

# Understanding traffic safety culture for a safer society: Key challenges and insights

---

Ritsumeikan University  
Yasuhiro Shiomi

# Self introduction

- **Sep. 2008**: Doctor of Engineering, Kyoto University  
(Supervised by Prof. Ryuichi Kitamura)
- **Oct. 2008**: Assistant professor at Department of  
Urban Management,  
Graduate School of Engineering,  
Kyoto University
- **Apr. 2011 to Mar. 2012**: Visiting researcher in TU Delft
- **Apr. 2012 to now**: Lecturer (Mar. 2014),  
Associate professor (~Mar. 2022),  
Professor (Apr. 2022~)
- **Nov. 2021 to Aug. 2022**: Visiting researcher in TU Delft
- **Research Interest:**

Traffic flow theory and analysis, Traffic safety  
Travel behavior analysis, Freight transport management



# Ritsumeikan University

- Since 1900
- Kyoto, Shiga, and Osaka
- 16 colleges
- 32,467 students



# Colleges



## KYOTO

### KINUGASA Campus

- Law
- Social Sciences
- International Relations
- Letters
- Design art



## SHIGA

### BIWAKO-KUSATSU Campus

- Sport and Health Science
- Economics
- Gastronomy Management
- **Science and Engineering**
- **Life Sciences**
- Pharmaceutical Sciences



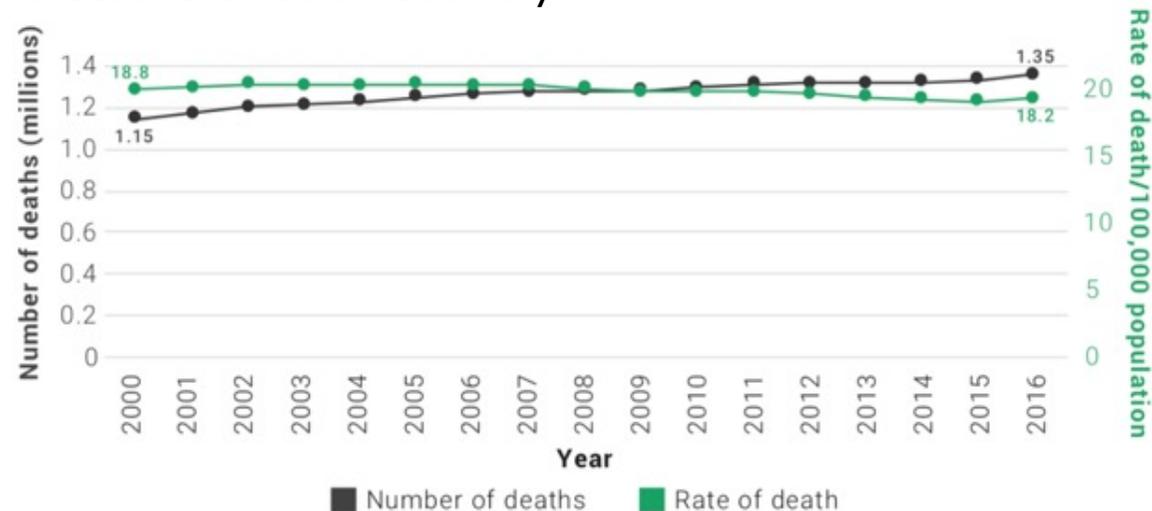
## OSAKA

### IBARAKI Campus

- Business Administration
- Policy Science
- Comprehensive Psychology
- Global Liberal Arts
- Image Arts and Sciences
- Information Science and Engineering

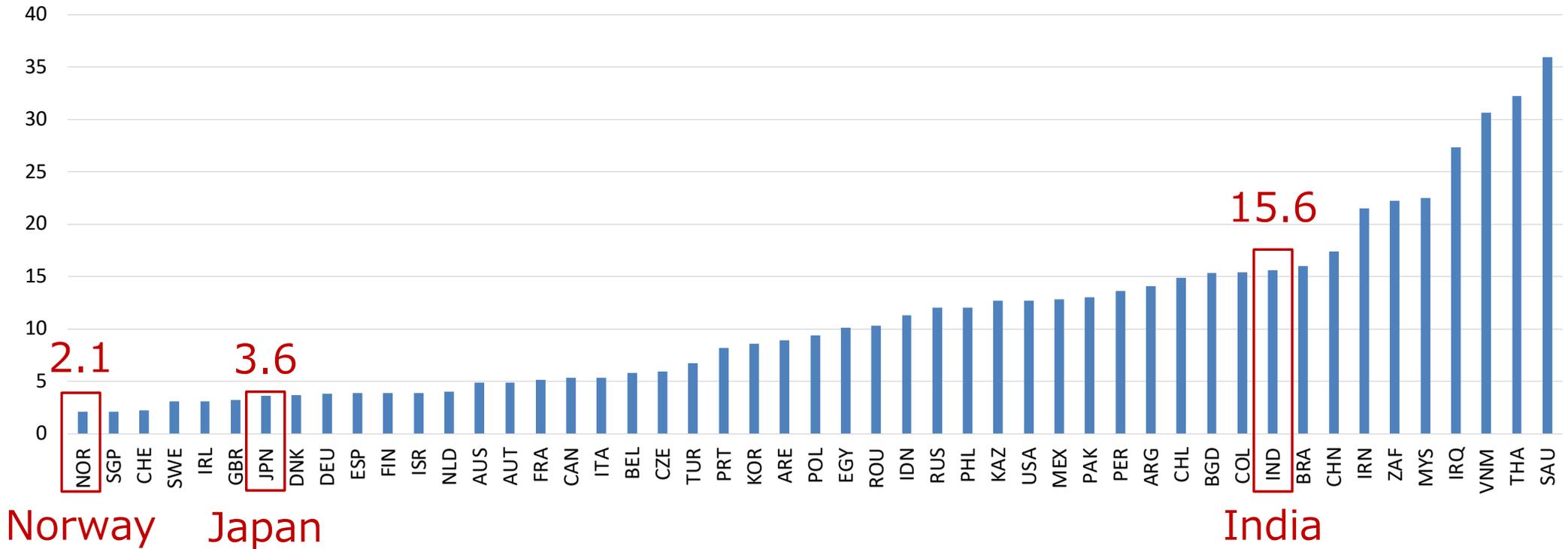
# Introduction

- SDGs Target 3.6
  - By 2030, halve the number of global deaths and injuries from road traffic accidents.
- The number of traffic accident deaths in the world
  - 115 million (2000) and 135 million (2016).
- Urgent needs for **the appropriate policies** on road traffic safety
  - It must suit the status of each country.



