causal model of safety behavior for cycling showed that there were 10 nonsignificant coefficient correlations between observation variables in the matrix. There were 5 coefficient correlations with significant level at 0.05 and 76 coefficient correlations with significant level at 0.01. When considering the positive coefficient correlations in subcategories were cycling behavior (BEH1-BEH3), attitude to safety behavior (ATT1-ATT3), motivation to comply (SN1-SN5), but there was no correlation in perceived power of control factor to safety (PBCF1-PBCF2)

Table 3 Correlation matrix in observation variables in safety behavioral cycling in causal model

		I	B			AB			SN					PBC	
		INT	BEH1	BEH2	BEH3	ATT1	ATT2	ATT3	SN1	SN2	SN3	SN4	SN5	PBCF1	PBCF2
I	INT	1.000													
B	BEH1	0.428**	1.000												
	BEH2	0.365**	0.352**	1.000											
	BEH3	0.630**	0.519**	0.465**	1.000										
AB	ATT1	0.247**	0.130**	0.109**	0.257**	1.000									
	ATT2	0.094*	0.041	-0.173**	0.049	0.363**	1.000								
	ATT3	0.145**	0.073	0.063	0.140**	0.572**	0.399**	1.000							
SN	SN1	0.114**	0.114**	0.138**	0.103*	0.325**	0.119**	0.346**	1.000						
	SN2	0.200**	0.152**	0.206**	0.187**	0.314**	0.119**	0.350**	0.442**	1.000					
	SN3	0.147**	0.139**	0.153**	0.201**	0.381**	0.088*	0.259**	0.358**	0.385**	1.000				
	SN4	0.088*	0.107**	0.109**	0.199**	0.399**	0.061	0.309**	0.351**	0.427**	0.542**	1.000			
	SN5	0.149**	0.137**	0.198**	0.220**	0.452**	0.170**	0.427**	0.368**	0.591**	0.572**	0.589**	1.000		
PBC	PBCF1	0.049	-0.007	-0.019	0.021	0.222**	0.311**	0.314**	0.164**	0.185**	0.050	0.135**	0.112**	1.000	
	PBCF2	0.100*	0.110**	0.130**	0.175**	0.303**	0.116**	0.479**	0.281**	0.354**	0.235**	0.341**	0.354**	0.352**	1.000

* significant level at 0.05

** significant level at 0.01

Note I means Intention (Result Variable), INT means Intention of Safety Behavior (Element of Result Variable), B means Safety Behavior for cycling (Result Variable), BEH1-BEH3 means Safety Behavior for cyclist (Element of Result Variable), AB means Attitude Toward of Safety Behavior (Result Variable), ATT1-ATT3 means Attitude Toward of Safety Behavior (Element of Result Behavior), SN mean Subjective Norm of Safety Behavior (Result Variable), SN1-SN5 means Subjective Norm of Safety Behavior (Element of Result Variable), PBC means Perceived Behavioral Control for Safety Cycling (Result Variable) and PBCF1-PBCF2 means Perceived Behavioral Control for Safety Cyclist (Element of Result Variable).

From the investigation of safety behavior for cycling to validate the invented model, conceptual model was determined to explain the safety behavior modified from [4]. The total, direct and indirect effects were analyzed by linear structural equation model (SEM) as presented in Figure 2

