



公益財団法人 国際交通安全学会
International Association of Traffic and Safety Sciences



Traffic Safety Education for Young Road Users: Implications from the IATSS Project in Cambodia

Yuto Kitamura

Professor, Graduate School of Education
The University of Tokyo

Background and Objective of the Study

- In Southeast Asia, which is experiencing accelerating foreign direct investment and human migration as a growth center for the 21st century, **Cambodia** has achieved remarkable socio-economic development.
- Like many **developing countries** in the growth phase, Cambodia is experiencing **rapid motorization**. Particularly in **Phnom Penh**, the capital city of Cambodia, traffic congestion and accidents are becoming more and more serious since **infrastructure development** and **improvement of people's consciousness** have not kept pace with the rapid motorization.
- This study focuses on **young people (i.e., high school and university students)** who are still actively using roads for attending school and other objectives, and who will continue to be important road users in the future.
- After clarifying **the traffic awareness and driving behavior of young people**, we researched, developed, practiced, and proposed measures (i.e., awareness campaigns and educational curriculums) to improve traffic safety, especially from **an intangible perspective**.

IATSS Research: Approaches to intangible measures

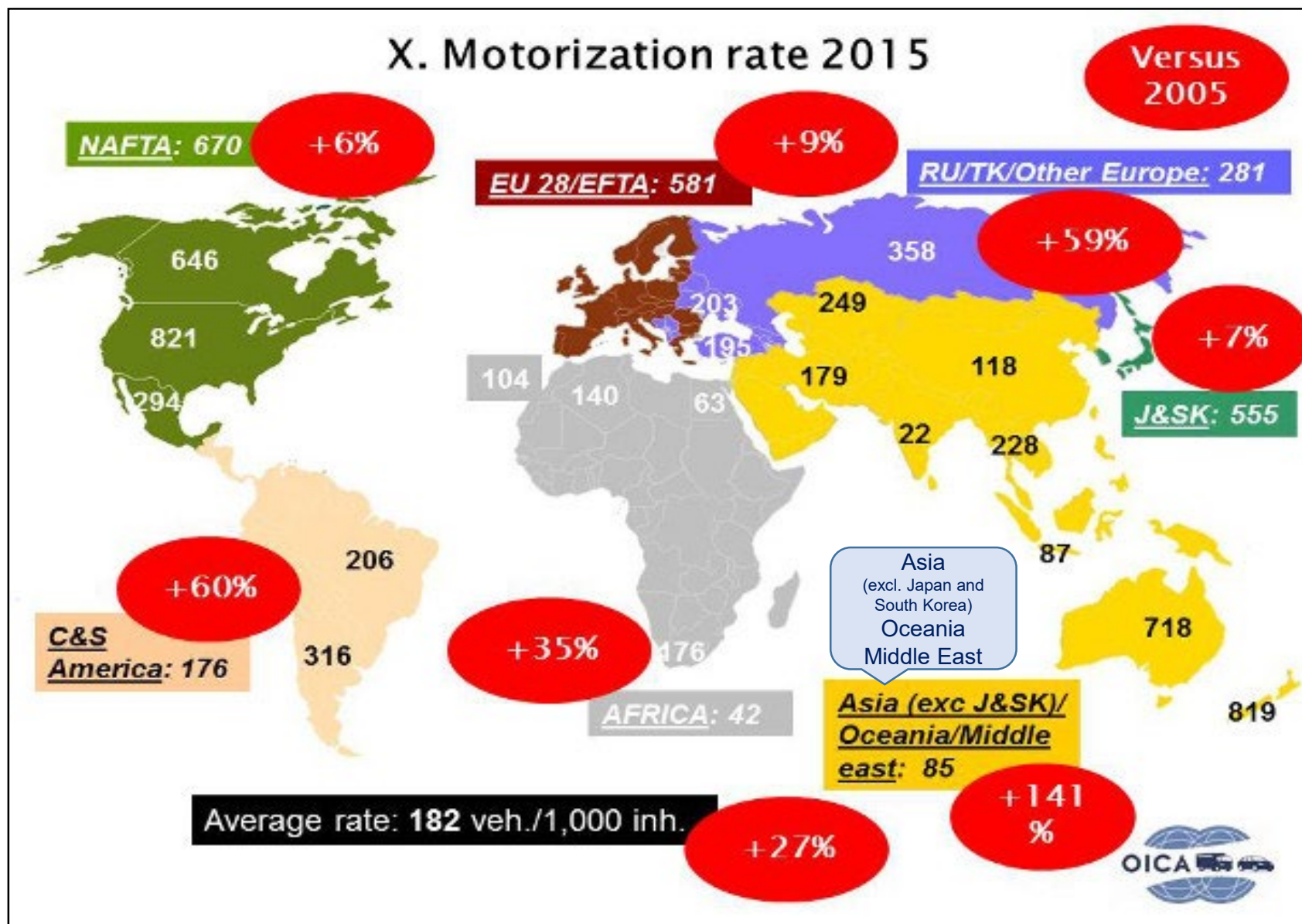
1. **Analysis of driving behavior of young people:** In order to clarify how young people actually behave on the road, we recorded and analyzed the actual driving behavior (= motorcycles) of high school and university students and road conditions.
2. **Driving skills training for young people:** In cooperation with the IATSS Forum Alumni Association, we held a workshop on July 16, 2017 for high school and university students to improve their motorcycle driving skills.
3. **Contribution to the improvement of traffic infrastructure:** In cooperation with the Japan International Cooperation Agency (JICA), we conducted a study to clarify the impact of the introduction of new traffic signals and the establishment of a traffic control center on improving traffic conditions.
4. **Training for traffic police officers:** We held a workshop on December 15, 2017 for traffic police officers of Phnom Penh Municipal Police to improve their motorcycle driving skills and to provide them with knowledge about traffic safety education.
5. **Cross-sector cooperation:** In carrying out the above-mentioned research and activities, we cooperated with various stakeholders.

1. Background

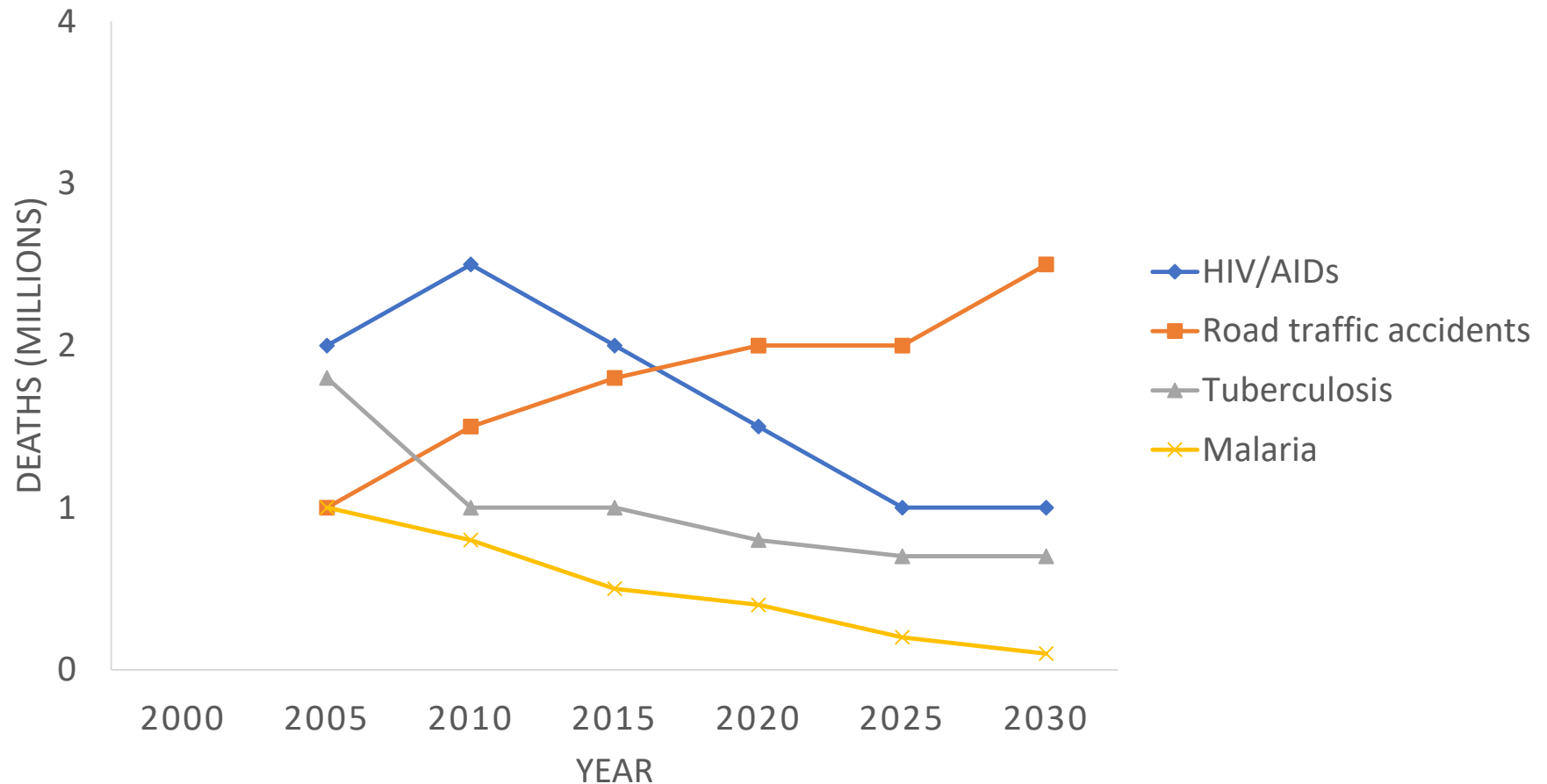
- Global motorization and traffic situation in Cambodia –