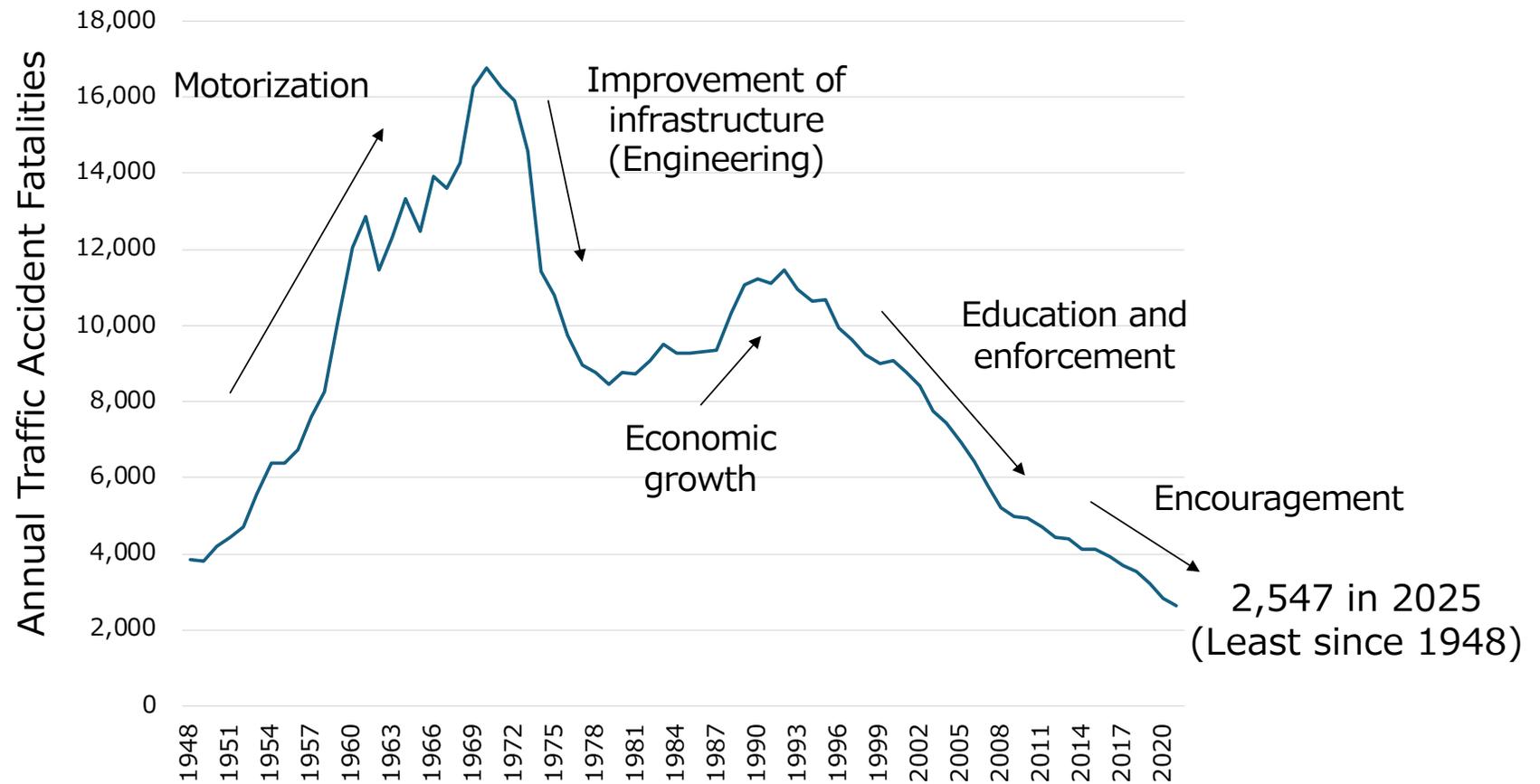
# Fatality rate by top 50 GDP countries

Number of Fatalities per 100K population



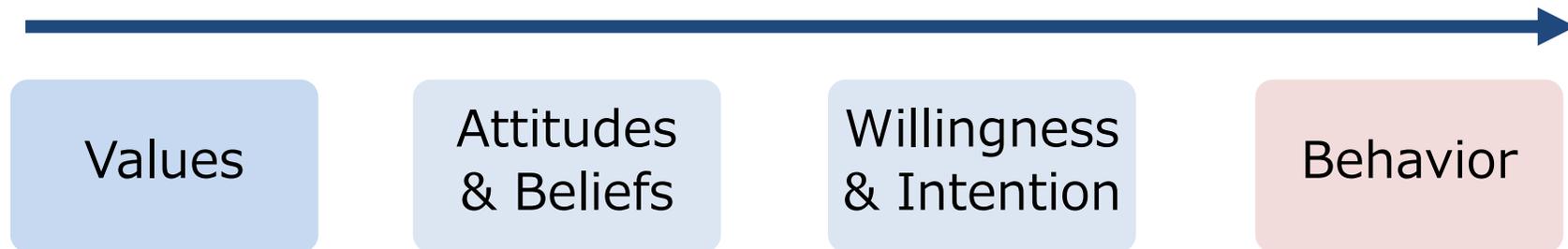
# Transportation and safety

- Annual Traffic Accident Fatalities in Japan



## Traffic safety culture (TSC)

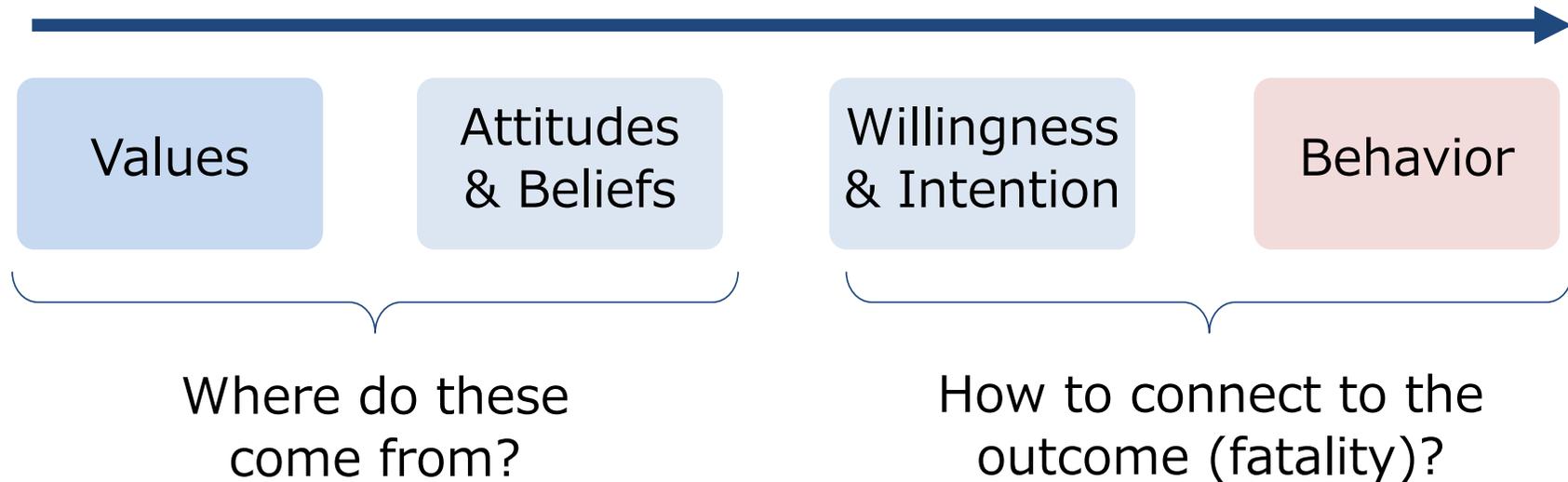
- Culture (Center for health & safety culture, Montana State University)
  - Shared values, beliefs and attitudes, and behaviors of a group of people



