# A Comparative Study of Road Traffic Violation between Thai and Japanese Teenagers

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During the last ten years. Accidents of vulnerable road users in Thailand have increased significantly and hit the most serious accident in 2017, especially cause by teenagers between 15-19 year-old. When comparing to Japan in 2017, Japan has reached the lowest accident of all-time since 1960. Considering differences, there are differences in attitudes and behavior toward violation behavior. This study aims to analyze the factor affecting violation behavior between Thai and Japanese to determine the appropriate policies and recommendations. By studied from road users behavior and attitude based on the theory of planned behavior (TPB) in Bangkok, Thailand and Sapporo, Hokkaido, Japan. Questionnaires with scenario of road user violation behaviors was designed and developed for each country, and the surveys was conducted and distributed. The 201 samples in Japan and 477 samples in Thailand were collected, which have been valid responses. The validity and reliability of the questionnaire were evaluated. The data were analyzed by using the structural equation model (SEM). It was found that all of the models were significant. In Japan, the bicycle and the pedestrian model were used. Found that the most impactful factors of the bicycle model were notice failure and bicycle stun. Besides, for the pedestrian model were Instrumental attitude and conformity tendency. In Thailand, the motorcycle and the pedestrian model were used. The most impactful factors were traffic error and motorcycle stunt. For the pedestrian model were instrumental attitude, descriptive norm, and conformity tendency. It could be concluded that promoting the awareness of violation and accident by teaching the exact way to ride a motorcycle in detail and realize how they could act to decrease injuries and violations. However, in the community to prevent accidents, the community has to make the environment safe, build healthy communities and societies, giving importance to teenagers and open up opportunities for adjustment. Lastly, the activities and promoting should emphasize parents and companions about the intention to violate the traffic rule. Moreover, cultivate consciousness in their own behavior.

***Key Words :*** *Vulnerable road users, Cyclist, Motorcyclist, Pedestrian, Violation, Violation behavior, Road traffic violation.*

## 1. Introduction

From the World Health Organization (WHO), the road accident fatality is about 1.25 million people per year or an average of 2,500 people per day. (World Health Organization, 2018) Especially in people age around 15-29, which is still considered the age of children and teenagers. The record of teenage fatality from road accidents was 350,000 people in 2012.

In Thailand, the accident is one of the significant causes of fatality as well, being the first ranking in the world with the highest number of road accident deaths. From the statistics in 2016, it was found that 22,356 people killed by accidents (62 cases per day). There were about 100,000 people in the hospital from a car crash accident, and about 60,000 people became disabled[24].
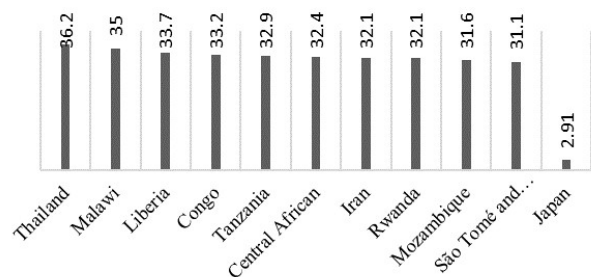


Fig.1 Road traffic death rate per 100k people in 2017

The city has lost a budget of over 500,000 billion. Clearly, death data show that 2,510 children die from accidents per year, or an average of 7 people a day,

including working-age, equal to two-thirds of all deaths, or about 1.4 billion people/year and become disabled. Also new 6,000-7,000 people/year makes the proportion of working-age to care for the elderly is not enough. These days, statistics show that Japan is one of the safest countries in terms of not only crime but also traffic accidents. People in Japan have been struggling and working over the last several decades to reach these levels of traffic safety. Traffic safety in Japan profiles the significant efforts that organizations implemented at key junctures along the way and compares Japan with several other developed countries[18].

Comparing with Sapporo, Japan has found a very low fatality. From National Police Agency in japan said the traffic fatalities in japan reach a low record; only 3,532 people in 2018 are 2.79 fatalities per 100,000 persons. The number of traffic fatalities involving those aged 65 or older fell by 54 deaths year-on-year in 2018 to 1,966 in total (see Figure 1-2), but the proportion in that age compared with the overall number of traffic fatalities lose by one percentage point to 55.7%. The decrease reflected police efforts to step up traffic safety education programs and the crackdown on traffic offenses.

This study uses concepts from the theory of planned behavior and reviews of relevant research on the behavior of motorcyclists, pedestrians, and bicycles, or road users who violate various traffic rules. To incorporate the structure, ideas, and behavior of vulnerable road users by determining the factors that will influence the behavior of vulnerable road users, including the personality and attitude of teenager road users that will cause the violation of traffic rules and lead to the accident by using SEM

**(1) Theory of planned behavior (TPB)**

In psychology, the theory of planned behavior (TPB) (see Fig.2) is a theory that connects the beliefs and behaviors of the person. The theory states that attitude towards behavior, subjective norms or compliance according to the reference group and perceived behavior control will jointly determine the behavior, intent, and behavior of each individual. This concept is presented by Ajzen[3] to develop the predictive power of planned behavior theory, including the perception of behavior control. They applied to the relationship between belief, attitude, and intention in behavior. Moreover, behavior in various fields, whether directly or in psychology, by using the model to develop the research area of interest such as using the TPB model to predict the behavior of individuals who violate traffic rules or driving risky.