Global automobile penetration rate (motorization rate)

(Number of vehicles per 1,000 inhabitants in 2015; growth rate from 2005 to 2015)



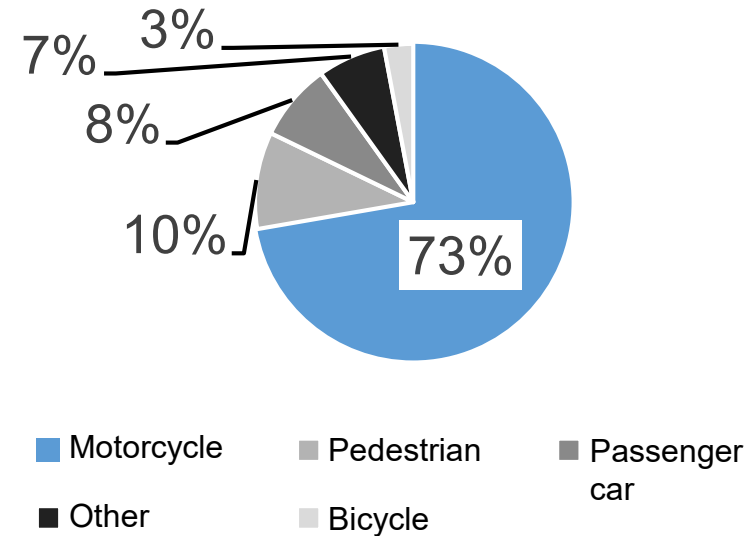
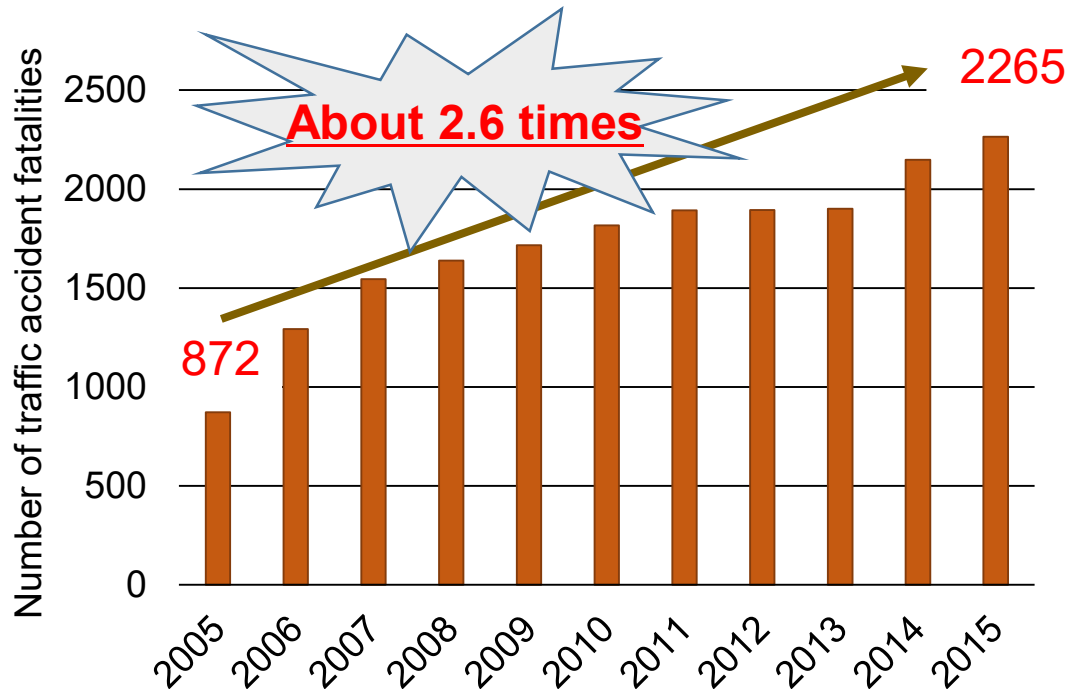
Projected global deaths for selected causes, 2004 – 2030



Source: Prepared by partially excerpting from Global Burden of Disease 2004

Traffic Accidents in Cambodia

Changes over time in the number of traffic accident fatalities in Cambodia



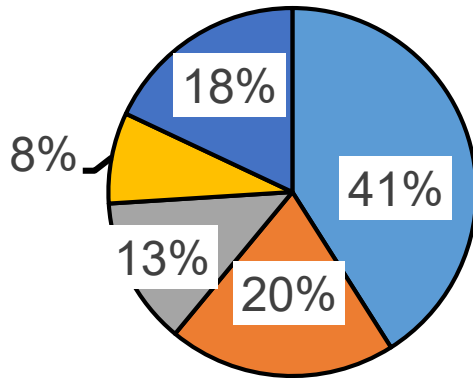
Traffic accident fatalities by means of transport in Cambodia, 2014

Similar to the period of high traffic accidents due to popularization of cars in Japan

In Japan, motorcycle driver education began around 1970

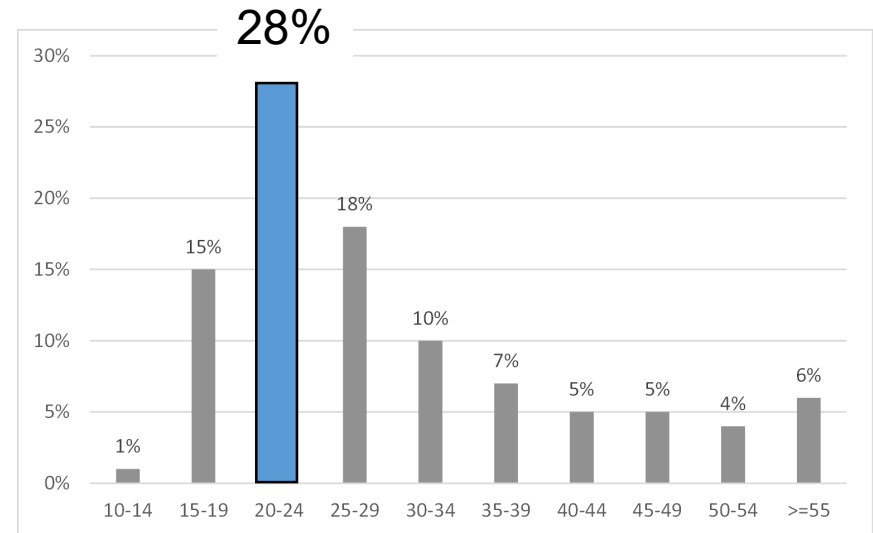
→ The increase in the number of traffic fatalities involving motorcycles was halted.

Motorcycle Accidents and Young People



Speeding
Drunk-driving
Dangerous passing
Ignorance of priority rules
Other

Causes of motorcycle fatalities



Percentage of motorcycle accidents due to negligence by driver's age in Cambodia, 2014

The noteworthy point is the high rate of motorcycle fatalities of young people.

2. Analysis of Motorcycle Driving Behavior of Young People

Analysis of Driving Behaviors Using On-Board Cameras

– Measuring the effect of traffic safety education workshops (WS) –

Considering the individual attributes of the questionnaire survey (gender, student category, driving experience, driving confidence, weather conditions), the survey was conducted twice (before and after the WS).