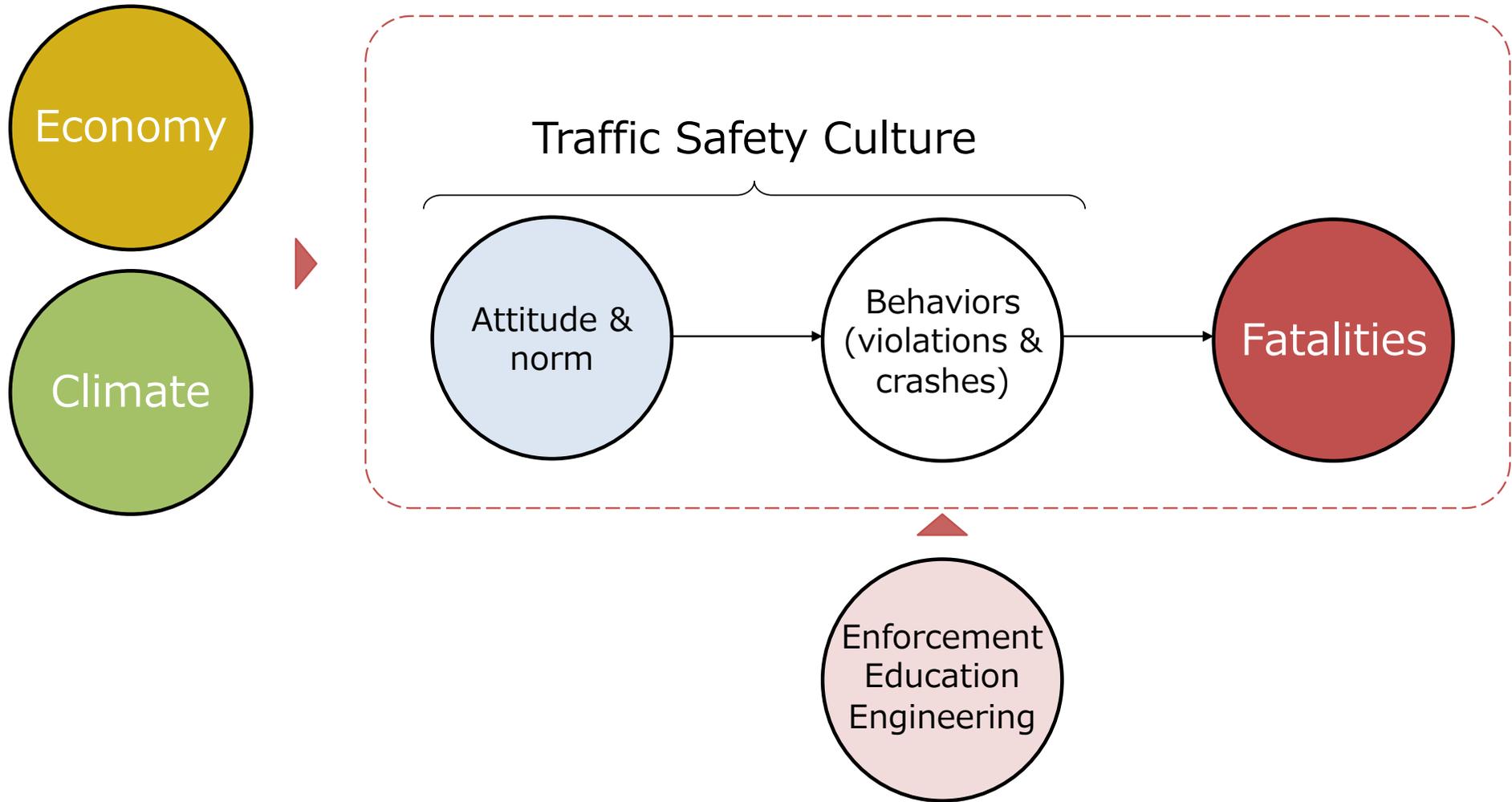
- AAA (American Automobile Association) suggested TSC in 2006
  - TSC index: identifying driver's attitudes and behaviors related to traffic safety
  - Road safety topics covered include speeding, red light running, seat belt use, distracted, drowsy and drunk driving
  - Annual survey of TSC index has been conducted since 2008

# Research question

- Previous researches on TSC
  - Comparison among sub-groups (Sinclair, 2013)
  - A cross-country investigation
    - Russian and Norway (Rundmo et al., 2012)
    - China, Japan and US (Atcheley, et al., 2014) etc.

