A Comparative Study of Road Traffic Violation between Thai and Japanese Students

Mr. Napattharakorn Katanararoj

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering in Civil Engineering
Department of Civil Engineering
FACULTY OF ENGINEERING
Chulalongkorn University
Academic Year 2020

การศึกษาเชิงเปรียบเทียบของการฝ่าฝืนการจราจรระหว่างนักเรียนไทยและญี่ปุ่น

นายณภัทรกร กถานาราโรจน์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
สาขาวิชาวิศวกรรมโยธา ภาควิชาวิศวกรรมโยธา
คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2563

Thesis Title	A Comparative Study of Road Traffic Violation between Thai and Japanese Students
By	Mr. Napattharakorn Katanararoj
Field of Study	Civil Engineering
Thesis Advisor	Professor KASEM CHOOCHARUKUL, Ph.D.
Thesis Co Advisor	Associate Professor Kunihiro Kishi, Ph.D.

Accepted by the FACULTY OF ENGINEERING, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Engineering

..... Dean of the FACULTY OF ENGINEERING
(Professor SUPOT TEACHAVORASINSKUN, D.Eng.)

THESIS COMMITTEE

..... Chairman
(Associate Professor SORAWIT NARUPITI, Ph.D.)
..... Thesis Advisor
(Professor KASEM CHOOCHARUKUL, Ph.D.)
..... Thesis Co-Advisor
(Associate Professor Kunihiro Kishi, Ph.D.)
..... External Examiner
(Professor Vatanavongs Ratanavaraha, Ph.D.)

ณภัทรกร กถานาราโรจน์ : การศึกษาเชิงเปรียบเทียบของการฝ่าฝืนการจราจรระหว่างนักเรียนไทยและญี่ปุ่น. (A Comparative Study of Road Traffic Violation between Thai and Japanese Students) อ.ที่ปรึกษาหลัก : ศ. ดร.เกษม ชูจารุกุล, อ.ที่ปรึกษาร่วม : รศ. ดร.คูนิฮิโระ คิชิ

จากในช่วง 10 ปีที่ผ่านมา อุบัติเหตุที่เกิดจากผู้ใช้ถนนที่เปราะบางในประเทศไทยเพิ่มขึ้นอย่างมากจนเป็นประเทศที่มีอุบัติเหตุมากที่สุดในปี 2017 โดยเฉพาะเด็กที่มีอายุอยู่ในช่วง 15-29 ปี เมื่อเปรียบเทียบกับประเทศญี่ปุ่นในปี 2017 ญี่ปุ่นได้ประสบความสำเร็จในการลดอุบัติเหตุให้น้อยที่สุดตลอดกาลนับตั้งแต่ปี 1960 เมื่อพิจารณาถึงผลต่าง สิ่งที่แตกต่างกันอาจจะเป็นพฤติกรรมหรือทัศนคติที่ส่งผลไปยังพฤติกรรมการฝ่าฝืนกฎจราจร การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ปัจจัยที่มีผลต่อพฤติกรรมการฝ่าฝืนกฎจราจรระหว่างไทยและญี่ปุ่นเพื่อกำหนดนโยบายและข้อเสนอแนะที่เหมาะสม โดยศึกษาพฤติกรรมและทัศนคติของผู้ใช้รถใช้ถนนตามทฤษฎีพฤติกรรมตามแผน (TPB) ในกรุงเทพฯประเทศไทยและซัปโปโรฮอกไกโดประเทศญี่ปุ่น แบบสอบถามเกี่ยวกับพฤติกรรมการฝ่าฝืนกฎจราจรได้ถูกออกแบบและปรับปรุงเพื่อให้เหมาะกับแต่ละประเทศและได้ทำการสำรวจและเก็บตัวอย่างได้ 201 ตัวอย่างในประเทศญี่ปุ่น และ 477 ตัวอย่างในประเทศไทย ความถูกต้องและความน่าเชื่อถือของแบบสอบถามได้ถูกทดสอบและนำไปวิเคราะห์แบบจำลองสมการเชิงโครงสร้าง (SEM) พบว่าแบบจำลองทั้งหมดมีนัยสำคัญ ในประเทศญี่ปุ่นมีการใช้งานจักรยานและคนเดินเท้า พบถึงปัจจัยที่ส่งผลกระทบมากที่สุดคือความผิดพลาดในการสังเกตและพฤติกรรมเสี่ยง นอกจากนี้สำหรับคนเดินเท้าพบว่าการโน้มน้าวและทัศนคติส่งผลต่อพฤติกรรมเป็นหลัก ในประเทศไทยมีการใช้งานจักรยานยนต์และคนเดินเท้า พบถึงปัจจัยที่ส่งผลกระทบมากที่สุดคือความผิดผลาดในการจราจรและพฤติกรรมเสี่ยง สำหรับคนเดินเท้า พบถึงปัจจัยที่ส่งผลกระทบมากที่สุดคือทัศนคติ การทำตามกลุ่มอ้างอิง และการโน้มน้าว ซึ่งสามารถสรุปได้ว่าการส่งเสริมให้ตระหนักถึงการฝ่าฝืนและอุบัติเหตุที่จะเกิดขึ้นโดยสอนวิธีการขี่มอเตอร์ไซค์ที่ถูกต้องโดยละเอียด เพื่อให้เห็นและตระหนักว่าจะลดการบาดเจ็บและการฝ่าฝืนได้อย่างไร อย่างไรก็ตามในชุมชน เพื่อป้องกันอุบัติเหตุชุมชนจะต้องทำให้สภาพแวดล้อมปลอดภัย สร้างชุมชนและสังคมที่ดีต่อและให้ความสำคัญกับวัยรุ่นและเปิดโอกาสให้ปรับตัว ประการสุดท้ายกิจกรรมและการส่งเสริมควรเน้นย้ำผู้ปกครองและผู้ร่วมกิจกรรมเกี่ยวกับเจตนาที่จะฝ่าฝืนกฎจราจร นอกจากนี้ควรจะเป็นการปลูกจิตสำนึกในพฤติกรรมของผู้ใช้รถใช้ถนน

สาขาวิชา	วิศวกรรมโยธา	ลายมือชื่อนิสิต .....
ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....
		ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

6170153621 : MAJOR CIVIL ENGINEERING
KEYWORD: Vulnerable road users, Cyclist, Motorcyclist, Pedestrian, Violation, Violation behavior, Road traffic violation, Student

Napattharakorn Katanararoj : A Comparative Study of Road Traffic Violation between Thai and Japanese Students. Advisor: Prof. KASEM CHOOCHARUKUL, Ph.D. Co-advisor: Assoc. Prof. Kunihiro Kishi, Ph.D.

During the last ten years. Accidents of vulnerable road users in Thailand have increased significantly and hit the most severe accident in 2017, especially 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 studying road user's behavior and attitude based on the theory of planned behavior (TPB) in Bangkok, Thailand and Sapporo, Hokkaido, Japan. Questionnaires with road user violation behaviors were designed and developed for each country, and the surveys were 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 decrease injuries and violations. However, in the community to prevent accidents, the community has to make the environment safe, build healthy communities and societies, give teenagers importance, 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.

Field of Study:	Civil Engineering	Student's Signature .....
Academic Year:	2020	Advisor's Signature .....
		Co-advisor's Signature .....

ACKNOWLEDGEMENTS

Firstly, I would like to thank my thesis advisor, Professor Dr. Kasem Choocharukul, for patiently guiding and supporting me throughout my study. Thank you for your helping hand and always giving guidance whenever I have questions or difficult situations and blind spots about my study.

I would also like to thank my thesis co-advisor, Associate Professor Dr. Kishi Kunihiro for the greatest experience 1 year in Japan. Good taking care and motivating to me. Also always give such a good advice about my study.

I would also like to thank the committee members involved in the evaluation and endorsement of this study project: Associate Professor Sorawit Narupiti, (committee chairman) Professor Dr. Vatanavongs Ratanavaraha (External Examiner) for their evaluation and comment for this study and without their passionate critique and input, this research would have gone subtle and extensive.

Lastly, To my friends and family, for always the being with me, continuous encouragement and being such a good listener also their care and support that you have given me and got through the end of this part of my study. Thank you very much.

Napattharakorn Katanararoj

TABLE OF CONTENTS

Page

List of Tables

Page

List of Figures

Page

Chapter 1
Introduction

1.1 Background of the study

When we mention “The Accident” no one wants to happen because it affects many factors such as the economy and government budgets to support our facilities for safety. The road accident tends to rise every year. 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. Nowadays, this fatality is quite stable as in 2012. Therefore, many countries are highly concern and alert about the development of sustainable and safe transportation.

In Thailand, the accident is one of the significant causes of fatality as well, being first ranking in the world with the highest number of road accident deaths (see Figure 1-1). From the statistics in 2016, it was found that 22,356 people were 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 (World Atlas, 2017). The state has lost a budget of over 500,000 billion. It is such a huge loss. However, what is worrisome is that road accidents kill young and working life. 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. New 6,000-7,000 people/year makes the proportion of working-age to care for the elderly is not enough.

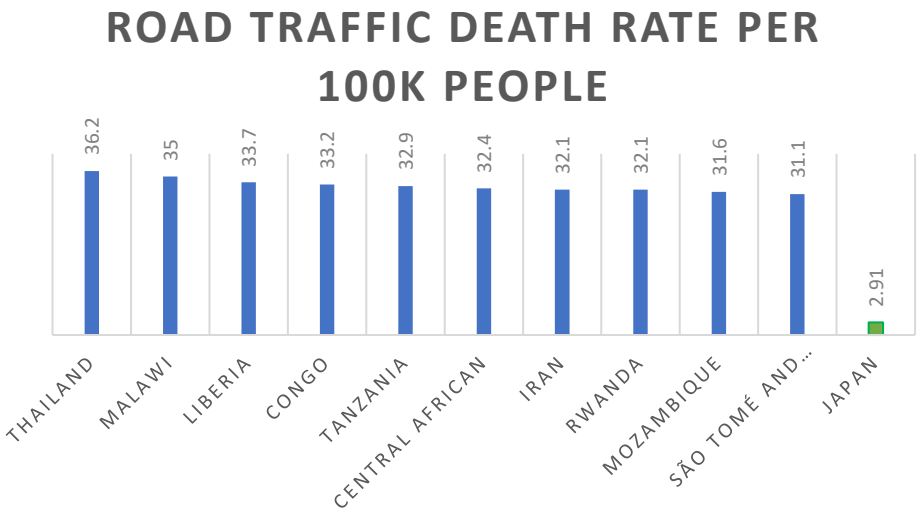


Figure 1-1: Road traffic death rate per 100k people
(Source: WHO, 2018)

Motorcycles in Thailand are the vehicle with the highest proportion of accidents compared to another mode of travel such as pedestrian or bicycle mode. Most of the research related to motorcycle accidents is the behavior of accidents. It is a question of both attitude and safety compared with personal information or background.

Comparing with Sapporo, Japan has found a very low fatality. From National Police Agency, Japan said the traffic fatalities in japan reach a low record, only 3,532 people in 2018 or about 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.

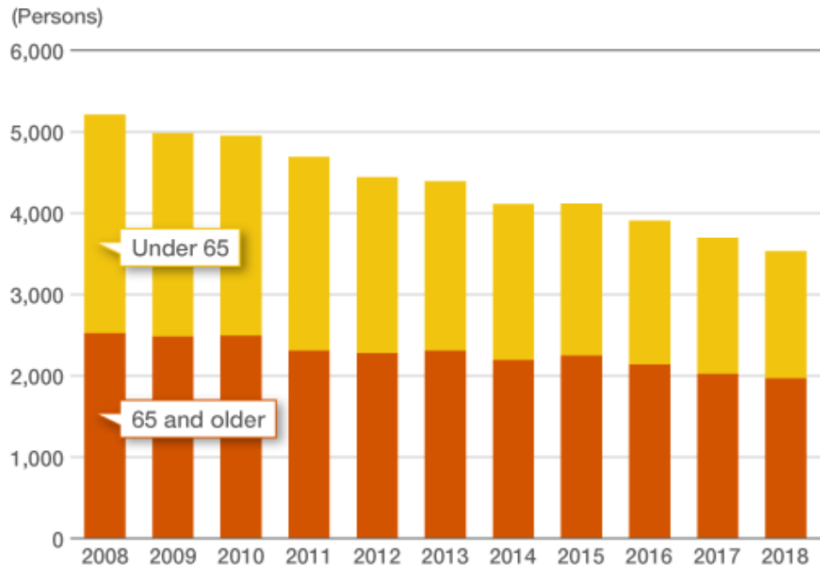


Figure 1-2: Traffic fatalities among senior and other citizens in japan
(Source: National Police Agency, 2018)

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 (Oguchi, 2016).

As a result, Japan is a good model of safety that we want to learn about their behavior and personal attitude of Japanese people. Japan is a country in Asia and is more suitable for comparative studies than in European countries. Also, the leader of various innovations in Thailand, which has a significant influence on Thai people. Therefore, they should be a study model by analyzing the factors in-person attitude

factor and traffic engineering factors, which is information that can be used to plan to solve traffic violations.

This study uses concepts from the theory of planned behavior and reviews 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 teenage road users that will cause the violation of traffic rules and lead to the accident.

1.2 Objectives of the study

The primary objective is to understand the behavior of teenagers between Thai and Japanese, especially to violation behavior comparing with a psychological model. In order to achieve this objective, the following specific objective must be accomplished.

1) Study factors affecting teenager road users, consisting of “Behaviors” and “Psychological” in different areas.
2) Recommend appropriate policies based on analysis results.

1.3 Expected Benefit of Study

1) A study of information about the behavior of teenage road user, to be used in a campaign to prevent and resolve problems that may arise from traffic violation behaviors.
2) Guideline to regulate the accident reduction policy. Moreover, reduce the number of injuries and fatalities from the accident of a teenage group in the future.

1.4 Hypothesis of the study

1) The positive attitude of the Japanese teenager is better than Thai teenager.
2) Thai teenagers have more violations than Japanese teenagers.
3) People who are motorcyclists are the most related to violation behaviors.
4) Motorcyclists have the worst attitude on safety behavior.

1.5 Scope and limitations of the study

Therefore, the scope of the study will determine only teenagers between 15-29 both of Thai and Japanese who are Bangkok and Sapporo and concentrate on behavior and attitude of road users who is a pedestrian, motorcycle, and bicycle by using a psychological model called “Theory of planned behavior” to measure violations as a descriptive statistic.

Chapter 2
Review and Related Literature

2.1 Concept of accident

Accident means danger from lack of consciousness safety which occurs unintentionally but may be done negligently, lack of knowledge, lack of consciousness, control, hurry, tiredness, and sleepiness. Accidents are things that everyone does not wish to happen (National Accident Prevention Committee, 2010). Refers to events or hazards that occur without anticipation or intention before which has resulted in injured persons, death or loss of property. While a term of "accident" is widely used today mean "Danger or risk that may occur to the body, life, and property of the person, which are familiar to accident and risk. Can be classified as follows:

1) Traffic accidents, including caused by traffic, land, water, and air.
2) Occupational accidents both factory and outsides such as construction and agriculture.
3) Home accidents, including falling, being cut, electric suction, LPG explosion, fire, scald, etc.
4) Public accidents such as accidents in schools, entertainment centers, Public Park, and fire.

2.1.1 Traffic accidents

Refers to accidents that occur from all types of vehicles on the road, whether motorcycles, cars, bicycles that cause damage to other users and also include pedestrians on both sides and across the road.

2.1.2 Causes of traffic accidents

Causes of traffic accidents can separate into two parts which are driver and environment as follows:

1) The causes of driver or road user.
   - The driver is the most important cause of road accidents. Caused by behavior, attitude, negligence, lack of expertise in driving and stimulus such as alcohol drinking, substance abuse which has a high chance of accidents.
   - Pedestrians do not follow the rules of safety.
2) Caused by the environment such as damaged roads, damaged light signals, road conditions are not standard. Including abnormal weather conditions, severe rain, haze, etc.

2.1.3 Factors affecting accidents

From the review of the literature. There are four factors (see Figure 2-1) that are related to people, vehicles, roads, the environment, and legal deficiencies. (Vijit, 1995)

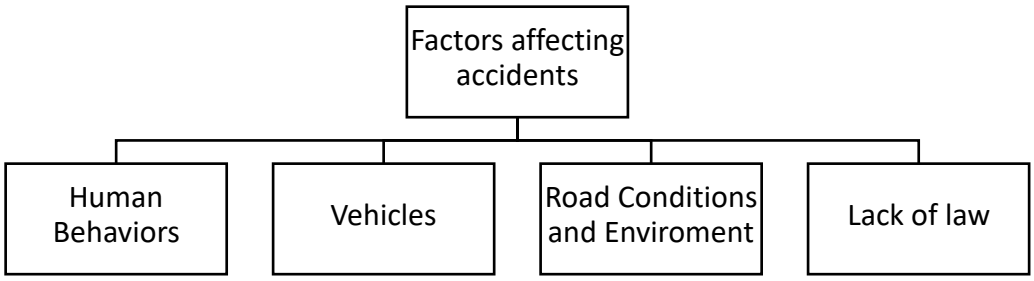


Figure 2-1: Factors affecting accidents
(Source: Vijit, 1995)

1) Human behaviors and accidents are caused by drivers up to 80 percent regardless of intention or no intention which can be divided into a variety of factors as follows:

- Sex, from many studies, those studies found that sex is associated with significant accidents. Males are more likely to have accidents than females because of their character and society such as excitement (Stunt) wildness due to group behavior and like to speed up particularly motorcycle. It was found the women were more likely to have accidents than males. In a small accident such as collision but not a fatal accident (Massie, Campbell, & Williams, 1995).

- Age of the drivers is another essential factor due to the lack of thought and risk perception among teenagers such as the excitement of teenagers on past studies, there is the comparison of age found that 1 in 3 of motorcycle riders aged less than 20 years have the highest chance of accidents (Chang & Yeh, 2007).

- Driving experience. Drivers with less driving experience will be more involved in accidents respectively.

- A physical disability such as sudden illness or diseases epilepsy, hypertension and other defects such as color blindness.

- Traffic violation, Violations of road traffic regulations of vulnerable road users such as driving on the sidewalk, driving with high speed and negligence. There are frequent accidents of traffic violations. Moreover, there will be other factors including violations of substance abuse and alcohol use, making bad decisions respond and take a lot of reaction time. When an unexpected incident happened, the driver not be able to catch up or avoid it immediately. Regarding the report on the

world situation of road safety, they are also providing details on the law regarding three major risk factors on vulnerable road users, including speed, drunk driving, wearing a helmet. It is also essential to be a significant factor in causing accidents.

2) The vehicles can be a factor if it is not ready to use. The broken vehicle severe accidents. In Thailand, there is no law to support for cars or motorcycles and still not up to date. It will also harm other vulnerable road users and themselves as well. The car and motor vehicle inspection factors of Thailand are not good enough. It is affecting air pollution too. Regarding private cars and motorcycles in Bangkok, the registration record is 8,392,867 vehicles (Department of Land Transport Report, 2019), which area high number. Therefore, the deterioration of defects should have a standard.

- The performance of tires, rubber tread deteriorates, the tire's condition expires due to the tire unable to stick to the road as well as it should be. The lack of maintenance or replacement of the tire will cause the tire to explode or should not carry overweight.

- Defective or breakdown equipment such as the accelerator, the brake pedal of the car (stiffness and damage) result in an inability to brake or accelerate effectively. Brake pads are worn out or deteriorated due to heavy use, no cleaning and check regularly. The signal system is damaged headlight, brake lights and turn lights at night.

3) Road and environment condition external factors that have little impact if the driver does not have negligence or inappropriate behavior but in other

words, roads and environments can cause many accidents as well when careless.

- Road conditions that cause accidents.

The damaged of the road. There is a hole or mud, due to water erosion or unstandardized compaction. The friction of the road, narrow road or road shoulder direction is not apparent. Design that does not conform to standards such as sharp curves or curves that are not geometrically standard. In Bangkok, there are many curves which are not standard due to limited space for road cuts which is considered as a dangerous bend by many in rural area and roads are under construction, obstructing traffic, etc.

- Environment causes accidents

The environment that causes accidents is from both nature and surface environments such as traffic signs are damaged, lighting conditions, no lights, and signal at intersections or weather problems.

4) Lack of law

The legal deficiencies of Thailand have many deficiencies, such as the social condition and lack of public relations because Thai society is lack consciousness and much violating. The primary is a lack of enforcement and rules. For example, motorcycle drivers in Thailand did not wear a safety helmet which is one of the most violations in Bangkok although the regulation is “Not wearing a helmet, the fine is 200 bath/time up to 1000 THB. (Thailand Road Traffic Act, 2009)

2.2 Legal concepts

2.2.1 Legal concept in Thailand

The laws relate to road users are obsoleted and have not developed as they should be. Some cannot apply to the present day. The law relates to vulnerable road user pedestrians, bicycles, motorcycles, and cars are follow by Road traffic act in 1979 to enforce and ensure safety for all users. Most of the laws for road users have similar meanings. The researcher will comply with relevant laws concerning driving and being neglected often.

1) Article 6: The user whose use incomplete vehicle or equipment which not ready to use, the effect will harm vulnerable road users and others.
2) Article 18: The truck which uses for carrying people, animals or stuff should be by the rules and procedures prescribed in the ministerial regulations. Means car or motorcycle must be following the registration book as prescribed by the Ministerial Regulation No. 4 in 1979, said that motorcycles or cars carry overloaded commonly be seen in educational areas and community area because it is a nearby footpath and the distance is not that far.
3) Article21: The driver must follow with the traffic signs that have been installed or appear on the road. Alternatively, the police officer shows the traffic signal which requires them to pass the test before on duty. The rules and procedures are prescribed in the ministerial regulations.
4) Article 33: Driving, the driver must drive on the left side of the road and must not drive in the middle lane. Except for the following cases, to travel right lane or center lane.

   • The left side of the road has obstacles or is closed for traffic.

• The road is designated as a one-way route.

• The road is less than six meters wide.

5) Article 34: Road using which has divide lanes in the same direction from two or more. Alternatively, bus lane, drivers must be in the left lane or near the bus lane, except in the following cases to travel right of the bus.

• There are obstructions or traffic closes in the bus lane.

• The route is designated as a one-way bus.

• Must enter the correct lane when entering the area near the junction.

• When overtaking in front of other cars.

• When the driver is driving at a higher speed than the car on the left lane.

6) Article 35: Cars with slow speed. The driver must drive in the only left lane. Notice that driving a motorcycle at the left edge of the road is a good thing to do because the law is defined. However, sometimes driving along the left edge may be dangerous because there are many obstacles, cars coming out of the alleys, gas station entrance and drain cap cause the motorcycle drive unstable through the drain cap. In the present, large motorcycles or big bike ride with high speeds but they also have particular safety than usual such as ABS technology or traction control systems.
In order to allow the motorcycle to ride only on the left edge, it may not be the social norms that are being treated.

7) Article 104: Distance, not over 100 meters from the crosswalk or overpass, does not allow pedestrians to cross the road outside the crossing path. This

Article, many pedestrians never acknowledge before. As a result, when the accident happened nearby the crosswalk or overpass, the parties will use this Article against in court and no blame at all. As a result, Pedestrians should be aware of it.

8) Article 122: Motorcycle riders and passengers must wear a safety helmet specially designed to prevent danger while riding. Both of stricture and train found that it helps to reduce accidents but they are a few numbers of the user in Bangkok. Nowadays, still solving this problem.

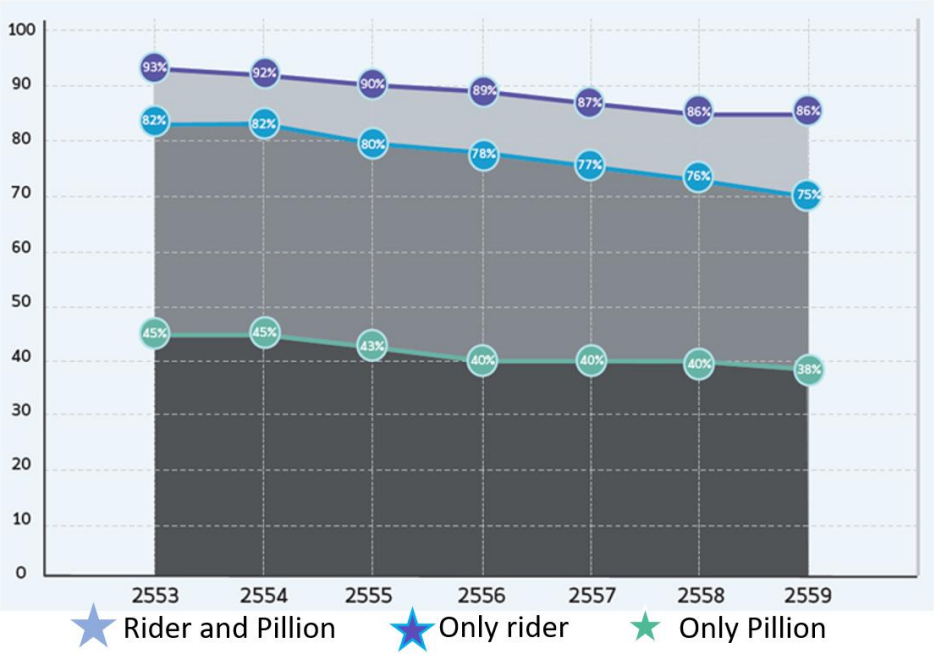


Figure 2-2: Percentage of wearing a helmet B.E. 2553-2559
(Source: THAIROADS, 2017)

From the enforcement of laws in Thailand (see Figure 2-2), it found that it does not help to solve the safety problem as effectively as it should be. Therefore, a complete study of the behavior of road traffic violations users in Thailand is another way to answer questions and concerns about the behavior.

2.2.2 Legal concept in Japan

Traffic laws in Japan are used as the Road Traffic Act No. 105 of June 29, 1960 and are continually being updated to maximize the safety of Japanese people. Most of the laws for road users have similar meanings. The researcher will comply with relevant laws concerning driving and being neglected often as follows (Japan Road Traffic Act, 1960)

- Obligations of the drivers of vehicles when entering onto pedestrian paths

Article 9 When entering onto a road on which a road sign or marking indicates that vehicular entry has been prohibited so as to ensure the safety and fluidity of pedestrian traffic after obtaining the permission (Article 8 (2)) prescribed of the preceding Article or by reason of being exempt from that prohibition, the driver must be particularly careful of pedestrians and drive at a reduced speed.