Camera positions



A scene captured by the front camera

Focusing on dangerous driving items to clarify actual driving behaviors

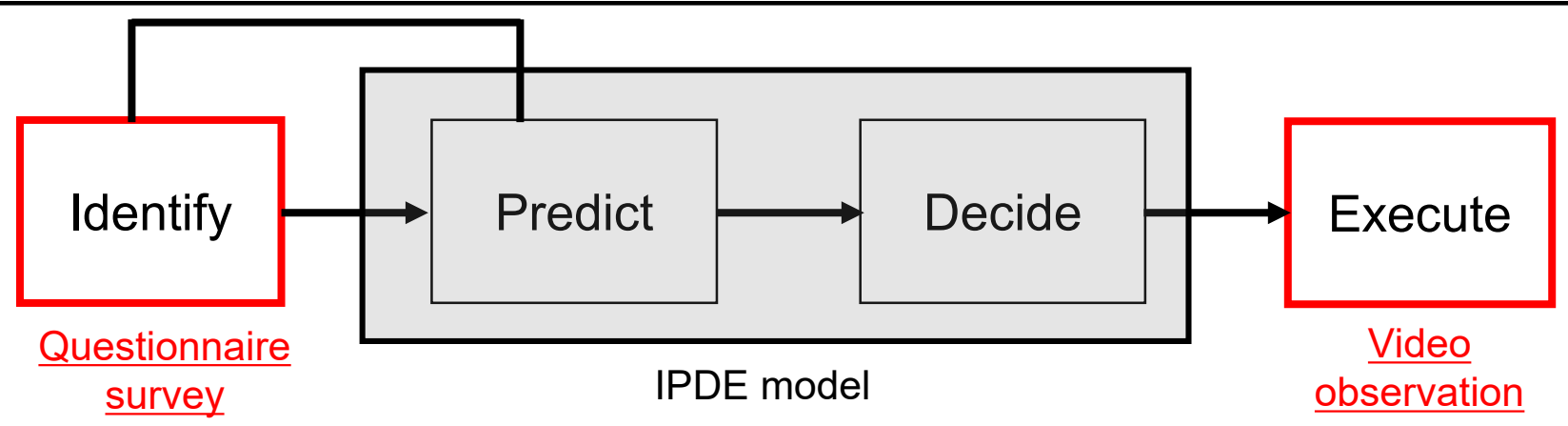
Analysis (1): Gaps b/w Recognition & Behavior

Background: In Cambodia, the fatality rate in traffic accidents involving motorcycles driven by young people is high.

In Japan, the increase in fatal motorcycle accidents was halted by driver educations provided around 1970.

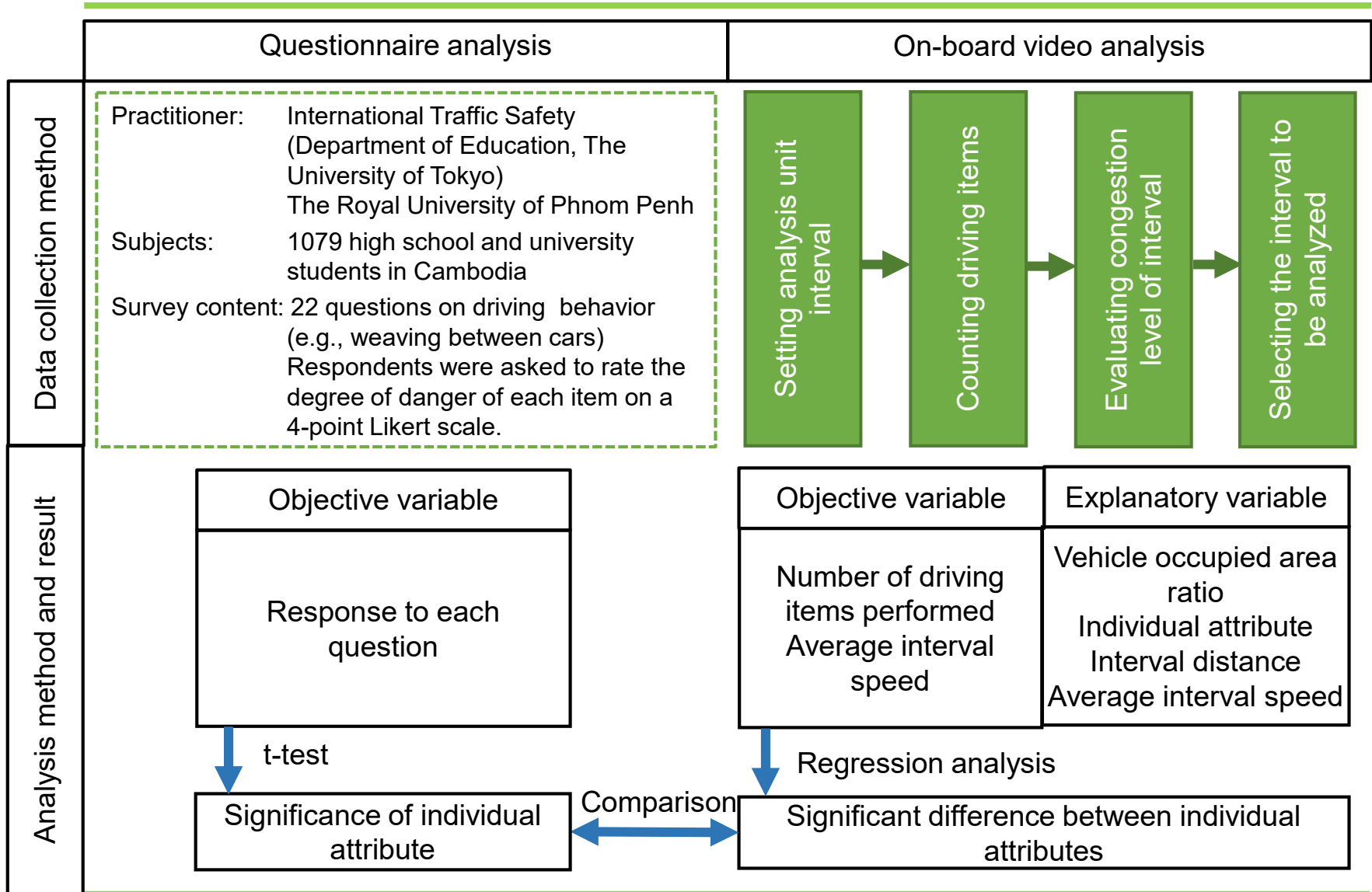
Thailand: Evaluation of safety education methods through questionnaire surveys before and after safety education

This study: Adding video observation to grasp driving behavior



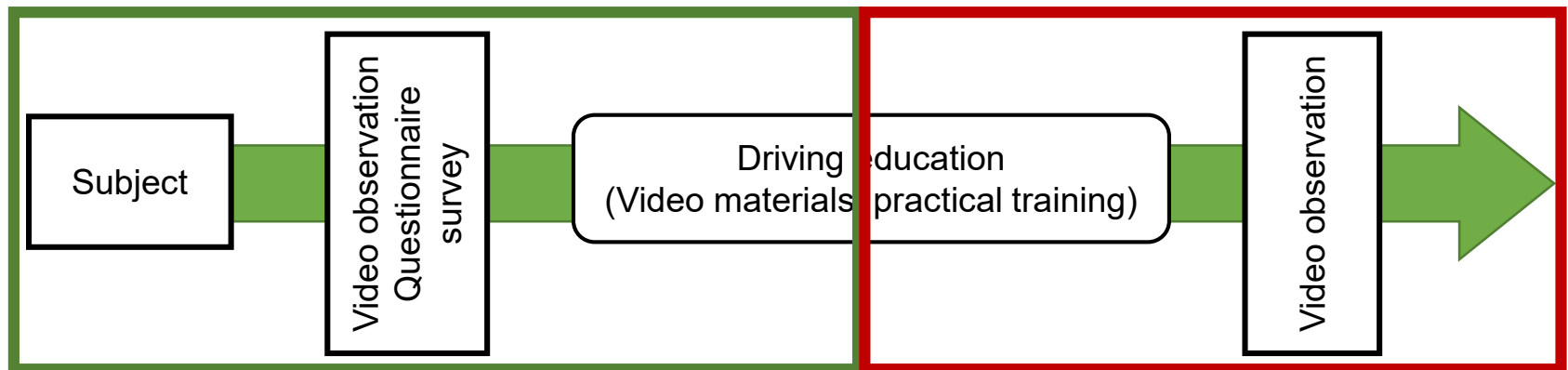
Objective: To clarify the difference between drivers' recognition and behavior, thereby obtaining specific knowledge effective for traffic safety education

Analysis Method



Analysis Results

Questionnaire analysis	Male, high school students → Low degree of risk awareness
Video analysis	Male, one year or more → High incidence of aggressive driving behaviors Female, university students, less than one year → High incidence of their motorcycles being passed Male, university students → Tend to drive at high speeds
Comparison between video and questionnaire	Female → Less dangerous driving due to high degree of risk awareness Male → Dangerous driving due to lower degree of risk awareness One year or more → Dangerous driving in spite of high degree of risk awareness