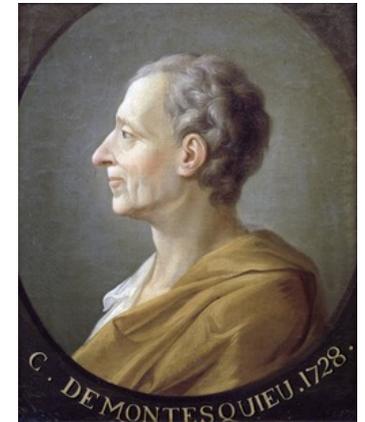


# Traffic Safety Culture (TSC) and Fatalities



## Charles-Louis de Montesquieu: “De l’esprit des lois” (1748)

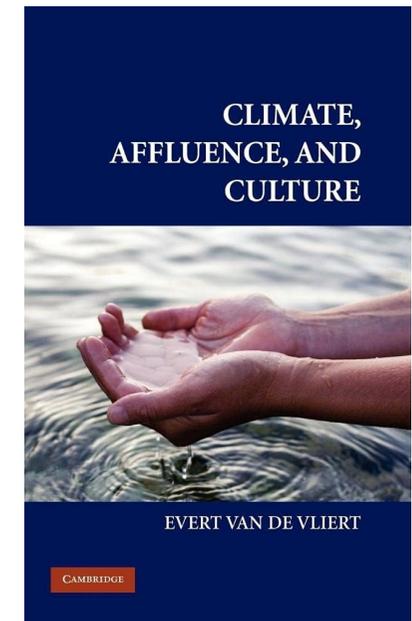
- Climate influences **human character**.
  - **People in hot climates tend to be more emotional and passionate, while those in cold climates are more calm and patient.** He viewed climate as a natural factor that affects both the body and the mind.
- Differences in **political systems** also stem from climate.
  - According to him, **despotic governments tend to arise in warm regions**, whereas **cold regions are more inclined toward valuing liberty**. Thus, political institutions and laws are shaped in adaptation to climate conditions.
- **Laws** should conform to climate, environment, and customs.
  - Therefore, good laws are not universal but must be suited to each nation’s climate, religion, economy, and customs. The “spirit of the laws” refers to the inner logic or reason that arises from each society’s particular circumstances.



# Influence of Climate

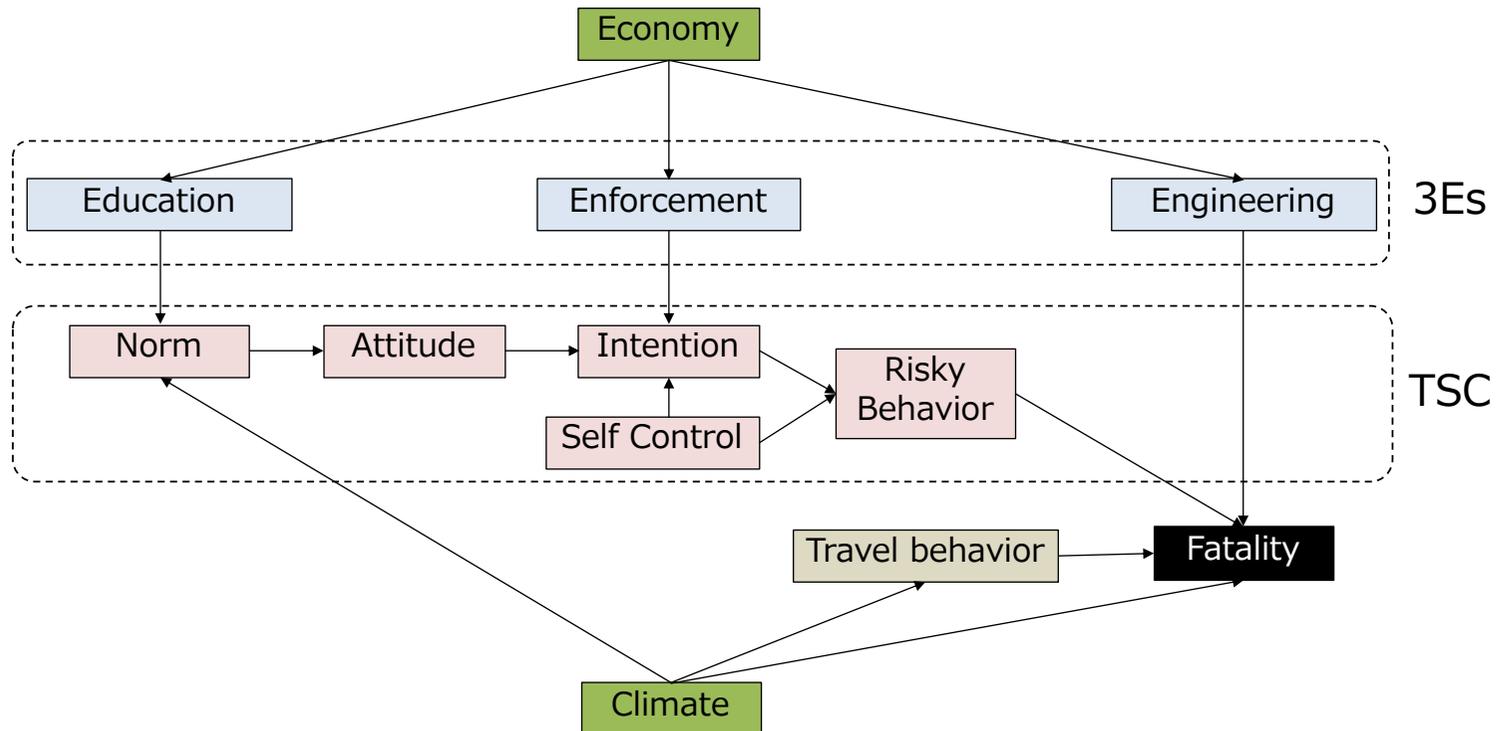
## Evert van de Vliert: “Climate, affluence, and culture” (2009)

- Climate and wealth jointly shape culture.
  - Climate alone does not determine national character; rather, the effects of climatic stress depend on a country’s affluence, which can either buffer or amplify environmental hardship.
- Three cultural types emerge from climate–wealth interaction.
  - **Survival cultures:** Harsh climates with low affluence foster values emphasizing safety and material security.
  - **Self-expression cultures:** Harsh climates with high affluence encourage values of autonomy and life satisfaction.
  - **Easygoing cultures:** Moderate climates, regardless of wealth, promote relaxed and stable value systems.