- Pedestrian Traffic Distribution

Article 10 (1) On a road without demarcations between the roadway and either the sidewalk or a side strip sufficiently wide for safe use by pedestrians a pedestrian must keep to the right edge of the road; provided, however, that if it is dangerous to use the right edge of the road or if there are other compelling circumstances, a pedestrian may keep to the left edge of the road.

(2) On the road with demarcations between the sidewalk or side strip and the roadway, a pedestrian must use the sidewalk or side strip, except in the following cases:

(i) When crossing the roadway.

(ii) If the sidewalk or side strip cannot be used for reasons such as road works, or if there are other compelling circumstances.

(iii) When using a sidewalk pursuant to the preceding paragraph, a pedestrian must endeavor to avoid any part of the sidewalk for use by standard bicycles.

- Pedestrian Crossing

Article 12 (1) When crossing a road near a pedestrian crossing, a pedestrian must use the pedestrian crossing.

(2) A pedestrian must not cross a road diagonally at an intersection unless permitted to do so by road signs or markings.

- Places at Which Crossing Is Prohibited

Article 13 (1) A pedestrian must not cross the road immediately in front of or behind a vehicle or streetcar; provided, however, that this does not apply if the pedestrian is using a pedestrian crossing, crossing in compliance with the signal indicated by a traffic light, or crossing in compliance with the alternative signal of officer.

(2) A pedestrian must not cross a part of the road where the crossing is prohibited by road signs or markings.

- Special Rules for Roads Such as Pedestrian Paths

Article 13-2 Article 10 through the preceding Article does not apply to a pedestrian using a pedestrian path or a road that a vehicle or streetcar cannot enter for structural reasons.

- Protection of the Visually Impaired, Children Not Yet of School Age, the Elderly, and Others.

Article 14 (1)A person with a visual impairment (including persons equivalent thereto; the same applies hereinafter) must carry a cane as prescribed by Cabinet Order or be accompanied by a guide dog as prescribed by Cabinet Order when using the road.

(2) A person without visual impairment (other than a person with a hearing impairment or with a physical disability of the grade that Cabinet Order prescribes) must not carry a cane as prescribed by Cabinet Order or be accompanied by a dog outfitted as prescribed by Cabinet Order when using the road.

(3) A person responsible for the protection of an elementary school (meaning a person at least six years old but less than 13 years old; the same applies hereinafter) or a child not yet of school age (meaning a person under six years old; the same applies hereinafter) must not allow the elementary or child not yet of school age to play on a busy road, at a railroad crossing, or on road in the vicinity of railroad crossing; and must not allow a child not yet of school age for whose protection the person is responsible for walking on such a road or crossing unaccompanied by that person or a caretaker acting in that person's stead.

(4) In a location where it is found to be necessary to instruct, signal, or take other appropriate measures when elementary or children not yet of school age are passing down the road on the way to elementary school, preschool, an authorized childcare center with combined preschool and daycare facilities, or another educational or childcare facility, an officer or any person who happens to be present at

that location must take those measures in an effort to ensure that the elementary or children not yet of school age are able to pass safely down the road.

(5) If requested by an elderly pedestrian, a pedestrian with a physical disability, or any other pedestrian with difficulty using the road who is crossing or attempting to cross the road, an officer or any person who happens to be present at that location must instruct, signal, or take other appropriate measures in an effort to ensure that the pedestrian is able to cross the road safety.

- Rules to Be Observed by Riders of Large Two-Wheeled Vehicles and other vehicles.

Article 71-4 (1) A person riding a standard or large motorcycle must not ride that vehicle without wearing a motorcycle helmet, and must not carry a passenger who is not wearing a motorcycle helmet.

(2) A person riding a motorized bicycle must not ride that vehicle without wearing a motorcycle helmet.

(3) A person holding a large motorcycle license who is under 20 years of age or who has not held that license for at least three years in total (not counting any period during which it was suspended) (other than a person currently holding a standard motorcycle license as referred to in that paragraph who has held that license for at least three years in total (not counting any period during which the person's license was suspended) and other persons that Cabinet Order prescribes) must not carry a passenger while driving a standard or large motorcycle (other than one with a sidecar; the same applies hereinafter in this Article) on a national expressway or limited highway.

(4) A person holding a standard motorcycle license a person also holding a large motorcycle license as referred to in that paragraph who is under 20 years of age or who has not held that license for at least three years in total (not counting any period during which the person's license was suspended) (other than a person who has held a standard motorcycle license at some point within the six months before the day on which the person came to hold the current license and other persons that Cabinet Order prescribes) must not carry a passenger while driving a standard motorcycle on a national expressway or limited highway.

(5) A person holding a large motorcycle license who has not held that license for at least one year in total (not counting any period during which the person's license was suspended) (other than a person currently holding a standard motorcycle license as referred to in that paragraph who has held that license for at least one year in total (not counting any period during which the person's license was suspended) and other persons that Cabinet Order prescribes) must not carry a passenger while driving a standard or large motorcycle.

(6) A person holding a standard motorcycle license (other than a person also holding a large motorcycle license as referred to in that paragraph) who has not held that license for at least one year in total (not counting any period during which the person's license was suspended) (other than a person who has held a standard motorcycle license at some point within the six months before the day on which the person came to hold the current license and other persons that Cabinet Order prescribes) must not carry a passenger while driving a standard motorcycle.

(7) Cabinet Office Order provides for the standards for motorcycle

helmets due to Japan was once a country with a high fatal road accident problem in the past. Moreover, there are efforts to solve problems including discipline people in the nation about this for over 60 years continuously (Nation Police Agency, 2018), resulting in many years Japan has a very small number of deaths from drunk driving accidents compared to other countries, as well as other non-drunk driving accidents. Of course, good public transport and road structures also contribute. But nowadays, Japan's drunk driving laws are also very strict as well Can say that Japan's' Advance' in both the transportation and public utility. And do not forget to solve any outstanding problems like strict laws to control road users. Although the current Japanese law permits to sale alcoholic beverages for 365 days, 24 hours, those who can drink must be 20 years of age or older and if driving a vehicle must not exceed 30 milligrams of alcohol. Importantly, there is no discrimination on the age or type of driver's license. All drivers, young drivers or professional drivers must not exceed 30 milligrams.

From what has been said about Japanese law, it is apparent that Japan has been enforcing the law seriously. Moreover, there is also a comprehensive law for motorcycles, bicycles and pedestrians in order to strictly solve the problems of vulnerable road users. Especially the law for large motorcycles it can be found that in Thailand there are no laws for large motorcycles as seriously as Japan. And the law also covers child safety. Therefore, the application of Japanese laws to apply and study is another factor that will cause Thailand to develop traffic laws more efficiently.

2.3 Related accident statistics

Japan used to face a heavy increase in road accidents. Due to the rapid economic growth of the country from the late 1950s to1970s. In the early 1960s, accidental deaths were higher than the average annual death rate. During the First Sino-Japanese War in 1894-1895, the death toll reached a peak of 16,765 in the 1970s and dropped to 8,719 in 1981 with the endeavors of the Japanese government.

The number of cars and the total distance that the whole country runs continuously. Although there are organizations tried to reduce this risk, the deaths annually number increased again in 1981 and reached 11,452 cases in 1992. However, after 1992, the number of annual deaths steadily decreased. While the number of accidents increased steadily until 2004, therefore decreased. From the report of Japan times and Nation Police Agency said Japan's road safety is divided into 4 eras as follows:

The first era: 1951-1970 "The economy grew rapidly. Road deaths have increased markedly". The annual death increased from 4,429 in 1951 to 16,765 in the 1970s, or almost 4 times. The number of cars increased from about 413,000 vehicles to 16,528,000 vehicles, the population increased from 7 million people to 87 million people or 23%. GDP increase from 5 trillion yen in 1955 to 75.3 trillion yen in the 1970s, or almost 9 times, bringing a high increase in the number of vehicle ownership. It is the main cause of the rising trend of death at that time. Transportation development is still slower than rapid economic growth. The total road length has increased from 923,000 kilometers in 1953 to 1,024,000 kilometers in 1970, or less than 11% over the last 17 years. 1960 The Road Transportation Law enacted alcohol restrictions for motorists as specified under this law.

The installation of traffic signals in the 1960s and 1970s found that traffic lights significant results in reducing the number of road accidents. Accidents were reduced by 31-64%, injuries were reduced by 32-75% and deaths were reduced by 50-89%.(National Police Agency, 2018)

The second era 1970-1981 "Japanese government's hard work" The number of deaths dropped to 8,719 in 1981, about half of the maximum was 16,765 in 1970. The number of vehicles has more than doubled. The population has increased by 13%. GDP grew by almost 5 times, but the length of roads has increased less than10%. 1975 Force to wear helmets. 1981 Legislation for promoting safe bicycle lanes And Law for promotion of safe use of bicycle lanes and provision of bicycle parking.

The third era: 1981-1992 Another 'boom' economy more cars and dead. Japan has to face the gradual increase of the dead. Despite constant efforts from all sectors such as government, industry, educational institutions And the general public Although the number of deaths increased by about 500 people in the first half of the second era (1981-1986), but in the second half, it increased more than 2,000 people the second half It is a period called the Bubble Economy Period, which is the period when GDP has grown from 260 trillion yen in 1981 to 471 trillion yen in 1992, or more than 8 times, and the number of cars increased from 37 million cars in 1980 to 62 million vehicles in 1992, or nearly 1.7 times, causing overall distance of traveling throughout the country increased. Therefore, the factors that cause a significant increase in accidents.

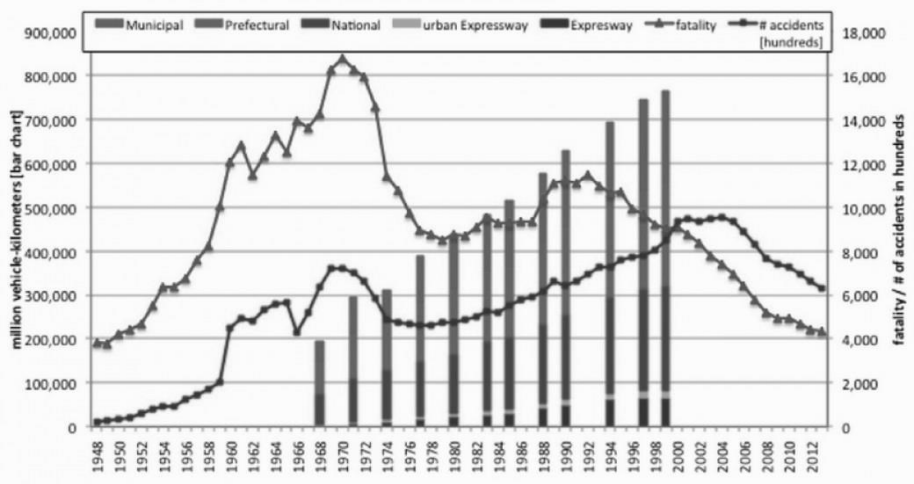


Figure 2-3: Vehicle millage and death rate in Japan
(Source: Nation Police Agency, 2017)

Last era: 1992-Present the annual number of road deaths continues to decline in 2002, down to 8,396, the lowest after this level in 1981 = 8,719 cases. In 2000, seats must be available for all children under 6 years of age. In 2015, to get a driver's license driver must practice up to 34 hours and must attend "History of road deaths and the creation of safety in Japan". About law and vehicle mechanics for up to 26 hours to obtain a general driving license, according to the Road Traffic Law regulations.

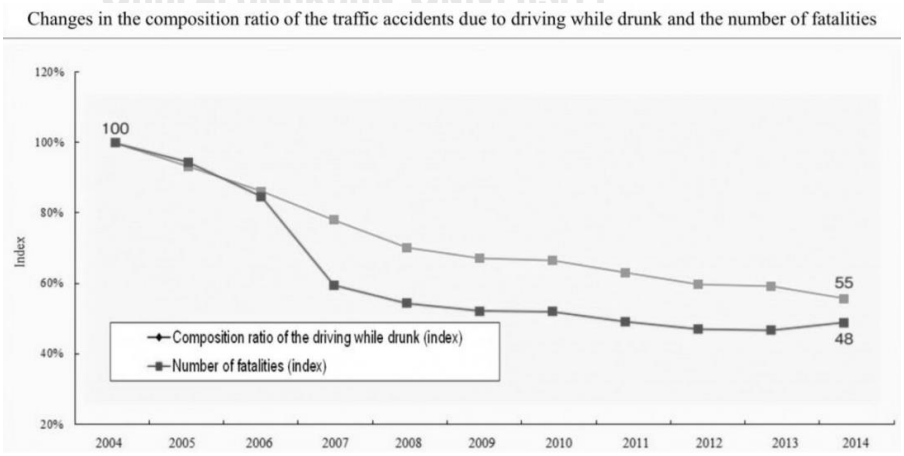


Figure 2-4: Drunk driving fatalities index
(Source: Cabinet Office Government of Japan, 2014)

Found that after becoming aware of the tragedy of drunk driving in the Japanese society that began again during the years 2006-2007, the death rate from accidents caused by drunk drivers in Japan has decreased significantly. That was said to be a tragedy in Fukuoka in 2006 (The Japan Times, 2006) brings us to the current drunk driving law in Japan (Act No. 105), which was released in September 2007, with rough details as follows:

1) Driving While Intoxicated (DWI) Blood Alcohol Content (Blood Alcohol Content / Concentration: BAC) 0.08 and up, imprisonment not exceeding 5 years or a fine not exceeding 1 million yen. (284,250 Thai Bath)

2) Riding under the influence of alcohol (Driving Under the Influence: DUI) is the breath alcohol level 0.15 Mg / l or blood alcohol level between 0.03 and 0.07999, imprisonment not more than 3 years or fined not more than 500,000 yen. (142,125 Thai Bath)

3) Refuse to blow alcohol, imprisonment for no more than 3 Month or a fine of not more than 300,000 yen (85,275 Thai Bath).

4) Hit and run, imprisonment for no more than 10 Years or a fine of not more than 1 million yen.

Due to the accident data collection, make known of the difference in the number of accidents each year. Including some factors that cause the increase such as the number of cars in the road increase, urban expansion, increased roads and economic expansion or specific causes such as drinking alcohol, which tends to increase significantly. Therefore, the law has been strictly enforced up to the present day and found that the accident rate has decreased significantly as well.

From the previous topic that discussed the concepts of law in Japan Moreover, the comparison of accident statistics can be summarize the differences between the two countries that used in this study. Considered from Figure 2-5 shows the rate of road accidents per 100k people, both Thailand and Japan. Data in 2017 showed that Thailand had a ratio of 36.2 and Japan at 2.91.

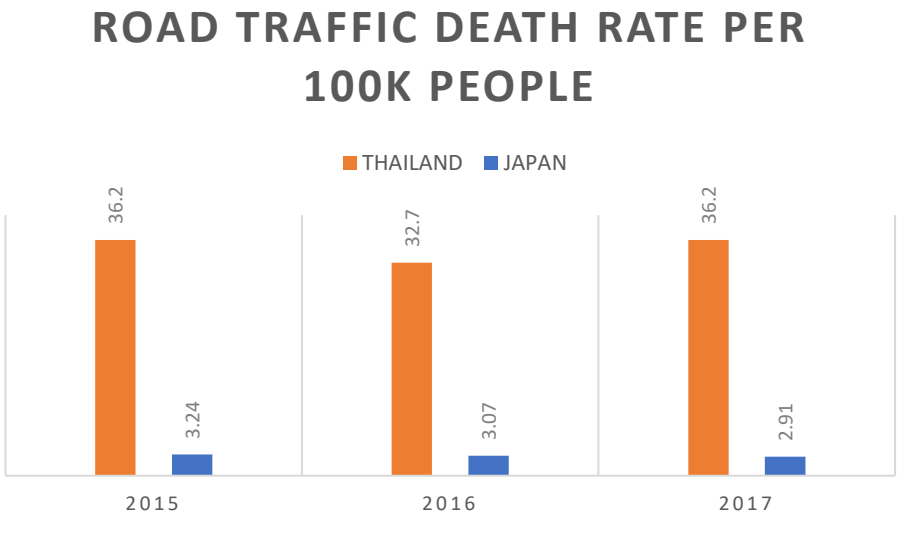


Figure 2-5: Road Traffic Death Rate Per 100k People
(Source: WHO, 2017)

2.4 Road user behavior

Research related to the behavior of most teenage road users is using descriptive statistics, regression analysis or multiple regression analysis. By the methods mentioned above, there are limitations in analyzing many variables simultaneously. Which to analyze, it is necessary to use a structural equation model analysis method to solve it.

By reviewing the literature, the researcher has studied and reviewed the research based on the behavior violations of road users. Whether from the analysis of other forms of statistics to be studied and adapted to the research of structural equation models of vulnerable road users that violate traffic rules. The next section will be a study related to the behavior of vulnerable road users from using both descriptive statistics and structural equation models.

Hezaveh, Zavareh, Cherry, and Nordfjærn (2018) studied the errors and violations of bicycles by using the Psychological model applied and designed a questionnaire to measure the bicycle crash behavior and violations, called “Bicycle Rider Behavior Questionnaire” (BRBQ) were tested with a 306 sample of bicycling in Iran. The study said that to analyze the dimensions with the Varimax Rotation method, able to identify the behavior of bike users into 5 dimensions, including: "Stunts and Distractions", "Traffic Violations", "Notice Failures", "Control Errors", and "Signaling Violations" with Cronbach's alpha ranging from 0.70 to 0.84. The results show that males tend to be more involved in stunts and distractions than females. Moreover, females were found to have more control error behavior than males. As a result of the Bivariate correlations between behavior and driving

experience, found that more experienced people will less error behavior, when the driver is older, control errors and signal violations will increase as well.

Table 2-1: Average score of male and females on BRBQ dimensions

Average score of males and females on BRBQ dimensions.

Dimensions	Male	Female	Z (p value)
Stunts and Distractions	2.02 (0.79)	1.66 (0.79)	-4.23 (0.000)
Control Errors	1.67 (0.56)	2.00 (0.76)	-4.36 (0.000)
Traffic Violations	1.98 (0.67)	1.90 (0.80)	-1.16 (0.248)
Signaling Violations	2.96 (1.14)	2.74 (1.08)	-1.20 (0.229)
Notice Failure	1.92 (0.71)	1.81 (0.82)	-1.24 (0.214)

(Source: Hezaveha et al., 2018)

Table 2-2: Correlations between Self-reported clash and BRBQ dimensions

Table 5

Correlation between the BRBQ dimensions, self-reported multi-vehicle crashes, and rider's characteristics.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	**All self-reported multi-vehicle crashes**	1																	
2	**Self-reported at fault multi-vehicle crashes**	.65**	1																
3	**Traffic Violations**	.23**	.21**	1															
4	**Stunts and Distractions**	.19**	.22**	0	1														
5	**Control errors**	0.02	0.05	0	0	1													
6	**Notice Failure**	0.02	0.04	0	0	0	1												
7	**Signaling Violations**	0.04	-0.06	0	0	0	0	1											
8	**Riding hours per day**	.22**	0.09	0.03	.31**	-.15**	-0.01	.12**	1										
9	**Riding experience**	-0.03	-0.09	-0.05	-0.06	-.13*	-.14*	.13*	0.04	1									
10	**Rider's age**	-.24**	-.19**	-.12*	-.36**	0.1	-.14*	.11*	-.32**	.28**	1								
11	**Education**	-0.07	-0.01	-0.05	-.28**	.12*	-0.11	0.06	-.31**	0.1	.35**	1							
12	**Gender**	0.02	0.03	0.05	.19**	-.22**	0.06	0.08	.24**	.24**	0.01	-0.1	1						
13	**Professional Bicycling**	-0.01	-0.04	-0.02	-0.03	-0.02	-0.03	-0.06	-0.09	0.06	0.06	.19**	-0.03	1					
14	**Recreational Purpose**	-0.01	0.01	-0.01	-0.12*	-0.02	-0.08	-0.14*	-0.18**	0.07	0.21**	0.23**	-0.02	-0.52*	1				
15	**Other Purposes**	-0.11**	-0.11**	-0.05	-0.14**	0.14**	0.02	0.11**	-0.13**	-0.00	0.12**	0.10*	-0.06	-0.25**	-0.69**	1			
16	**Urban Context**	0.16**	0.17**	0.09*	0.23**	-0.12**	0.00	0.11**	0.24**	0.10**	-0.07	-0.07	0.26**	0.15**	0.08*	-0.23**	1**		
17	**Rural Context**	-0.22**	-0.28**	-0.08*	-0.17**	0.05	0.00	-0.056	-0.15**	-0.054	0.08*	0.04	-0.18**	-0.05	-0.11**	0.17**	0.63**	1	
18	**Mountainous Context**	0.01	0.05	-0.04	-0.14**	0.09*	-0.011	-0.092*	-0.17**	-0.09*	0.00	0.05	-0.17**	-0.15**	0.00	0.11**	0.65**	0.16**	1

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

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

(Source: Hezaveha et al., 2018)

As shown in Table 2-2 correlation between BRBQ dimensions and self-report clash found the BRBQ dimensions and demographic characteristics. Among the BRBQ dimensions, Stunts and Distractions (for all crashes: $r = 0.19$, $p < 0.001$; for at-fault crashes: $r= 0.22$, $p < 0.001$) and Traffic Violations (for all crashes: $r = 0.23$, $p < 0.001$; for at-fault crashes: $r = 0.21$, $p < 0.001$) had significant positive correlations with self-reported multi-vehicle crashes. Except for Signaling Violations that have a positive correlation with all self-reported multi-vehicle crashes ($r= 0.39$, $p < 0.500$) and a negative correlation with at-fault self-reported multi-vehicle crashes ($r = -0.06$, $p < 0.332$), the rest of the dimensions were positively correlated with self-reported

multi-vehicle crashes. However, these correlations failed to reach significance. This study aimed to develop a bicycle-behavioral questionnaire that follows a similar methodological approach as the motorcycle (MRBQ) instruments. So, BRBQ can be applied to any subset of the bicycling area, and the results will likely differ. This study is limited to the development of the instrument and limited application in other areas of study.

A. S. Cheng and Ng (2010) studied and developed a questionnaire about the violation of motorcyclist traffic rules for Chinese people by making 19 questionnaires and experimenting with a sample of 920 motorcycle riders. The questionnaire was developed by experts in motorcycle driving. From the driving school as a Likert's scale which will be a 2-factor analysis by dividing the driver into 2 types: 1) aggressive violations, 2) ordinary violations. The result of the understanding test or Cronbach's alpha is in the range between 0.876 and 0.914. The test-retest reliability is between 0.729 and 0.829. The results of the questionnaire testing of drivers with accident history and those who have no history of accidents throughout the past 3 years have found that those who have history got a higher score questionnaire with the most significant at $r = 0.75$ ($P < 0.001$). Overall, the area under the ROC graph is 0.75. The results can be reliable and accurate for traffic violations of Chinese drivers. The development of this questionnaire is for Chinese drivers only. If being developed or used, it is necessary to test reliability. Moreover, the new Cronbach's alpha for the sample we are interested in again for another studied area.

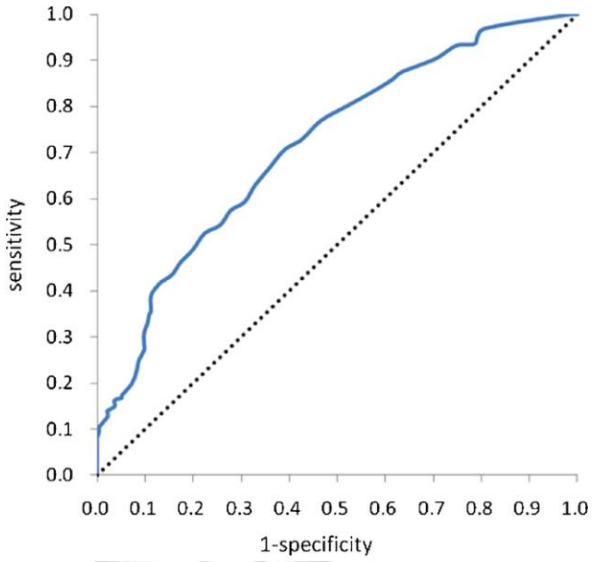


Figure 2-6: Roc Curve of CMRDV total score and accident involvement of motorcycle rider (n=920)
(Source: A. S. Cheng et al., 2010)

A. S. K. Cheng, Liu, and Tulliani (2015) studied the relationship between driving behavior that violates traffic rules and the risk of motorcycle accidents by means of the questionnaire about the behavior, traffic violations and the perception of 621 people who are motorcycle users in China. The questionnaire consists of 3 parts: 1) the driver's information and the history of accidents in the last 3 years 2) the questionnaire about the risk perception 3) the question about traffic violation behavior. Analyzed using bivariate correlation analysis between traffic violation behaviors and perceived risk of accidents. The results showed that the relationship between behavior and perceived risk is significantly related as the researcher has hypothesized on the relationship can predict the participation of motorcyclists in accidents. Important to show that motorcyclists with their history of accidents in the past 3 years will have aggression and their driving is riskier than ordinary people. Moreover, there is still less risk awareness by specifying the risk in the form of belief

rather than their behavior. By the correlation of ordinary and aggressive violations found that indicate the behavior of violations related to the accident is involved shallow incidents r = .15 and .006 respectively, and as for the environment, it is also less (r = .030, r = .076) but they also found that the belief is identified risks are higher than the behavior and external environment (r = .153, r = .174). This study identifies motorcycle riders in Hong Kong and China only. To be adopted, it needs to be improved first, and the researcher has deduced the relationship of driving and beliefs may not be able to infer reliably from this relationship because each individual foundation of belief is different.

Champahom, Jomnonkwao, Satiennam, Suesat, and Ratanavaraha (2019)Champahom, Jomnonkwao, Satiennam, Suesat, and Ratanavaraha (2019)Champahom, Jomnonkwao, Satiennam, Suesat, and Ratanavaraha (2019) studied the model of helmet wearing in Thailand by using TPB (Theory Planned Behavior) and LOC (Locus of Control) to create a structural equation model developed from TPB and LOC. Divided into 6 dimensions 1) Helmet use intention 2) Positive Attitude 3) Negative Attitude 4) Subjective Norm 5) Behavior control and internality) 6) Externality. The questionnaires, 5 and 6, were used to measure internal behavioral factors and external factors of the driver according to the LOC theory and the questionnaire in areas 1-4. It was according to TPB theory.