From the previous study about the theory of behavior according to the plan, there is a reasonable

explanation of human behavior, that person's behavior was not caused by coincidence, but three factors are behavioral beliefs, normative beliefs, and control beliefs. Behavioral beliefs will cause an attitude to action, which may be positive or negative, called attitude toward behavior. At the same time, the belief about the reference group is expressing. In the form of awareness of the pressure received from a society called Subjective Norm. Moreover, beliefs about factors that support or obstruct behavior cause are the perception of the ability to control behavior or called Perceived Behavioral Control.
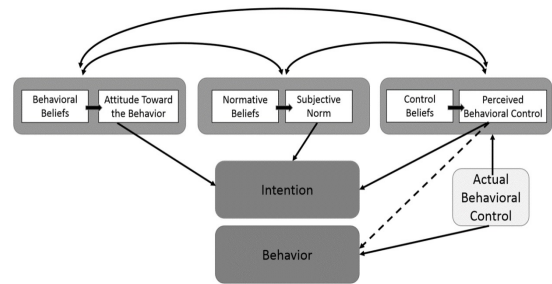


Fig.2 Model of the Theory of Planned Behavior

Many kinds of research using TPB as a based model to indicate the behavior in the various field by developing a model of road user behavior, from which it was found that the main reasons why people tend to violate the traffic laws are related to their subjective decisions, and people in their community.

The TPB has been used in many research paper to analyze the violation behavior[11], Safety helmet intention[4], Errors and violations in relation to bicyclists[12], Errors and violations in relation to motorcyclists[9] and violating crossing behavior[26].

## 2. Method

**(1) Questionnaire and survey**

The data from this study were collected from the survey questionnaire. From literature reviews which are all three related models of vulnerable road users can be synthesized based on the Bicycle Riding Behavior Model[12], Motorcycle Riding Behavior[9], and Pedestrians Behavior[26] to measure violations of the three modes.

The pedestrian model has a specific scenario describe to make it more clear. the scenario:
"You are on your way to school, work or to handle some affairs and you must go to the other side of the road. You reach an intersection and the current pedestrian signal displays red light. You are in a hurry so you take your chance and cross the road in a gap in the traffic."

**Table 1** Respondent characteristics

| Japanese (n=201) | Freq. | Percent(%) | Thai (n=477) | Freq. | Percent(%) |
|---|---|---|---|---|---|
| **Age** | | | **Age** | | |
| 15-17 | 48 | 23.9 | 18-20 | 231 | 48.4 |
| 18-20 | 23 | 11.4 | 21-23 | 175 | 36.7 |
| 21-23 | 112 | 55.7 | >23 | 71 | 14.9 |
| >23 | 18 | 9 | **Gender** | | |
| **Gender** | | | Male | 169 | 35.4 |
| Male | 160 | 79.6 | Female | 308 | 64.6 |
| Female | 41 | 20.4 | **Education** | | |
| **Education** | | | High school | 6 | 1.3 |
| High school | 49 | 24.4 | Undergraduate | 441 | 92.5 |
| Undergraduate | 122 | 60.7 | Other | 30 | 6.3 |
| Master | 30 | 14.9 | **Violation experience** | | |
| **Violation experience** | | | Yes | 398 | 83.4 |
| Yes | 81 | 40.3 | No | 79 | 16.6 |
| No | 120 | 59.7 | **Most frequent violation** | | |
| **Most frequent violation** | | | Driving or riding invert direction | 40 | 10.1 |
| Driving or riding invert direction | 6 | 7.4 | Crossing while red light | 24 | 6.1 |
| Crossing while red light | 60 | 74.1 | Over speed limit | 63 | 15.8 |
| Over speed limit | 12 | 14.8 | Run red light | 38 | 9.5 |
| Run red light | 1 | 1.2 | No helmet | 203 | 51 |
| Other | 2 | 2.5 | Other | 30 | 7.5 |
| **Accident experience** | | | **Accident experience** | | |
| Yes | 46 | 22.9 | Yes | 306 | 64.2 |
| No | 155 | 77.1 | No | 171 | 35.8 |

Moreover, develop the questionnaire to suitable for the people in each country. For example, it was normal when the Japanese teenager ride a bicycle without a helmet or have not to make a signal before turning. However, in Thailand, it has to do every time when riders are turning or stop.

Thus, the research hypotheses could be put as follows:

a) The hypothesis of Motorcycle Riding Behavior Model

H1a. Control error is related to the behavior of motorcyclists.

H2a. Stunt is related to motorcyclist behavior.

H3a. Traffic error is related to motorcyclist behavior.

H4a. Use of Safety Equipment is related to the behavior of motorcyclists.

b) The hypothesis of Bicycle Riding Behavior model

H1b. Control error is related to the violation behavior of cyclists.

H2b. Notice failure is related to the violation behavior of cyclists.

H3b. Stunt is related to the violation behavior of cyclists.

c) The hypothesis of Pedestrian Behavior Model

H1c. Instrumental attitude is related to the violation behavior of pedestrians.

H2c. Descriptive norm is related to the violation behavior of pedestrians.

H3c. Conformity tendency is related to the violation behavior of pedestrians.

The questionnaires were distributed by hand at Hokkaido University, nearby Sapporo station (Japan) and Chulalongkorn University (Thailand), which has many teenagers who come to study, relax and shopping. Respondents were randomly selected, individually asked to participate in the study of the behavior of vulnerable road users. Primarily teenagers are at risk and use roads regularly[25]. So, it is appropriate to collect data and compare the behavior of traffic violations. About their behavior and attitude In Bangkok, it is expected that most of the motorcycle users and pedestrians will be found, and Sapporo is expected to find the majority of bicycles and pedestrians.