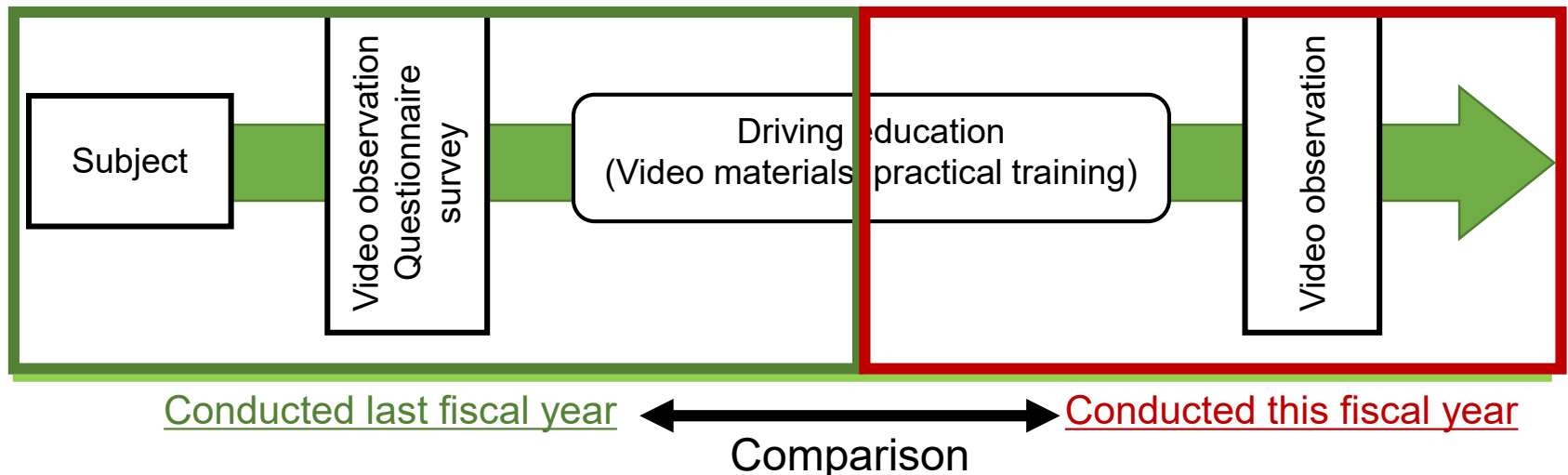
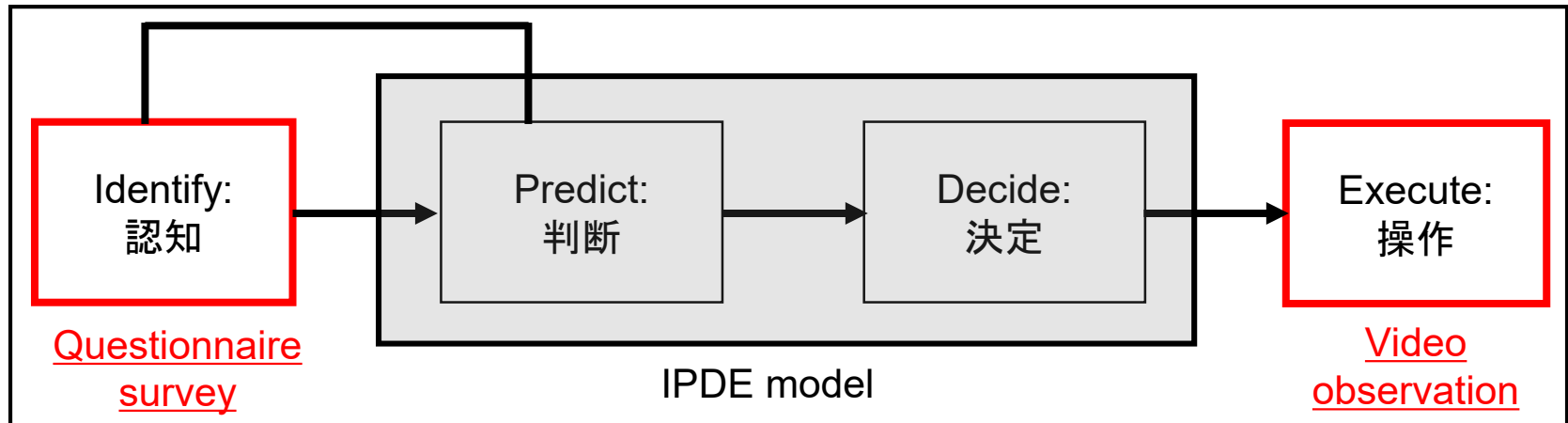


Conducted last fiscal year

Conducted this fiscal year

Analysis (2): Effects of Traffic Safety Education

Objective: To measure the effects of Traffic Safety Education Workshop (WS)
To clarify how the improvement of prediction and judgment will affect driving behavior



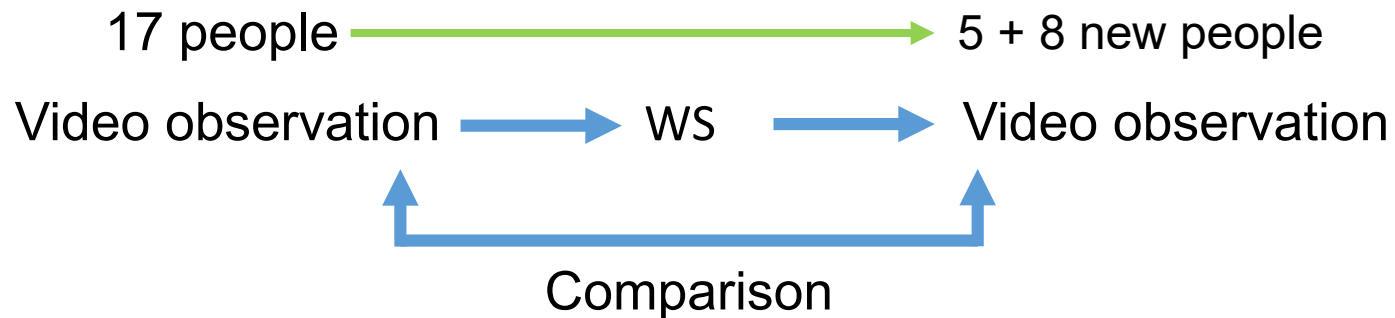
Overview of Video Survey

Fundamental information on video survey

	Before WS	After WS
Date and time of survey	January through December 2015	July 2017
Number of subjects observed	17	13 (5 of 17 people were common subjects before and after WS. 8 people were newly observed.)
Number of non-intersections	584	538
Number of intersections	571	538
Gender	8 males / 9 females	7 males / 6 females
Student category	9 high school students / 8 university students	6 high school students / 7 university students
Driving experience	Less than 1 year: 5 people / 1 year or more: 12 people	1 year or more: 13 people
Motorcycle category	50 cc: 4 people / 90 -125 cc: 13 people	50 cc: 3 people / 90 -125 cc: 10 people
Observation time zone	Morning/day/evening	
Weather	Clear / cloudy	

Analysis Method

- Overview of analysis



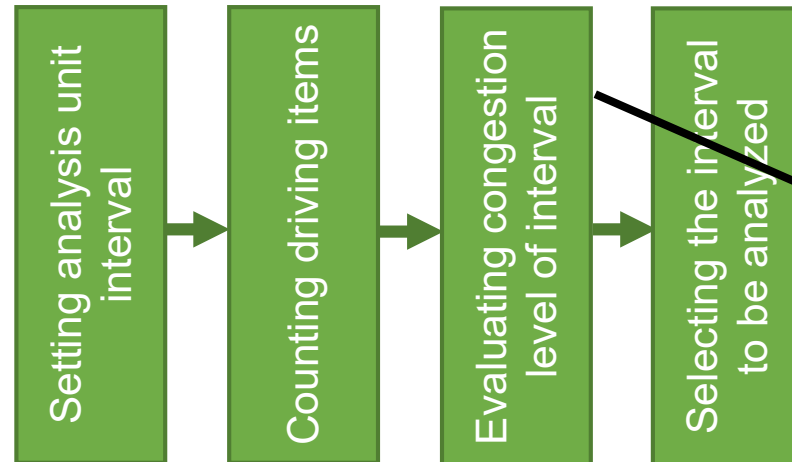
Three people were excluded from the analysis since the camera shook widely or for other reasons.

Before WS After WS

- ① 4 people ↔ 4 people Comparison of the same person (limited sample analysis)
 - ② 17 people ↔ 10 people (4 people repeated) Overall comparison
-

Analysis Method

On-board video analysis



Evaluated by means of the area occupied by other vehicles within 9 or 8 meters in front of the running subject.

Counting other vehicles at 5-second intervals to determine their instantaneous area occupancy, and it is averaged over the interval for analysis.

Objective variable	Explanatory variable
Number of driving items performed Average interval speed	Vehicle occupied area ratio Individual attribute Interval distance Average interval speed

Regression analysis

Significant difference between individual attributes

Interval to be analyzed
Intervals of arterial roads, excluding intervals where vehicles overlap with each other and prevent the determination of vehicle occupancy.