The researcher collected data from 801 samples from an urban and rural area to be compared with data in 401 urban areas and 400 rural samples taken by SEM. Comparison between 2 study areas showed that there are significant differences by finding that in the urban area, the latent variables affecting helmet wearing are

positive attitudes, control of behavior, and internal factors. The rural areas, found a positive attitude was the most effective and the internal factors, according to the Subjective norms respectively because rural areas have different road usage with urban areas, fewer cars and more people do violations.

Moreover, they also found the result of research between urban and rural areas has many aspects of different results such as the model of user expectations with tour bus drivers, found both areas have different expectations as well. Therefore, each area of the study was significant. The researcher should apply the theory to suit the study area for accuracy and reliability.

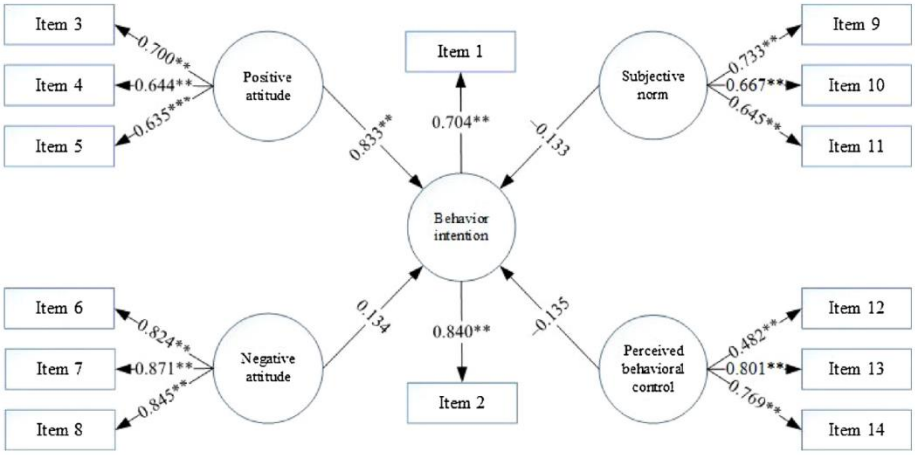


Figure 2-7: The result of the behavior intention in an urban area on the TPB *(Champahom et al., 2019)*

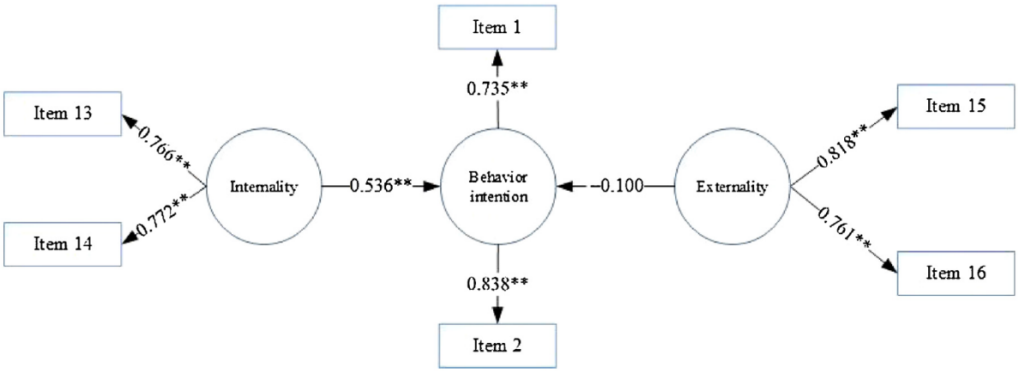


Figure 2-8: The result of the behavior intention in an urban area on the LOC *(Champahom et al., 2019)*

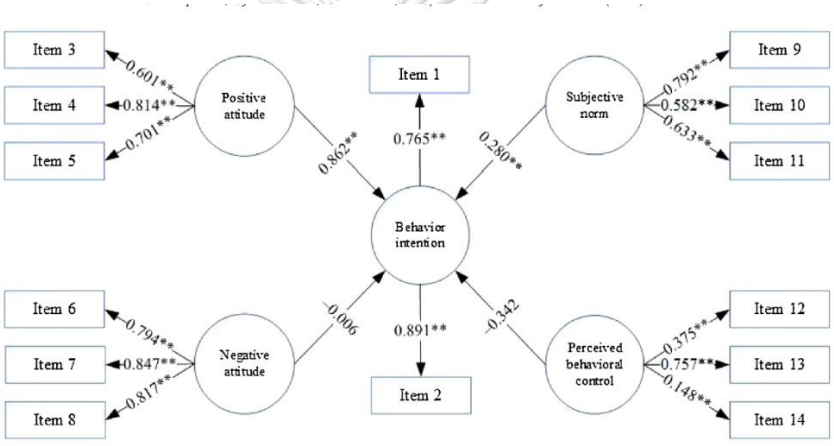


Figure 2-9: The result of the behavior intention in a rural area on TPB Model *(Champahom et al., 2019)*

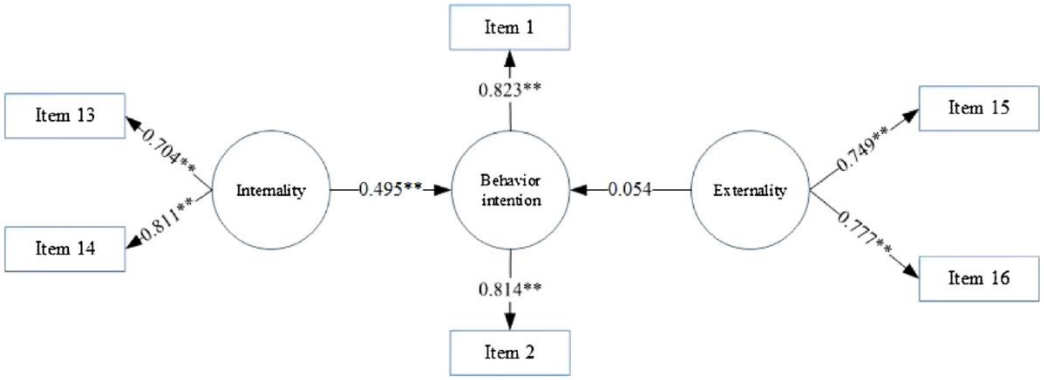


Figure 2-10: The result of the behavior intention in a rural area on the LOC *(Champahom et al., 2019)*

Chang and Yeh (2007) conducted a motorcycle accident study involving age, sex and risk behavior in Taipei, Taiwan. By finding the relationship between age, sex and risk behavior of motorcycle riders with 1451 samples. In the risk behavior, the study was conducted in 3 main topics: 1) carelessness of the driver 2) traffic violation 3) negligence in vehicle inspection by using a two-step cluster analysis and logistic regression model. The study found that young male drivers do not respect traffic rules and also do the violation. The young drivers are very likely to underestimate the driving time and do not check the vehicles properly. However, the questionnaire does not mention the attitude of the driver in the analysis as well.

Topolšek and Dragan (2015) studied the relationship of driver behavior when driving a motorcycle or car by using the Structural equation model. The study aims to explore whether the driver behaves differently between motorcyclists and cars. The researcher conducted the questionnaire in 2 sections. 1) Motorcycle Driving Behavior Questionnaire 2) Driver Behavior Questionnaire by testing with the same sample group. The structure of SEM divides the latent factors into 2 factors: 1) Motorcycle driving behavior 2) Driving behavior using parameter estimation methods the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) methods by Maximum likelihood. The results show that the behavior of motorcyclists affects car behavior with weight values between latent variables equal to 0.59 $p < 0.05$. It can be seen that the relationship is significantly different because motorcycle riders need to be aware of various risks more than driving a car and need more riding skills.

Therefore, motorist riding with safety rather than cars and also confirm that car driver is only concerned about speed violations when compared to motorcycles which require careful monitoring of external factors such as car or road conditions. On the other hand, people who ride motorcycles will push their brave when the perfect road. Therefore, the researcher has suggestions on how to improve traffic policies and laws in order to be consistent with the behavior of motorcyclists and cars. However, the research is only collected in Slovenia. Sampling needs to be adjusted according to factors of the questionnaire to be consistent and suitable for the study area.

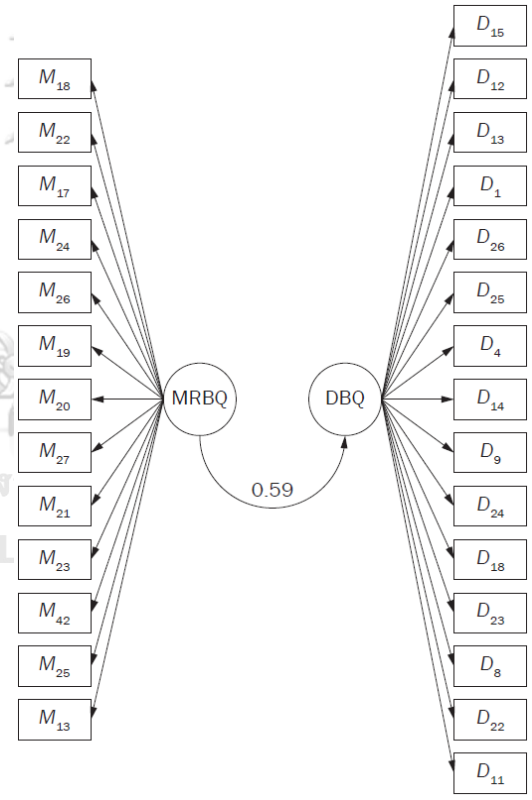


Figure 2-11: The regression weight between Driving and Riding Behaviors
(Source: Topolšek, 2015)

Elliott, Baughan, and Sexton (2007) studied the errors of behavior and violations of traffic rules related to the collision risk of motorcyclists by 1) creating a

questionnaire to ask the behavior of motorcyclists 2) testing behavior to predicted as a risky driver. The questionnaire consists of 43 topics to measure the behavior of motorcycle riders by testing with samples which are a motorcycle rider n = 8666. Section 1 of the questionnaire, the behavior can be divided into 5 parts as the following 1) traffic error 2) control error 3) speed violations 4) performance of stunts, 5) use of safety equipment. Section 2: Name, gender, age, driving experience (Driving hours) and the estimated distance of driving in the past 12 months. Section 3: The information of the crash asks about the number of collisions that occurred during the past 12 months and the number of times blames clash. Using the data obtained from the questionnaire to analyze by dividing the collision behavior into 2 types are 1) all clash 2) blame clash. The results of the analysis with General linear modeling (GLM) found that traffic error ($z=4.00$ $P<0.01$) is an essential factor in predicting the outcome of all clash cases. Regard to clashing, the factor of control error and speed violations ($z = 2.46$, $z=2.50$ $P<0.001$) is a factor in the predictions that have both significant. The researcher classified the behavior mentioned above is quite detailed and in-depth. To make it possible to estimate the cause directly.

Zhou et al. (2016)Zhou et al. (2016)Zhou et al. (2016)Zhou et al. (2016) studied on pedestrian crossing violations by using the TPB model. This model was conducted in Dalian, China with 260 samples. The questionnaire is divided into 3 dimensions according to the TPB and the dimension of interest is added into 3 dimensions which are 1) Descriptive Norm 2) Perceive Risk 3) Conformity Tendency to evaluate their respective impacts on pedestrian’s behavior intentions. The

researcher has divided the model to use as a study of 4 models based on the TPB model as the main and analyzed with SEM. The results from the study found that attitude ($\beta = 0.43$ $p < 0.001$) affects the crossing of most pedestrians in China which is most people are aware of crossing road danger that violates traffic rule, causing accidents and also recognize that there is a risk of accidents. The result also shows helpful attitude and subjective norm were significant in the basic TPB model after adding a descriptive norm (β=0.27 $p<0.01$) instead of perceiving behavior, the subjective norm was not significant. Because subjective norms and descriptive norms are nearly the same, but the subjective norm is more like the attitude of the family and friend or people who essential but the descriptive norm is an action. Based on the results, descriptive norm appeared to be a more reliable predictor than the subjective norm. In other words, the action of the family members and friends is more influential on pedestrians than whether or not they approve of the behavior. Other models show that conformity tendency was a strong predictor too, indicating that the presence of other pedestrians would influence behavioral intention.

Table 2-3: Regression weight of the model

	Model 1			Model 2			Model 3			Model 4		
	Estimate	S.E.	*P*	Estimate	S.E.	*P*	Estimate	S.E.	*P*	Estimate	S.E.	*P*
IA	0.082	0.021	**	0.075	0.021	**	0.096	0.021	**	0.070	0.022	**
SN	0.043	0.014	0.003*	0.021	0.016	0.186						
PBC	0.138	0.092	0.136	0.100	0.100	0.315						
DN				0.223	0.083	0.007*	0.314	0.073	**	0.217	0.0917	0.008*
PR							0.103	0.064	0.111			
CT										0.243	0.075	0.004*

* Significant at 0.01.
** Significant at 0.001.

(Source: Zhou et al., 2016)

The results of the study can help to design more efficiently and safety campaigns, such as changing people's attitudes towards this violation of behavior.

Amending social norms, increasing safety awareness to reduce road crossing violations. The limitations of this study are the bias of reported behavior, especially negative behavior. If it is a negative question, people will not respond truthfully, making it challenging to collect data. In order to keep high internal reliability of the data, a small number of items were included in the final questionnaire, which could affect the results.

Hajek et al. (2018) studied the age and gender factors of motorcyclists who were students violated traffic rules by using the Structural Equation Model at Mataram City, Indonesia. Most accidents are interested in the framework of motorcycle drivers who are students of the sample group, a total of 394 people to do questionnaires related to 3 parts as follows: 1) Driving behavior 2) Traffic violation and 3) Causes of accidents. Analyzed by using the Structural Equation model, 87.5% of drivers are students who do not have a driver's license and 53.7% about 17 years old students have related to accidents. Moreover, it also found that the relationship between driving behavior and traffic violation (r^2 = 0.814) and traffic violations with accidents (r^2 = 0.285) are also important indicators. Gender and age show significant differences (chi-square) and values between relationships of driving behavior and traffic violation and accidents as well. The male behavior and traffic violations will be less. The percentage of 6%women and students younger than 17 years are more susceptible to violations than other groups. (See Table 2-4)

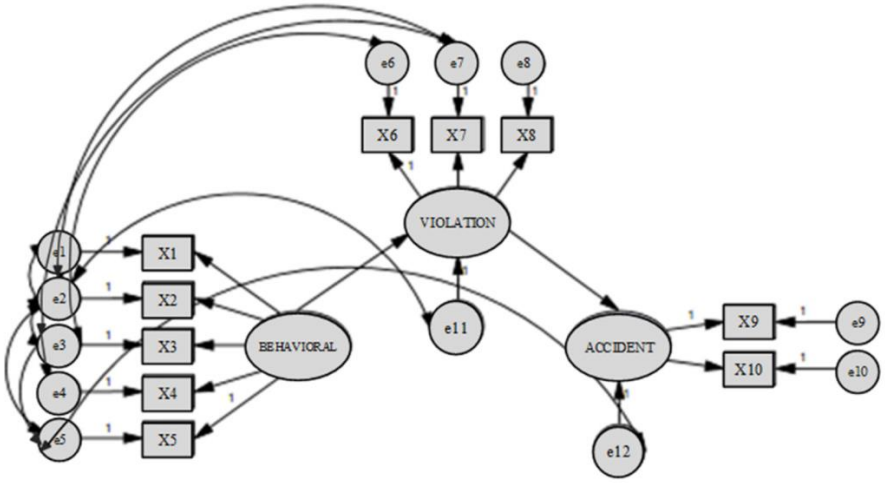


Figure 2-12: Structural equation model of traffic violation
(Source: Hajek et al., 2018)

Table 2-4: Regression weight of the variable

Relationship	estimate
Violations ← Riding behavoior	0.439
Accident ← Violations	0.375
X5 ← Behavior	0.454
X4 ← Behavior	0.675
X3 ← Behavior	0.454
X2 ← Behavior	0.246
X1 ← Behavior	0.574
X6 ← Violations	0.655
X7 ← Violations	0.787
X8 ← Violations	0.416
X9 ← Accident	0.740
X10 ← Accident	0.674

Source: Output of AMOS V. 22.0

(Source: Hajek et al.,2018)

Wong, Chung, and Huang (2010) studied risky driving behavior of young motorcycle riders by using a questionnaire to collect a sample of 683 people between the ages of 18 to 28 years by collecting data of 7 latent variables: 1) Sensation seeking 2) Altruism 3) Normless 4) Riding Anger 5) Risk perception 6) Utility perception 7) Attitude toward Safe Riding which are the relationship of personality of risky motorcyclist. Developed from the structure of TPB and applied the data to analyze in 2 steps, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) by Maximum likelihood. The model is fit from EFA and CFA analysis, as shown in Figure 2-13.

The results from the analysis can be summarized as follows. Conclude that the critical factor in risky behavior is Sensation Seeking, Amiability and Impatience are the main factors of personalities that cause unsafe riding among teenagers whom the

adult rider will ride safer because the teenager will seek too much excitement and too much self-confidence without being aware of an accident or anxiousness. Moreover, the impatient, low-confident riding and lack of traffic awareness will cause a significant accident as well. However, being afraid too much could be another factor that makes riding unsafe.

Therefore, the researcher recommended that the policy of the driver's license be adjusted more strictly. Besides, it will also help with proper training giving awareness of danger but not too much and including the development of the Intelligent Transportation System (ITS) according to teenager riding to reduce further accidents.

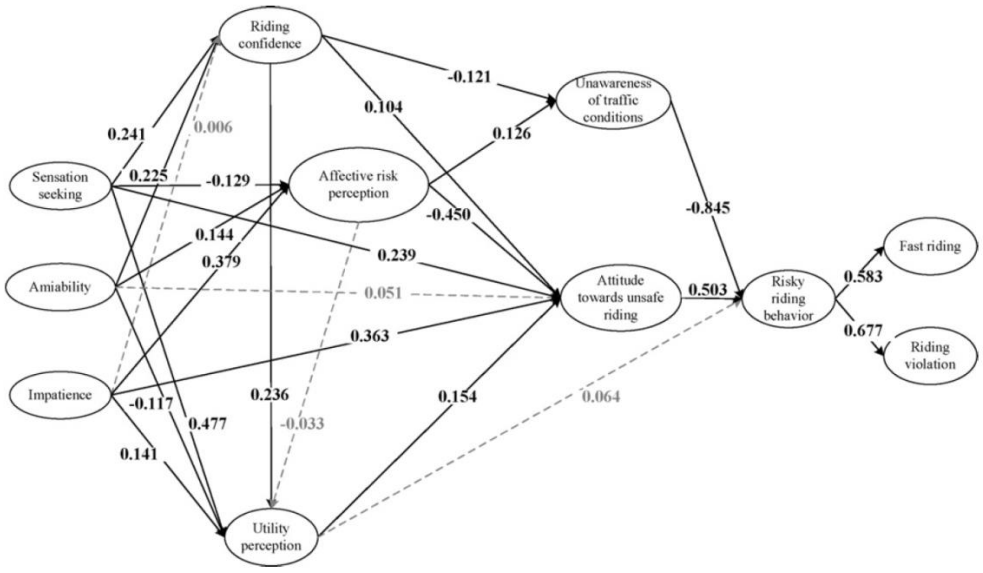


Figure 2-13: The regression weight of the risky behavior on teenager
(Source: Wong et al., 2010)

2.5 The Theory of planned behavior

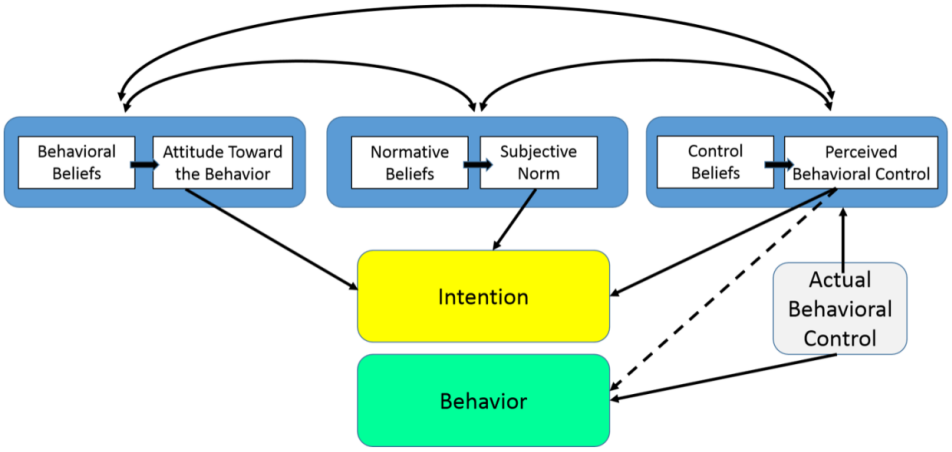


Figure 2-14: Model of the Theory of Planned Behavior
(Source: Ajzen, 2006)

In psychology, the theory of planned behavior (TPB) (see Figure 2-14) 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 (2006) 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. While 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 Perception of the ability to control behavior or called Perceived Behavioral Control.

2.5.1 Behavioral beliefs

An individual's behavioral beliefs serve as the link between their behaviors to the outcome that the behavior is expected to produce or bring about. It is a person's behavioral beliefs that will have a direct influence on their attitude toward behavior. If the expected outcome is something favorable, then there is no doubt that they will also have a positive attitude toward the behavior, increasing the likelihood of actual performance.

Primarily, the behavioral beliefs of a person will focus on favorable or unfavorable. For example, we believe that using a public car is a way to reduce global warming. If everyone agrees, there will be helpful. Moreover, the indirect advantage is also to solve the traffic jams.

2.5.2 Normative beliefs

If decisions on actions and behaviors were made solely by the individual, predicting their responses is going to be easy. However, since there are other – internal and external – factors at play, that is not the case.

Normative beliefs involve the key people or characters around the individual, precisely their behavioral expectations as they perceive them to be. On top of that, it

is also shaped in part by the level of importance that they place on these people's expectations. Together, these determine the subjective norm that will play an important part in his decisions on whether to behave in a certain way or not. For example, a person with a private car and driving to work a regular basis, there is someone who has no car traveling around, they will use a public car into groups. Then some of them will stop using their own car and use public transportation instead. We can find this type of behavior very often in adolescents.

2.5.3 Control beliefs

Perceive the presence of factors (called 'control factors') that will have an impact on how the performance of the action will go. These are the control beliefs, which will dictate your perceived behavioral control. Each control factor can be viewed individually, and your perception of the power of one control factor may be different from the power of the other control factors. If there is a high probability that the power control factor is present, it will very likely to act as a line with the power factor.

For example, using a public car to the workplace does not have the policy to enforce the use of public vehicles to work. However, if there is a policy and effective use of public cars to work, the behavior of the company will change. Moreover, they tend to use more public cars as well.

When combining all three beliefs will result in the intention of the person's behavior which will lead to the inevitable behavior. By a direct relationship between these three elements If both the attitude and reassessment of the reference group are

positive and the firm belief that you can doa behavior, it means enhancing the intention of showing that behavior.

However, if considering the model, it is found that perceived behavior control can be relevant and will continue to affect the behavior at all times. This means that even after the behavior has begun, there is still a possibility that awareness still affects the performance of the behavior.

2.6 Summary

Ajzen (2006) studied human behaviors which is an indication of human actions that will consist of influences from 3 factors: 1) beliefs about the consequences of actions and assessments from actions (Behavioral Beliefs) which can be both positive and negative. It is called the attitude of action 2) beliefs about reference groups and motivations (Normative Beliefs) that will defer referencing groups which will be expressed in the form of social pressure or the other way is called Subjective norms. 3) Beliefs about factors that support or interrupt actions behavior and perception of these factors is called Control Beliefs. Therefore, when 3 factors together will result in humans acting out that behavior will call the intention to behave (Behavioral Intention) is one of the most theoretical frameworks that have been picked up due to clearly showing human behavior and has been tested to be able to fit together in many models.

From a literature review related to the behavior of vulnerable road users. The past studies found that there are many different factors such as thought and attitude, personality factors or even personal status, gender, age, education level, driving experience, etc. By violating the traffic were influenced mainly by the TPB

conceptual framework due to the behaviors that follow the pattern with an attitude driven primarily. However, in many types of research, they also found not only the attitude will determine behavior but also develop the conceptual framework of TPB to be suitable for the study area and pull out complex behavior to explain by using SEM analysis to be fit and compatible with more detailed data and behavior. The researcher compiled all the factors together to creating factors that affect vulnerable road users and the drafting model for development. The model used to develop uses the theoretical behavioral framework is the set belong to attitude towards behavior subject norms and perception of the control of plan behavior theory, in order to measure the behavior of vulnerable road users. Moreover, personal factors and perceiving risk, the researcher wanted to be a part in measuring the behavior of vulnerable road user according to the conclusion of Andy et al. (2015) discussing the behavior of motorcyclists and Hajek et al. (2018) , Mentioned to personal status, sex and age to compare with driving experience in this model and measurement, Does the behavior affect the violation of traffic rules? The behavior of users of Thai and Japanese teenagers will follow the above conclusion or not? The TPB model framework used to measure the psychology of vulnerable road users (Ajzen, 2006) and the violation behaviors model used to measure the behaviors.