**Table 2** Correlation among the cyclist variables (n=201)

| Variable | TV1 | TV2 | TV3 | BS2 | BS3 | BCE1 | BCE2 | BCE3 | NF1 | NF2 | NF3 | SV1 | SV2 | SV3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TV1 | 1 | | | | | | | | | | | | | |
| TV2 | .240** | 1 | | | | | | | | | | | | |
| TV3 | .166* | .051 | 1 | | | | | | | | | | | |
| BS2 | .220** | .127 | .101 | 1 | | | | | | | | | | |
| BS3 | .196** | .129 | .091 | .468** | 1 | | | | | | | | | |
| BCE1 | .173* | .037 | -.030 | .121 | .064 | 1 | | | | | | | | |
| BCE2 | .063 | .162* | .093 | .191** | .093 | .487** | 1 | | | | | | | |
| BCE3 | .026 | .034 | .200** | .085 | .041 | .310** | .419** | 1 | | | | | | |
| NF1 | .165* | .158* | .164* | .084 | .116 | .221** | .374** | .344** | 1 | | | | | |
| NF2 | .193** | .129 | .213** | .220** | .151* | .323** | .458** | .343** | .569** | 1 | | | | |
| NF3 | .151* | .099 | .285** | .181** | .136 | .172* | .348** | .378** | .439** | .562** | 1 | | | |
| SV1 | .471** | .185** | .244** | .202** | .206** | .163* | .089 | .066 | .153* | .232** | .167* | 1 | | |
| SV2 | .498** | .201** | .168* | .083 | .104 | .058 | -.022 | -.066 | .085 | -.007 | -.001 | .406** | 1 | |
| SV3 | .285** | .259** | .124 | .106 | .068 | .164* | .210** | .048 | .124 | .251** | .162* | .395** | .246** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**Table 3** Correlation among the pedestrian variables (n=201)

| Variable | IA1 | IA2 | IA3 | IA4 | DN1 | DN2 | CT1 | CT2 | BI1 | BI2 |
|---|---|---|---|---|---|---|---|---|---|---|
| IA1 | 1 | .472** | .579** | .398** | .506** | .516** | .455** | .487** | .630** | .582** |
| IA2 | .522** | 1 | .452** | .579** | .480** | .421** | .420** | .428** | .513** | .525** |
| IA3 | .548** | .481** | 1 | .386** | .627** | .573** | .538** | .546** | .673** | .677** |
| IA4 | .375** | .684** | .408** | 1 | .373** | .400** | .285** | .353** | .393** | .397** |
| DN1 | .163* | .167* | .328** | 0.126 | 1 | .630** | .464** | .558** | .662** | .672** |
| DN2 | .429** | .397** | .527** | .358** | .429** | 1 | .544** | .624** | .675** | .645** |
| CT1 | .372** | .338** | .428** | .262** | .284** | .442** | 1 | .676** | .603** | .619** |
| CT2 | .376** | .366** | .471** | .361** | .353** | .544** | .525** | 1 | .705** | .698** |
| BI1 | .510** | .426** | .622** | .395** | .372** | .547** | .687** | .568** | 1 | .869** |
| BI2 | .495** | .398** | .616** | .384** | .348** | .507** | .674** | .545** | .961** | 1 |

**. Correlation is significant at the 0.01 level.

*. Correlation is significant at the 0.05 level.

Note: Data for Japanese pedestrians (n=201) are above the diagonal and the data for Thai pedestrians (n=477) are below the diagonal

The first section is the personal information of the sample in order to know the necessary behavior and basic information of the respondents. Section 2 of the questionnaire is a question about the behavior and attitudes of teenage road users in different modes: motorcycles, bicycles, and pedestrians. The data collection methods will be discussed in the survey method topic. The researcher designed the question by allowing the respondents to answer the questionnaire by scoring according to the level of behavior towards the message by using the Likert Scale to measure attitude and behavior metrics which identify their attitudes with five levels (5 points Likert scale ) From 1 – 5.

For the survey, the researcher will give out the questionnaire and explain how to answer the questionnaire correctly, including answering questions and survey-related questions to respondents. For respondents, the survey will have been a correct understanding clearly, including realizing the objectives of this research before the respondents started. The benefits of using this technique in data collection to complete the returned questionnaire correctly since there are many questions in the questionnaire.

Moreover, take the time to respond and think specifically. Especially questions about attitude to accurate information. Therefore, the respondents must have time and think carefully. The questionnaire was conducted for a total of 201 questionnaires in Japan and 477 questionnaires in Thailand collected and the missing data questionnaires were removed. The distributions of their age, gender, education background, violation experience, and were presented in Table 1

**(2) Data reliability and validity**

For each construct, the internal consistency of the items should be evaluated for the reliability of the survey data. Cronbach's alpha (α) correlation test was performed. A Cronbach's alpha (α) generally ranges between 0 and 1. The closer it is to 1, the higher the internal consistency of the items in the construct[19]. The validity of the items was tested by the confirmatory factor analysis (CFA), which evaluates a priori hypothesis on what items should be associated with what factors. CFA was conducted in the SPSS software

**(2) Correlation matrix**

Tables 2,3,4 present the correlation of all the study variables. The study including bicycle model, pedestrian model in Japan and motorcycle model, pedestrian model in Thailand. Most of the items were positively correlated to violation behaviors. Nevertheless, some of the behaviors are negatively. Otherwise, the results are not significant. However, Items with the same construct were highly correlated.

**(3) Descriptive statistics of the questionnaire**

Tables 5,6,7 presented the descriptive statistics of the questionnaire included means, standard deviation, maximum and minimum score.

## 3. Result of the structural equation modeling

The data investigated using structural equation modeling (SEM). To find the violation behavior and compare it with each country or area. Maximum likelihood estimation (MLE) and Generalized least square estimate (GLSM) were used in this method. The model fit that used for this assessment were as follows: 1) Chi-square/df (cmin/df) which is the value showing that there was enough mathematical information available to estimate the model parameters for the comparisons in the observed and estimated matrices and degrees of freedom (df) 2) Comparative fit index (CFI) 3) The goodness of fit index (GFI) 4) Standardized Root Mean Squared Residual (SRMR) 5) Root Mean square error of approximation (RMSEA).