# Objectives and hypothesis

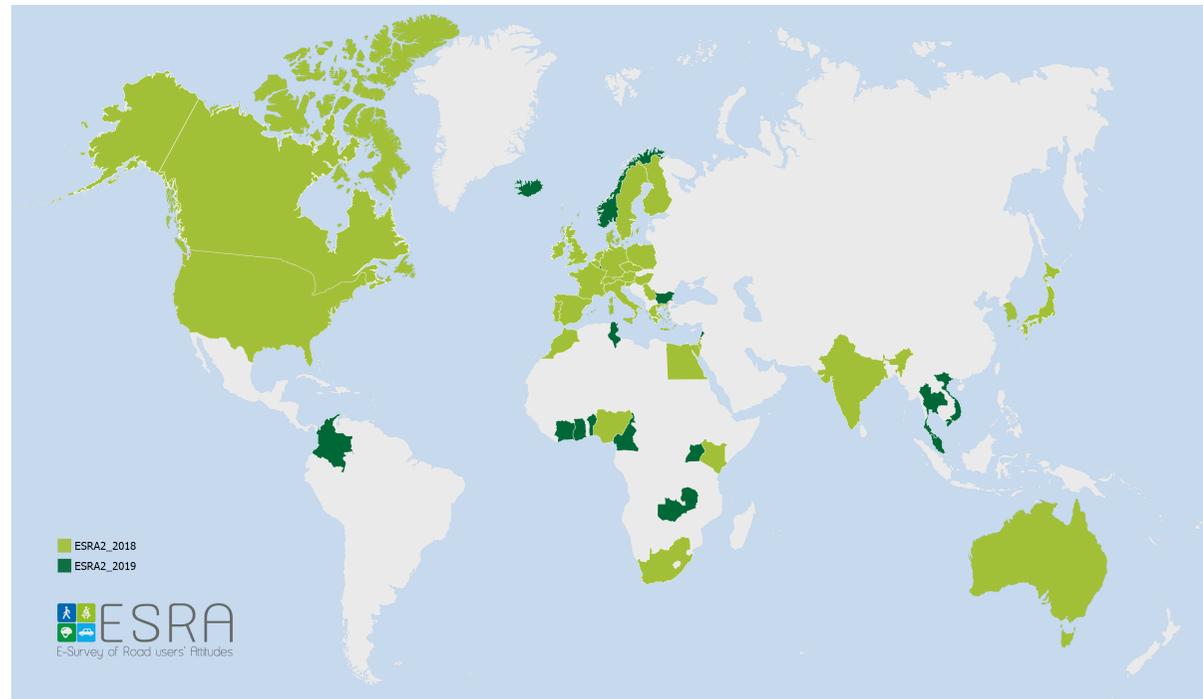
- To structure the casual relationship of Traffic Safety Culture (TSC) and traffic fatality rate based on SEM using cross-country dataset  .
- To propose traffic safety policy depending on country states.



# What is ESRA ?

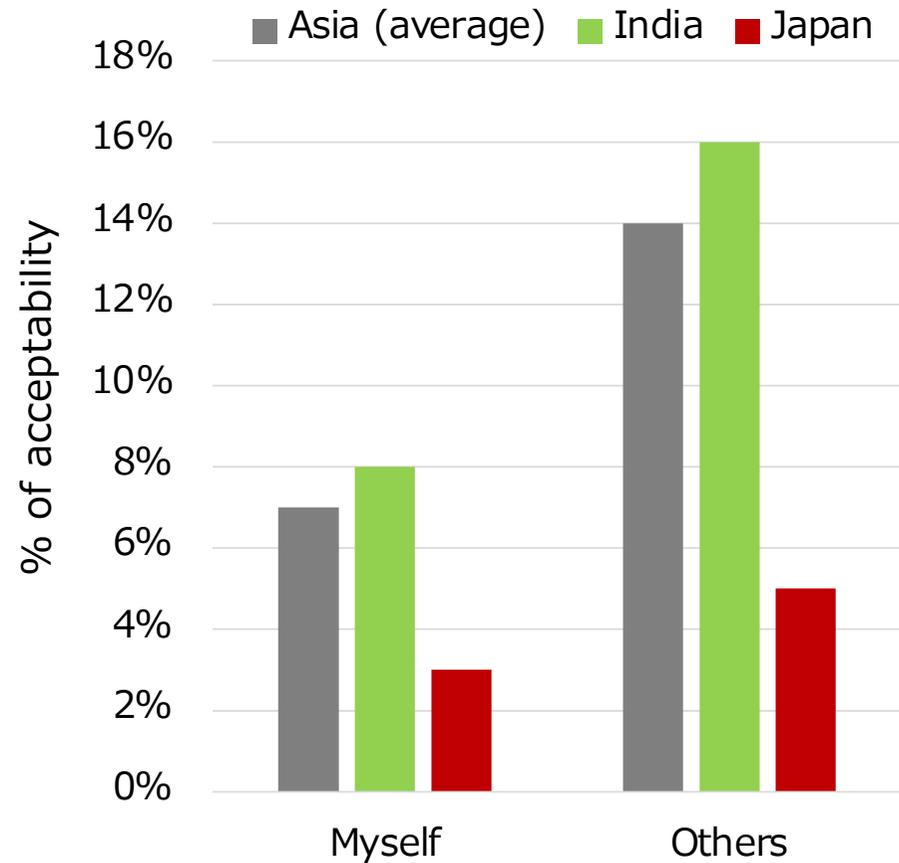
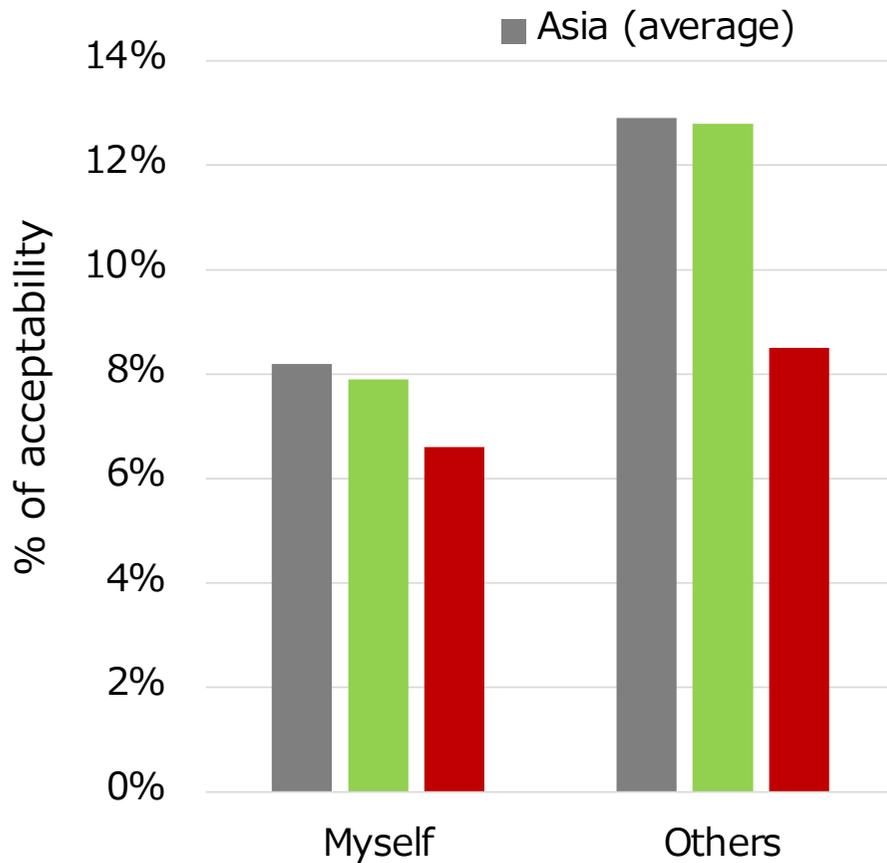
E-Survey of Road users' Attitudes

- E-Survey of Road Users' Attitudes.
- Coordinated by VIAS institute in Belgium.
- To collect and analyse comparable data on road safety performance and road safety culture.
- ESRA2 dataset conducted in 2018 and 2019 in 48 countries is used for the further analysis.