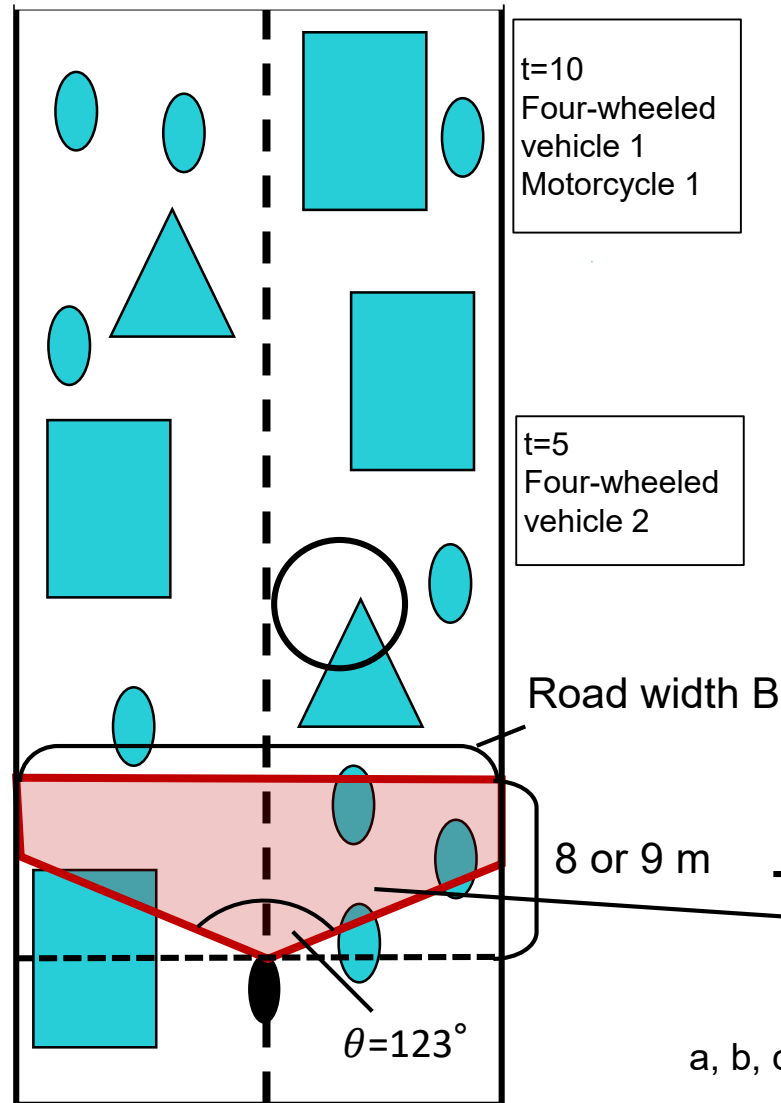
* After WS, the intervals of 9 people were analyzed after excluding those intervals where the cameras were not fixed stably.

Analysis Method

	Operation items observed in each interval
Items indicating driving condition	Lane change (number of times)
	Passing other motorcycles (number of times)
	Being passed by other motorcycles (number of times)
Dangerous driving items (items extracted from questionnaire)	Q9.2 Driving motorcycle on sidewalk for a few meters (number of times).
	Q9.3 Driving in the wrong direction on a one-way road (number of times).
	Q9.4 Weaving between cars on a congested road (number of times).
	Q9.5 Driving off sooner than other cars after waiting for a traffic light at an intersection (number of times).
	Q9.6 Passing when cars turning left/right ahead are stopped (number of times).
	Q9.8 Driving directly in front of an oncoming car when turning left at an intersection (number of times).
	Q9.10 Not paying attention to sudden opening of doors when passing stationary cars (number of times).
	Q9.21 Driving closer to the car in front when it seems as though other cars might try to cut in (number of times).

Analysis Method

Vehicle occupancy rate calculation method



Area parameter

	Number of samples (vehicles)	Average vehicle area (m ²)	Standard deviation (m ²)
Motorcycle	6 (Vehicles observed)	1.22	0.14
Four-wheeled vehicle	6 (incl. 3 SUVs)	8.51	0.51
Tuk-tuk	10	4.59	0.17

● Subject

Equation for vehicle occupancy rate for interval m with count n

$$\frac{\sum_{k=1}^n (1.22a_{mn} + 4.59b_{mn} + 8.51c_{mn})}{n \cdot B(9(8) - B \cdot \tan 28.5/4)} \quad (1)$$

a, b, c: Number of motorcycles, four-wheeled vehicles, tuk-tuks, etc.

α, β, γ : Area parameters 19

Analysis Method

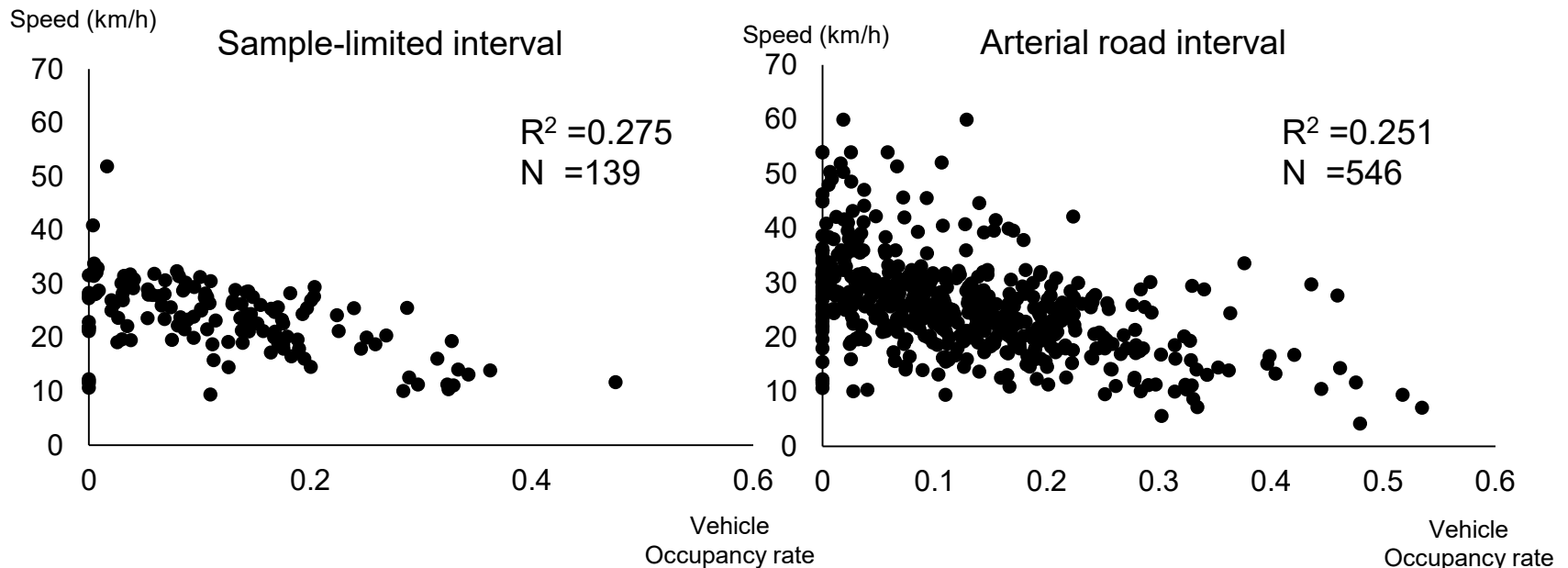
- Selection of the intervals to be analyzed

Intervals on arterial roads, excluding intervals where vehicles overlap with each other and prevent the determination of vehicle occupancy rate.

* After WS, the intervals of 9 people were analyzed after excluding those intervals where the cameras were not fixed stably.



Typical conditions of the interval used for analysis



Analysis Method

Basic information about the interval to be used for analysis

	① The same person (sample-limited interval)	② Arterial road interval
Number of subjects observed	4	27 (including 4 people repeated)
Non-intersection	139 intervals	546 intervals
Gender	2 males / 2 females	13 males / 14 females
Student category	3 high school students / 1 university student	14 high school students / 13 university students
Driving experience	Before WS Less than 1 year: 1 person / 1 year or more: 3 people After WS Less than 1 year: 0 people / 1 year or more: 4 people	Before WS Less than 1 year: 5 people / 1 year or more: 12 people After WS Less than 1 year: 0 people / 1 year or more: 10 people
Motorcycle category	50 cc: 0 people / 90 -125 cc: 4 people	50 cc: 7 people / 90 -125 cc: 20 people
Observation time (transit time in minute)	92.20	260.92
Travel distance (km)	34.80	102.86
Average interval distance (km)	0.25	0.19
Average interval transit time (s)	39.80	28.67
Average interval speed (km/h)	23.75	26.07
Lane change (number of times/km)	1.87	1.86
Passing motorcycle (number of times/km)	6.67	7.24
Being passed by motorcycle (number of times/km)	8.71	9.84
Passing cars (number of times/km)	2.85	2.64
Passing through congestion (number of times/km)	0.29	0.24
Passing vehicle (number of times/km)	0.09	0.10
Paying attention to car door (number of times/km)	0.58	0.68
Reducing the distance to the car in front (number of times/km)	0.55	0.82

Speed Analysis

- Sample-limited interval

Results of multiple regression analysis with speed as the objective variable

	Coefficient	t-value	
Constant term	29.20	10.47	**
Vehicle occupancy rate	-34.24	-6.76	**
Female dummy	1.52	0.72	
University student dummy	-1.31	-0.76	
Morning dummy	-0.66	-0.38	
Evening dummy	-0.35	-0.13	
Sunny weather dummy	-0.34	-0.16	
WS dummy	-0.72	-0.48	
Coefficient of determination	0.25		
Number of intervals	139		

The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant **: 1% significant

Speed Analysis

- Arterial road interval

Results of multiple regression analysis with speed as the objective variable

	Coefficient	t-value	
Constant term	32.99	21.78	**
Vehicle occupancy rate	-44.30	-14.65	**
Female dummy	-4.92	-5.21	**
University student dummy	3.05	4.26	**
One year or more dummy	1.33	1.26	
Motorcycle 90 cc - 125 cc dummy	-0.88	-0.85	
Morning dummy	-1.15	-1.45	
Evening dummy	-1.04	-1.05	
Sunny weather dummy	0.97	1.31	
WS dummy	-3.52	-4.70	**
Coefficient of determination	0.36		
Number of intervals	546		

The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant **: 1% significant

Males and university students tend to drive the motorcycle at high speed. They reduced their driving speed after WS.