Chapter 3
Methodology

3.1 Overview of Methodology

From the previous literature review, all three related models of vulnerable road users can be synthesized based on the Bicycle Riding Behavior Model (Hezaveha et al., 2016) ,Motorcycle Riding Behavior (Elliott et al., 2007) and Pedestrians Behavior (Zhoua et al., 2016) to measure violations of the 3 modes as follows :

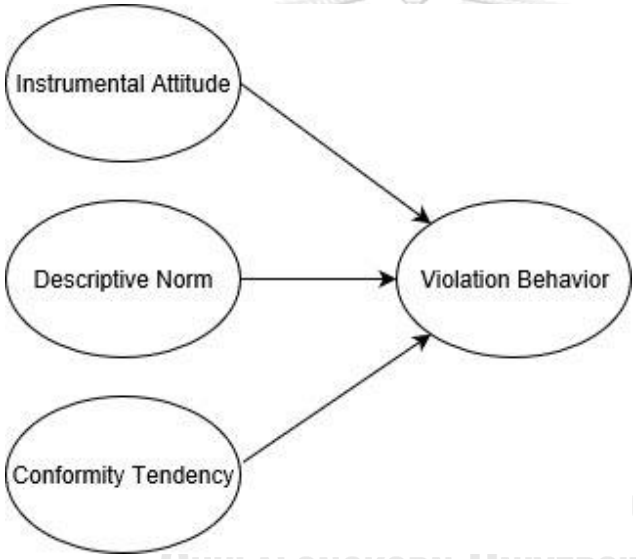


Figure 3-1 :Draft Pedestrian model framework

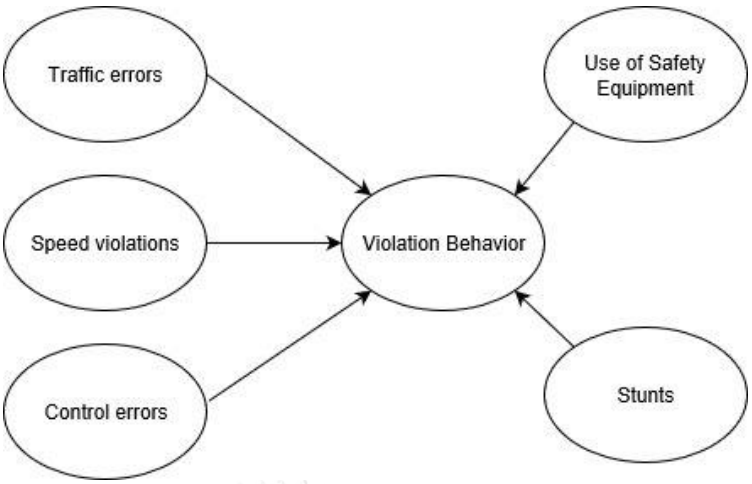


Figure 3-2: Draft motorcycle model framework

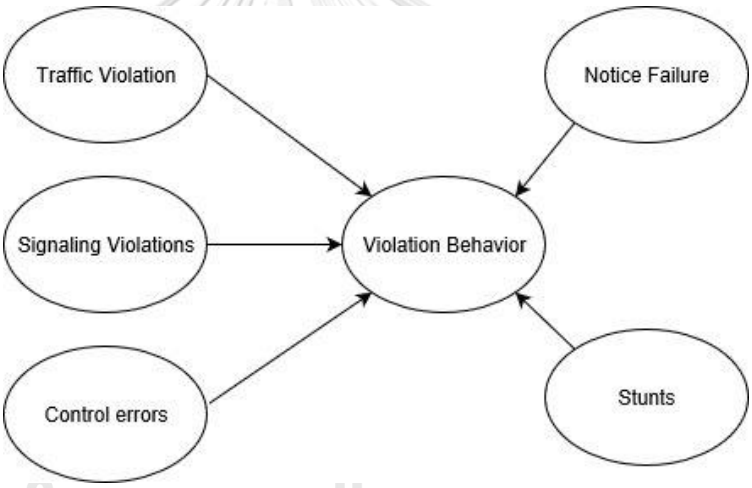


Figure 3-3: Draft bicycle model framework

This chapter present the methods of planning and surveying data. In order to study the violating behavior of vulnerable road users, all steps of the survey and data collection process for analysis are “Survey Research”. With steps as in Figure 3-1 from the start of studying and reviewing the literature to be used to design questionnaires and collect data and analyze the structural equation model of vulnerable road user behavior.

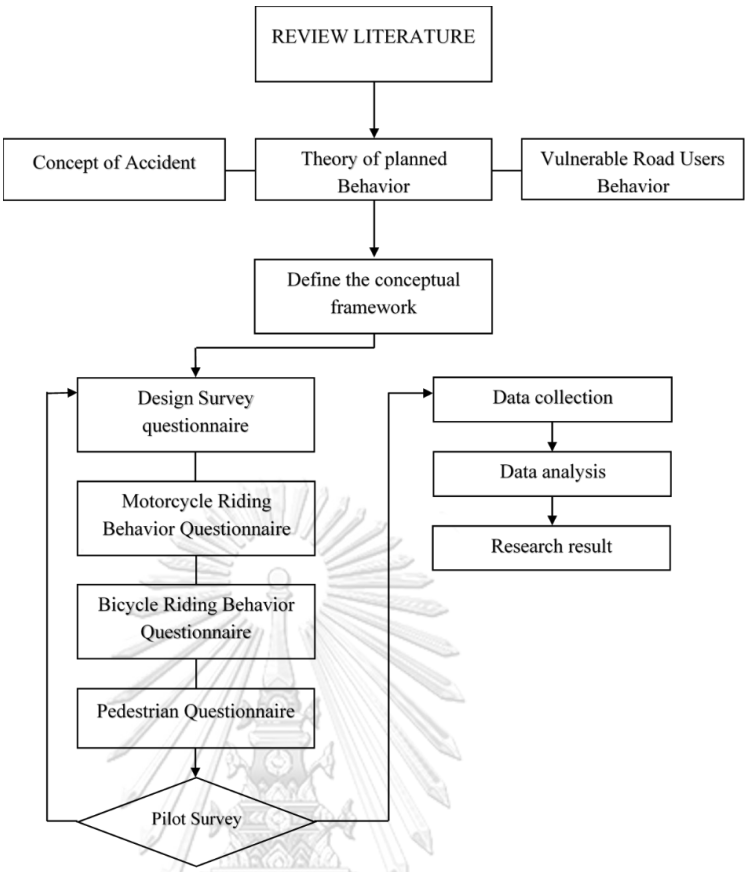


Figure 3-4: Research Methodology

2.6 Concept of Structural Equation Model, SEM

The structural equation model was started from a model of influence analysis or path analysis, a causal analysis in one direction from left to right. The structural equation model is a statistical technique used in testing and estimating causal relationships. The structural equation model is intended for both analytical testing or builds a theoretical model. In addition, structural equation models can test the characteristics, direct Effects, and indirect Effects assumptions between the observed variables (variable that can be measured) with latent variables (variable that cannot be measured), which allows an error in measurement and error in correlated.

Another apparent difference between SEM and other data analysis techniques is that SEM estimates multiple regression equations over and over again at one time. By each equation separated but have a relationship which defined as a structural model (structural model) or in other words, SEM will not analyze the relationship for each variable (dependent variable) with many variables in the analysis. Including latent variables that are independent variables created in a relationship, maybe classified as a dependent variable in another relationship.

2.6.1 Elements of structural equation models

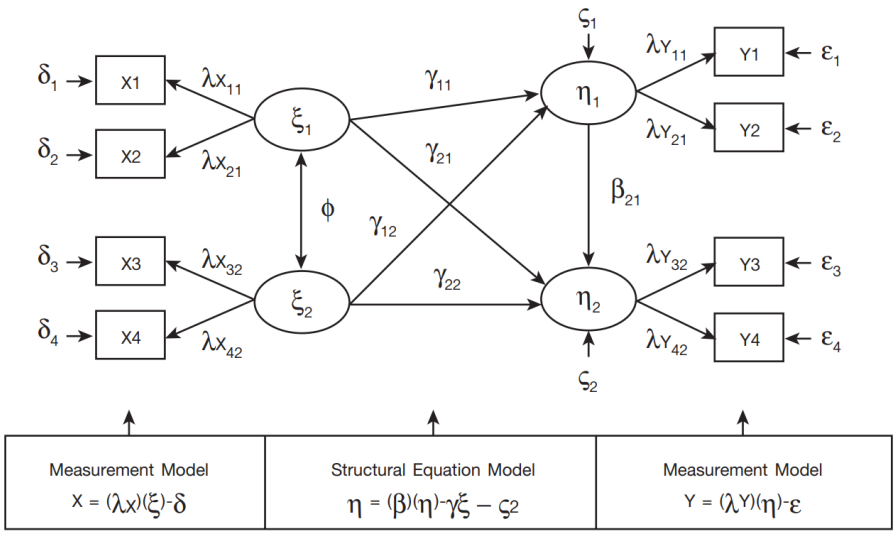


Figure 2-15: Elements of structural equation models

Figure 2-15 shows examples of structural equation models with full elements that consist of exogenous variables and endogenous variables, both external and internal variables, consisting of latent variables and observable variables. Latent variables cannot be measured on their own. However, it can be measured by observing variables that are the elements of each variable.

The full structural equation model consists of two essential sub-models: Measurement model and Structural model. The measurement model is a model that shows the relationship between latent and observable variables or measurable variables. The measurement model will have both Measurement model for external variables (Exogenous measurement model) and measurement models for internal variables (Endogenous measurement model). For structural equation models is a model that shows the relationship between external latent variables and internal latent variables. The relationship models can be written in the form of the following matrix equations.

1. A measurement model for external variables

$$X = \Lambda_X \xi + \delta$$

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} \lambda_{X11} & 0 \\ \lambda_{X21} & \lambda_{X22} \\ 0 & \lambda_{X32} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{bmatrix}$$

$$X_1 = \lambda_{X11}\xi_1 + \delta_1$$
$$X_2 = \lambda_{X21}\xi_1 + \lambda_{X22}\xi_2 + \delta_2$$
$$X_3 = \lambda_{X32}\xi_2 + \delta_3$$

Equation (1)

2. A measurement model for internal variables

$$Y = \Lambda_Y \eta + \varepsilon$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix} = \begin{bmatrix} \lambda_{Y11} & 0 \\ \lambda_{Y21} & 0 \\ 0 & \lambda_{Y32} \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix}$$

$$Y_1 = \lambda_{Y11}\eta_1 + \varepsilon_1$$
$$Y_2 = \lambda_{Y21}\eta_1 + \varepsilon_2$$
$$Y_3 = \lambda_{Y32}\eta_2 + \varepsilon_3$$

Equation (2)

3. A measurement model for the structural equation model

Equation (3)

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0 & 0\\ \beta_{21} & 0\end{bmatrix}\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} + \begin{bmatrix}\gamma_{11} & 0\\ \gamma_{21} & \gamma_{22}\end{bmatrix}\begin{bmatrix}\xi_1\\ \xi_2\end{bmatrix} + \begin{bmatrix}\zeta_1\\ \zeta_2\end{bmatrix}$$

$$\eta_1 = \gamma_{11}\xi_1 + \zeta_1$$

$$\eta_2 = \beta_{21}\eta_1 + \gamma_{21}\xi_1 + \gamma_{22}\xi_2 + \zeta_2$$

The variable explanations as follow:

X = Eks = Exogenous Variable vector

Y = Wi = Endogenous Variable Vector

ξ = Xi = Exogenous Latent Variable vector

Η = Eta =Endogenous Latent Variable Vector

δ = Delta = Measurement error vector of variable X

ε = Epsilon = Measurement error vector of variable Y

ζ = Zeta = Measurement error vector of variable Η

Λx = Lambda-X = Regression coefficient Matrix of X on Y

Λy = Lambda-Y = Regression coefficient Matrix of X on Y

Γ = Gamma = Causal Influence Matrix from ξ to Η

β = Beta= Causal Influence Matrix between η

Φ = Phi=Variance - Joint Variance Matrix between Exogenous Latent Variable vector ξ

2.6.2 Types of structural equation models

Joreskog and Sorbom (1989) have divided the equation model into 3 types of models.

1. Measurement Model and Confirmatory Factor Analysis Models

Consisting of latent external variables and external variables can be observed, but there are no internal variables written in the form

The equation is the following:

$$X = \Lambda_X \xi + \delta$$ Equation (4)

The group model is divided into 3 types:

(1) Congeneric Measurement Models

(2) Confirmatory Factor Analysis Models and

(3) Multigrain-Multi method Models

2. Causal Structural Models. This group model consists of relationship models both with and without measurement error terms. Models that do not have measurement errors will be composed of all observable variables without latent variables.

The equation is the following:

$$Y = \beta Y + \Gamma X + \zeta$$ Equation (5)

For the case of error terms in the process. The group model will have all the elements like the full structural equation model. And there is a relationship equation

between the variables as shown in the equation (1) (2) and (3). The group of these models is divided into 3 types: 1) Regression Models and ANOVA Models 2) Path Analysis and 3) Multiple Indicators and Multiple Causes Models or MIMIC Models.

3. Non-Observable Exogenous Variable Models. The group model consists of external latent variables, internal latent variables, and internal variables that can be observed as elements or in some cases may be no External latent variable. The equation is the following:

$$Y = \Lambda_Y \eta + \varepsilon$$
$$\eta = \beta\eta + \Gamma\xi + \zeta$$

Equation (7)

The group of the model is also divided into 3 subgroups:

(1) Second-Order Factor Analysis

(2) two-wave Models and

(3) Simplex Models

At present, the structural equation model has been developed in many areas such as economics, transportation, business administration, or even psychology. Most of the analysis with the structural equation model is used when there are many latent variables. Commonly analysis can be used either, but there will be difficulties with hypothesis testing because of many latent variables. Moreover, the data used to observe variables may not be relevant and consistent with the hypothesis. By using the structural equation model, it will be more comfortable and more accurate because it can allow the error values of each variable to be observed by its.

3.2 Conceptual framework and Hypothesis of the study

From the previous literature, to define the conceptual framework of the research, it is to analyze the behavior and attitude of violators of the road user by using descriptive statistics. Moreover, the psychological study will be used as a questionnaire for pedestrians in order to find the cause of the violator's behavior by analyzing the structural equation model due to the psychological behavior model. For variables that will be used to study the causal relationship of the violations of the road users. The researcher has identified latent variables or predictions based on the behavior of motorcycle users (Elliott et al., 2007), bicycle user behavior (Hezaveh et al., 2018) and pedestrians violation behaviors (Zhou et al., 2016)

The behavior of motorcyclists consists of Control Error, Traffic error, Speed violations, Stunts, and Use of Safety Equipment. The behavior of cyclists consists of Control error, Traffic violations, Signaling violations, Notice Failure, and Stunts Pedestrian behavior, which is a model of psychological behavior consisting of Instrumental attitude, Descriptive Norm, and Conformity Tendency. Due to the behavior of pedestrians. Previous studies have found that these three factors are the best model fit for the pedestrian. It is a TPB model developed explicitly for pedestrians, and it has been tested that the new model has significant differences.

Analysis of the Causal Relationship Model of Traffic Violation Behavior of road users. The researcher has defined 3 models of violation behavior, which shown in Figures 2-16, 2-17 and 2-18.

The models in Figures 2-16 and 2-17 are models of motorcycle and bicycle riding behavior, while the models in Figure 2-18 is a model that measures the attitude and behavior of pedestrians, based on the TPB model. This analysis will test the

behavior of road users between Thailand and Japan in order to explain the similarities or differences between the behaviors of both nations. The theory below would be able to explain the behavior of road users reasonably. The researcher has set the hypothesis to test the model as follows:

1) The hypothesis of Motorcycle Riding Behavior Model

   H1: Control error is related to the behavior of motorcyclists.

   H2: Speed Violation is related to motorcyclist behavior.

   H3: Stunt is related to motorcyclist behavior.

   H4: Traffic error is related to motorcyclist behavior.

   H5: Use of Safety Equipment is related to the behavior of motorcyclists.

2) The hypothesis of Bicycle Riding Behavior model

   H1: Control error is related to the behavior of cyclists.

   H2: Notice failure is related to the behavior of cyclists.

   H3: Signaling violation is related to the behavior of cyclists.

   H4: Stunt is related to the behavior of cyclists.

   H5: Traffic violation is related to the behavior of cyclists.

3) The hypothesis of Pedestrian Behavior Model

   H1: Instrumental attitude is related to the behavior of pedestrians.

   H2: Descriptive norm is related to the behavior of pedestrians.

H3: Conformity tendency is related to the behavior of pedestrians.

The latent variables used in various behavioral and psychological measurements have meanings as follows:

- Motorcycle Control error (MCE)

Refers to errors in controlling the vehicles, whether braking without being careful or whether braking while in the curve. The behavior that causes a violation, both intended and unintentional can cause an accident.

- Speed Violations (SV)

Means riding at a faster speed than specified, for example, Fast riding in the rural area, riding fast in villages or residences, etc.

- Motorcycle Stunts (MS)

Mention to riding recklessness and levity and excitement. It was found in teens because of the subjective norm that can be explained by the TPB theory. It is another critical variable to measure riding behavior. For example, Ride very close to the front car while riding at high speed, participate in unofficial races on the road or accidentally causing the rear wheel free (Drift).

- Traffic error (TE)

Means a traffic error such as “Not seeing a pedestrian crossing a road or riding off to the main road without noticing” or “a car is coming and not be able to determine the speed of the approaching, whether it is fast or slow

- Use of Safety Equipment (USE)

Refers to the use of protective equipment when riding a motorcycle. A motorcycle is not safe to ride on the road, and there are many factors can cause accidents. As a result, using protective clothing or helmets is essential to be able to measure riding behavior.

- Bicycle Control error (BCE)

Means a mistake in controlling a bicycle, for example having trouble controlling a bicycle downhill or when riding a bicycle slowly, or not knowing how to use the gear in a bicycle.

- Notice failure (NF)

This refers to an error in the risk perception that will occur. Alternatively, did not notice that certain events occurred, such as did not notice people crossing the road or waiting to cross the road, did not notice that someone was walking down from a parked vehicle, or would not notice the traffic sign at the crossroad.

- Signaling violations (SV)

Refers to violation of the traffic signal at the intersection. It is typical behavior in riding a bicycle because of its high agility which causes many violators to be one of the variables that can measure the behavior of the bike very well. Forgot to give a hand signal when turning, not give a hand signal when to stop.

- Bicycle Stunts (BST)

This refers to the behavior of riding with recklessness and needs excitement, such as riding a bicycle with one hand, taking a picture of yourself while biking.

- Traffic violations (TV)

Meaning a general violation of traffic rules, such as riding at speed to passing red lights, riding in a prohibited place, such as crossing the highway bridge.

- Instrumental attitude (IA)

Behavioral beliefs that will have a direct influence on the attitude toward behavior. If the expected outcome is something favorable, then there is no doubt that it will also have a positive attitude toward the behavior, increasing the likelihood of actual performances. For example, Respondents were presented with two behavioral beliefs which were: “Crossing the road in the scenario described would save me time” and “Crossing the road in the scenario described would be more convenient.”

- Descriptive norm (DN)

Each respondent was asked about whether each reference (family and friends in our study) performs the behavior Such as: “My family crosses the road as described in the scenario” and “My friends cross the road as described in the scenario.”

- Conformity tendency (CT)

Conformity tendency was measured Such as: “If other pedestrians cross the road during the red light, I would do the same” and “When I am with companions, I cross the road as described in the scenario.”

3.3 Research Instrument

This research uses surveying techniques and data collection by questionnaire. The questionnaire is divided into 2 sections. 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 5 levels (5 points Likert scale) From 1 - 5. Each number has the following meaning.

- A weighted score is 5 when performed very often or with a negative attitude.
- A weighted score is 4 when performed frequently or with a slightly negative attitude.
- A weighted score is 3 when sometimes performed or with a neutral attitude.
- A weighted score is equal to 2 when performed a little or slightly positive attitude.
- A weighted score is equal to 1 when hardly performed or with a positive attitude.

The questions that are used to measure the latent variables of the teenager road users are in Table as follows:

Table 3-1: Motorcycle Riding Behavior Variable

Latent Variable	Symbol	Observed variable	Questionnaire item
Motorcycle Control Error	MCE1	High-speed motorcycle control behavior.	Find that you have difficulty controlling the bike when riding at speed (e.g., steering wobble).
	MCE2	The ability to control motorcycles while towing.	Unable to control the motorcycle while ride pillion.
	MCE3	Control behavior and understanding of the ability of motorcycles while riding.	Brake or throttle-back when going round a corner or bend.
Speed Violation	SV1	Speed Violation Behavior.	Exceed the speed limit on a country/rural road.
	SV2	Speed violation behavior in an urban area.	Exceed the speed limit on a road.
	SV3	Speed violation behavior at different periods.	Disregard the speed limit late at night or in the early hours of the morning.

Table 3-1 (continued).

Latent Variable	Symbol	Observed variable	Questionnaire item
Speed Violation	SV4	Exciting riding behavior.	Open up the throttle and just ‘go for it’ on good traffic conditions.
Motorcycle Stunt	MS1	Risk perception behavior while riding.	Ride between two lanes of fast-moving traffic.
	MS2	Danger awareness while controlling a car.	Pull away too quickly and your front wheel comes off the road.
Traffic Error	TE1	Being aware of pedestrians crossing the road.	Not notice a pedestrian waiting to cross at a zebra crossing, or a pelican crossing that has just turned red.
	TE2	Traffic sign perception.	Miss “Give Way” signs and narrowly avoid colliding with traffic having the right of way.
	TE3	Being aware of other road users.	Not notice someone stepping out from behind a parked vehicle until it is nearly too late.

Table 3-1 (continued).

Latent Variable	Symbol	Observed variable	Questionnaire item
Use of Safety Equipment	USE1	Awareness of safe riding.	Wear a protective jacket. (leather or non-leather)
	USE2	Awareness of safe riding.	Wear protective trousers. (leather or non-leather)
	USE3	Awareness of safe riding.	Wear helmet protection.

(Source: Elliott et al., 2007)

Table 3-2: Bicycle Riding Behavior Variable

Latent Variable	Symbol	Observed variable	Questionnaire item
Bicycle Control Error	BCE1	Bicycle control at low speeds.	Hard to maintain balance at low speeds.
	BCE2	Bicycle control while high speed.	Have difficulty controlling your bicycle downhill.
	BCE3	Expertise in using bicycles.	Do not know which gear to use.
Notice Failure	NF1	Being aware of other road users.	Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late.
	NF2	Being aware of the pedestrian while turning.	Fail to notice that pedestrians are crossing the street when you are turning.
	NF3	Being aware of the pedestrian at crossing.	Fail to notice a pedestrian waiting to cross at a crosswalk.

Table 3-2: (continued).

Latent Variable	Symbol	Observed variable	Questionnaire item
Signaling and Sign Violation	SV1	The behavior of violate traffic signaling.	Run red light.
	SV2	The behavior of violate the traffic signaling.	Cross the road while green light flashes.
	SV3	Traffic sign violation.	Cycling inverts the road directions.
Bicycle Stunt	BS1	Risky riding behavior.	Riding without having at least one hand on handlebars at all times.
	BS2	Risky riding behavior.	Talk on the phone while riding.
	BS3	Risk perception.	Listen to music while riding.

Table 3-2: (continued).

Latent Variable	Symbol	Observed variable	Questionnaire item
Traffic Violations	TV1	Signaling violation.	Speed up to beat the traffic light turning red.
Use of Safety Equipment	TV2	Traffic sign violation.	Ride in prohibited expressways, highways, interstate routes, bridges, and thruways unless authorized by signs.
Traffic Violations	TV3	Aggressive behavior towards other road users.	Become angered by another road user and indicate your hostility by whatever means you can.
	TV1	Signaling violation.	Speed up to beat the traffic light turning red.

(Source: Hezaveha et al., 2016)

Table 3 3: Pedestrian Behavior Variables

Latent Variable	Symbol	Observed variable	Questionnaire item
Instrumental Attitude	IA1	The attitude of road crossing violation.	Crossing the road in the scenario described** would save me time.
	IA2	Attitude towards saving time.	Saving time is important to you.
	IA3	The attitude of road crossing violation.	Crossing the road in the scenario described** would be more convenient.
	IA4	Attitude toward saving time.	Convenience is important to you.
Descriptive Norm	DN1	Conforming to family behavior.	My family cross the road as described in the scenario.**
	DN2	Conforming to friend or companion behavior.	My friends cross the road as described in the scenario.**
Conformity Tendency	CT1	Conforming to pedestrian behavior nearby.	If other pedestrians cross the road during the red light, I would do the same.

Table 3-3: (continued).

Latent Variable	Symbol	Observed variable	Questionnaire item
Conformity Tendency	CT2	Conforming to the behavior of friends or companions nearby.	When I am with companions, I cross the road as described in the scenario.**
Behavior Intention	BI1	Violate Behavior.	Would you cross the road as described in the scenario.**
	BI2	Violate Behavior.	If you encounter this situation in the future, you would cross the road as described in the scenario.**

(Source: Zhoua et al., 2016)

1) You are on your way to school, work or to handle some affairs and you must go to the other side of the road.

2) You reach an intersection and the current pedestrian signal displays turn to red light.

3) You are in a hurry so you take your chance and cross the road in a gap in the traffic."

3.3.1 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 (Nunnally and Bernstein, 1994). 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

3.4 Population and Sample

The population used in this study are teenagers aged between 15-29 in Bangkok, Thailand and Sapporo, Japan. The scope of research focuses on teenager behavior in Bangkok, Thailand and Sapporo, Japan. The place which has many teenagers was nearby the university. From statistics, Chulalongkorn University has 48,917 students, including undergraduate, graduate, Ph.D. (Chulalongkorn University, 2019) and Hokkaido University has 20,936 students, including undergraduate, graduate, and Ph.D. (Hokkaido University, 2019).

Primarily teenagers are at risk and use roads regularly (WHO, 2019). 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.

3.4.1 Sampling Method

The study will utilize the non-probability of respondents for both Thai and Japanese teenager road users which is the motorcycle, bicycle, and pedestrian. Using

purposive sampling according to the mode of travel which is 100 for each mode. (Hair, Black, & Babin, 2010) (see Table 3-4)

Table 3-1: Number of sample size for Structure Equation Model

Number of construct	Number of indicators	Communality	Number of Sample Size
≤ 5	≥3	High(≥.6)	Minimum 100
≤7	≥3	Modest(≈ .5)	Minimum 150
≤7	<3	Low(<.45)	Minimum 300
More than 8	<3	Low(<.45)	Minimum 500

(Source: Hair et al., 2010)

3.5 Survey Method and instruments

The primary instrument will be employed to collect data through survey questionnaires which MRBQ (Motorcycle Riding Behavior Questionnaire) (Elliott et al., 2007), BRBQ (Bicycle Riding Behavior Questionnaire) (Hezaveh et al., 2018), and PBQ (Pedestrian Behavior Questionnaire) (Zhou et al., 2016). The researcher will have a pilot survey first to test the reliability of the questionnaire (Cronbach alpha) and Pearson's Discrimination. To improve and apply the experience from the pilot survey in authentic sample groups.

The questionnaire for each type of road users to be tested is divided into 2 parts as follow:

- The first part is a questionnaire consist of personal information of the respondents, such as gender, age, education, riding experience. Violations of Traffic Laws, Purpose of Riding and Accidents Experience. The Questionnaire responses are a checklist.
- The second part is the question of riding behavior and attitude of the violation, which the researcher described in Table 3-1, 3-2, 3-3.

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.

3.6 Statistical procedure

Part 1 Analyze with descriptive statistics, such as the number of samples, the average frequency, etc., in order to explain the characteristics of the samples being surveyed. Moreover, describes various social features riding habits and attitude.

Part 2 Analyze the causal relationship of behavior and attitude of each mode to show which kinds of latent variables have the most effect. By using structural equation analysis which the inspection the model fit must be considered as follows:

- Analyzing the relationship between variables by analyzing the coefficient Pearson's product-moment correlation coefficient between variables and check whether the correlation matrix of data should be significantly different from zero.