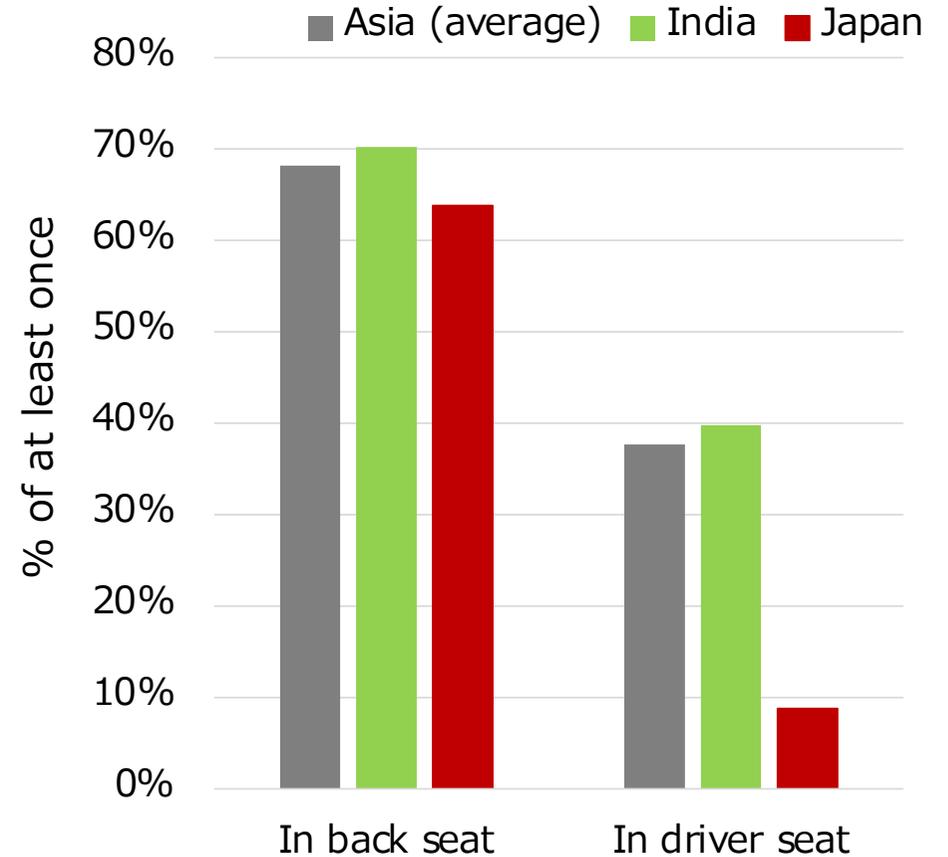
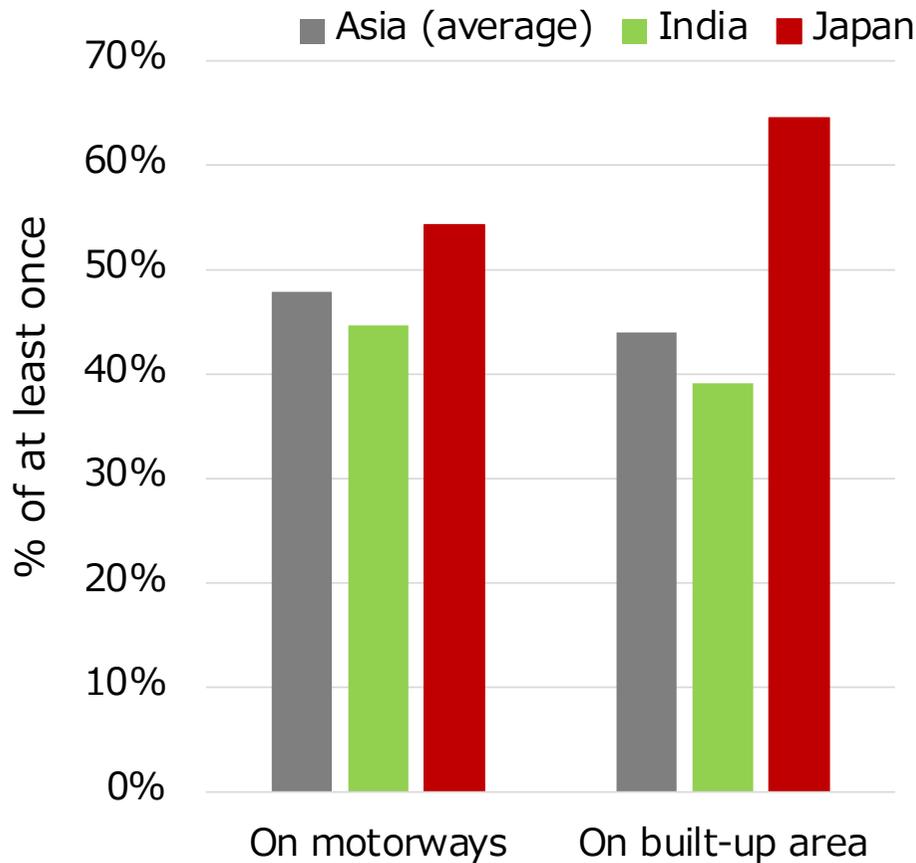
# Acceptability

- Drive faster than the speed limits?
- Travel/drive without seat?



# Self-declared behavior

- Drive faster than the speed limits?
- Travel/drive without seat?



# Definition of variables

- **Economy**
  - GNI per capita (WHO)
- **Climate\***
  - Temperature by month (NERC)
  - Precipitation by month (NERC)
- **Fatality**
  - Number of fatalities per capita (WHO)
- **Education**
  - Higher education rate (WB)
- **Engineering**
  - Infrastructure
    - Road length per area (WHO)
  - Motorization
    - Number of registration vehicles per capita (WHO)
- **Enforcement**
  - Likelihood to be coughed ( ESRA Q20)
- **Frequency of transportation modes\*\***
  - Walk ( ESRA Q10)
  - Motorcycle ( ESRA Q10)
  - Bicycle ( ESRA Q10)
  - Private car ( ESRA Q10)
- **Attitude\*\*\***
  - Acceptance of no-seatbelt by myself ( ESRA Q14)
- **Norm\*\*\***
  - Acceptance of no-seatbelt by others ( ESRA Q13)
- **Self control**
  - Support for rigid enforcement ( ESRA Q19)
- **Intention**
  - Number of self-reported violations in 2 years ( ESRA Q12)
- **Risky behavior**
  - Number of injured crashes in 2 years ( ESRA Q23)

\* A climate data of capital city is used.

\*\* Higher value means more frequent.

\*\*\* Higher value means better attitude and norm.