Driving Item Analysis

- Sample-limited interval

Results of Poisson regression analysis with driving items as the objective variables

	Lane change		Passing motorcycle		Being passed by motorcycle		Passing car	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-0.51	-0.49	0.57	1.01	3.27	8.09 **	0.47	0.60
log (interval extension)	1.07	4.95 **	1.14	10.62 **	1.07	12.44 **	0.76	5.02 **
Average interval speed	0.00	0.14	0.02	1.60	-0.03	-3.04 **	-0.04	-1.97 *
Vehicle occupancy rate	-1.59	-0.97	1.93	1.96	-1.61	-2.01 *	1.48	1.17
Dummy for female	0.18	0.46	0.86	5.11 **	-0.17	-1.25	1.13	4.17 **
Dummy for university student	-0.74	-2.21 *	-0.56	-3.30 **	0.62	4.75 **	-0.55	-2.06 *
Dummy for WS	1.86	3.46 **	0.77	3.90 **	-0.43	-3.24 **	1.17	3.35 **
Coefficient of determination	0.29		0.47		0.52		0.16	
Number of samples	139		139		139		139	

The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant ** : 1% significant

Females tend to drive carefully. University students tend to pass motorcycles and cars. They change lanes and pass cars more frequently after WS.

Driving Item Analysis

- Sample-limited interval

Results of Poisson regression analysis with driving items as the objective variables

	Passing through congestion		Passing vehicle		Paying attention to car door		Reducing the distance to the car in front	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-0.85	-0.27			-0.57	-0.37	1.57	1.03
log (interval extension)	0.84	1.23			0.29	0.74	0.71	1.84
Average interval speed	-0.08	-0.95			0.01	0.23	-0.13	-3.17**
Vehicle occupancy rate	13.30	2.97**			-1.28	-0.42	-1.58	-0.69
Dummy for female	-0.25	-0.21			-1.89	-1.82	-0.21	-0.31
Dummy for university student	-2.73	-2.56*			-0.76	-1.31	-0.15	-0.29
Dummy for WS	-0.93	-0.82			-0.80	-1.68	0.80	1.04
Coefficient of determination	0.24				0.02		0.13	
Number of samples	139		139		139		139	

The number of trials for passing a vehicle was only three, making the analysis impossible.
The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant **: 1% significant

No significant difference is found probably due to a small number of trials.

Driving Item Analysis

• Arterial road interval

Results of Poisson regression analysis with driving items as the objective variables

	Changing lanes		Passing motorcycle		Being passed by motorcycle		Passing car	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-0.76	-1.13	-1.47	-4.16**	4.59	19.48**	-2.41	-4.07**
log (interval extension)	0.94	9.07	1.25	24.40**	1.12	25.21**	0.88	10.15**
Average interval speed	0.02	1.41	0.06	11.80**	-0.07	-12.11**	0.03	3.28**
Vehicle occupancy rate	0.94	0.97	3.03	6.02**	-0.52	-1.33	5.03	6.78**
Dummy for female	-0.46	-2.01*	0.06	0.61	0.39	5.22**	0.27	1.67
Dummy for university student	-0.17	-1.09	-0.09	-1.06	0.50	7.03**	-0.18	-1.39
One year or more dummy	0.32	0.86	1.26	5.78**	-0.45	-4.69**	0.93	2.58**
Motorcycle dummy	0.15	0.45	0.42	2.39*	-0.53	-5.72**	0.33	1.37
Dummy for WS	0.87	4.76**	0.24	2.87**	-0.25	-3.57**	0.84	5.66**
Coefficient of determination	0.23		0.47		0.46		0.18	
Number of samples	546		546		546		546	

The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant **: 1% significant

Motorcycle drivers tend to become more aggressive in driving as the years of driving experience increases. They tend to pass cars and other motorcycles more frequently as they drive a motorcycle with higher performance. The frequency of lane changing and passing increased after WS.

Driving Item Analysis

- Arterial road interval

Results of Poisson regression analysis with driving items as the objective variables

	Passing through congestion		Passing vehicle		Paying attention to car door		Reducing the distance to the car in front	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-2.84	-1.58	-1.46	-0.57	2.27	2.57 **	1.16	1.25
log (interval extension)	1.03	3.25 **	1.02	2.03 *	0.84	4.68 **	0.99	6.32 **
Average interval speed	-0.01	-0.31	-0.03	-0.47	-0.06	-3.00 **	-0.08	-4.28 **
Vehicle occupancy rate	8.10	4.02 **	1.64	0.44	-1.04	-0.74	1.19	0.98
Dummy for female	-0.45	-0.84	0.00	0.01	-0.76	-2.33 *	-0.80	-2.70 **
Dummy for university student	-0.91	-2.10 *	-1.32	-1.86	-0.71	-2.76 **	-0.05	-0.19
One year or more dummy	0.45	0.69	0.56	0.48	-0.21	-0.63	1.61	2.67 **
Motorcycle dummy	0.70	0.63	-0.28	-0.27	-0.32	-0.75	-0.61	-1.58
Dummy for WS	-0.35	-0.74	-0.18	-0.25	-0.75	-2.74 **	-0.86	-3.75 **
Coefficient of determination	0.12		-0.01		0.04		0.22	
Number of samples	546		546		546		546	

The numerical values in the yellowed columns indicate significant differences in individual attribute.

*: 5% significant **: 1% significant

Females and university students are less likely to exhibit some dangerous driving items. Some items were improved after WS.

Analysis Results

Speed analysis

- Males and university students tend to drive at high speeds.
- Driving speed decreased after WS.

Driving item analysis

- Females tend to drive carefully.
- University students tend to pass motorcycles and cars.
- Motorcycle drivers tend to become more aggressive in driving as they accumulate driving experience. They tend to pass cars and other motorcycles more frequently as they drive a motorcycle with higher performance.
- The frequency of lane changing and passing vehicles increased after WS.
- Some dangerous driving items extracted from the questionnaire have been improved after WS.

3. Workshop for Improving Motorcycle Driving Skills

Workshop for High School and University Students

At Cambodia-Japan Cooperation Center (CJCC) on December 1, 2018

1. Classroom lecture

- Explanation of the workshop
 - (1) Overview of traffic accidents in Cambodia
 - (2) Risk prediction video
 - (3) Enjoyment and safety of motorcycles
(Explanation of the practical training that will be conducted in the afternoon)



2. Driving practice

- Driving on a log bridge
- Figure-8 driving





Training through classroom lecture

- Screening of educational videos
- Group discussion and presentation on the videos
- What we learned from the videos
- New findings
- Unclear points and what I want to know more about
- Impressions





**Introduction of instructors
and explanation of the
practical exercise items**



Driving Practice

1. Warm-up
2. Driving on a log bridge
3. Figure-8 driving





Group discussion and presentation on practical exercise

- What we learned from the practice
- New findings
- Unclear points and what I want to know more about
- Impressions