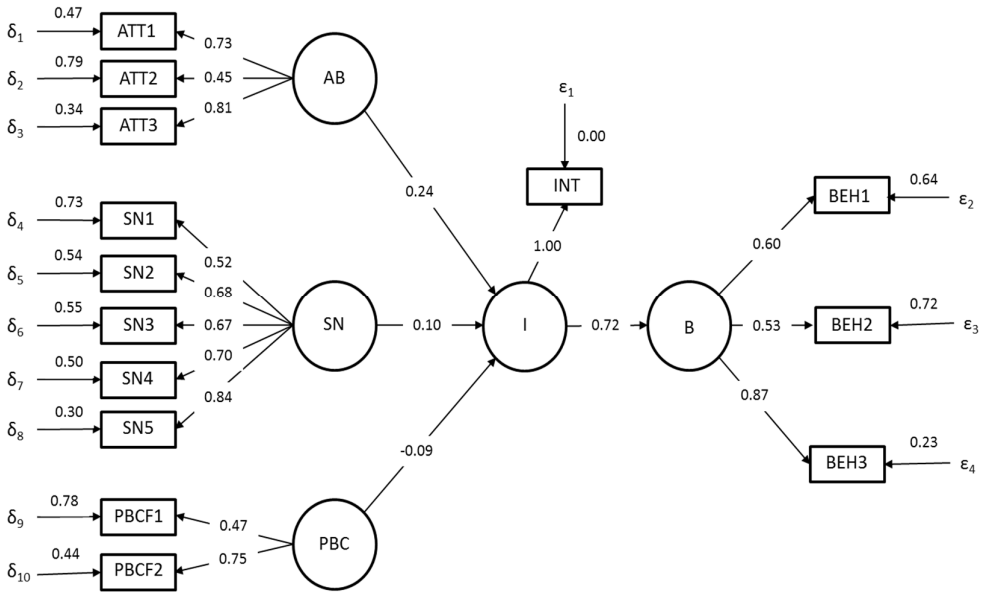

Figure 2 Standardize solution of the model analyzed by SEM.

After modification of the causal model standardized solution (Figure 3), the chi-square (λ^2) = 64.72, df = 56, λ^2/df = 1.15, p-value = 0.198, RMSEA = 0.019, SRMR = 0.029, GFI = 0.98, AGFI = 0.96, CN = 612.59 but empirical models are not accurate with respect to structural models. However, statistics and modification indices have passed the criteria as shown in Table 4.