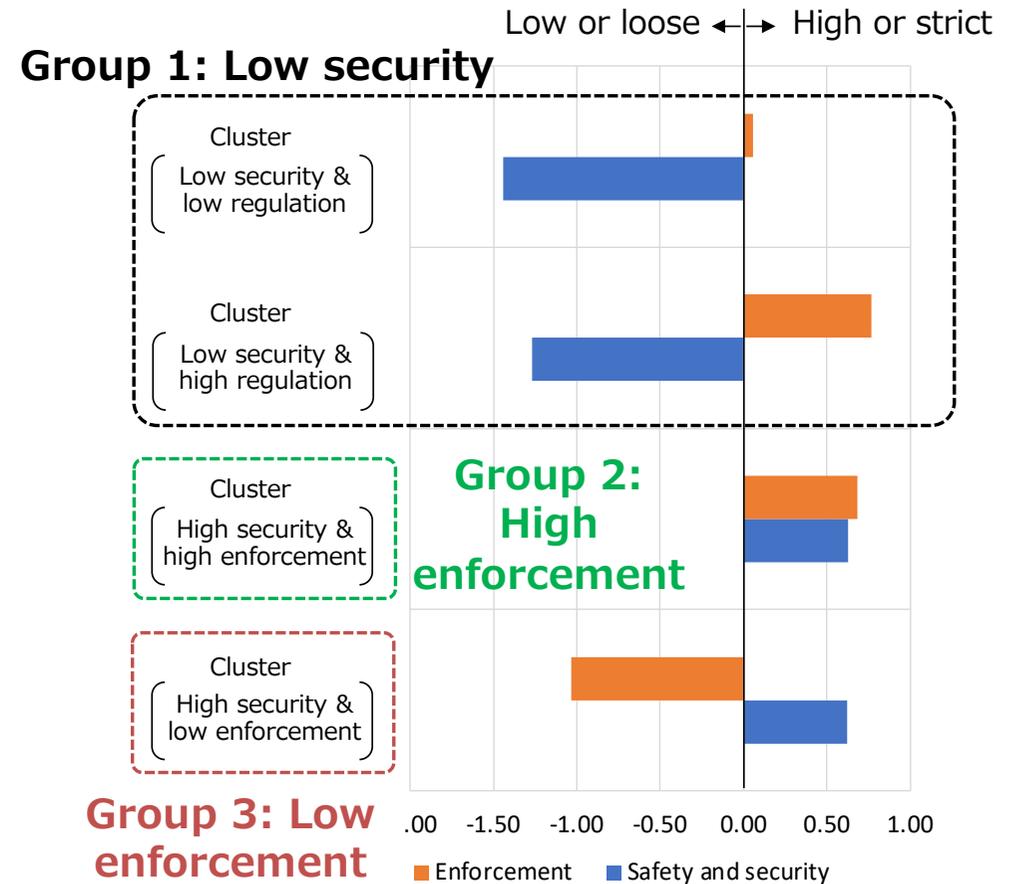
# Clustering countries

- Factor analysis on traffic safety related variables (Source: WHO, WB, ESRA)

Variables	Safety and security	Enforcement
Frontal impact standard	0.929	-0.021
Total registered vehicles*	0.777	0.042
Total physicians*	0.770	-0.110
Higher education rate	0.741	-0.034
Total beds*	0.689	-0.119
Gini coefficient	-0.739	-0.262
Enforcement level (drug)	-0.070	0.879
Enforcement level (speed)	0.179	0.860
Enforcement level (mobile)	-0.296	0.849
Enforcement level (alcohol)	0.225	0.843
Enforcement level (seatbelt)	-0.348	0.805
Internet users	0.265	0.021
Ban on hands-free mobile phone use	-0.395	-0.204
SS loadings	5.252	3.949
Proportion Var	0.263	0.197
Cumulative Var	0.263	0.460