Questionnaire Survey after Workshop

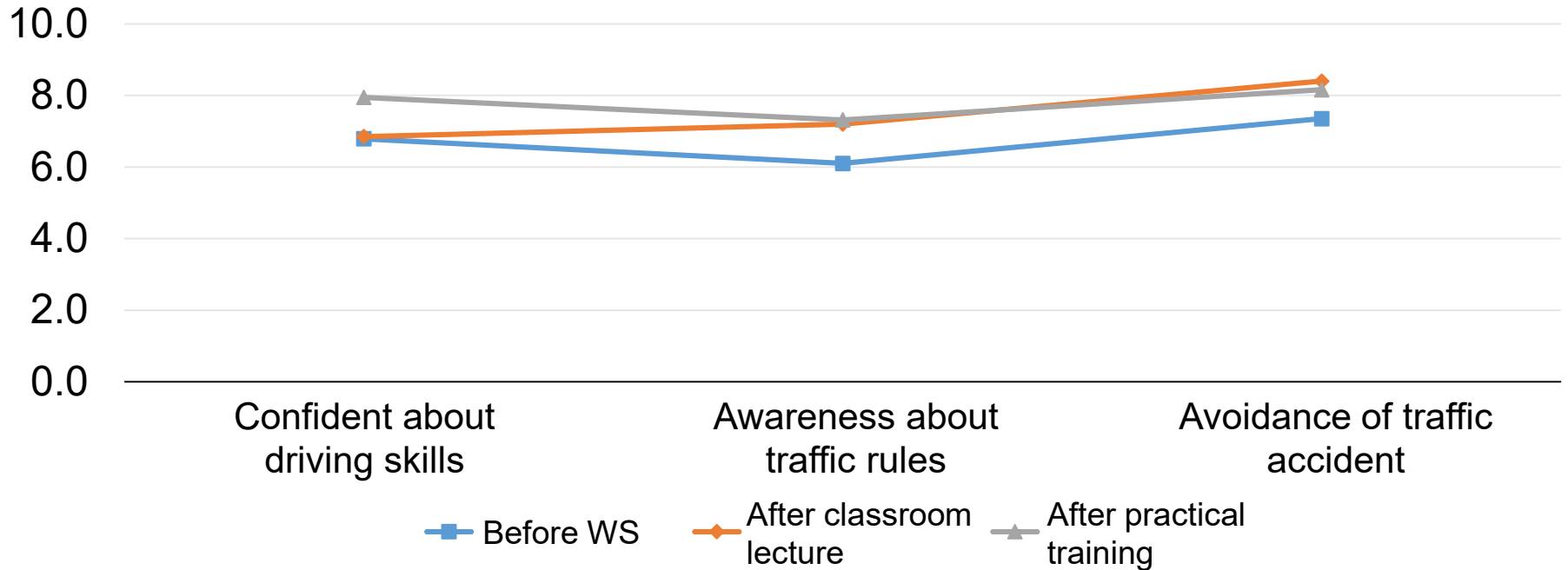
Individual attribute		Number of people
Gender	Male	13
	Female	7
Student category	High school student	7
	University student	13
Frequency of motorcycle usage (4 non-respondents)	Driving every day	16
Driving experience (5 non-respondents)	Less than 1 year	1
	1 to less than 2 years	5
	2 years or more	9
Experience of being caught for traffic violation	Yes	13
	No	7
	Average number of experiences	2.62 times
Experience of traffic accident (2 non-respondents)	Yes	6
	No	12
	Average number of experiences	1.17 times

Q10: How confident are you about your motorcycle driving skills? Circle one of the degrees that applies. Not confident at all: 0 \longleftrightarrow 10: Perfectly confident

Q11. How much do you think you know about traffic rules in Cambodia? Circle one of the degrees that applies. Do not know at all: 0 \longleftrightarrow 10: Know perfectly

Q12. How much do you think you can reduce the possibility of being involved in a traffic accident if you can drive a motorcycle in compliance with traffic rules? Circle one of to the degrees that applies. Cannot reduce it at all: 0 \longleftrightarrow 10: Can reduce it completely

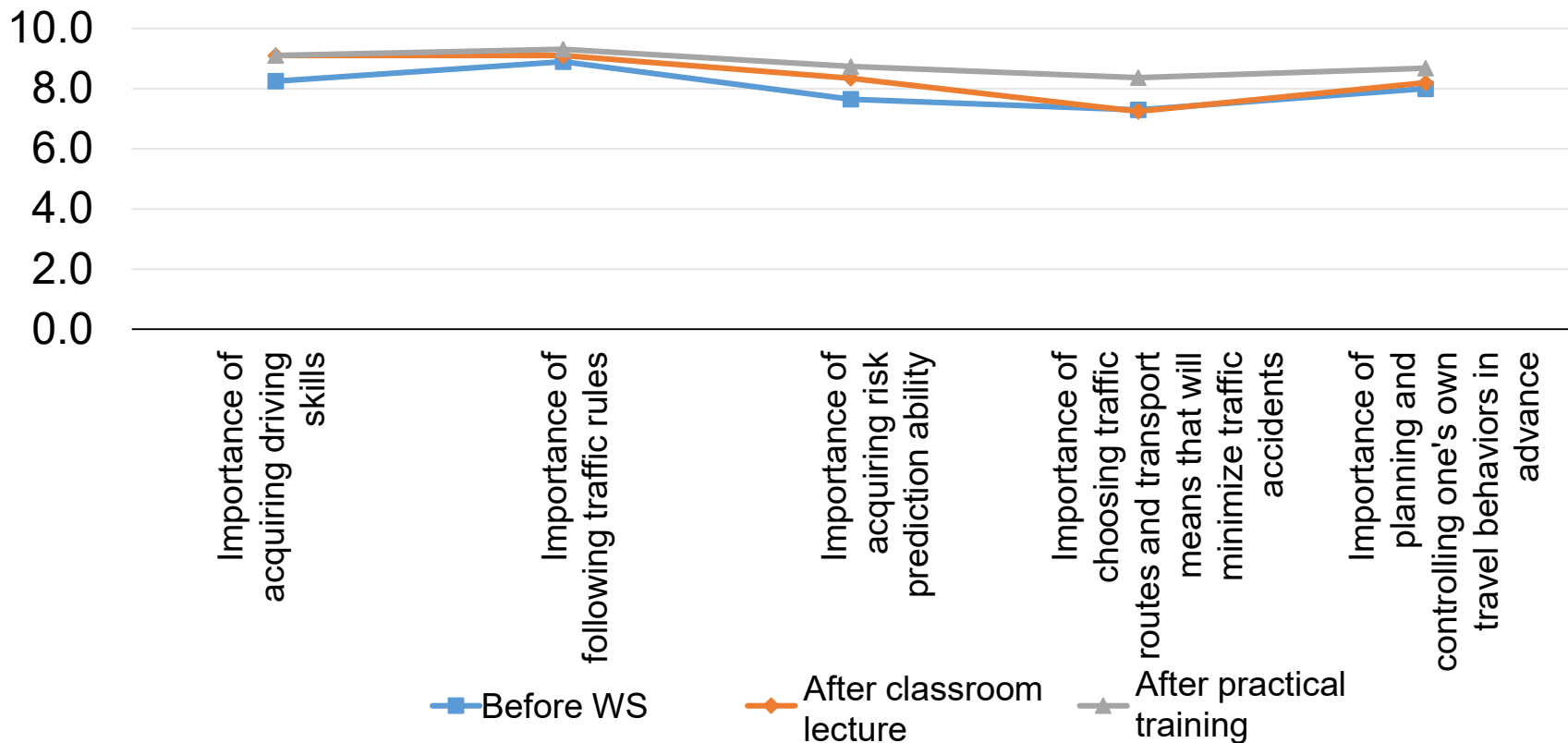
Aggregate result for Q10, 11, and 12



- Awareness about traffic rules and awareness about the possibility of avoiding traffic accidents increased after the classroom lecture. →
Trainees increased their awareness that accidents can be avoided if various road users understand and follow traffic rules
- Trainees improved their confidence in their driving skills after practical training. →
Practical driving courses give the trainees confidence in their own driving skills and ability to avoid traffic accidents.

Q13: To what extent do you think each of the following items is important in preventing traffic accidents. Circle one of the degrees applicable to each item. It is completely unimportant: 0 \longleftrightarrow 10: It is very important

Importance for avoiding traffic accident



- After the classroom lecture, the students improved their driving skills. They also enhanced the spirit of compliance with traffic rules and improved risk prediction ability.
- After the practical training, the students improved their risk prediction ability. They also recognized the importance of choosing safer traffic routes and pre-planning their own driving behavior.

Experience of Receiving Traffic Safety Education (Number of Times)

Elementary school	Junior high school	High school	University	Driving school	At home	No experience	Do not remember	Other
4	4	5	1	1	7	2	1	3

- Formal safety education in schools and other institutions is not sufficiently performed.
- Considering the fact that Phnom Penh City often provides safety education, Cambodia as a whole is performing the education to only a very limited extent.
- The need for awareness-raising videos → Link to the website of the Ministry of Education

4. Conclusions and Future Prospects: Possibilities for Cross-sector Cooperation

Conclusions

<Analysis of motorcycle driving behavior>

- It was found that the implementation of traffic safety education workshops helps **reduce dangerous driving behavior by young people to some extent.**
- However, the implementation of a workshop only once **may be ineffective to sustain its effects**, and it is important to raise the awareness of young people about traffic safety by periodically conducting traffic safety education.
- Further study is needed to conclude **whether** the results of this survey targeting young people **can be applied to general drivers.**

Conclusions

<Impact of introducing new traffic signals>

- Although it depends on the configuration of the intersection, the introduction of new traffic signals has made it possible to improve the order between vehicles to some extent, thereby increasing traffic capacity.
- However, enabling drivers to pass smoothly through intersections has led to more disorderly behavior (shortcuts, etc.) in situations that have nothing to do with other vehicles.
- Basically, it is indispensable to improve the awareness of drivers about traffic safety.