- Consider the Bartlett's Test of Sphericity which must be significantly different from zero.

- Consider the Kaiser-Miyer-Olkin Measure of Sampling Adequacy (KMO), which must have a close to 1.

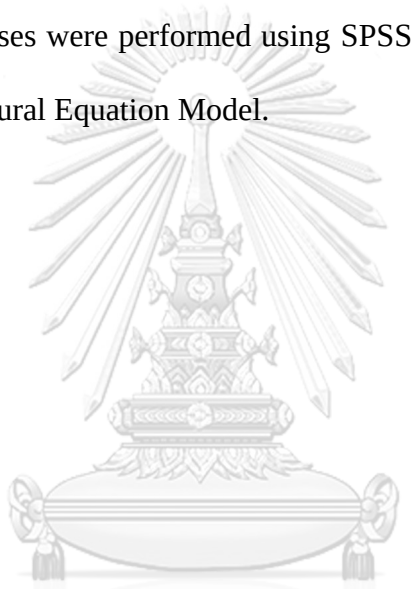
- The comparative fit index (CFI) is between 0 and 1 which are used to compare the research hypotheses that how much better is the model fit. With values from 0.90 onwards, the model is fitted with the empirical data.

- The goodness of fit index (GFI) is between 0 and 1 which are used to compare the research hypotheses that how much better is the model fit. With values from 0.90 onwards, the model is fitted with the empirical data.

- Standardized Root Mean Squared Residual (Standardized RMR) Which is the error of the two models compared by using the same set of data. SRMR is less than 0.05, indicating that the model is fitted with the empirical data.

Part 3 Analysis and comparison between teenagers in Thailand and Japan To find the cause of behavior and attitude of traffic violation that there is a difference. According to the hypothesis in Chapter 1.

Statistical analyses were performed using SPSS 22.0 for Descriptive statistics and Amos 22 for Structural Equation Model.



Chapter 4

Descriptive Statistics

In this chapter, the researcher summarized the results of the survey with descriptive statistics. The research distributes questionnaires by hand at Hokkaido University and nearby Sapporo station (See figure 4-1), which have many teenagers who come to study, relax and shopping. Most of the sample was a college student and some are high school students.

a **b**

Figure 4-1: Questionnaire distribution at Hokkaido University area (a) and Sapporo station area (b)

The researcher distributes questionnaires for 1 week from 2/12/2019-9/12/2019 daily between 15:00-17:00 both of Hokkaido University and Sapporo station. Able to collect all 201 data, which is enough for further analysis according to Chapter 3. The details are shown as follows:

4.1 Descriptive statistics of Japanese teenagers

The descriptive statistics from the sample in Japan showed as follows:

Table 4-1: Descriptive, frequency and percentage of Japanese teenagers classified by gender and age

Descriptive statistics		Mean	S.D.	Min.	Max
Age		20.37	2.715	15	25
Information		Frequency	Percentage (%)		
Age (years)	5-17	48	23.9		
	8-20	23	11.4		
	21-23	112	55.7		
	>23	18	9		
Gender	Male	160	79.6		
	Female	41	20.4		

From Table 4-1 found that most of the sample was male 160 people (79.6%). Then, was female 41 people (20.4%). Most of the sample age was between 21-23 years old 112 people (55.7%). Then, 15-17 years old 48 people (23.9 %) and 18-20 years old 23 people (11.4 %), > 24 years old 18 people (9%). The mean was 20.37 years old. The maximum and minimum were 25 and 15, respectively.

Table 4-2:Frequency and percentage of Japanese teenagers classified by education

Information	Frequency	Percentage(%)
High school	49	24.4
Undergraduate	122	60.7
Master	30	14.9

From Table 4-2 when considering the educational level of all samples. As a result, Undergraduate education was the most which accounted for 122 people (60.7%). Then, High school and Master were almost the same accounted for 49 people (24.4%) and 30 (14.9%), respectively.

Table 4-3: Frequency and percentage of Japanese teenagers classified by driving and riding experience and own a driving and riding license

Information		Frequency	Percentage(%)
Driving experience (years)	Never	79	39.3
	1-5	119	59.2
	6-10	3	1.5
Bicycle Riding experience (years)	1-5	12	6
	6-10	45	22.4
	>10	144	71.6
Car driving License	Do not own	69	34.3
	Own	132	65.7
Motorcycle riding license	Do not own	181	90
	Own	20	10

From Table 4-3 when considering driving experience, most of them were around 1-5 years of driving experience 119 people (59.2%). Then, Never and 6-10 years accounted for 79 people (39.3%) and 3 people (1.5%), respectively. About riding experience, most Japanese teenager riding a bicycle for more than 10 years 144 people (71.6%). Second, 6-10 years 45 people (22.4%). Lastly, 1-5 years 12 people

(6%). About driving and riding license, most of them owned a car license 132 people (65.7%), and 69 people (34.4%) did not own. However, riding license, most of them did not own which accounted for 181 people (90%) and 20 people (10%) owned a riding license.

Table 4-4: Frequency and percentage of Japanese teenagers license duration obtained.

Information		Frequency	Percentage (%)
Duration obtained (years)	1-2	85	63.9
	3-4	37	27.8
	>4	11	8.3

From Table 4-4 the mean of driving and riding license duration obtained was 1.5 years. The maximum and minimum were 7 and 0, respectively. The most duration obtained was 1-2 years 85 people (63.9%). Afterward, 3-4 Years 37 people (27.8%). Lastly > 4 years 11 people (8.3%).

Table 4-5: Frequency and percentage of Japanese teenagers classified by violation behaviors and the most frequent violations.

Information		Frequency	Percentage (%)
Violation experience	No	120	59.7
	Yes	81	40.3
Most frequent violations	Driving or riding invert direction.	6	7.4
	Crossing while red light.	60	74.1
	Over the speed limits.	12	14.8
	Run red light.	1	1.2
	Other	2	2.5

From Table 4-5 found, most of the sample have not done violations within 6 months 120 people (59.7%), and 81 people (40.3%) had done violations. Moreover, when considering the causes of traffic violations of the samples that have violated traffic rules. All found that most crossing while red light 60 people (74.1%). Then, over the speed limits 12 people (14.8%), driving or riding invert direction 6 people (7.4%), other 2 people (2.5%), run red light 1 people (1.2%) respectively.

Table 4-6: Frequency and percentage of the Japanese teenagers classified by accident information

Information		Frequency	Percentage (%)
Accident experience	No	155	77.1
	Yes	46	22.9
Damage of accident	Only asset	27	58.7
	Slightly injuries	18	39.1
	Serious injuries	1	2.2

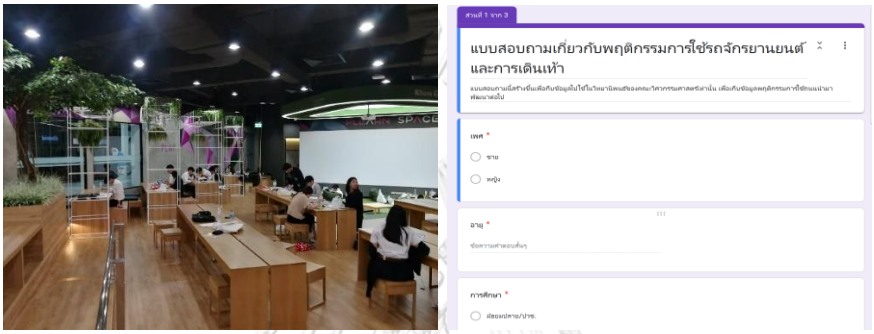
From Table 4-6 when considering the accident experience found, most of the samples have not experienced an accident, 155 people (77.1%) and have experienced the accident, 46 people (22.9%). Moreover, when considering the damage of accident, found most of the sample has only asset damage 27 people (58.7%) and slightly injuries 18 people (39.1%), serious injury only 1 people (2.2%)

4.2 Descriptive statistics of Thai teenagers

The research distributes questionnaires at Chulalongkorn University and uses an online survey (See

a **b**

Figure 4-1). Most of the sample was a college student between 18-25 year old.



a **b**

Figure 4-2: Questionnaire distribution at Plearn Space (Co-working space) (a) and Online survey (b)

The researcher distributes questionnaires for 1 week from 8/2/2020-15/2/2020 between 16:00-18:00. For an online questionnaire, the period is also 1 week (See figure xx). Be Able to collect all 4 7 7 data, which is enough for further analysis, according to Chapter 3. The descriptive statistics from the sample in Bangkok showed as follows:

Table 4-7: Descriptive, frequency and percentage of Thai teenagers classified by gender and age

Descriptive statistics		Mean	S.D.	Min.	Max
Age		21.18	2.290	18	29
Information		Frequency	Percentage (%)		
Age (years)	18-20	231	48.4		
	21-23	175	36.7		
	>23	71	14.9		
Gender	Male	169	35.4		
	Female	308	64.6		

From Table 4-7 found that most of the sample was a female 308 people (64.6 %). Then, was a male 168 people (35.4%). Most of the sample age was between 18-20 years old 231 people (48.4%). Equal or greater than 24 years old 71 people (14.9%). The mean was 21.18 years old. The maximum and minimum were 29 and 18, respectively.

Table 4-8: Frequency and percentage of Thai teenagers classified by education

Information	Frequency	Percentage(%)
High school	6	1.3
Undergraduate	441	92.5
Master	30	6.3

From table 4-8 when considering the educational level of all samples. As a result, Undergraduate education was the most which accounted for 441 people (92.9%). Then, High school and Master were almost the same accounted for 6 people (1.3%) and 30 (6.3%), respectively.

Table 4-9: Frequency and percentage of Thai teenagers classified by driving and riding experience and own a driving and riding license

Information		Frequency	Percentage(%)
Driving experience (years)	Never	275	57.7
	1-5	161	33.8
	6-10	36	7.5
	>10	5	1
Motorcycle riding experience (years)	1-5	202	42.3
	6-10	219	45.9
	>10	56	11.7
Driving and riding license	Do not own	77	16.1
	Car	30	6.3
	Motorcycle	238	49.9
	Both	132	27.7

From Table 4-9 when considering driving experience, most of them were never have driving experience 275 people (57.7%). Then, 1-5 years, 6-10 years, and more than 10 years accounted for 161 people (33.8%), 36 people (7.5%), and 5 people (1%), respectively. About riding experience, most of the Thai teenager riding a

motorcycle 6-10 years 219 people (45.9%). Second, 1-5 years 202 people (42.3%). Lastly, more than 10 years 56 people (11.7%). About driving and riding license, most of them owned a motorcycle license 238 people (49.9%), and 132 people (27.7%) owned both of licenses. However, Thai teenagers did not own which accounted for 77 people (16.1%), and 30 people (6.3%) have owned only a car license.

Table 4-10: Frequency and percentage of Thai teenagers license duration obtained.

Information		Frequency	Percentage (%)
Duration obtained (years)	1-2	135	33.8
	3-4	149	37.2
	>4	116	29

From Table 4-10 most duration obtained was 3-4 years 149 people (37.2%). Afterward, 1-2 Years 135 people (33.8%). Lastly, more than 4 years, 116 people (29%%). As a result, Thai teenagers have a driving license earlier than Japanese teenagers.

Table 4-11: Frequency and percentage of Thai teenagers classified by violation behaviors and the most frequent violations.

Information		Frequency	Percentage (%)
Violation experience	No	79	16.6
	Yes	398	83.4
Most frequent violations	Driving or riding invert direction.	40	10.1
	Crossing while red light.	24	6.1
	Over the speed limits.	63	15.8
	Run red light.	38	9.5
	Drunk driving	27	6.8
	No helmet	203	51
	Other	3	0.7

From Table 4-11 found, most of the sample have done violations within 6 months 398 people (83.4%) and 79 people (16.6%) have not done violations. Moreover, when considering the causes of traffic violations of the samples that have violated traffic rules. All found that most Thai teenagers “Do not wear a helmet while riding” 203 people (51%). Then, over the speed limits 63 people (15.8%), driving or riding invert direction 40 people (10.1%), run red light 24 people (6.1%), Drunk

driving 27 people (6.8%), crossing while red light 24 people (6.1%), others 3 people (0.7%), respectively.

Table 4-12: Frequency and percentage of Thai teenagers classified by accident information

Information		Frequency	Percentage (%)
Accident experience	No	171	35.8
	Yes	306	64.2
Damage of accident	Only asset	38	12.4
	Slightly injuries	235	76.8
	Serious injuries	31	10.1
	Have died	2	0.7

From table 4-12 when considering the accident experience found most of the Thai teenagers have experienced with an accident, 306 people (64.2%) and have no experience with the accident, 171 people (35.8%). Moreover, when considering the damage of accidents found, most of the samples have Slightly injuries damage 235 people (58.7%) and Only asset 38 people (12.4%), serious injury 31 people (2.2%). Lastly, have died 2 people (0.7%).

4.3 Attitude and behaviors of teenagers on violation behaviors

Attitude and behavior of vulnerable road users in japan that affects on violation behavior. If we had known the thought of road users and the behavior correctly. Inevitably leads to the possibility or can predict the behavior of vulnerable road users and reduce the accident precisely

Attitude and behaviors of vulnerable road users in Bangkok and Sapporo. The criteria for measuring the attitude level. The researchers measured the by using the Likert Scale measurement which divided into 5 levels, sorted from positive attitudes to negative attitudes as follows:

- A weighted score is 5 when performed very often or with a negative attitude.
- A weighted score is 4 when performed frequently or with a slightly negative attitude.
- A weighted score is 3 when sometimes performed or with a neutral attitude.
- A weighted score is equal to 2 when performed a little or slightly positive attitude.
- A weighted score is equal to 1 when hardly performed or with a positive attitude.

For the interpretation of the mean score, the mean score will be interpreted as follows

- 4.201 - 5.000 are negative attitudes or negative behaviors
- 3.401 - 4.200 are relatively negative attitudes or behaviors
- 2.601 - 3.400 are having neutral attitudes or neutral behaviors
- 1.801 - 2.600 are relatively positive attitudes or behaviors
- 1.000 –1.800 are positive attitudes or positive behaviors

Table 4-13: Descriptive variables of teenage cyclists in Japan

Latent variable	Item	Questionnaire	Positive	Slightly positive	Neutral	Slightly negative	Negative	Mean	S.D.
Bicycle control error	BCE1	Hard to maintain balance at low speeds.	130 (64%)	38(18.9%)	17(8.5%)	10(5%)	6(3%)	1.63	1.032
	BCE2	Have difficulty controlling your bicycle downhill.	154 (76.6%)	33(16.4%)	9(4.5%)	1(0.5%)	4(2%)	1.35	0.878
	BCE3	Do not know which gear to use	169(84.1%)	14(7%)	9(4.5%)	6(3%)	3(1.5%)	1.31	0.650
Notice failure	NF1	Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late.	108(53.7%)	71(35.5%)	16(8%)	3(1.5%)	3(1.5%)	1.62	0.817
	NF2	Fail to notice that pedestrians are crossing the street when you are turning.	141(70.1%)	50(24.9%)	8(4%)	1(0.5%)	1(0.5%)	1.36	0.634
	NF3	Fail to notice a pedestrian waiting to cross at a crosswalk.	159(79.1%)	35(17.4%)	4(2%)	1(0.5%)	2(1%)	1.27	0.622
Signaling and sign violation	SV1	Run red light.	97(48.3%)	50(24.9%)	32(15.9%)	12(6%)	10(5%)	1.95	1.154
	SV2	Cross the road while green light flashes.	32(15.9%)	26(12.9%)	27(13.4%)	56(27.9%)	60(29.9%)	3.43	1.437
	SV3	Cycling invert the road directions.	110(54.7%)	51(25.4%)	22(10.9%)	12(6%)	6(3%)	1.77	1.057
Bicycle stunt	BS1	Riding without having at least one hand on handlebars at all times.	163(81.1%)	26(12.9%)	10(5%)	1(0.5%)	1(0.5%)	1.26	0.621
	BS2	Talk on the phone while riding.	161(80.1%)	30(14.9%)	8(4%)	2(1%)	0(0%)	1.26	0.577
	BS3	Listen to music while riding.	98(48.8%)	31(15.4%)	21(10.4%)	27(13.4%)	24(11.9%)	2.24	1.468
Traffic violation	TV1	Speed up to beat the traffic light turning red.	27(13.4%)	32(15.9%)	44(21.9%)	60(29.9%)	38(18.9%)	3.25	1.303
	TV2	Ride in prohibited expressways, highways, interstate routes, bridges, and thruways unless authorized by signs.	138(68.7%)	36(17.9%)	19(9.5%)	5(2.5%)	3(1.5%)	1.5	0.878
	TV3	Become angered by another road user and indicate your hostility by whatever means you can.	170(84.6%)	19(9.5%)	9(4.5%)	1(0.5%)	2(1%)	1.24	0.650

Table 4-14: Descriptive variables of teenage pedestrians in Japan.

Latent variable	Item	Questionnaire	Positive	Slightly positive	Neutral	Slightly negative	Negative	Mean	S.D.
Instrumental attitude	IA1	Crossing the road in the scenario described** would save me time.	21(10.4%)	22(10.9%)	26(12.9%)	89(44.3%)	43(21.4%)	3.55	1.236
	IA2	Saving time is important to you.	12(6%)	23(11.4%)	28(13.9%)	90(44.8%)	48(23.9%)	3.69	1.133
	IA3	Crossing the road in the scenario described** would be more convenient.	30(14.9%)	50(24.9%)	38(18.9%)	56(27.9%)	27(13.4%)	3.00	1.292
	IA4	Convenience is important to you.	9(4.5%)	29(14.4%)	32(15.9%)	92(45.8%)	39(19.4%)	3.61	1.090
Descriptive norm.	DN1	My family cross the road as described in the scenario.**	68(33.8%)	72(35.8%)	38(18.9%)	21(10.4%)	2(1%)	2.09	1.016
	DN2	My friends cross the road as described in the scenario.**	32(15.9%)	26(12.9%)	66(32.8%)	50(24.9%)	27(13.4)	3.07	1.247
Conformity tendency	CT1	If other pedestrians cross the road during the red light, I would do the same.	45(22.4%)	48(23.9%)	31(15.4%)	51(25.4%)	26(12.9%)	2.83	1.373
	CT2	When I am with companions, I cross the road as described in the scenario.**	49(24.4%)	57(28.4%)	38(18.9%)	41(20.4%)	16(8%)	2.59	1.274
Behavior intention	BI1	Would you cross the road as described in the scenario.**	54(26.9%)	48(23.9%)	36(17.9%)	43(21.4%)	20(10%)	2.64	1.343
	BI2	If you encounter this situation in the future, you would cross the road as described in the scenario.**	59(29.4%)	43(21.4%)	40(19.9%)	39(19.4%)	20(10%)	2.59	1.350

Table 4-15: Descriptive variables of teenage motorcyclists in Thailand

Latent variable	Item	Questionnaire	Positive	Slightly positive	Neutral	Slightly negative	Negative	Mean	S.D.
Motorcycle control error	MCE1	Find that you have difficulty controlling the bike when riding at speed (e.g., steering wobble).	50(10.5%)	87(18.2%)	193(40.5%)	115(24.1%)	32(6.7%)	2.98	1.055
	MCE2	Unable to control the motorcycle while ride pillion.	67(14%)	94(19.7%)	139(29.1%)	122(25.6%)	55(11.5%)	3.01	1.216
	MCE3	Brake or throttle-back when going round a corner or bend.	11(2.3%)	29(6.1%)	83(17.4%)	126(26.4%)	228(47.8%)	4.11	1.045
Speed violation	SV1	Exceed the speed limit on a country/rural road.	99(20.8%)	157(32.9%)	141(29.6%)	65(13.6%)	15(3.1%)	2.45	1.061
	SV2	Exceed the speed limit on a road	118(24.7%)	123(25.8%)	132(27.7%)	81(17%)	23(4.8%)	2.51	1.173
	SV3	Disregard the speed limit late at night or in the early hours of the morning.	80(16.8%)	100(21%)	125(26.2%)	133(27.9%)	39(8.2%)	2.90	1.216
	SV4	Open up the throttle and just ‘go for it’ on good traffic conditions.	11(2.3%)	40(8.4%)	113(23.7%)	191(40%)	122(25.6%)	3.78	0.995
Motorcycle stunt	MS1	Ride between two lanes of fast-moving traffic.	139(29.1%)	154(32.3%)	115(24.1%)	50(10.5%)	19(4%)	2.28	1.111
	MS2	Pull away too quickly and your front wheel comes off the road.	211(44.2%)	169(35.4%)	67(14%)	23(4.8%)	7(1.5%)	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.	148(31%)	189(39.6%)	101(21.2%)	30(6.3%)	9(1.9%)	2.08	0.969
	TE2	Miss “Give Way” signs and narrowly avoid colliding with traffic having the right of way.	167(35%)	172(36.1%)	109(22.9%)	25(5.2%)	4(0.8%)	2.01	0.930
	TE3	Not notice someone stepping out from behind a parked vehicle until it is nearly too late.	180(37.7%)	177(37.1%)	86(18%)	30(6.3%)	4(0.8%)	1.95	0.940
Use of safety equipment	USE1	Wear a protective jacket. (leather or non-leather)	220(46.1%)	91(19.1%)	92(19.3%)	41(8.6%)	33(6.9%)	2.11	1.269
	USE2	Wear protective trousers. (leather or non-leather)	25(5.2%)	76(15.9%)	178(37.3%)	114(23.9%)	84(17.6%)	3.33	1.099
	USE3	Wear helmet protection.	13(2.7%)	77(16.1%)	147(30.8%)	137(28.7%)	103(21.6%)	3.50	1.082

Table 4-16: Descriptive variables of teenage pedestrians in Thailand.

Latent variable	Item	Questionnaire	Positive	Slightly positive	Neutral	Slightly negative	Negative	Mean	S.D.
Instrumental attitude	IA1	Crossing the road in the scenario described** would save me time.	159(33.3%)	81(17%)	122(25.6%)	78(16.4%)	37(7.8%)	2.48	1.309
	IA2	Saving time is important to you.	85(17.8%)	99(20.8%)	158(33.1%)	85(17.8%)	50(10.5%)	2.82	1.221
	IA3	Crossing the road in the scenario described** would be more convenient.	173(36.3%)	110(23.1%)	127(26.6%)	45(9.4%)	22(4.6%)	2.23	1.171
	IA4	Convenience is important to you.	78(16.4%)	93(19.5%)	148(31%)	93(19.5%)	65(13.6%)	2.95	1.261
Descriptive norm.	DN1	My family cross the road as described in the scenario.**	188(39.4%)	119(24.9%)	112(23.5%)	37(7.8%)	21(4.4%)	2.13	1.150
	DN2	My friends cross the road as described in the scenario.**	115(24.1%)	112(23.5%)	144(30.2%)	75(15.7%)	31(6.5)	2.57	1.198
Conformity tendency	CT1	If other pedestrians cross the road during the red light, I would do the same.	113(23.7%)	72(15.1%)	130(27.3%)	115(24.1%)	47(9.9%)	2.81	1.305
	CT2	When I am with companions, I cross the road as described in the scenario.**	116(24.3%)	110(23.1%)	129(27%)	83(17.4%)	39(8.2%)	2.62	1.250
Behavior intention	BI1	Would you cross the road as described in the scenario.**	165(34.6%)	124(26%)	119(24.9%)	50(10.5%)	19(4%)	2.23	1.150
	BI2	If you encounter this situation in the future, you would cross the road as described in the scenario.**	181(37.9%)	107(22.4%)	116(24.3%)	49(10.3%)	24(5%)	2.22	1.200

4.2.1 Attitude and behaviors of Japanese teenage cyclists

From table 4-13 found that the score of attitude and behavior can be separated into different level according to the measurement question in each item as follows:

1. The group of cyclists had positive responses in the following aspects:

- Become angered by another road user and indicate your hostility by whatever means you can. (1.24)
- Riding without having at least one hand on handlebars at all times. (1.26)
- Talk on the phone while riding. (1.26)
- Fail to notice a pedestrian waiting to cross at a crosswalk. (1.27)
- Do not know which gear to use. (1.31)
- Have difficulty controlling your bicycle downhill. (1.35)
- Fail to notice that pedestrians are crossing the street when you are turning. (1.36)
- Ride in prohibited expressways, highways, interstate routes, bridges, and thruways unless authorized by signs. (1.5)
- Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late. (1.62)
- Hard to maintain balance at low speeds. (1.63)
- Cycling inverts the road directions. (1.77)
- Run red light. (1.95)

2. The group of cyclists had relatively positive responses in the following aspects:

- Listen to music while riding. (2.24)

3. The group of cyclists had a neutral response in the following aspects:

- Speed up to beat the traffic light turning red. (3.25)

4. The group of cyclists had a relatively negative response in the following aspects:

- Cross the road while green light flashes. (3.43)

Table 4-14 found the group of teenage cyclists in Sapporo had positive behaviors on bicycle behavior. Most of the adolescents thought about traffic violations and the safety of people nearby. Moreover, also how to control the bicycle well and had responsibility for pedestrian and other road users. Nevertheless, a relatively negative response was the only one which is “Cross the road while green light flashes.”. From my point of view, road safety in Sapporo was quite safe compared to other countries; therefore, teenage cyclists tend to violate the signaling violation.

4.2.2 Attitude and behaviors of Japanese teenage pedestrians

From the scenario explanation

1) You are on your way to school, work or to handle some affairs and you must go to the other side of the road.

2) You reach an intersection and the current pedestrian signal displays turn to red light.

3) You are in a hurry so you take your chance and cross the road in a gap in the traffic.

The group of pedestrians had relatively positive responses in the following aspects:

- My family cross the road as described in the scenario.** (2.09)
- When I am with companions, I cross the road as described in the scenario.** (2.59)
- If you encounter this situation in the future, you would cross the road as described in the scenario.** (2.59)

2. The group of pedestrians had neutral responses in the following aspects:

- Would you cross the road as described in the scenario.** (2.64)
- If other pedestrians cross the road during the red light, I would do the same. (2.83)
- Crossing the road in the scenario described** would be more convenient. (3.00)
- My friends cross the road as described in the scenario.** (3.07)

3. The group of pedestrians had relatively negative responses in the following aspects:

- Crossing the road in the scenario described**would save me time. (3.55)
- Convenience is important to you. (3.61)
- Saving time is important to you. (3.69)

Table 4-15 found that most of the pedestrian sample groups had neutral responses to crossing behavior. This means no matter who was crossing in the described scenario; in their opinion, it was not right or wrong. However, on relatively negative responses, found the attitude of pedestrians was the main impact on behavioral intention. Therefore, if the pedestrian had been facing those situations, they will tend to cross the road even it violates the traffic signaling.