**(1) Bicycle model in Japan**

The bicycle model consists of Bicycle Control error, Notice failure and Bicycle stunt that affect the violation behavior of cyclist[12]. Fig. 3 showed that all of the items highly loaded on each latent variable with values greater than 0.3. The model has a high correlation between bicycle control error and notice failure. There was a significant on notice failure and bicycle toward violation behavior.

**Table 4** Correlation among the motorcyclist (n=477)

| Variable | MCE1 | MCE2 | MCE3 | SV1 | SV2 | SV3 | SV4 | MS1 | MS2 | TE1 | TE2 | TE3 | USE1 | USE2 | USE3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCE1 | 1 | | | | | | | | | | | | | | |
| MCE2 | .41** | 1 | | | | | | | | | | | | | |
| MCE3 | 0.02 | 0.08 | 1 | | | | | | | | | | | | |
| SV1 | .27** | .10* | 0.03 | 1 | | | | | | | | | | | |
| SV2 | .18** | 0.03 | -0.01 | .64** | 1 | | | | | | | | | | |
| SV3 | .17** | 0.05 | 0.05 | .57** | .60** | 1 | | | | | | | | | |
| SV4 | .11** | 0.08 | .12* | .40** | .42** | .54** | 1 | | | | | | | | |
| MS1 | .19** | .11* | -0.03 | .49** | .48** | .40** | .32** | 1 | | | | | | | |
| MS2 | .23** | .15** | -.13** | .37** | .40** | .27** | .17** | .53** | 1 | | | | | | |
| TE1 | .15** | .16** | -.11* | .31** | .20** | .23** | .13** | .32** | .41** | 1 | | | | | |
| TE2 | .22** | .09* | -.12** | .30** | .25** | .18** | .14** | .33** | .46** | .62** | 1 | | | | |
| TE3 | .20** | .15** | -.12* | .26** | .21** | .24** | .12* | .36** | .47** | .52** | .57** | 1 | | | |
| USE1 | 0.05 | -0.01 | -0.04 | .13** | .19** | 0.07 | -0.02 | .27** | .21** | .11* | .11* | .15** | 1 | | |
| USE2 | 0.08 | 0.02 | .09* | -0.02 | 0.06 | -0.04 | 0.04 | .12* | 0.05 | 0.02 | 0.01 | 0.07 | .30** | 1 | |
| USE3 | 0.03 | 0.04 | .11* | -.11* | .15** | -0.08 | -0.02 | -0.03 | -0.05 | -0.04 | -0.05 | -0.01 | 0.06 | .20** | 1 |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

**Table 5** Mean and standard deviation of each item score (bicycle model)

| | | | Mean | S.D. |
|---|---|---|---|---|
| **Bicycle control error** | | | | |
| BCE1 | | Hard to maintain balance at low speeds. | 1.63 | 1.03 |
| BCE2 | | Have difficulty controlling your bicycle downhill. | 1.35 | 0.88 |
| BCE3 | | Do not know which gear to use | 1.31 | 0.65 |
| **Notice failure** | | | | |
| NF1 | | Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late. | 1.62 | 0.87 |
| NF2 | | Fail to notice that pedestrians are crossing the street when you are turning. | 1.36 | 0.63 |
| NF3 | | Fail to notice a pedestrian waiting to cross at a crosswalk. | 1.27 | 0.62 |
| **Signaling and sign violation** | | | | |
| SV1 | | Run red light. | 1.95 | 1.15 |
| SV2 | | Cross the road while green light flashes. | 3.43 | 1.44 |
| SV3 | | Cycling invert the road directions. | 1.77 | 1.06 |
| **Bicycle stunt** | | | | |
| BS1 | | Riding without having at least one hand on handlebars | 1.26 | 0.62 |
| BS2 | | Talk on the phone while riding. | 1.26 | 0.58 |
| BS3 | | Listen to music while riding. | 2.24 | 1.47 |
| **Traffic violation** | | | | |
| TV1 | | Speed up to beat the traffic light turning red. | 3.25 | 1.30 |
| TV2 | | Ride in prohibited | 1.5 | 0.88 |
| TV3 | | Become angered by another road user | 1.24 | 0.65 |

**Table 6** Mean and standard deviation of each item score (Pedestrian model)

| | | Japanese | | Thai | |
|---|---|---|---|---|---|
| | | Mean | S.D. | Mean | S.D. |
| **Instrumental attitude** | | | | | |
| IA1 | Crossing the road in the scenario described** would save me time. | 3.55 | 1.236 | 2.48 | 1.309 |
| IA2 | Saving time is important to you. | 3.69 | 1.133 | 2.82 | 1.221 |
| IA3 | Crossing the road in the scenario described** would be more convenient. | 3.00 | 1.292 | 2.23 | 1.171 |
| IA4 | Convenience is important to you. | 3.61 | 1.090 | 2.95 | 1.261 |
| **Descriptive norm.** | | | | | |
| DN1 | My family cross the road as described in the scenario.** | 2.09 | 1.016 | 2.13 | 1.150 |
| DN2 | My friends cross the road as described in the scenario.** | 3.07 | 1.247 | 2.57 | 1.198 |
| **Conformity tendency** | | | | | |
| CT1 | If other pedestrians cross the road during the red light, I would do the same. | 2.83 | 1.373 | 2.81 | 1.305 |
| CT2 | When I am with companions, I cross the road as described in the scenario.** | 2.59 | 1.274 | 2.62 | 1.250 |
| **Behavior intention** | | | | | |
| BI1 | Would you cross the road as described in the scenario.** | 2.64 | 1.343 | 2.23 | 1.150 |
| BI2 | If you encounter this situation in the future, you would cross the road as described in the scenario.** | 2.59 | 1.350 | 2.22 | 1.200 |

**(2) Pedestrian in Japan**

Therefore, the pedestrian model, modified TPB was analyzed: instrumental attitude, Descriptive norm and conformity tendency. Fig. 4 showed that all of the items have high loading except IA4. There was a high correlation in every pair of structure: Instrumental attitude and descriptive norm, instrumental attitude and conformity tendency, lastly, descriptive norm and conformity tendency. Moreover, there was a significant on instrumental attitude and conformity tendency toward the crossing violation of the pedestrian[26].