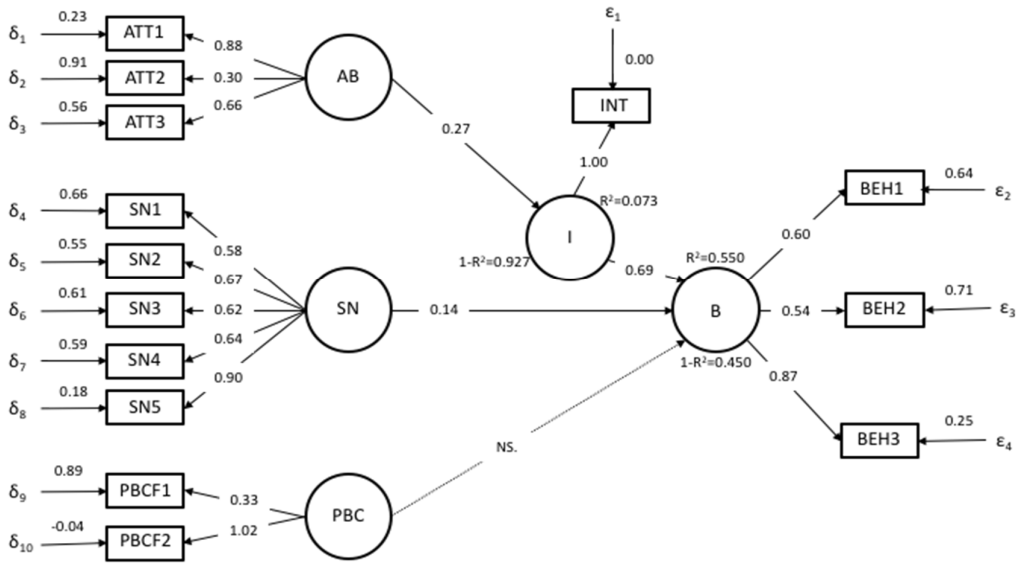

Figure 3 Modification these causal model standardized solution

Table 4 Statistics and modification indices for the criteria

Index	Criterion	Before Modification		After Modification	
		Statistic	Consideration	Statistic	Consideration
Chi-square (λ^2)	-	282.88	-	64.72	-
df	-	71	-	56	-
λ^2/df	<3	3.98	Do not meet	1.15	Passed of Criteria
p-value of λ^2	>0.05	0.00	Do not meet	0.198	Passed of Criteria
RMSEA	≤0.05	0.079	Do not meet	0.019	Passed of Criteria
SRMR	≤0.05	0.067	Do not meet	0.029	Passed of Criteria
GFI	>0.90	0.92	Passed of Criteria	0.98	Passed of Criteria
AGFI	>0.90	0.88	Do not meet	0.96	Passed of Criteria
CN	≥200	177.94	Do not meet	612.59	Passed of Criteria

The results of the total, direct and indirect effects of the causal variables in the model of safety behavior found that the intention behavior of safety cycling effected the most in total effect (TE_I = 0.686), and in direct effect (DE_I = 0.686). The attitude toward behavior of safety cycling was only one variable in indirect effect (IE_{AB} = 0.185) (Table 5).

Table 5 Results of the total effect, direct effect and indirect effect

Variable Cause / Result Variable	I			AB			SN			PBC			R^2
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	
I				0.270 (0.058)		0.270 (0.058)							0.073
t-value				5.321		5.321							
B	0.686 (0.037)		0.686 (0.037)		0.185 (0.026)	0.185 (0.026)	0.142 (0.051)		0.142 (0.051)	0.072 (0.076)		0.072 (0.076)	0.550
t-value	11.241		11.241		4.813	4.813	2.882		2.882	1.700		1.700	

Discussion

The TPB could not explain the causal model of safety behavior accurately because there were two internal factors which did not correspond with the structural model after modification of the causal model; Subjective norm and Perceived behavioral control. Subjective norm affected the safety behavior of cycling directly, perceived behavioral control did not affect to intention to safety behavior for cycling and safety behavior such as wearing safety gears,

helping each other during cycling, complying with traffic rules. These resulted from external factors to make the riders realize and get along with the safety behavior.

[8] had studied the effect of behavioral intervention by TPB and found that the behavior had been changed in high level, and high level in perceived behavioral control but low level in subjective norm. However, the intervention would affect to general behavior. Group intervention has more success than individual. [9] studied the effect after past behavior, habit and perspective in action of reason and found that the past behavior did not depend upon intention to behavior but depend on habit more than intention. Therefore, TPB could not explain some behaviors as well as safety behavior for cycling which showed that the community of riders was determined by rules and regulations with punishment and related to individuals in the community. From the causal model, TPB could explain only one variable accurately; Attitude toward safety behavior for cycling. It affected the intention to safety behavior for cycling and safety behavior.

When considering the direct effect and indirect effect, attitude toward safety behavior for cycling was the most influence to safety behavior because the concordance between the structural and causal models gets along with the TPB. Moreover, the community of the riders was determined by rules and regulations in safety, the experiences of the leader in the community. As for total effect, the intention to behavior and subjective norm affected to safety behavior along with TPB but the perceived behavioral control did not affect to behavior and the causal model which caused by the safety rules and regulations, the experiences of the leader in the community. In addition, the confidence of the riders made them think that they could be safe during cycling. The self-efficacy theory explained that the individual's perceptions arise from judging their ability to manage and demonstrate behaviors to achieve desired goal. It affects the patterns of thought and emotional reactions, the interaction with the environment around the individual as well [10]. As a result, the behavioral control variables do not influence the behavior like other variables.

Conclusions

In this study, TPB was able to explain safety behavior, only the attitude toward safety behavior for cycling that correlated with behavioral intention in cycling and affect the safety behavior for cycling. The study also found that the variation in subjective norm was directly related to safety behavior without intentional variation. Finally, the behavioral control variable was not related to the intentional behavior variable. It could be concluded that TPB cannot explain the safety behavior for cycling accurately.

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