4.2.3 Attitude and behaviors of Thai teenage motorcyclists

1. The group of motorcyclists had relatively positive responses in the following aspects:

- Pull away too quickly and your front wheel comes off the road.(1.84)
- Not notice someone stepping out from behind a parked. (1.95)
- Miss “Give Way” signs and narrowly avoid colliding with traffic having the right of way. (2.01)
- Not notice a pedestrian waiting to cross at a zebra crossing, or a pelican crossing that has just turned red. (2.08)
- Wear a protective jacket. (leather or non-leather) (2.11)
- Ride between two lanes of fast-moving traffic. (2.28)
- Exceed the speed limit on a country/rural road. (2.45)
- Exceed the speed limit on a road (2.51)

2. The group of motorcyclists had neutral responses in the following aspects:

- Disregard the speed limit late at night or in the early hours of the morning. (2.9)
- Find that you have difficulty controlling the bike when riding at speed. (2.98)
- Unable to control the motorcycle while ride pillion. (3.01)
- Wear protective trousers. (leather or non-leather) (3.33)
- Wear helmet protection. (3.35)

3. The group of motorcyclists had relatively negative responses in the following aspects:

- Open up the throttle and just ‘go for it’ on good traffic conditions. (3.78)
- Brake or throttle-back when going round a corner or bend. (4.11)

Table 4-16 found that the group of teenage motorcyclists in Bangkok had relatively positive behaviors. Most of the adolescents thought about traffic violations and the safety of people nearby. Moreover, also how to control the motorcycle as well and had responsibility for pedestrian and other road users. Nevertheless, the relatively negative responses were “Open up the throttle and just ‘go for it’ on good traffic conditions” and “Brake or throttle-back when going round a corner or bend” which mean teenage motorcyclists tend to violate and speed up when the road condition is good enough and do not know well how to control their motorcycle while going through the corner.

4.2.4 Attitude and behaviors of Thai teenage pedestrians

From the scenario explanation

1) You are on your way to school, work or to handle some affairs and you must go to the other side of the road.

2) You reach an intersection and the current pedestrian signal displays turn to red light.

3) You are in a hurry so you take your chance and cross the road in a gap in the traffic.

1. The group of pedestrian had relatively positive responses in the following aspects:

- My family cross the road as described in the scenario.** (2.13)
- If you encounter this situation in the future, you would cross the road as described in the scenario.** (2.22)
- Crossing the road in the scenario described** would be more convenient. (2.23)
- Would you cross the road as described in the scenario.** (2.23)
- Crossing the road in the scenario described** would save me time. (2.48)
- My friends cross the road as described in the scenario.** (2.57)

2. The group of pedestrian had neutral responses in the following aspects:

- When I am with companions, I cross the road as described in the scenario.** (2.62)

- If other pedestrians cross the road during the red light, I would do the same. (2.81)
- Saving time is important to you. (2.82)
- Convenience is important to you. (2.95)

Table 4-17 found that most of the pedestrians had relatively positive responses for crossing behavior. From a question “If you encounter this situation in the future, you would cross the road as described in the scenario.**”. This means no matter who was crossing in the described scenario, in their opinion, it was a violation and had no respondent. However, on neutral responses, found the companion was not affected to the pedestrian while crossing as the described scenarios. Therefore, if the pedestrian had been facing those situations (If other pedestrians cross the road during the red light, I would do the same), they might tend to cross the road even it violates the traffic signaling.

4.4 Summary

In chapter 4 present the analysis of descriptive statistics of both Thai and Japanese teenagers. Japanese cyclists have good behavior and attitude toward cycling. However, about signaling violation, they tend to violate while crossing the road.

Motorcyclists in Thailand have a positive attitude and behaviors on violations. However, more than 64.2% used to have an accident. Perhaps Thai teenager does not know how to control their vehicle correctly due to “control error”

From the data of pedestrian behavior, Japanese teenagers tend to violate the traffic rule than Thai teenagers. Perhaps road safety in Sapporo was quite safe compared to other countries; therefore, teenagers tend to violate the signaling violation. However, preliminary descriptive statistics are not enough to conduct a detailed analysis of violations. The researcher needs to analyze the structural equation model and find the cause of the relationship between latent variables. The model analysis content will continue to be shown in Chapter 5.

Chapter 5

Violation Behaviors Analysis and Structural Equation Model

5.1 Introduction

Analysis of the structural equation model of violation behaviors in this research. The researcher prepared and analyzed the following information.

1. Analyzing the correlation coefficient between various variable

2.Confirmatory Factor analysis to measure the behavior intention model of each latent variable. This method was to ensure that the observe variable was the proper indicator defined by SPSS AMOS programing.

3. Analyzed the model of behavior intention to validate the goodness of fit between the model and data observed by using SPSS AMOS. In order to analyze the model, the methods that the researcher using were Generalized Least Square Estimate (GLSM) and Maximum likelihood Estimate (MLE). If the analysis results show that the selected model is not fit with the empirical data, the researcher will modify the model based on “Modification Indices” in order to get the best model that suitable for empirical data.

To Summarize the goodness of fit, the researcher based on empirical data. According to table 5.1

Table 5-1: Criteria for considerate the goodness of fit of the model.

Measure	Threshold
Chi-sqare/df (cmin/df)	< 3 good ; < 5 sometimes permissible
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional
The goodness of fit index (GFI)	≥ 0.95great ; ≥0.90 traditional
Standardized Root Mean Squared Residual (SRMR)	< 0.08
Root Mean square error of approximation (RMSEA)	< 0.05

4. Presenting the value of factor and the relationship between each latent variable that affected the behaviors of vulnerable road users.

5.2 Correlation analysis between observed variables

5.2.1 Correlation analysis of Japanese and Thai teenage behaviors

Analysis of the correlation between the observed variable was to evaluate the strength of the relationship between two quantitative variables.

Table 5-2: Correlation coefficients of observed variables of Japanese teenage cyclists

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 5-3: Correlation among the pedestrian variables

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

Table 5-4: Correlation among the motorcyclist

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).

The reliability of the research instrument can be analyzed from Cronbach alpha of which the suitable values should be over 0.7, Measure of sampling Adequacy should be over 0.7, Barlett's Test of Sphericity should significant (Hair et al., 2010), the researcher calculated the Composite Reliability value and Measure of sampling Adequacy, Barlett's Test of Sphericity

Table 5-5: Questionnaire reliability of the model

Model	**Composite Reliability**	**Measure of Sampling Adequacy (KMO)**	**Barlett's Test of Sphericity**
Japanese Bicycle Model	0.746	0.782	Significant
Japanese Pedestrian Model	0.893	0.857	Significant
Thai Motorcycle Model	0.749	0.813	Significant
Thai Pedestrian Model	0.920	0.920	Significant

From table 5-5 found the Composite Reliability of each model was higher than 0.7, which is a satisfactory level for consistency between variables (Cronbach, 1970). Furthermore, the Measure of Sampling Adequacy (KMO) was higher than 0.7. Moreover, Barlett's Test of Sphericity was significant. The ability to measure variables with levels of accuracy meets acceptable criteria.

5.3 Statistic analysis of observed variables

5.3.1 Statistic analysis of observed variables in japan

The statistical analysis results of observed variables are basic statistics, skewness, and kurtosis of observable variables. The detail as shown in Table 5-6

Table 5-6: Basic statistics, skewness, and kurtosis of japan observed variables

Bicycle Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(BCE1) Hard to maintain balance at low speeds.	1	5	1.736	2.292
(BCE2) Have difficulty controlling your bicycle downhill.	1	5	2.874	9.407
(BCE3) Do not know which gear to use.	1	5	2.902	8.048
(NF1) Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late.	1	5	1.646	3.493
(NF2) Fail to notice that pedestrians are crossing the street when you are turning.	1	5	2.130	6.224
(NF3) Fail to notice a pedestrian waiting to cross at a crosswalk.	1	5	3.259	13.776
(SV1) Run red light.	1	5	1.133	.444
(SV2) Cross the road while green light flashes.	1	5	-.497	-1.122
(SV3) Cycling inverts the road directions .	1	5	1.393	1.236

Table 5-6 (continued).

Bicycle Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(BS1) Riding without having at least one hand on handlebars at all times.	1	5	2.797	9.122
(BS2) Talk on the phone while riding.	1	4	2.444	6.088
(BS3) Listen to music while riding.	1	5	.748	-.957
(TV1) Speed up to beat the traffic light turning red.	1	5	-.321	-.999
(TV2) Ride in prohibited expressways, highways, interstate routes, bridges, and thruways unless authorized by signs.	1	5	1.916	3.451
(TV3) Become angered by another road user and indicate your hostility by whatever means you can.	1	5	3.358	12.870
Pedestrian Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(IA1) Crossing the road in the scenario described** would save me time.	1	5	-.795	-.369
(IA2) Saving time is important to you.	1	5	-.848	-.028
(IA3) Crossing the road in the scenario described** would be more convenient.	1	5	-.042	-1.165
(IA4) Convenience is important to you.	1	5	-.699	-.252
(DN1) My family cross the road as described in the scenario.**	1	5	.657	-.408
(DN2) My friends cross the road as described in the scenario.**	1	5	-.211	-.844

Table 5-6 (continued).

Pedestrian Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(CT1) If other pedestrians cross the road during the red light, I would do the same.	1	5	.096	-1.304
(CT2)When I am with companions, I cross the road as described in the scenario.**	1	5	.320	-1.046
(BI1) Would you cross the road as described in the scenario.**	1	5	.262	-1.193
(BI2) If you encounter this situation in the future, you would cross the road as described in the scenario.**	1	5	.295	-1.167

5.3.2 Statistic analysis of observed variables in Thailand

The statistical analysis results of observed variables are basic statistics, skewness, and kurtosis of observable variables. The detail as shown in Table 5-7

Table 5-7: Basic statistics, skewness, and kurtosis of Thailand observed variables

Motorcycle Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(MCE1) Find that you have difficulty controlling the bike when riding at speed (e.g., steering wobble).	1	5	-.160	-.431
(MCE2) Unable to control the motorcycle while ride pillion.	1	5	-.101	-.908
(MCE3) Brake or throttle-back when going round a corner or bend.	1	5	-1.037	.334
(SV1) Exceed the speed limit on a country/rural road.	1	5	.336	-.568

Table 5-7 (continued).

Motorcycle Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(SV2) Exceed the speed limit on a road.	1	5	.273	-.874
(SV3) Disregard the speed limit late at night or in the early hours of the morning.	1	5	-.091	-1.015
(SV4) Open up the throttle and just ‘go for it’ on good traffic conditions.	1	5	-.631	-.039
(MS1) Ride between two lanes of fast-moving traffic.	1	5	.595	-.391
(MS2) Pull away too quickly and your front wheel comes off the road.	1	5	1.104	.872
(TE1) Not notice a pedestrian waiting to cross at a zebra crossing, or a pelican crossing that has just turned red.	1	5	.751	.196
(TE2) Miss “Give Way” signs and narrowly avoid colliding with traffic having the right of way.	1	5	.628	-.202
(TE3) Not notice someone stepping out from behind a parked vehicle until it is nearly too late.	1	5	.792	.033
(USE1) Wear a protective jacket. (leather or non-leather)	1	5	.861	-.387
(USE2) Wear protective trousers. (leather or non-leather)	1	5	-.113	-.610
(USE3) Wear helmet protection.	1	5	-.203	-.786

Table 5-7 (continued).

Pedestrian Model				
Observed variable	**Min.**	**Max.**	**Skewness**	**Kurtosis**
(IA1) Crossing the road in the scenario described** would save me time.	1	5	.333	-1.074
(IA2) Saving time is important to you.	1	5	.097	-.843
(IA3) Crossing the road in the scenario described** would be more convenient.	1	5	.592	-.556
(IA4) Convenience is important to you.	1	5	.021	-.943
(DN1) My family cross the road as described in the scenario.**	1	5	.756	-.276
(DN2) My friends cross the road as described in the scenario.**	1	5	.257	-.838
(CT1) If other pedestrians cross the road during the red light, I would do the same.	1	5	-.027	-1.143
(CT2)When I am with companions, I cross the road as described in the scenario.**	1	5	.249	-.957
(BI1) Would you cross the road as described in the scenario.**	1	5	.586	-.554
(BI2) If you encounter this situation in the future, you would cross the road as described in the scenario.**	1	5	.631	-.591

The statistical analysis results of observed variables are basic statistics, skewness, and kurtosis of observable variables. The detail as shown in Table 5-6 and 5-7

From Table 5-7 considered the properties of observed variables. Found most of the questionnaires, the absolute value of skewness is not greater than 3, and the absolute value of kurtosis was not greater than 10 except TV3 but sometimes permission. So the researcher will consider that this data has a normal distribution.

5.4 Confirmatory Factor Analysis

In SPSS AMOS 22 program, consists of 2 crucial model, Measurement model, and Structural Equation model. Generally, the measure model can solve the error of measurement error by confirmatory factor analysis. To measure the latent variable according to the relationship of the linear structure between observe variables and latent variables. Then using only latent variables to analyze the main independent variables. For this reason, the confirmatory factor analysis is a verifying of suitable empirical data with the model.

In the research, the researcher using confirmatory factor analysis to analyze the model of Thai and Japanese teenage behaviors. To verify the observed variable and the goodness of fit of the model, the researcher has to investigate the observed variables in each latent variable is a suitable indicator for measuring the latent variable set, which that the component weight value must be greater or equal than 0.30. If it not the research decided to cut it off the model.

5.3.1 Japanese teenage behavior model

- The bicycle model

The model of teenage cyclists consists of 4 latent variables which are 1) Control error (BCE) 2) Notice failure (NF) 3) Stunt (ST) and 4) Violation behaviors, which are Signaling violation (SV) and traffic violation (TV). The result is shown below in table 5-8

Table 5-8: Confirmatory factor analysis of bicycle model in Japan

Factor	Component weight (b)	Explained variation (R^2)
Control error		
BCE1	0.67	0.44
BCE2	0.77	0.60
BCE3	0.55	0.31
Notice failure		
NF1	0.70	0.49
NF2	0.82	0.67
NF3	0.61	0.37
Stunt		
BS2	0.61	0.37
BS3	0.75	0.56
Violation behavior		
SV1	0.68	0.46
SV2	0.67	0.45
SV3	0.49	0.24
TV1	0.82	0.67
TV2	0.37	0.14
TV3	0.33	0.11

Considered the component weight of each variable, found every variable was an excellent indicator to measure the latent variables. The researcher separated violation behaviors into 2 parts. Frist, Signaling and sign violation. Second General Traffic violations.

Control error consists of 3 observed variables that have Bicycle control at low speeds (BCE1), Bicycle control during high speed (BCE2), and Expertise in using bicycles. (BCE3). The component weight is 0.67, 0.77, 0.55, respectively. As a result, all of the observed indicators is greater than 0.5, but “Expertise in using bicycles” (BCE3) Has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in control error.

Notice failure consists of 3 observed variables that have “Being aware of other road users” (NF1), “Being aware of pedestrians while turning” (NF2), and “Being

aware of the pedestrian at a crossing" (NF3). The component weight is 0.70, 0.82, 0.61 ,respectively. As a result, all of the observed indicators is greater than 0.6; however, "Being aware of the pedestrian at a crossing." (NF3) has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in notice failure.

Stunt consists of 2 observed variables that have "Risky riding behavior" (BS2) and "Risk perception" (BS3). The component weight is 0.61, 0.75, respectively. As a result, all of the observed indicators is greater than 0.6; however, "Risky riding behavior (BS2) has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in a stunt.

Violation behavior consists of 6 observed variables that have "The behavior of violating traffic signaling" (SV1), "The behavior of violating the traffic signaling." (SV2), "Traffic sign violation"(SV3), "Signaling violation"(TV1) "Traffic sign violation" (TV2), and "Aggressive behavior towards other road users" (TV3). The component weight is 0.68, 0.67, 0.49, 0.82, 0.37, 0.33, respectively. As a result, all of the observed indicators are greater than 0.3; however, "Traffic sign violation (TV2), "Aggressive behavior towards other road users" (TV3), has a low component weight in the observed variable group, which is used to measure the values of latent variables in Violation behavior.

- The Pedestrian model

The model of teenage pedestrians crossing consists of 4 latent variables which are 1) Attitude (ATT) 2) Descriptive Norms (DN), and 3) Conformity tendency (CT) 4) Behavior intention (BI). The result is shown below in table 5-9

Table 5-9: Confirmatory factor analysis of the pedestrian model in Japan

Factor	Component weight (b)	Explained variation (R^2)
Attitude		
ATT1	0.74	0.52
ATT2	0.63	0.39
ATT3	0.83	0.69
ATT4	0.51	0.25
Descriptive Norm		
DN1	0.51	0.26
DN2	0.83	0.68
Conformity tendency		
CT1	0.80	0.64
CT2	0.73	0.53
Behavior intention		
BI1	0.99	0.98
BI2	0.97	0.94

Considered the component weight of each variable, found every variable was an excellent indicator to measure the latent variables. The component weight of each variable greater than 0.5

Attitude consists of 4 observed variables that have “Crossing the road in the scenario described would save me time” (ATT1), “Saving time is important to you” (ATT2), “Crossing the road in the scenario described would be more convenient” (ATT3), and “Convenience is important to you” (ATT4) The component weight is 0.74, 0.62, 0.83, 0.51, respectively. As a result, all of the observed indicators is

greater than 0.5; but “Convenience is important to you” (ATT4) has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in attitude.

Descriptive Norm consists of 2 observed variables that have “My family cross the road as described in the scenario.” (DN1), and “My friends cross the road as described in the scenario.” (DN2). The component weight is 0.51 and 0.83, respectively.

Conformity tendency consists of 2 observed variables that have “If other pedestrians cross the road during the red light, I would do the same.” (CT1) Furthermore, “When I am with companions, I cross the road as described in the scenario.”(CT2). The component weight is 0.80 and 0.72, respectively. Both components have a high weight to measure the values of the latent variable in conformity tendency.

Behavior intention consists of 2 observed variables that have “Would you cross the road as described in the scenario. (BI1), and “If you encounter this situation in the future, you would cross the road as described in the scenario.” (BI2). The component weight is 0.99 and 0.97, respectively. Both components have a high weight to measure the values of the latent variable in Behavior intention.

5.3.2 Thai teenage behavior model

- The motorcycle model

The model of teenage cyclists consists of 4 latent variables which are 1) Control error (MCE) 2) Traffic error (TE) 3) Stunt (ST) and 4) Use of safety equipment (USE) 5) Violation Behavior which is signaling violation (SV). The result is shown below in Table 5-10

Table 5-10: Confirmatory factor analysis of the Motorcycle model in Thailand

Factor	Component weight (b)	Explained variation (R^2)
Control error		
MCE1	0.83	0.69
MCE2	0.49	0.24
Traffic error		
TE1	0.74	0.54
TE2	0.83	0.68
TE3	0.69	0.48
Stunt		
MS1	0.76	0.58
MS2	0.70	0.50
Use of safety equipment		
USE1	0.97	0.95
USE2	0.31	0.09
Violation behavior		
SV1	0.79	0.63
SV2	0.82	0.67
SV3	0.71	0.51
SV4	0.51	0.26

Considered the component weight of each variable, found every variable was an excellent indicator to measure the latent variables.

Motorcycle control error consists of 2 observed variables that have “High-speed motorcycle control behavior”(MCE1), “The ability to control motorcycles while towing” (MCE2). The component weight is 0.83, 0.49, respectively. As a result,

all of the observed indicators are greater than 0.4, but “The ability to control motorcycles while towing” Has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in control error.

Traffic error consists of 3 observed variables that “Being aware of pedestrians crossing the road” (TE1), “Traffic sign perception” (TE2), and “Being aware of other road users” (TE3). The component weight is 0.74, 0.83, 0.69 ,respectively. As a result, all of the observed indicators are greater than 0.6; which is used to measure the values of latent variables in notice failure.

Stunt consists of 2 observed variables that “Speed violation behavior in an urban area” (SV2), “Speed violation behavior at different periods” (SV3). The component weight is 0.76, 0.70 ,respectively. As a result, all of the observed indicators are greater than 0.7; which is used to measure the values of latent variables in stunt very well.

Use of safety equipment consists of 2 observed variables in this model that “Awareness of safe riding” (USE1, USE2). The component weight is 0.97, 0.31 ,respectively. As a result, the observed indicator (USE1) greater than 0.9; which is used to measure the values of latent variables in the use of safety equipment. The researcher decided to cut USE1 off because it can not indicate the Thai teenage sample well due to component weight.

Violation behavior consists of 4 observed variables that have “Speed Violation Behavior” (SV1), “Speed violation behavior in an urban area” (SV2) “Speed violation behavior at different periods” (SV3) “Exciting riding behavior leads to violation“(SV4). The component weight is 0.79, 0.82, 0.71, 0.51, respectively. As a

result, all of the observed indicators are greater than 0.5; however, “Exciting riding behavior leads to violation“(SV4) has a low component weight in the observed variable group, which is used to measure the values of latent variables in Violation behavior.

- The pedestrian model

The model of pedestrian crossing consists of 4 latent variables which are 1) Attitude (ATT) 2) Descriptive Norms (DN), and 3) Conformity tendency (CT) 4) Behavior intention (BI). The result is shown below in Table 5-11

Table 5-11: Confirmatory factor analysis of the pedestrian model in Thailand

Factor	Component weight (b)	Explained variation (R^2)
Attitude		
ATT1	0.71	0.51
ATT2	0.64	0.41
ATT3	0.82	0.68
ATT4	0.49	0.24
Descriptive Norm		
DN1	0.81	0.65
DN2	0.79	0.62
Conformity tendency		
CT1	0.79	0.62
CT2	0.86	0.73
Behavior intention		
BI1	0.94	0.88
BI2	0.93	0.86

Considered the component weight of each variable, found every variable was an excellent indicator to measure the latent variables.

Attitude consists of 4 observed variables that have “Crossing the road in the scenario described would save me time” (ATT1), “Saving time is important to you”

(ATT2), “Crossing the road in the scenario described would be more convenient” (ATT3), and “Convenience is important to you” (ATT4) The component weight is 0.71, 0.64, 0.82, 0.49, respectively. As a result, all of the observed indicators is greater than 0.5; but “Convenience is important to you” (ATT4) has the lowest component weight in the observed variable group, which is used to measure the values of latent variables in attitude.

Descriptive Norm consists of 2 observed variables that have “My family cross the road as described in the scenario.” (DN1), and “My friends cross the road as described in the scenario.” (DN2). The component weight is 0.81 and 0.79, respectively.

Conformity tendency consists of 2 observed variables that have “If other pedestrians cross the road during the red light, I would do the same.” (CT1) Furthermore, “When I am with companions, I cross the road as described in the scenario.”(CT2). The component weight is 0.79 and 0.86, respectively. Both components have a high weight to measure the values of the latent variable in conformity tendency.

Behavior intention consists of 2 observed variables that have “Would you cross the road as described in the scenario. (BI1), and “If you encounter this situation in the future, you would cross the road as described in the scenario.” (BI2). The component weight is 0.94 and 0.93, respectively. Both components have a high weight to measure the values of the latent variable in Behavior intention.

From the analysis of the Confirmatory factor. When considering the goodness of fit of the model, the model is fit with empirical data from the survey. The

component weight of each latent variable is greater than 0.3. Show that observable variables are good indicators or suitable indicators of latent variables that will be used in this study.

5.5 Analysis of structural equation model in Japan

In Japan, the researcher using a bicycle model and pedestrian model because Japanese teenagers ride a bicycle daily and walk to the school or university often than a motorcycle. The statistical values 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). The results of the analysis are presented as follows:

5.5.1 The analysis of bicycle behavior model

The result of the adjusted model. The statistical values and the goodness of fit and is shown in Figure 5-1 and Table 5-12

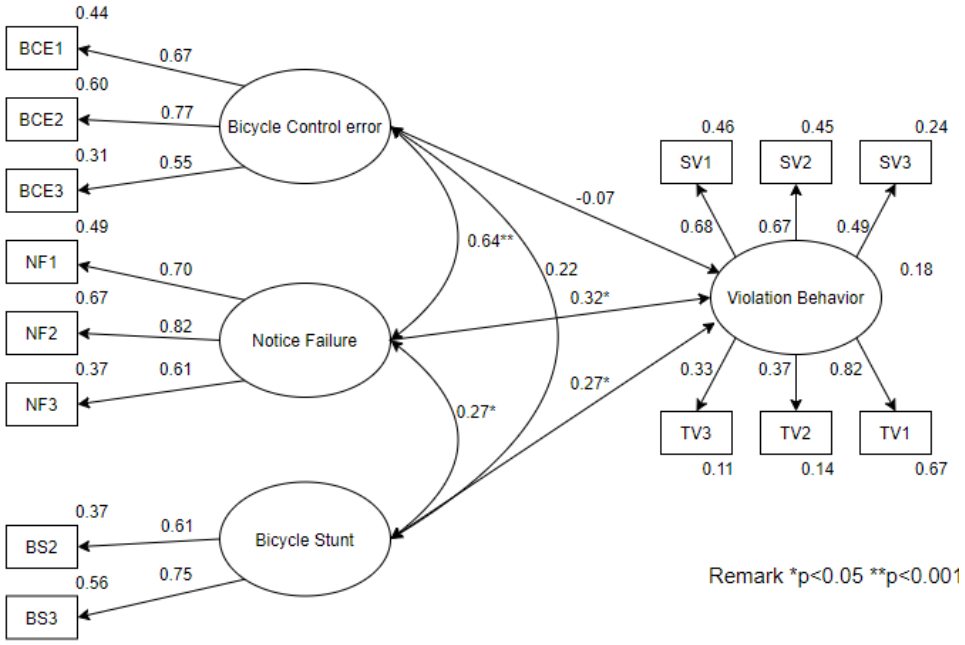


Figure 5-1: The adjusted structural equation model of teenage cyclists in Japan

Table 5-12: The adjusted goodness of fit of the teenage cyclists in Japan

Measure	Threshold	Model	
		Statistic values	The result
Chi-square/df (cmin/df)	<3 good ; <5 sometimes permissible	1.121	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.939	Pass
The goodness of fit index (GFI)	≥ 0.95great ; ≥0.90 traditional	0.942	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.066	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.025	Pass

The result of the analysis shown in Table 5-12. Measurements had to be checked for validity by assessing the acceptance level of the goodness of fit. The values for the model fit indices for the model were Chi-square/df (cmin/df) = 1.121, Comparative fit index (CFI) = 0.939, The goodness of fit index (GFI) = 0.942, Standardized Root Mean Squared Residual (SRMR) = 0.066, Root Mean square error of approximation (RMSEA) = 0.025. Based on the criteria, the model could also be accepted

5.5.2 The analysis of pedestrian behavior model

The result of the adjusted model. The statistical values and the goodness of fit and is shown in Figure 5-2 and Table 5-13.