**(3) Motorcycle model in Thailand**

The motorcycle model consists of Motorcycle Control error, use of safety equipment, traffic error and motorcycle stunt that affect the violation behavior[9]. Fig. 5 showed that all of the items highly loaded on each latent variable with values greater than 0.3. The model has a high correlation between use of safety equipment and motorcycle stunt, motorcycle control error and traffic error, and motorcycle control error and motorcycle stunt. There was a significant on traffic error and motorcycle stunt toward violation behavior.

**(4) Pedestrian in Thailand**

The pedestrian model consists of instrumental attitude, Descriptive norm and conformity tendency. that affect to the violation behavior[26]. Fig. 6 showed that all of the items highly loaded on each latent variable with values greater than 0.3. The model has high correlation in every pair.

Table 8 present the goodness of fit of the models. All models are fit with empirical data. Model 4 is the best fit. Table 5 shows the standardized regression for each construct.

## 4. Discussion

**(1) Descriptive statistical of sample**

In Thailand, teenagers who participate in answering the questionnaire is 477 people. Most of the respondents are 64.6 percent female, and the rest are male, 35.4 percent. Most of them aged between 18-20, which are 48.4 percent. About the education, most of the sample is an undergraduate student and has been studying at Chulalongkorn University,

**Table 7** Mean and standard deviation of each item score (Motorcycle model)

| | | Mean | S.D. |
|---|---|---|---|
| **Motorcycle control error** | | | |
| MCE1 | Find that you have difficulty controlling the bike when riding at speed (e.g., steering wobble). | 2.98 | 1.055 |
| MCE2 | Unable to control the motorcycle while ride pillion. | 3.01 | 1.216 |
| MCE3 | Brake or throttle-back when going round a corner or bend. | 4.11 | 1.045 |
| **Speed violation** | | | |
| SV1 | Exceed the speed limit on a country/rural road. | 2.45 | 1.061 |
| SV2 | Exceed the speed limit on a road | 2.51 | 1.173 |
| SV3 | Disregard the speed limit late at night or in the early hours of the morning. | 2.90 | 1.216 |
| SV4 | Open up the throttle and just 'go for it' on good traffic conditions. | 3.78 | 0.995 |
| **Motorcycle stunt** | | | |
| MS1 | Ride between two lanes of fast-moving traffic. | 2.28 | 1.111 |
| MS2 | Pull away too quickly and your front wheel comes off the road. | 1.84 | 0.940 |
| **Traffic error** | | | |
| TE1 | Not notice a pedestrian waiting to cross at a zebra crossing, or a pelican crossing that has just turned red. | 2.08 | 0.969 |
| TE2 | Miss "Give Way" signs and narrowly avoid colliding with traffic having the right of way. | 2.01 | 0.930 |
| TE3 | Not notice someone stepping out from behind a parked vehicle until it is nearly too late. | 1.95 | 0.940 |
| **Use of safety equipment** | | | |
| USE1 | Wear a protective jacket. (leather or non-leather) | 2.11 | 1.269 |
| USE2 | Wear protective trousers. (leather or non-leather) | 3.33 | 1.099 |
| USE3 | Wear helmet protection. | 3.50 | 1.082 |
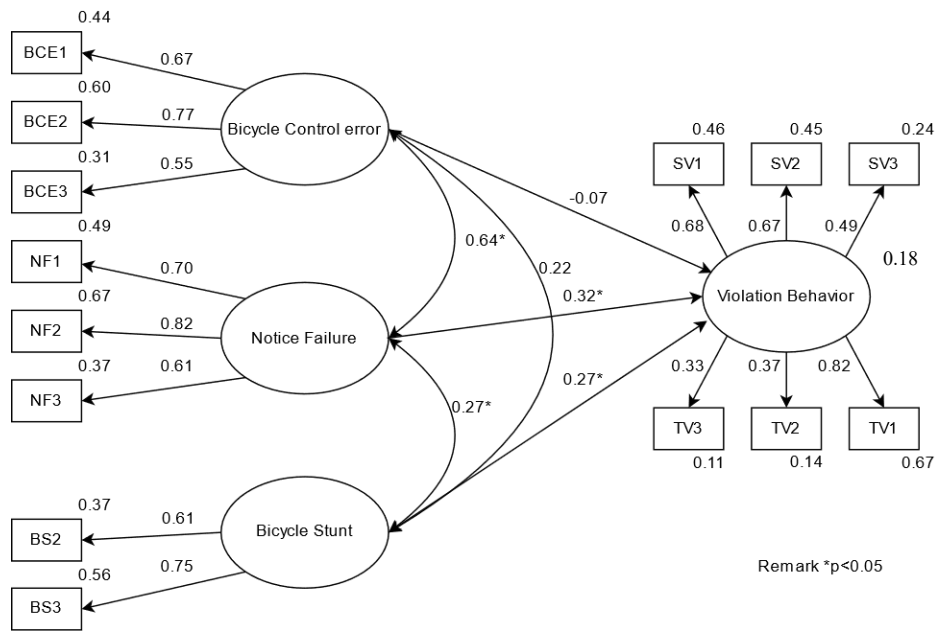
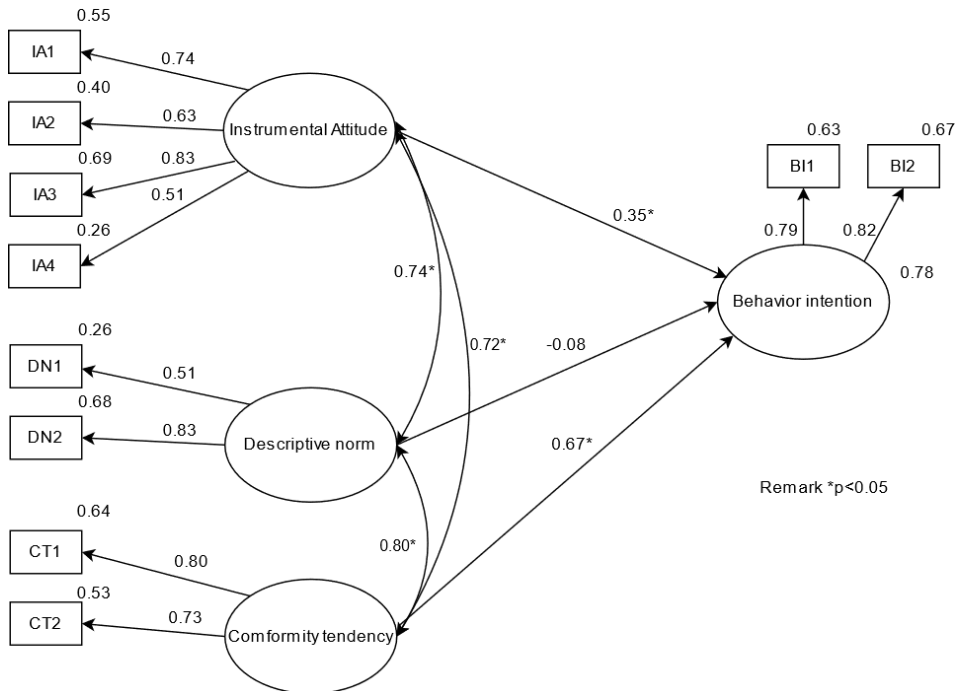**Fig.3** Bicycle model for Japanese teenager