Future Prospects

<Development of Traffic Safety Education Programs>

- (1) Development and implementation of traffic safety education programs (including general drivers)
- (2) Training traffic safety education experts

<Cross-sector cooperation>

High school

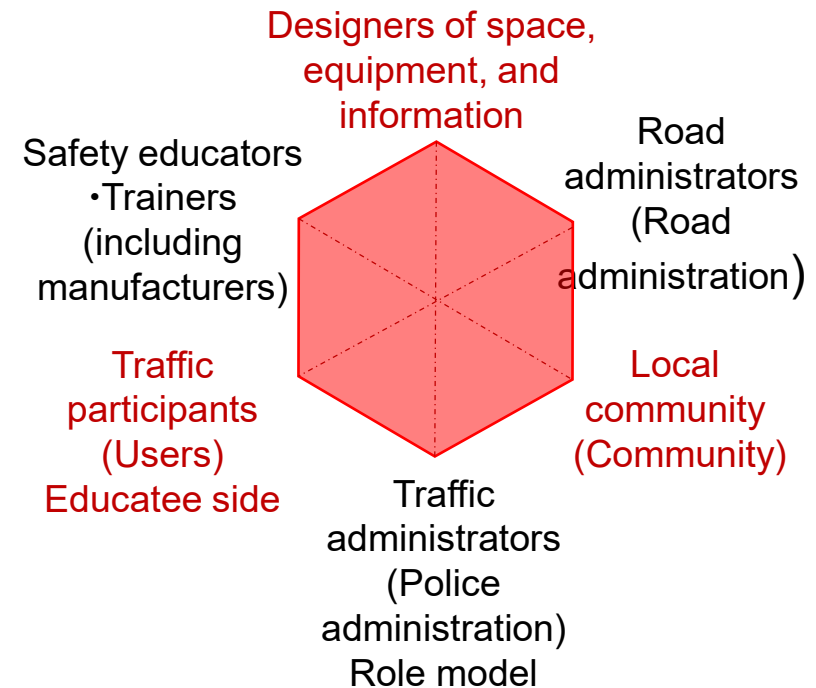
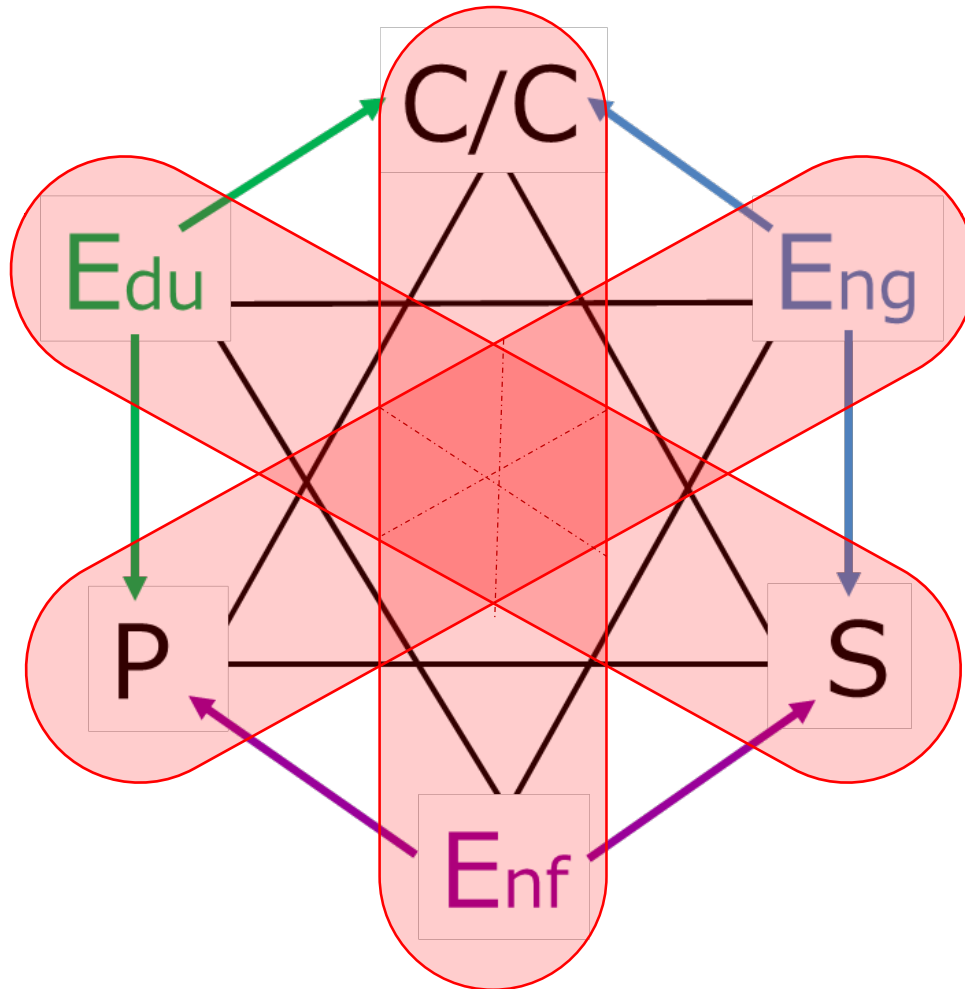
Ministry of Education, Ministry of Public Works and Transportation,
and Phnom Penh City Police

Japan International Cooperation Agency (JICA)

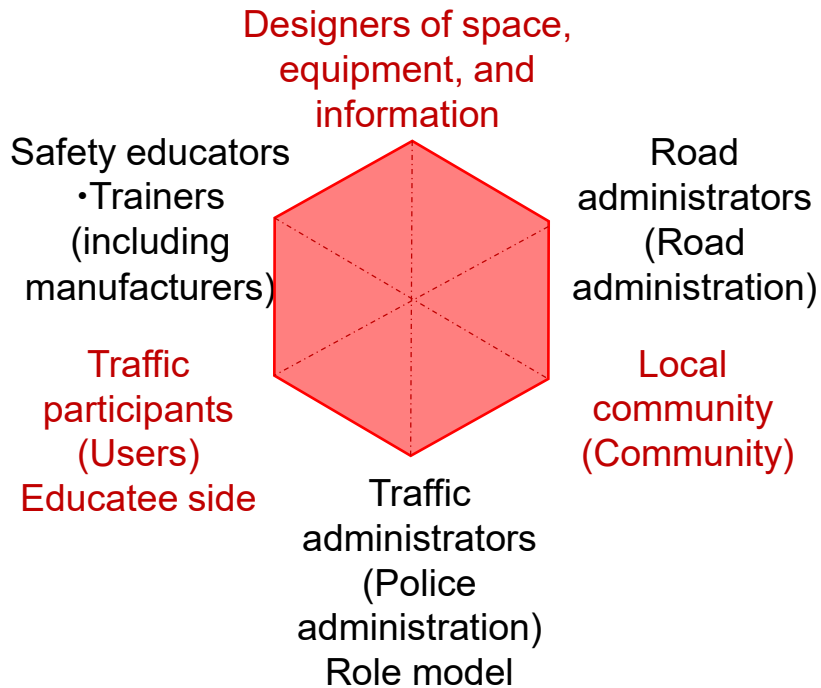
International Association for Traffic and Safety Sciences (IATSS)

NCX Honda Safety Riding Center

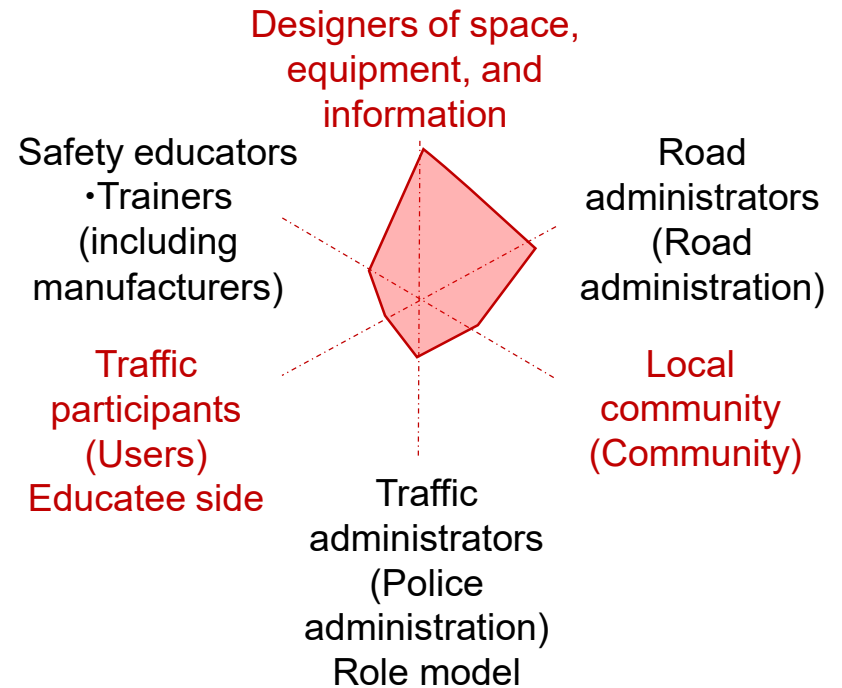
Cross-sector Cooperation for Traffic Safety (Image)



Concept of Cross-Sector Cooperation



Balanced cooperation



Irregular cooperation with hardware first
(Undesirable cooperation)

Thank you very much for your kind attention.

<Acknowledgement>

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