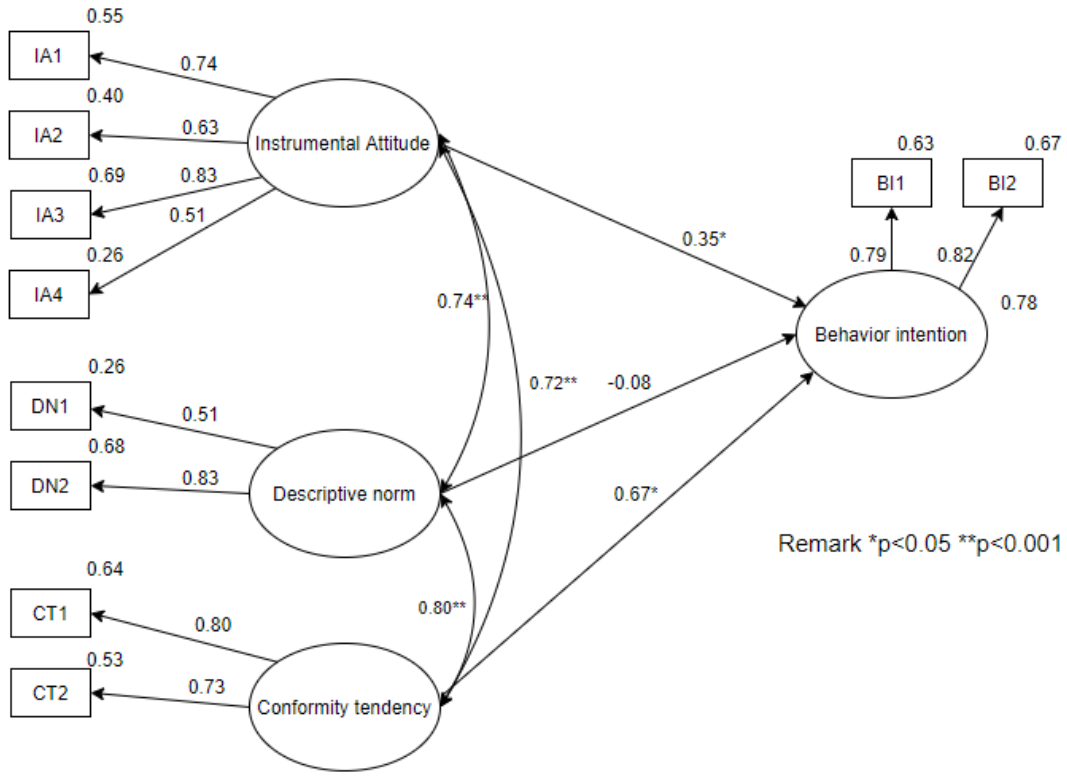


Figure 5-2: The adjusted structural equation model of teenage pedestrians in Japan.

Table 5-13: The adjusted goodness of fit of the teenage pedestrian in Japan

Measure	Threshold	Model	
		Statistic values	The result
Chi-sqare/df (cmin/df)	<3 good ; <5 sometimes permissible	1.422	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.935	Pass
The goodness of fit index (GFI)	≥ 0.95great ; ≥0.90 traditional	0.962	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.042	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.046	Pass

The value for the model fit indices for the model were Chi-square/df (cmin/df) = 1.422, Comparative fit index (CFI) = 0.935, The goodness of fit index (GFI) = 0.962, Standardized Root Mean Squared Residual (SRMR) = 0.042, Root Mean square error of approximation (RMSEA) = 0.046. The goodness of fit standard criterion indicated a good model fit.

5.6 Analysis of structural equation model in Thailand

In Thailand, the researcher using a motorcycle model and pedestrian model because most of Thai teenagers ride a motorcycle daily and walk to the school or university often than a bicycle.

Thailand, especially in Bangkok, hardly to find cyclists. Bangkok city is too dangerous for cycling, no bicycle lane and bad road conditions.

The statistical values 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).

The results of the analysis are presented as follows:

5.6.1 The analysis of motorcycle behavior model

The result of the adjusted model. The statistical values and the goodness of fit and is shown in Figure 5-3 and Table 5-14

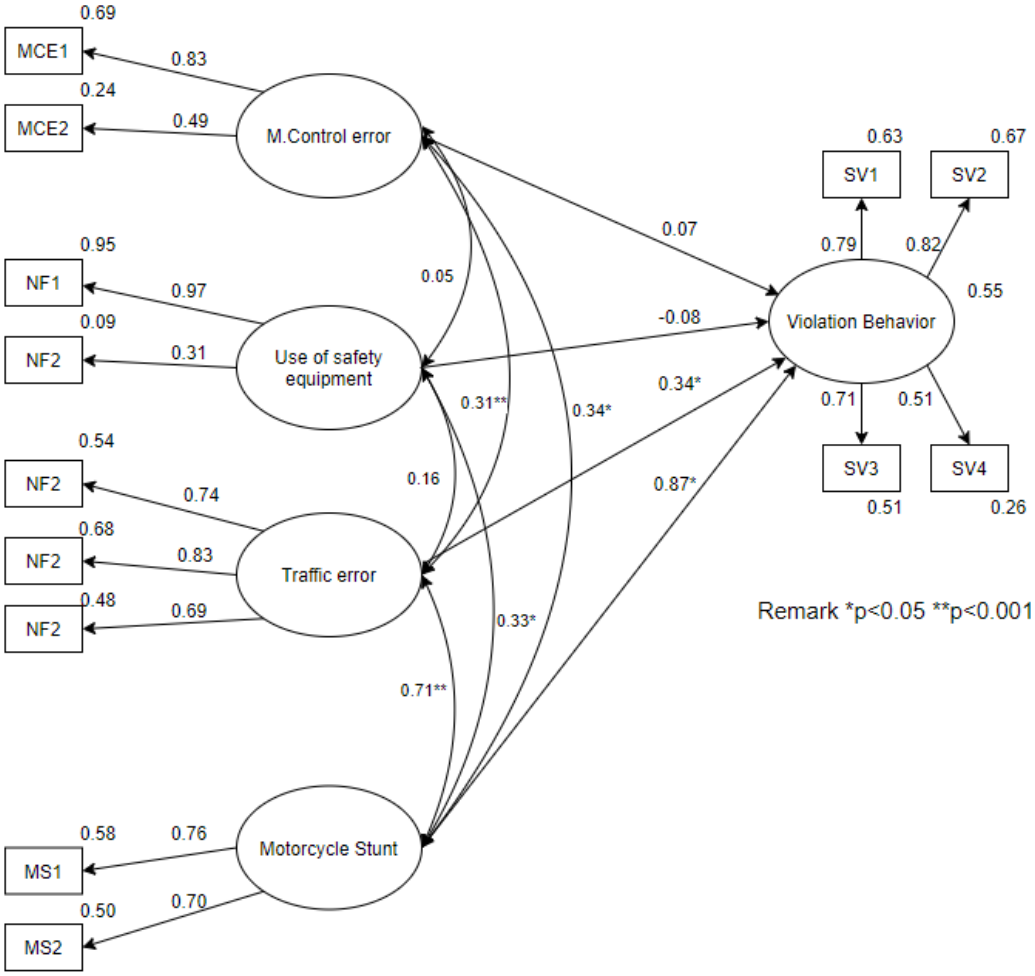


Figure 5-3: The adjusted structural equation model of teenage motorcyclist in Thailand

Table 5-14: The adjusted goodness of fit of the teenage cyclists in Thailand

Measure	Threshold	Model	
		Statistic values	The result
Chi-square/df (cmin/df)	<3 good ; <5 sometimes permissible	2.238	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.967	Pass
The goodness of fit index (GFI)	≥ 0.95great ; ≥0.90 traditional	0.966	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.037	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.05	Pass

The result of the analysis shown in Table 5-15. Measurements had to be checked for validity by assessing the acceptance level of the goodness of fit. The values for the model fit indices for the model were Chi-square/df (cmin/df) = 2.238, Comparative fit index (CFI) = 0.967, The goodness of fit index (GFI) = 0.966, Standardized Root Mean Squared Residual (SRMR) = 0.037, Root Mean square error of approximation (RMSEA) = 0.05. Based on the criteria, the model could also be accepted

5.6.2 The analysis of pedestrian behavioral model

The result of the adjusted model. The statistical values and the goodness of fit and is shown in Figure 5-4 and Table 5-15

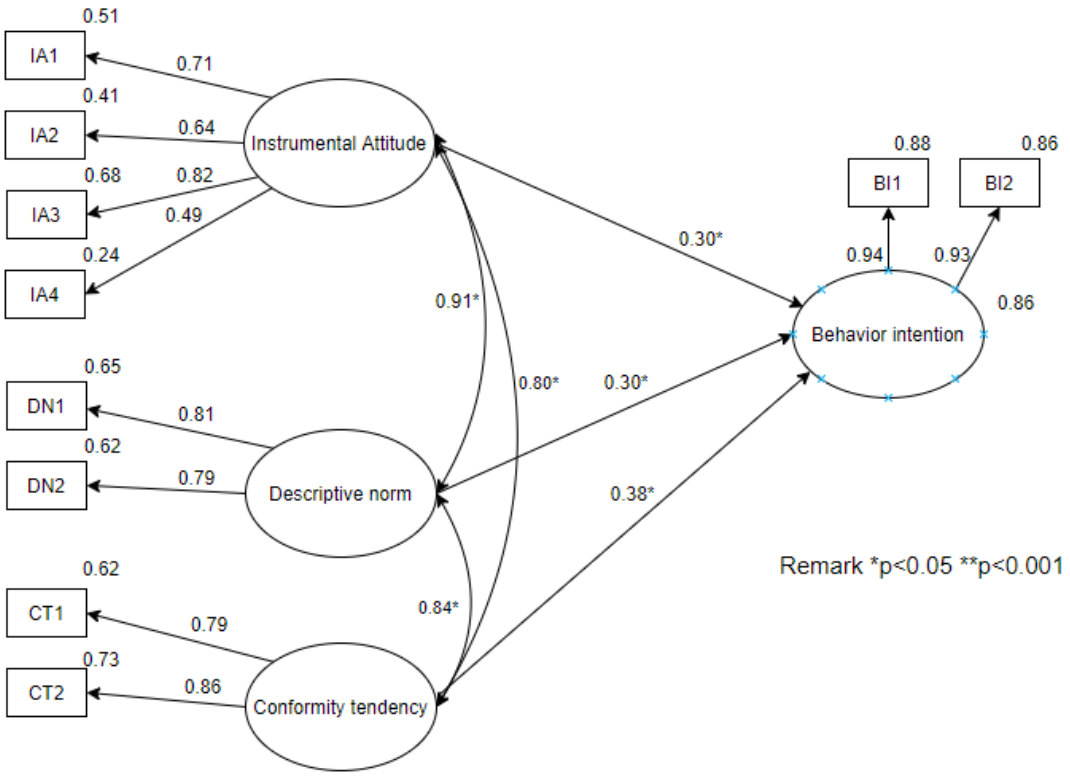


Figure 5-4: The adjusted structural equation model of teenage pedestrians in Thailand

Table 5-15: The adjusted goodness of fit of the teenage pedestrian in Thailand

Measure	Threshold	Model	
		Statistic values	The result
Chi-sqare/df (cmin/df)	<3 good ; <5 sometimes permissible	1.265	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.998	Pass
The goodness of fit index (GFI)	≥ 0.95 great ; ≥0.90 traditional	0.988	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.014	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.024	Pass

The value for the model fit indices for the model were Chi-square/df (cmin/df) = 1.422, Comparative fit index (CFI) = 0.935, The goodness of fit index (GFI) = 0.962, Standardized Root Mean Squared Residual (SRMR) = 0.042, Root Mean square error of approximation (RMSEA) = 0.046. The goodness of fit standard criterion indicated a good model fit.

5.7 Simultaneous analysis of multiple group by gender aspects

From the main model, the researcher performed a multiple group analysis to clarify the differences. From all the models, the pedestrian model is the only one significant on gender aspect and interesting to discuss. The result of the adjusted model. The statistical values and the goodness of fit and is shown in Figure 5-5, 5-6 and Table 5-16

5.7.1 Male aspect of Japanese pedestrian

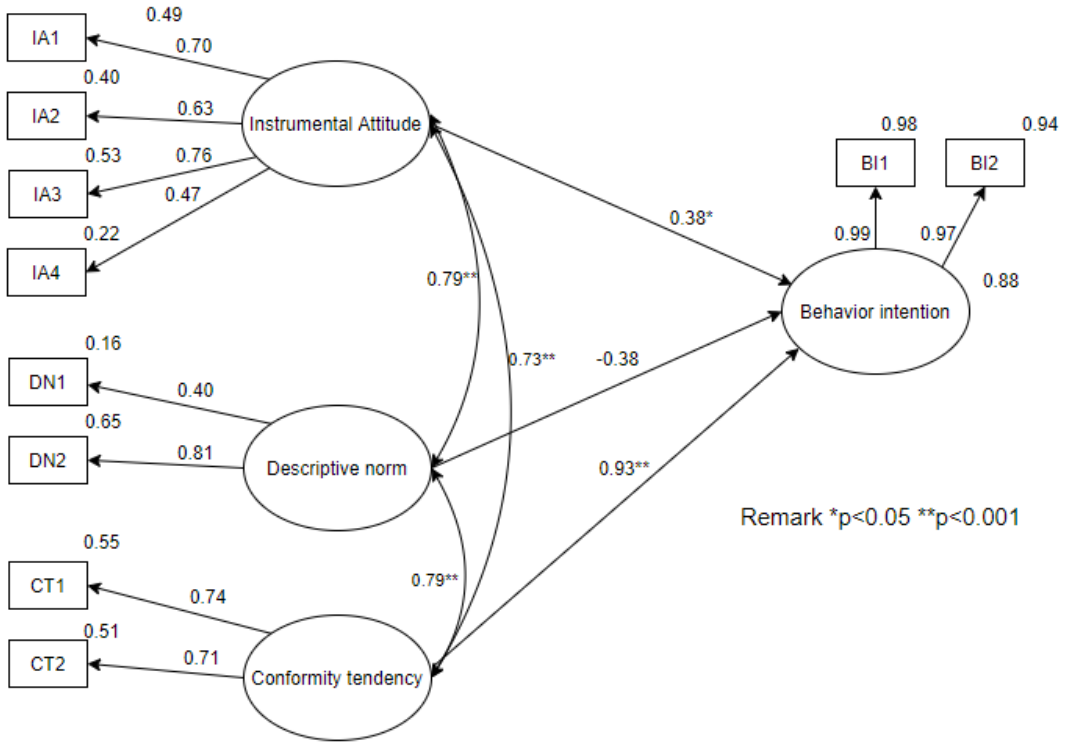


Figure 5-5: The adjusted structural equation model of male teenage pedestrians in Japan

5.7.2 Female aspect of Japanese pedestrian

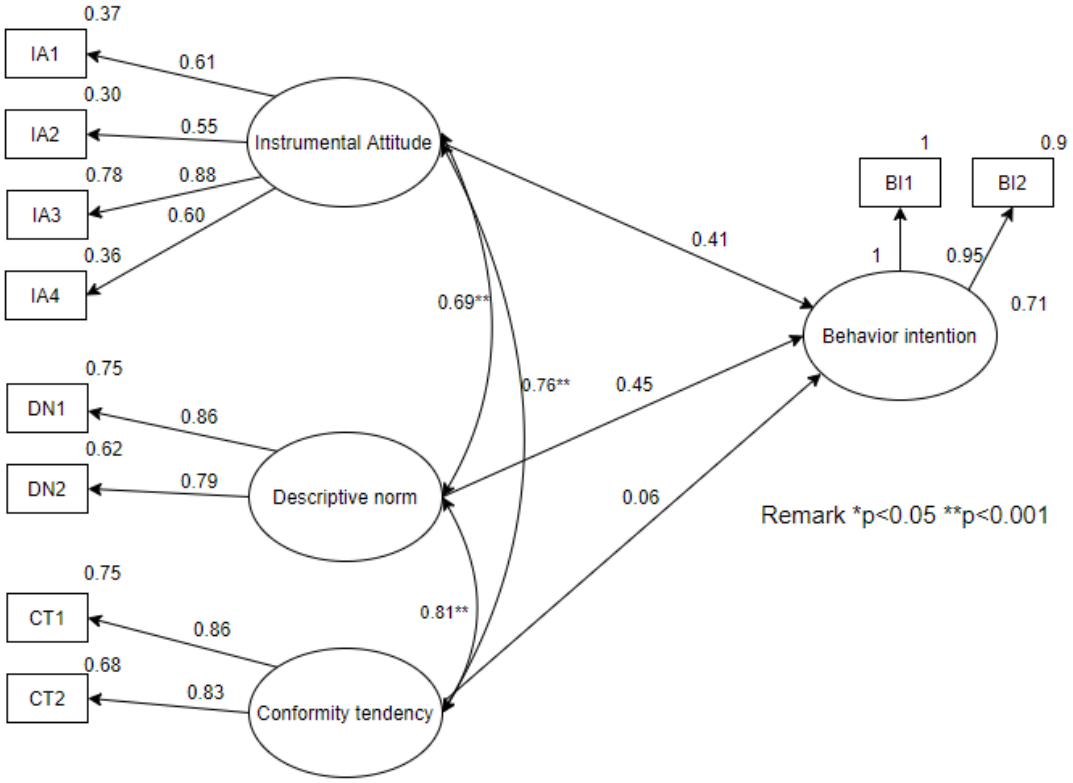


Figure 5-6: The adjusted structural equation model of female teenage pedestrians in Japan

Table 5-16: The adjusted goodness of fit of the teenage pedestrian in Japan by gender

Measure	Threshold	Model	
		Statistic values	The result
Chi-sqare/df (cmin/df)	<3 good ; <5 sometimes permissible	1.514	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.978	Pass
The goodness of fit index (GFI)	≥ 0.95 great ; ≥0.90 traditional	0.934	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.041	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.05	Pass

The value for the model fit indices for the model were Chi-square/df (cmin/df) = 1.514, Comparative fit index (CFI) = 0.978, The goodness of fit index (GFI) = 0.934, Standardized Root Mean Squared Residual (SRMR) = 0.041, Root Mean square error of approximation (RMSEA) = 0.05. The goodness of fit standard criterion indicated a good model fit.

5.7.3 Male aspect of Thai pedestrian

The result of the adjusted model by gender. The statistical values and the goodness of fit and is shown in Figure 5-7, 5-8 and Table 5-17

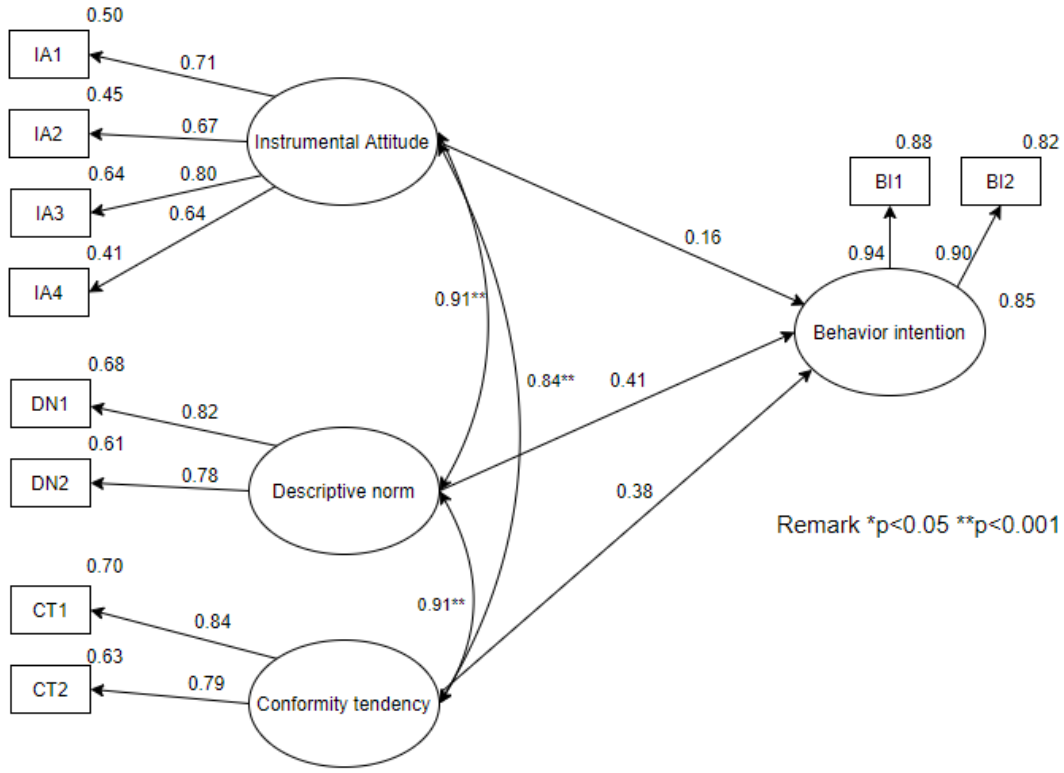


Figure 5-7: The adjusted structural equation model of male teenage pedestrians in Thailand

5.7.3 Female aspect of Thai pedestrian

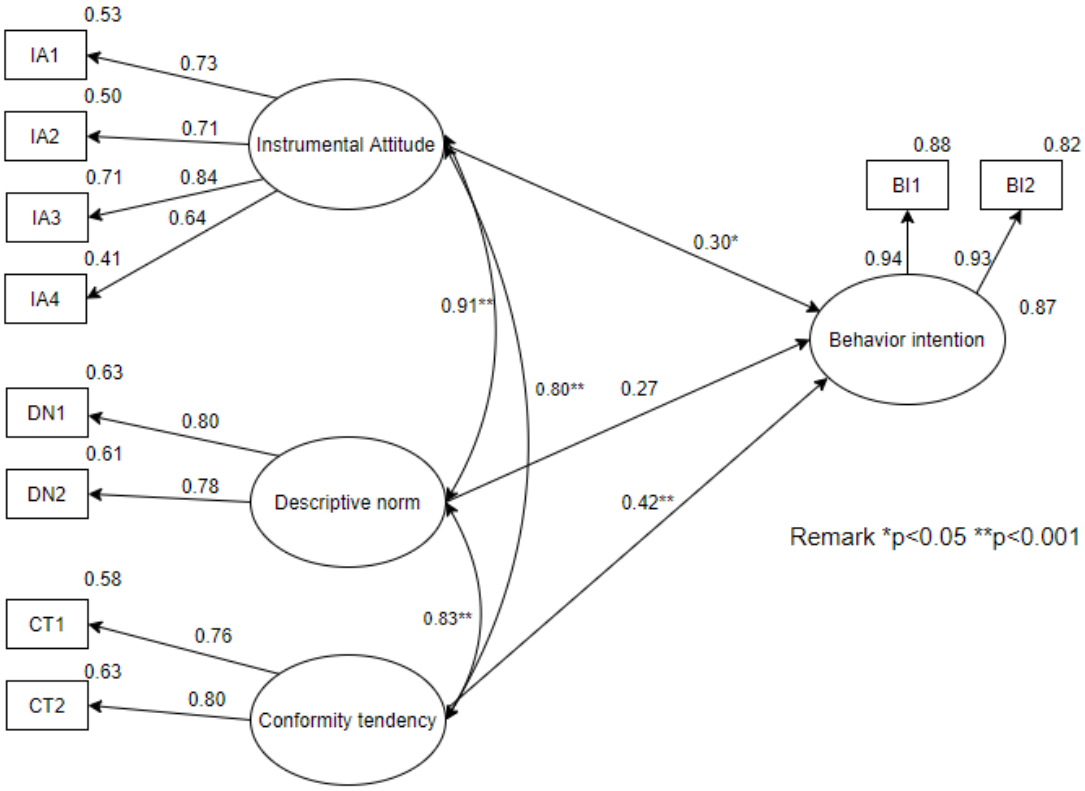


Figure 5-8: The adjusted structural equation model of female teenage pedestrians in Thailand

Table 5-17: The adjusted goodness of fit of the teenage pedestrian in Thailand by gender

Measure	Threshold	Model	
		Statistic values	The result
Chi-sqare/df (cmin/df)	<3 good ; <5 sometimes permissible	2.099	Pass
Comparative fit index (CFI)	≥ 0.95 great ; ≥0.90 traditional	0.983	Pass
The goodness of fit index (GFI)	≥ 0.95 great ; ≥0.90 traditional	0.960	Pass
Standardized Root Mean Squared Residual (SRMR)	< 0.08	0.051	Pass
Root Mean square error of approximation (RMSEA)	< 0.05	0.041	Pass

The value for the model fit indices for the model were Chi-square/df (cmin/df) = 2.099, Comparative fit index (CFI) = 0.983, The goodness of fit index (GFI) = 0.960, Standardized Root Mean Squared Residual (SRMR) = 0.051, Root Mean square error of approximation (RMSEA) = 0.041. The goodness of fit standard criterion indicated a good model fit.

5.8 Summary

After modifying the model, the model is a good fit with the empirical data. The model fit between Thai and Japanese teenage behavior is excellent. Moreover, the interpretation from each variable in both models, it is reasonable to explain the relationship of attitudes that affect behavior and some risk behavior that lead to violating the traffic laws.

In Japan, the bicycle model, Notice failure (NF) and Stunt (ST) behaviors are directly affecting the violation behavior (0.27 and 0.32, respectively). The pedestrian model, Instrumental attitude (IA) and Conformity tendency (CT) are directly affecting the crossing behavior (0.35 and 0.67, respectively)

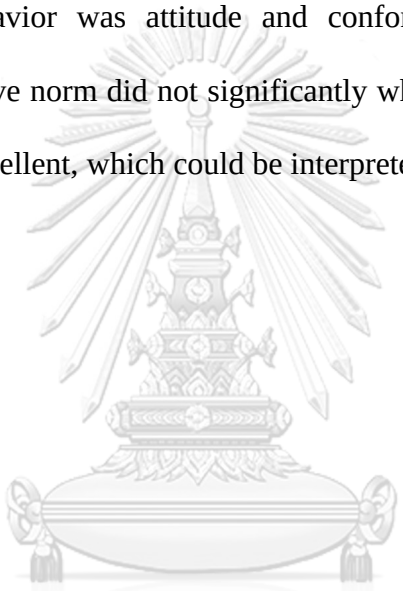
In Thailand, the motorcycle model, Traffic error (TE) and Stunt (ST) behaviors are affecting the violation behaviors (0.87 and 0.34, respectively). The pedestrian model, Attitude (IA), Descriptive Norm (DN), and Conformity tendency (CT) all of the latent variables are significantly affecting the violate behavior while crossing (0.30, 0.30, and 0.38, respectively).