**Fig.4** Pedestrian model for Japanese teenager

which is 92.5 percent. About the violation behavior, most of the sample used to violate the traffic laws, which is 83.4 percent, and the most frequent violation is not wearing a helmet while riding, which is 51 percent. Lastly, most of Thai teenage rider used to has an accident 64.2 percent and has slightly injuries 76.8 percent.

In Japan, the 201 people are adolescents who take part in answering the questionnaire. The majority of respondents are male at 79.6 percent and the rest are female at 20.4 percent. Most are between 21-23 years of age, which is 55.7 percent. Most of

the sample is an undergraduate student and has been studying at Hokkaido University, which is 60.7 percent. Due to the violation behavior, most of the sample used to violate the traffic laws, which is 59.7 percent, and the most frequent violation is crossing while red light, which is 74.1 percent. Lastly, most of the Japanese teenage riders never has an accident 77.1 percent.

**(2) Behavior and attitude on violation behaviors**

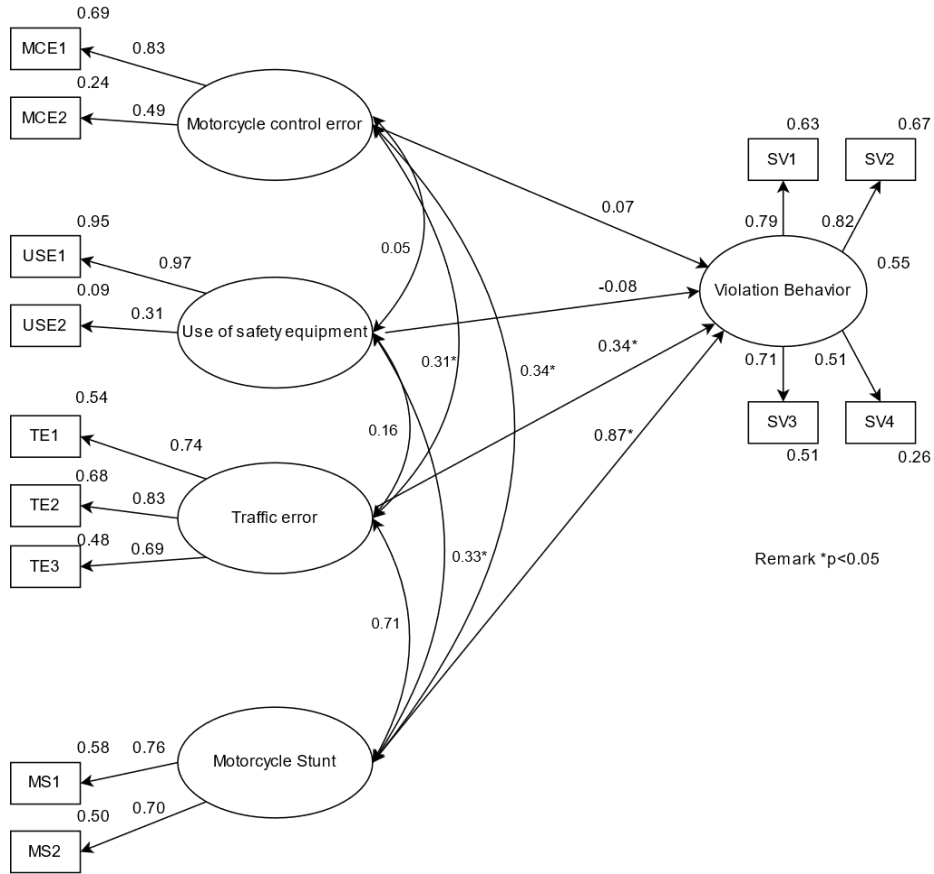Japanese teenage cyclists, the behavior of cycling is positive. Teenagers were worried about traffic-

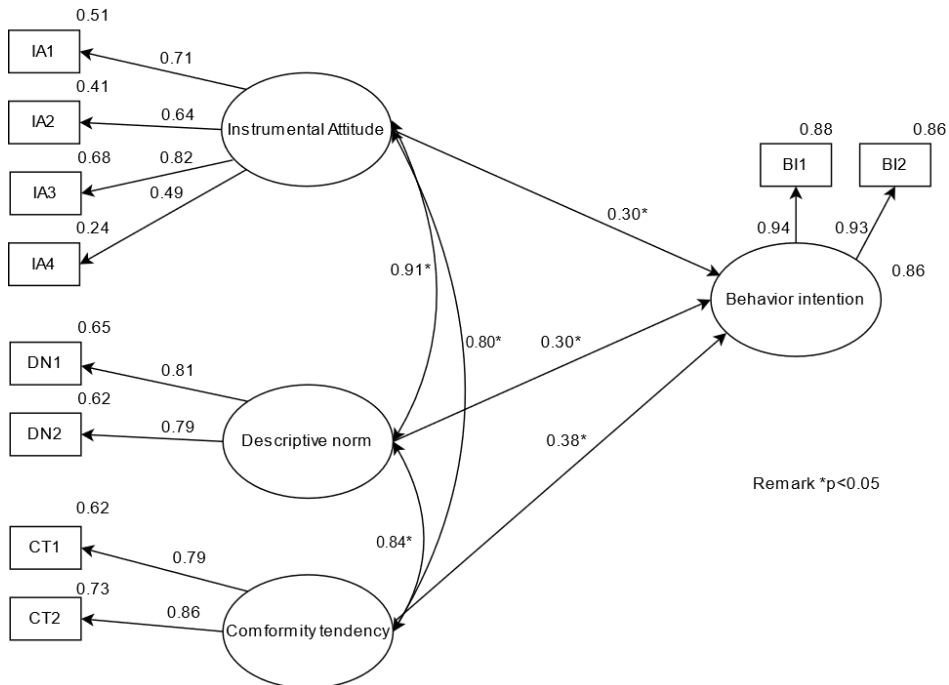**Fig.5** Motorcycle model for Thai teenager



**Fig.6** Pedestrian model for Thai teenager

**Table 8** Summary of the goodness of fit for all models.

| | Japanese teenager | | Thai teenager | |
|---|---|---|---|---|
| | Bicycle model | Pedestrian model | Motorcycle model | Pedestrian model |
| CMIN/DF | 1.121 | 1.422 | 2.238 | 1.265 |
| CFI | 0.939 | 0.935 | 0.967 | 0.998 |
| GFI | 0.942 | 0.962 | 0.966 | 0.988 |
| SRMR | 0.066 | 0.042 | 0.037 | 0.014 |
| RMSEA | 0.025 | 0.046 | 0.05 | 0.024 |

**Table 9** Unstandardized regression weight of the comstructs

| | Japanese teenagers | | | | | | Thai teenagers | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bicycle model | | | Pedestrian model | | | Motorcycle model | | | Pedestrian model | | |
| | Estimate | S.E. | $P$ | Estimate | S.E. | $P$ | Estimate | S.E. | $P$ | Estimate | S.E. | $P$ |
| CE | -1.21 | 0.214 | 0.571 | | | | 0.067 | 0.06 | 0.263 | | | |
| NF | 1.04 | 0.434 | 0.017 | | | | | | | | | |
| USE | | | | | | | -0.2 | 0.141 | 0.157 | | | |
| TE | | | | | | | -0.251 | 0.126 | 0.047 | | | |
| ST | 0.335 | 0.128 | 0.009 | | | | 1.115 | 0.173 | *** | | | |
| IA | | | | .434 | 0.152 | 0.004 | | | | 0.529 | 0.219 | 0.016 |
| DN | | | | -.104 | 0.215 | 0.629 | | | | 0.341 | 0.162 | 0.036 |
| CT | | | | .984 | 0.248 | *** | | | | 0.38 | 0.078 | *** |

***Significant at 0.001

violations and the protection of people in the area. In addition, how to handle the bicycle well and to be responsible for pedestrians and other road users. However, on the negative aspect, the samples tend to cross the road while red light. About pedestrian, Most of the Japanese teenagers have a positive attitude and behavior on crossing violation. For a negative attitude, Japanese teenagers have a negative attitude on saving time aspects. Mean, Japanese teenagers tend to violate the traffic laws if they in a hurry or busy.

Thai teenage riders have an excellent attitude to defending other road users, to stunt and to be vigilant about speed violation. Control error is a concern; many Thai teenagers do not know how to handle their bikes correctly. This means that they would have a risk of causing an incident due to a control error. From the pedestrian point of view, most Thai adolescents have an excellent attitude and neutral attitude to the violation of saving time and descriptive norm aspects. Means, Thai teenagers have a better violation of crossing than Japanese teenagers.

**(3) Discussion of behavior and attitude toward violation behaviors of teenagers**

Table 9 show the unstandardized regression weight of each construct. In bicycle model, Notice failure (NF) and Stunts (ST) are significant predictors of cycling violation. In pedestrian model, instrumental attitude (IA) and conformity tendency (CT) are significant predictors of crossing violation.