As described, Traffic Error and Notice failure in bicycle and motorcycle models are nearly the same. These two latent variables use to indicate the awareness of behavior. However, about stunt Japan rider and Thai rider are nearly the same (0.32 and 0.34 respectively)

When compared by gender, the result shows that gender is one of the reason affect the behavior of both Japanese and Thai teenager. On Japanese male aspect show that conformity tendency (0.93) and Instrumental attitude (0.38) are substantially different from the female aspect, which is not significant in all latent

variables even though the model coefficient of determination (R^2) equal to 71 percent. On the other hand, on Thai male aspect show that none of latent variables are significant and the coefficient of determination (R^2) equal to 85 percent. Nevertheless, on female aspect conformity tendency (0.42) and Instrumental attitude (0.30) are significant and coefficient of determination (R^2) equal to 87 percent

For both Thai and Japan pedestrians, the main factor affecting the pedestrian model's violation behavior was attitude and conformity tendency. However, in Thailand, the Descriptive norm did not significantly while crossing. Given the above, all these models are excellent, which could be interpreted to the policies.



Chapter 6

Conclusions and discussion

6.1 Overview of the research

This research is survey research to find out the exact behavior of people on violation behaviors. According to the accident number from Who, 2017, Thailand is number 1 on traffic death per 100k person. Moreover, Japan has been hit the lowest record of all time since 1948. This research wants to find out the differences between these nations. The sample group used in this research is Thai and Japanese teenagers, especially in Bangkok city, Thailand and Sapporo city, Hokkaido, Japan.

The questions consist of 3 parts; 1) Basic information and personal information 2) Motorcyclist and cyclist behaviors questionnaire 3) Pedestrian questionnaire.

The vulnerable road user questionnaires based on TPB Theory (Ajzen, 2006) and has been developed into road user behaviors, the Bicycle Riding Behavior Model (Hezaveha et al., 2016), Motorcycle Riding Behavior (Elliott et al., 2007) and Pedestrians Behavior (Zhoua et al., 2016). The motorcycle model consists of 15 items that used to indicate the behavior of teenage motorcyclists in Thailand. The bicycle model consists of 15 items that used to indicate teenage cyclists in Japan. Lastly, the pedestrian model consists of 10 items that used to indicate behaviors in both Thai and Japanese teenagers. The items in the questionnaire perform a reliability test (Cronbach alpha). The pilot survey was distributed to test the reliability of the questionnaire with a sample of 50 people. As a result, the questionnaire has the total confidence of every question Above 0.7, which is excellent.

To survey and collect data, the researcher distributes the questionnaire at Sapporo city from 2/12/2019-9/12/2019 daily between 15:00-17:00 and at Bangkok city from 8/2/2020-15/2/2020 between 16:00-18:00. The number of samples in Thailand is 477 people, and Japan is 201 people. After that, use the complete data questionnaire to analyze the descriptive statistics with the IBM SPSS program. In order to analyze the path diagram or structural equations model analysis, the researcher using IBM SPSS AMOS to analyze the model and clarify the most affect behavior on violation behavior on each model in this section.

6.2 Result of the research

6.2.1 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 is 48.4 percent. About the education, most of the sample is an undergraduate student and has been studying at Chulalongkorn University, which is 92.5 percent.

About driving experience, Most Thai teenagers never have a driving experience which is 57.5 percent. Alternatively, for Thai teenage riders, most of the sample has 6-10 years of riding experience, which is 45.9 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 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 about education and has been studying at Hokkaido University, which is 60.7 percent.

About driving experience, Most of the Japanese teenagers has 1-5 years of driving experience, which is 59.2 percent. However, Japanese teenage rider, most of the sample has more than 10 years of riding experience, which is 71.6 percent. About 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 Japanese teenage riders never has an accident 77.1 percent.

6.2.2 Behavior and attitude on violation behaviors

Japanese teenage cyclists, the behavior of cycling was positive. Many teenagers were worried about traffic 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 pedestrians, Most Japanese teenagers have a positive attitude and behavior on crossing violation. For 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 violations. 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. In the present context, the emergence of Control error in addition to traffic errors can be accounted for by the fact that motorcycling is an inherently demanding task with respect to certain aspects of control skills, much more so than car driving.(Elliott et al., 2007) 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.

6.2.3 Discussion of behavior and attitude toward violation behaviors of teenagers

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 variable. The models are from literature reviews, which are 1) Bicycle Riding Behavior Model (Hezaveha et al., 2016) 2) Motorcycle Riding Behavior (Elliott et al., 2007) and 3) Pedestrians Behavior (Zhoua et al., 2016), which are shown in chapter3. To verify the model fits with the empirical data or not, each weight factor of latent variables should more than 0.3.

For 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 a motorcycle and pedestrian models. According to Japan, a small number of people using a motorcycle. The 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 compared to this model.

After analyzing the models by using confirmatory factor analysis, then, analyze by AMOS SPSS programming to reveal the correlation between latent

variables evidently, which is Structural equation model analysis. At the first phase of model analysis, the models were not fit. The researcher had modified the models by modification indices functions and using techniques for determining error term to find which error is related. Finally, The models are fit to the data and reach the goodness of fit index, which are Chi-square/df (cmin/df), Comparative fit index (CFI), The goodness of fit index (GFI), Standardized Root Mean Squared Residual (SRMR), and Root Mean square error of approximation (RMSEA) which are the best indices for structural equation model (Hooper, Coughlan, & Mullen, 2007).

From the consideration of both Thai and Japanese models. Found, the models could explain the behavior and attitude well. Moreover, the models are reasonable to explain the relationship between behavior and attitude toward violation behaviors. In Japan, the result of analysis shown that the most factor loading and reach the significant level on cyclist violation is Notice failure (NF), which is 0.32 following by bicycle stunt, which is 0.27. Moreover, when considered the square multiple correlations (R^2) explain the variance of the model equal to 18 percent. While the pedestrian model, the result of analysis shown that the most factor loading on pedestrian violation is instrumental attitude (IA), which is 0.35 following by conformity tendency, which is 0.67. when considered the square multiple correlations (R^2) explain the variance of the model equal to 78 percent.

In Thailand, the result of analysis shown that the most factor loading that reaches the significant level on motorcyclist violation is motorcycle stunt, which is 0.87 following by traffic error (TE), which is 0.54. Moreover, when considered the square multiple correlations (R^2) explain the variance of the model equal to 55

percent. While the pedestrian model, the result of analysis shown that the most factor loading on pedestrian violation is instrumental attitude (IA), which is 0.30 following by descriptive norm 0.30 and conformity tendency, which is 0.38. when considered, the square multiple correlations (R^2) it explains the variance of the model equal to 78 percent.

6.3 Comparison between Thai and Japanese teenage violation behaviors

Japanese teenagers and Thai teenagers have different in some aspects. The research compared between bicycle model and motorcycle model based on Bicycle riding behavior (Hezaveha et al., 2016) and Motorcycle rider behavior (Elliott et al., 2007). Both models based on the same concept of thinking to find the exact behaviors, violation behaviors, and risk behaviors on these modes.

Although, these two models cannot be compared because it is different modes and different areas of study. But bicycle and motorcycle model behaviors. both could explain the behavior well. It is no difference between these models. The bicycle model has a high loading factor on notice failure and stunt, which are the same as a motorcycle model. However, on the motorcycle model, Traffic error and Stunt aspects are significant predictors especially have a lot more factor loading on Stunt. But Some behavior studies “errors” relating to inexperience or unskilled, in addition to errors involving high-risk and mistakes (Rimmö & Hakamies-Blomqvist, 2002). The researcher would say it is the main predictor of violation behavior which is different from Elliott et al. (2007) said that it was traffic errors that were consistently the main predictors of accident or violation. From the point of view, it could be concluded that Thai teenager has more negative behavior. Because it is one of the reasons toward

accident (See Table 4-2), Thai teenagers used to have an accident up to 64 percent of the sample, 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 SEM in chapter 5 (See Figure 5-4). Thai teenage pedestrians tend to cross the road while red light depending on “Descriptive Norm” this is the only one 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 researcher's perspective, means Thailand it easy to do violation behaviors and tend to violate according to adult or close friends 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 could potentially lead to greater motivation for violation. This confirms the opinion of Lajunen and Räsänen (2004) 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.

6.3.1 Gender aspect between Thai and Japanese teenagers

The gender aspect between pedestrians is a fascinating model to interpret. Due to the correlation between latent variables are high and significant at 0.001 level and the difference between gender that significant. It means the model of pedestrian has an indirect effect that affects the violation behavior. Gender is one of the most different behave between Thai and Japanese teenagers.

Gender aspects between Japanese and Thai show a huge difference in pedestrian behavior when performing simultaneous analysis of multiple groups. In Japan, males tend to cross while red light or do a violation depending on conformity tendency (0.93) and attitude (0.38) which is the same as the primary model. Moreover, on the correlation between Instrumental attitude and Descriptive norm is significant (0.79). It means the model has some indirect effect that could explain the violation behavior. Table 6-1 shows that Instrumental attitude through the Conformity tendency can explain the violation behavior 25 percent. Mean, The pedestrian could change their attitude base on other road users or other pedestrians nearby. For example, “ the pedestrian waiting for the green light and then someone nearby crossing while redlight. So the pedestrians change their attitude and cross the road while redlight.”

Table 6-1: Indirect effect of male Japanese teenagers model

Variables	Beta	Direct	Indirect			Sum	Total effect
			Instrumental Attitude	Descriptive Norm	Conformity tendency		
Instrumental Attitude	0.38	0.14		-0.11	0.26*	0.14	0.29
Descriptive Norm	-0.38	0.14	-0.11		-0.28	-0.39	-0.25
Conformity tendency	0.93	0.86	0.26*	-0.28		-0.02	0.84
*p<0.05						R^2	0.88

On the other hand, on the female aspect none of latent variables are significant. It means male has more aggressive behavior and do not care about the violation much which is the same from previous studied said that gender comparisons indicated that females were more prone to Control Errors; on the other hand, males reported more intentional traffic violations (Hezaveh et al., 2018).

Table 6-2: Indirect effect of female Thai teenagers model

Variables	Beta	Direct	Indirect			Sum	Total effect
			Instrumental Attitude	Descriptive Norm	Conformity tendency		
Instrumental Attitude	0.30	0.09		0.07	0.10*	0.17	0.26
Descriptive Norm	0.27	0.07	0.07		0.09	0.17	0.24
Conformity tendency	0.42	0.18	0.10*	0.09		0.19	0.37
*p<0.05						R^2	0.87

However, in Thailand, it shows that females intentionally committed more violations that males and behave violate behavior depending on Conformity tendency (0.42) and negative Attitude (0.30) same difference as Japanese males but has a huge different on conformity tendency factor loading (Thai = 0.42, Japanese = 0.93). Table 6-2 shows the indirect effect that Instrumental attitude through the Conformity

tendency can explain the violation behavior 10 percent. This indirect effect is the same as a Japanese male. Mean, The pedestrian could change their attitude base on other road users or other pedestrians nearby. However, the behavior of tendency is lower than Japanese male. It shows that Thai teenager rarely have an effect on external incentive but it mostly depends much more on their attitude. This confirms the previous studied from González-Iglesias, Gómez Fraguela, and Luengo-Martín (2012) that females tend to adopt quieter and more covert aggression forms like violate while crossing the road whereas males tend to exhibit more explicit and directly observable aggressive behaviors.

6.4 Suggestion and recommendation

The results of this research show the difference 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 teenager behavior.

Motorcycle riding behavior in Thailand, a teenager tends 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 Thai teenagers do not know how to control a motorcycle correctly and safely. Taken at face value, the findings suggest that training interventions that improve traffic skills, such as hazard perception and control skills associated with cornering and speed, would be effective at improving safety (Hezaveh et al., 2018). Moreover, do not know the laws and careless on other road users such as pedestrian 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. Also, the motorcycle needs to respect other road users if everybody could do and have some policies to support this problem, it could improve the violation behaviors.

The next factor was the stunt aspect in motorcycle and descriptive norms in the pedestrian model. As we know, a teenager is energetic and does not think carefully according to their age. These behaviors as acts of sensation seeking or mental distractions (e.g., listening to music), which could help them to facilitate their performances (Laukka & Quick, 2011). The behaviors were tendency by external factors such as family, friends or even people in their society. Community and social level 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 violation and accident. Family and friends have to encourage teenagers not to violate and taught them carefully about the risk of violation and loss of the accident. In addition, teaching about accidents to children from elementary school. Contribute to helping reduce traffic violations and accidents. As for in Japan The policies are taught and instill danger from the violation. This will develop norms for the society that will take into account. 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. (Champahom et al., 2019).

6.5 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 are only 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 fulfil the consideration of bicycle behavior in a various range of age. Moreover, find others 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 frequently behaviors or violations. And develop a new questionnaire based on this research to fulfill the blank or unclear behaviors.

REFERENCES

Ajzen, I. (2006). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. doi:https://doi.org/10.1016/0749-5978(91)90020-T

Champahom, T., Jomnonkwao, S., Satiennam, T., Suesat, N., & Ratanavaraha, V. (2019). Modeling of safety helmet use intention among students in urban and rural Thailand based on the theory of planned behavior and Locus of Control. *The Social Science Journal*. doi:10.1016/j.soscij.2019.02.003

Chang, H.-L., & Yeh, T.-H. (2007). Motorcyclist accident involvement by age, gender, and risky behaviors in Taipei, Taiwan. *Transportation Research Part F: Traffic Psychology and Behaviour*, 10(2), 109-122. doi:10.1016/j.trf.2006.08.001

Cheng, A. S., & Ng, T. C. (2010). Development of a chinese motorcycle rider driving violation questionnaire. *Accid Anal Prev*, 42(4), 1250-1256. doi:10.1016/j.aap.2010.01.018

Cheng, A. S. K., Liu, K. P. Y., & Tulliani, N. (2015). Relationship between Driving-Violation Behaviours and Risk Perception in Motorcycle Accidents. *Hong Kong Journal of Occupational Therapy*, 25(1), 32-38. doi:10.1016/j.hkjot.2015.06.001

Department of Land Transport Report. (2019). *Car Registration Statistics*. Retrieved from https://web.dlt.go.th/statistics/

Elliott, M. A., Baughan, C. J., & Sexton, B. F. (2007). Errors and violations in relation to motorcyclists' crash risk. *Accid Anal Prev*, 39(3), 491-499. doi:10.1016/j.aap.2006.08.012

González-Iglesias, B., Gómez Fraguela, X., & Luengo-Martín, A. (2012). Driving anger and traffic violations: Gender differences. *Transportation Research Part F: Traffic Psychology and Behaviour*, 15, 404–412. doi:10.1016/j.trf.2012.03.002

Hair, J., Black, W., & Babin, B. (2010). Anderson. RE, 2010. Multivariate Data Analysis. *New Jersey, Pearson Prentice Hall*.

Hajek, P., Suteja, I. W., Holman, M., Wedagama, D. M. P., Suthanaya, P. A., Han, A. L., . . . Hidayat, B. A. (2018). The influence of age and gender of student motorcycle riders on traffic violations and accidents using a structural equation model. *MATEC Web of Conferences*, 195. doi:10.1051/matecconf/201819504015

Hezaveh, A. M., Zavareh, M. F., Cherry, C. R., & Nordfjærn, T. (2018). Errors and violations in relation to bicyclists' crash risks: Development of the Bicycle Rider Behavior Questionnaire (BRBQ). *Journal of Transport & Health*, 8, 289-298. doi:10.1016/j.jth.2017.11.003

Hooper, D., Coughlan, J., & Mullen, M. (2007). Structural Equation Modeling: Guidelines for Determining Model Fit. *The Electronic Journal of Business Research Methods*, 6.

Japan Road Traffic Act. (1960). Retrieved from http://www.japaneselawtranslation.go.jp/law/detail/?id=2962&vm=04&re=02

Jöreskog and Sörbom. (1989). LISREL 7: A Guide to the Program and Applications.

Lajunen, T., & Räsänen, M. (2004). Can social psychological models be used to promote bicycle helmet use among teenagers? A comparison of the Health Belief Model, Theory of Planned Behavior and the Locus of Control. *Journal of Safety Research*, 35(1), 115-123. doi:https://doi.org/10.1016/j.jsr.2003.09.020

Laukka, P., & Quick, L. (2011). Emotional and motivational uses of music in sports and exercise: A questionnaire study among athletes. *Psychology of Music*, 41. doi:10.1177/0305735611422507

Massie, D. L., Campbell, K. L., & Williams, A. F. (1995). Traffic Accident involvement rates by driver age and gender. *Accident Analysis & Prevention*, 27(1), 73-87. doi:https://doi.org/10.1016/0001-4575(94)00050-V

National Accident Prevention Committee. (2010). Accident. Retrieved from portal.disaster.go.th

National Police Agency. (2018). *Traffic Annual Report*.

Oguchi, T. (2016). Achieving safe road traffic — the experience in Japan. *IATSS Research*, 39(2), 110-116. doi:https://doi.org/10.1016/j.iatssr.2016.01.003

Rimmö, P.-A., & Hakamies-Blomqvist, L. (2002). Older drivers' aberrant driving behaviour, impaired activity, and health as reasons for self-imposed driving limitations. *Transportation Research Part F: Traffic Psychology and Behaviour*, 5, 47-62. doi:10.1016/S1369-8478(02)00005-0

Thailand Road Traffic Act. (2009). Retrieved from http://web.krisdika.go.th/data/law/law2/%A803/%A803-20-9999-update.htm

The Japan Times. (2006, Jan 9, 2008). Drunk driver gets 7 1/2 years for killing kids. *The Japan Times*,. Retrieved from https://www.japantimes.co.jp/news/2008/01/09/national/drunk-driver-gets-7-12-years-

for-killing-kids/#.XaQVpm5uLfM

Topolšek, D., & Dragan, D. (2015). Behavioural Comparison of Driverswhen Driving a Motorcycle or a Car: A Structural Equation Modelling Study. *Promet-Traffic & Transportation*, 27, 457-466. doi:10.7307/ptt.v27i6.1816

Vijit, B. (1995). Problems from Land Traffic. Retrieved from http://www.4shared.com/doc/cihttjpk/preview.html.

Wong, J. T., Chung, Y. S., & Huang, S. H. (2010). Determinants behind young motorcyclists' risky riding behavior. *Accid Anal Prev*, 42(1), 275-281. doi:10.1016/j.aap.2009.08.004

World Atlas. (2017). Countries With the Most Car Accidents. Retrieved from https://www.worldatlas.com/articles/the-countries-with-the-most-car-accidents.html

World Health Organization. (2018). *Road Safety Global Health Observatory (GHO) data*. Retrieved from World Health Organization: https://www.who.int/gho/road_safety/en/

Zhou, H., Romero, S. B., & Qin, X. (2016). An extension of the theory of planned behavior to predict pedestrians' violating crossing behavior using structural equation modeling. *Accid Anal Prev*, 95(Pt B), 417-424. doi:10.1016/j.aap.2015.09.009

APPENDICES

Appendix A

Japanese Questionnaire

Questionnaire:

設問 1　あなた自身や普段の行動について、あてはまる欄に✔または数字を入れてください。

1. 性別　☐1.男性　☐2.女性

2. 年齢……歳

3. 現在通っている学校

☐1. 高校　☐2. 大学、専門学校　☐3. 大学院　☐4.その他……

4. 運転歴（全て）　☐ 自動車…… 年 ☐ 自転車 …… 年 ☐ 原付・オートバイ ……年

5. 所有している運転免許（全て）　☐1.自動車 ☐2.原付・オートバイ ☐3.持っていない

6. 運転免許 (自動車、単車どちらでも)を取得してから約 ……年

7. 今まで交通違反をしたことはありますか（ はいと答えた方、直近 6 か月間で犯した違反のおおまかな回数を教えてください。）☐1.はい……回　☐ 2 .いいえ

8. 今まで交通違反をしたことがある方にお尋ねします。直近の交通違反について教えてください。（いくつでも）
☐1.進行方向無視　☐2. 赤信号無視 (徒歩)　☐3. 速度超過　☐4. 赤信号無視（自動車）
☐5.飲酒運転　☐6. その他……

9. 今まで交通事故に遭ったり、交通事故を起こしたりことはありますか。

☐1.はい……回　☐2.いいえ
→ある方 : 直近の事故の程度について教えてください。

☐1.物損のみ　☐2. 軽傷　☐3. 重症　☐4. 死亡

Figure A-1: Japanese questionnaire page one

設問２　自転車に乗る時の行動について教えてください。

あなたの普段の行動に当てはまる欄に✔を入れてください。

番号	質問内容	とてもよくある	よくある	ときどきある	たまにある	ない
1	信号が赤に変わる前に道路を渡るためにスピードを上げる					
2	標識に従わずに、自動車専用道路等、通行が禁止されている道路を走る					
3	他の道路利用者に対して怒りを覚え、何らかの方法で敵意を示す					
4	ハンドルに手を触れず（両手放しで）運転をする					
5	通話しながら運転する.					
6	音楽を聴きながら運転する					
7	低速で走っているときにバランスを崩す					
8	下り坂で運転操作が難しくなる					
9	どの変速段階を使えばいいかわからない					
10	ギリギリまで駐車車両の後ろから飛び出してくる人に気付かない					
11	右左折時に歩行者が横断してくるのに気づかない					
12	横断歩道を渡ろうと待っている歩行者に気付かない					
13	赤信号を無視する					
14	青の点滅信号で横断歩道を渡る					
15	道路の進行方向に反して逆走する					

Figure A-2: Japanese questionnaire page two

設問 3　　歩いている時のことについて教えてください。

あなたにもっとも当てはまる欄に✔を入れてください。

以下のことを想定してください

・あなたは仕事や学校に行くため、または何か用がありそのために道路の反対側に渡らなければなりません。

・あなたは交差点に差し掛かりました。現在信号は赤色です。

・あなたは急いでいるので、合間を縫って道路を渡ろうとしています。

番号	質問内容	とてもそう思う	そう思う	どちらともいえない	そう思わない	全くそう思わない
1	この状況では、道路を渡ることで時間を節約できる					
2	時間を節約することは自分にとって重要である					
3	この状況では、道路を渡ることが効率的である					
4	効率的であることは自分にとって重要である。					
5	この状況で自分の家族は道路を渡る					
6	この状況で自分の友人は道路を渡る					
7	他の歩行者が赤信号を渡っていたら、自分もそうする					
8	この状況で自分がだれかと一緒にいたら、道路を渡る					
9	この状況で自分は道路を渡る					
10	もし今後このような状況に出くわしたら、自分は道路を渡る。					

Figure A-3: Japanese questionnaire page three

Appendix B

English questionnaire

Questionnaire: Part 1 Personal Information

Explanation: To put the check mark (✓) in the blank box which mean to your generally behave.

1. Gender ☐1.Male ☐2.Female

2. Age.....year old

3. Education

☐1. High school / Vocational ☐2. undergraduate ☐3. master's ☐4.Others.....

4. Riding experience (Can be more than 1). ☐ Car..... year ☐ Bicycle ..... year ☐ Motorcycle.....year

5. Do you have a driving/riding license? (Can be more than 1). ☐1.Car ☐2.Motorcycle ☐3.Do not have

6. Approximate duration of obtaining a driver's license (Both Car and motorcycle) .....Year

7. Have you ever violate the traffic rule? ☐1. Yes.....Time ☐ 2 .No

8. If you have violated this, please state the latest violations (Can be more than 1).

☐1.Riding not the same directions of the road ☐2. Crossing the road while red light (Walking) ☐3. Over the speed limits ☐4. Do not stop while red light ☐5.Drinking while riding or driving ☐6. Other.....

9. Have you ever had a traffic accident? ☐1.Yes.....Time ☐2.No

If yes : How is the severity of the latest accident?

☐1.Damaged only asset ☐2. There are Slightly injuries ☐3. There are serious injuries. ☐4. Have died

Figure B-1: English questionnaire page one

Questionnaire: Part 2 The questionnaire of characteristics and behavior of Bicycle user

Explanation: To put the check mark (✓) in the blank box which mean to your generally behave.

No.	Contents	Very often	Fre-quently	Some-times	Occa-sionally	Never
1	Speed up to beat the traffic light turning red					
2	Ride in prohibited expressways, drives, highways, interstate routes, bridges, and thruways unless authorized by signs					
3	Become angered by another road user and indicate your hostility by whatever means you can					
4	Riding without having at least one hand on handlebars.					
5	Talk on the phone while riding your bike.					
6	Listen to music while riding					
7	Hard to maintain balance at low speeds					
8	Have difficulty controlling your bicycle downhill					
9	Do not know which gear to use					
10	Fail to notice someone stepping out from behind a parked vehicle until it is nearly too late					
11	Fail to notice that pedestrians are crossing the street when you are turning					
12	Fail to notice a pedestrian waiting to cross at a crosswalk					
13	Run red light					
14	Cross the road while the green light flashes.					
15	Cycling invert the road directions					

Figure B-2: English questionnaire page two

Questionnaire: Part 2 The questionnaire of characteristics and behavior of Pedestrians.

Explanation: To put the check mark (✓) in the blank box which mean to your generally behave

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.

No.	Contents	Totally agree	Agree	Neutral	Disagree	Totally disagree
1	Crossing the road in the scenario* described would save me time					
2	Saving time is important to you					
3	Crossing the road in the scenario* described would be more convenient					
4	Convenience is important to you					
3	"My family cross the road as described in the scenario*					
4	My friends cross the road as described in the scenario*					
5	"If other pedestrians cross the road during the red light I would do the same					
6	When I am with companions I cross the road as described in the scenario*					
7	Would you cross the road as described in the scenario*					
8	"If you encounter this situation in the future you would cross the road as described in the scenario*					

Figure B-3: English questionnaire page three

VITA

NAME	NAPATTHARAKORN KATANARAROJ
DATE OF BIRTH	23 January 1995
PLACE OF BIRTH	BANGKOK
INSTITUTIONS ATTENDED	King Mongkut's University of Technology North Bangkok
HOME ADDRESS	5 Ramindra 5 7-2 Bangkean