However, for thai teenagers, instrumental attitude (IA), descriptive norm (DN), and conformity tendency (CT). All of the constructs are good predictors. Lastly, in motorcycle model, traffic error (TE) and stunts (ST) are significant predictors of violation behavior.

The result of factor analysis between latent variables shown that most of the factor reaches a significant level at 0.01 and 0.05. As well as have a positive relationship between each latent variables. The models are form literature reviews, which are 1) Bicycle Riding Behavior Model[12] 2) Motorcycle Riding Behavior[9] and 3) Pedestrians Behavior[26]. To verify the model fits with the empirical data or not. Each weight factor of latent variables should more than 0.3.

Hence, to analyzing the relationship between behavior and attitude that affect toward violation behaviors. The researcher separates the model into 2 modes for each country. Thailand is motorcycle and pedestrian models. According to Japan, a small number of people using a motorcycle. Similarity in Thailand, a small number of people are using a bicycle as well. However, these models are nearly the same behavior. According to the behavior, it could be compared between this model.

Japanese teenagers and Thai teenagers have different in some aspects. The research compared between bicycle model and motorcycle model based

on Bicycle riding behavior[12] and Motorcycle rider behavior[9]. Both models based on the same concept of thinking to find the exact behaviors, violation behaviors, and risk behaviors on these modes.

Bicycle and motorcycle model behaviors. Both of them could explain the behavior well. It is no difference between these models. Bicycle model has a high loading factor on notice failure and stunt, which are the same as a motorcycle model. However, motorcycle model has a lot more factor loading on stunt aspect. From this point of view, it could be concluded that Thai teenager has more negative behavior. Because it is one of the reasons toward accident, Thai teenagers used to have an accident up to 64 percent of the sample (See table 1), which is very high. The variable which did not affect violation intention was control error (Thai and Japanese) and use of safety equipment (Thai). For this issue, it can be identified that only control; may not affect the decrease in violation behavior and accident, which is the factor indicating the confidence of riding and their own decisions in both Thai and Japanese teenager.

From Figure 6, Thai teenage pedestrians tend to cross the road while red light depending on "Descriptive Norm" this is the only variable that different from Japanese teenage pedestrians. On the other hand, In japan, teenage pedestrians tend to cross by "Conformity tendency" and "Attitude" In Japan, 40 percent of teenage road users used to violate the traffic comparing to Thailand is about 80 percent used to violate. From the perspective, means Thailand is easy to do violation behaviors and tend to violate according to adult or close friend or family much like the research of Ajzen, 2006. However, the descriptive norm was an additional factor in the Thai pedestrian model, which indicated that parental pressures. In Thai, it could potentially lead to greater motivation for violation. This confirms the opinion that the behavior of parents has greatly influenced children. The policy suitable for increasing the pedestrian's intention in society is to prompt parents to encourage children not to violate while crossing, especially teenagers.

## 5. Suggestion and recommendation

The advantage of focus policies on the right behavior should be stressed and reduce the accident from vulnerable road users emphasized.

The results of this research show the differences between Thai and Japanese teenagers. The behavior and attitude of violation have some differences in some aspects. The result of SEM shown the exact behavior on violation behavior. It could present some policies to improve the behavior of Thai teenagers by the guideline of Japanese teenagers behavior.

Motorcycle riding behavior in Thailand, teenagers tend to violate due to traffic error and stunt aspects. It appears that if we want to reduce the violation behaviors and accidents, the perception of how to control and ride a motorcycle is essential. Most of Thai teenagers do not know how to control a motorcycle correctly and safely. Moreover, do not know the laws and carelessness on other road users such as pedestrians waiting to cross the road. The researcher suggestion to explain and teach the exact way to ride a motorcycle in detail. For example, how to change gear while in the curve or how to use a brake correctly. Besides, the motorcycle need to respect other road users. If everybody could do and have some policies to support this problem. It could be slove.

The next factor was the stunt aspect in motorcycle and descriptive norms in pedestrian model. As we know, a teenager is energetic and do not think carefully according to there age. The behaviors were tendency by external factors such as family, friends or even people in their society. Community and social levels have to promote the community to be dependable. To prevent accidents, make the environment safe, build healthy communities and societies, giving importance to teenagers and open up opportunities for adjustment. Moreover, provide the things that will contribute to positive development. It is another crucial factor that causes violations and accidents. Family and friends have to encourage teenagers not to violate and taught them carefully about the risk of violation and loss of the accident. The researcher would call "Ride safety starts with the family and society".

The variable which did not affect Thai teenage violation behavior was control error and use of safety equipment (such as wear a helmet or ride with the ability to control motorcycles while towing.). For this issue, it could be identified that only these may not affect decrease violation behavior. This does not agree with the research that found that this factor could affect the violation behavior significantly.

## 6. Limitation and future research

The limitation and future research of this research and guidelines for future studies was the bicycle model in Japan $R^2$ value is 18 percent. Means the model could not explain or cover most of the bicycle riding behavior in Japan. However, It is usually said that the $R^2$ value is very high, indicating that the regression model fits well with the data. It is not always necessary that low $R^2$

values are not ethical, especially for research in some fields. For example, in the social sciences and humanities behavior such as this research, some phenomena are unclear or incomplete. There may be many unexplained variations. Further study should fulfill the consideration of bicycle behavior in various ranges of age. Moreover, find other exact behavior by in-depth interview Japanese people who were riding a bicycle in daily life in order to get to know the opinions of frequent behaviors or violations. And develop a new questionnaire based on this research to fulfill the blank or unclear behaviors.

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