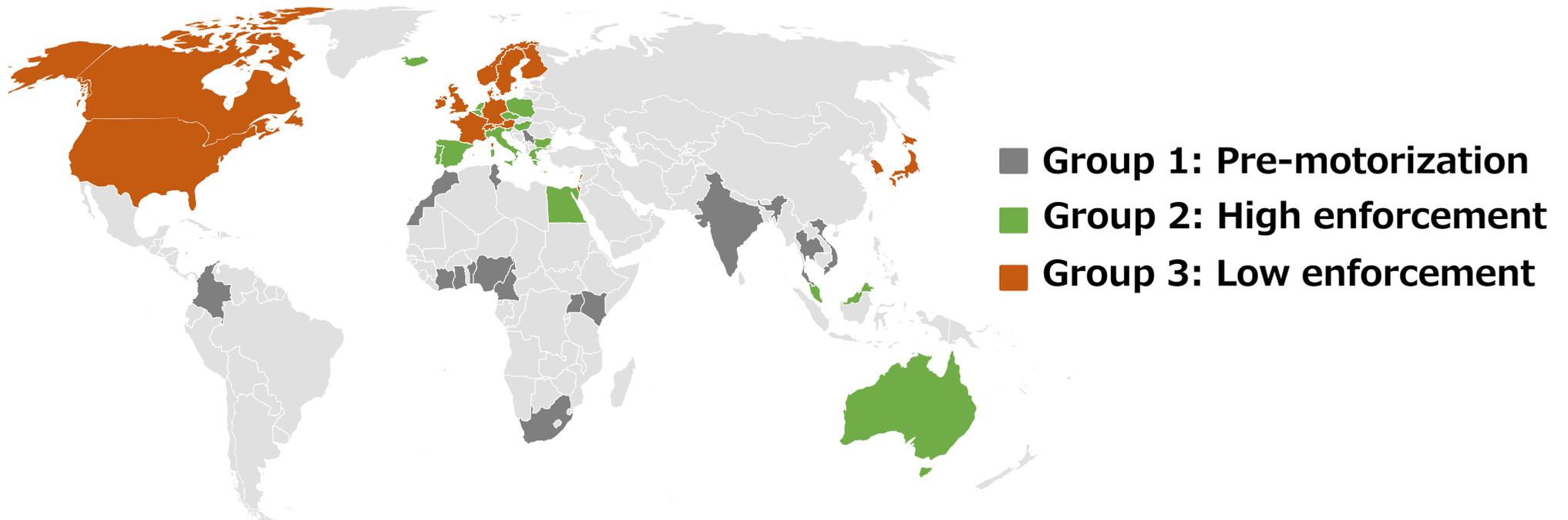
\* per capita

- k-means clustering by factor scores



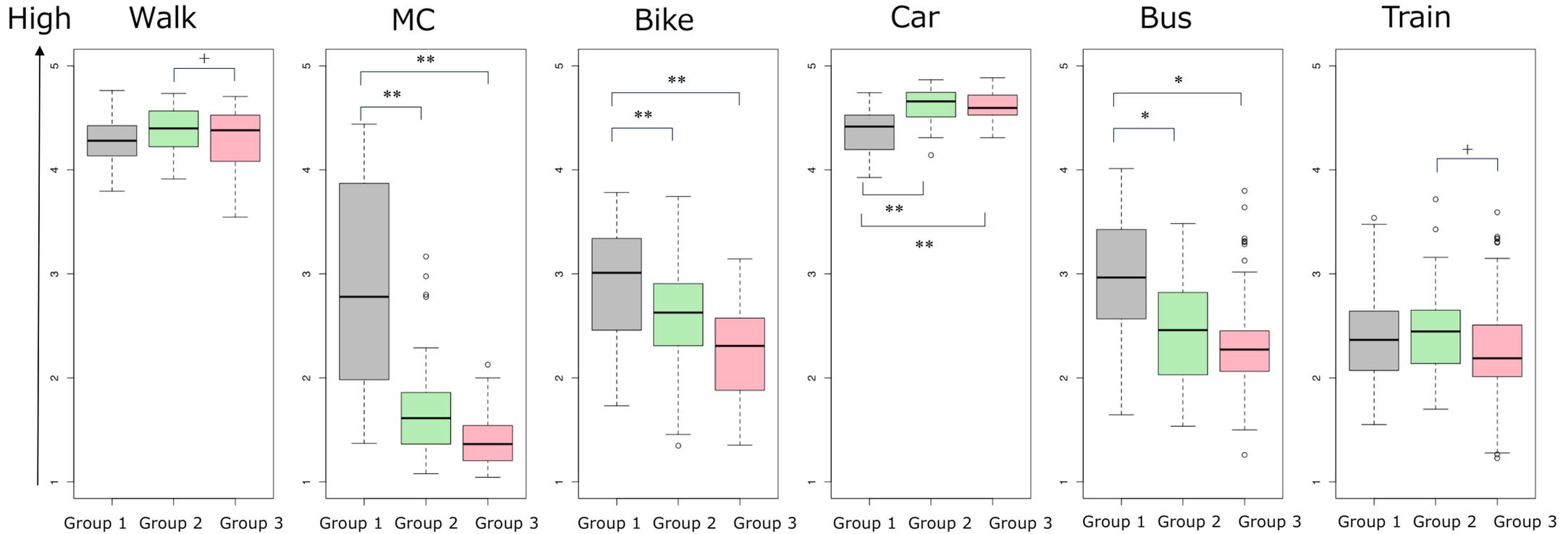
## Country groups

- Clustering countries by the similarities of traffic law, regulations, country status, and so on.



# Transportation modes in each group

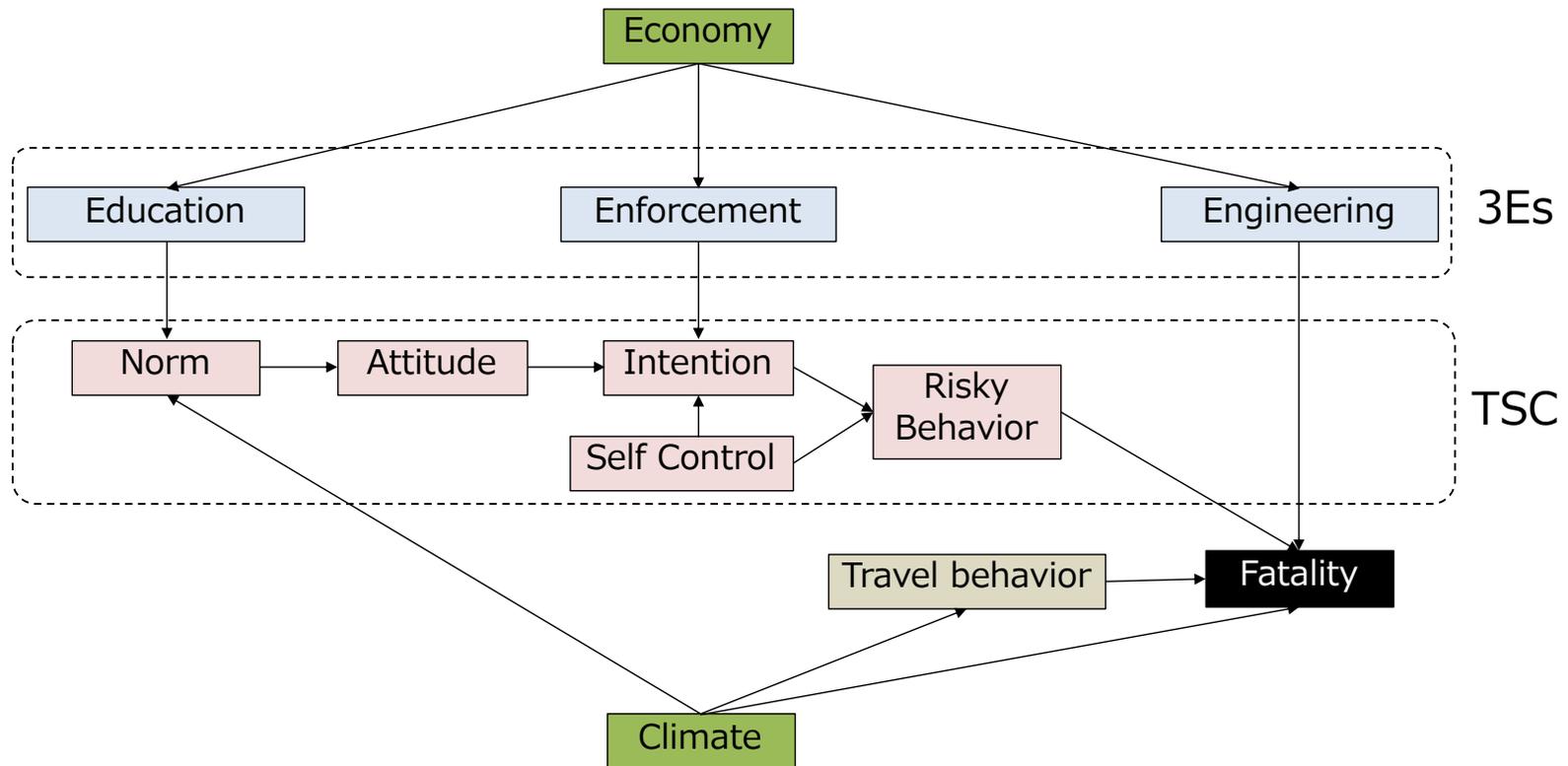
- Frequency of each transportation mode
  - Group 1 is categorized as pre-motorization state
  - Group 2 and 3 are motorized, but Group 3 is less frequent to go out.



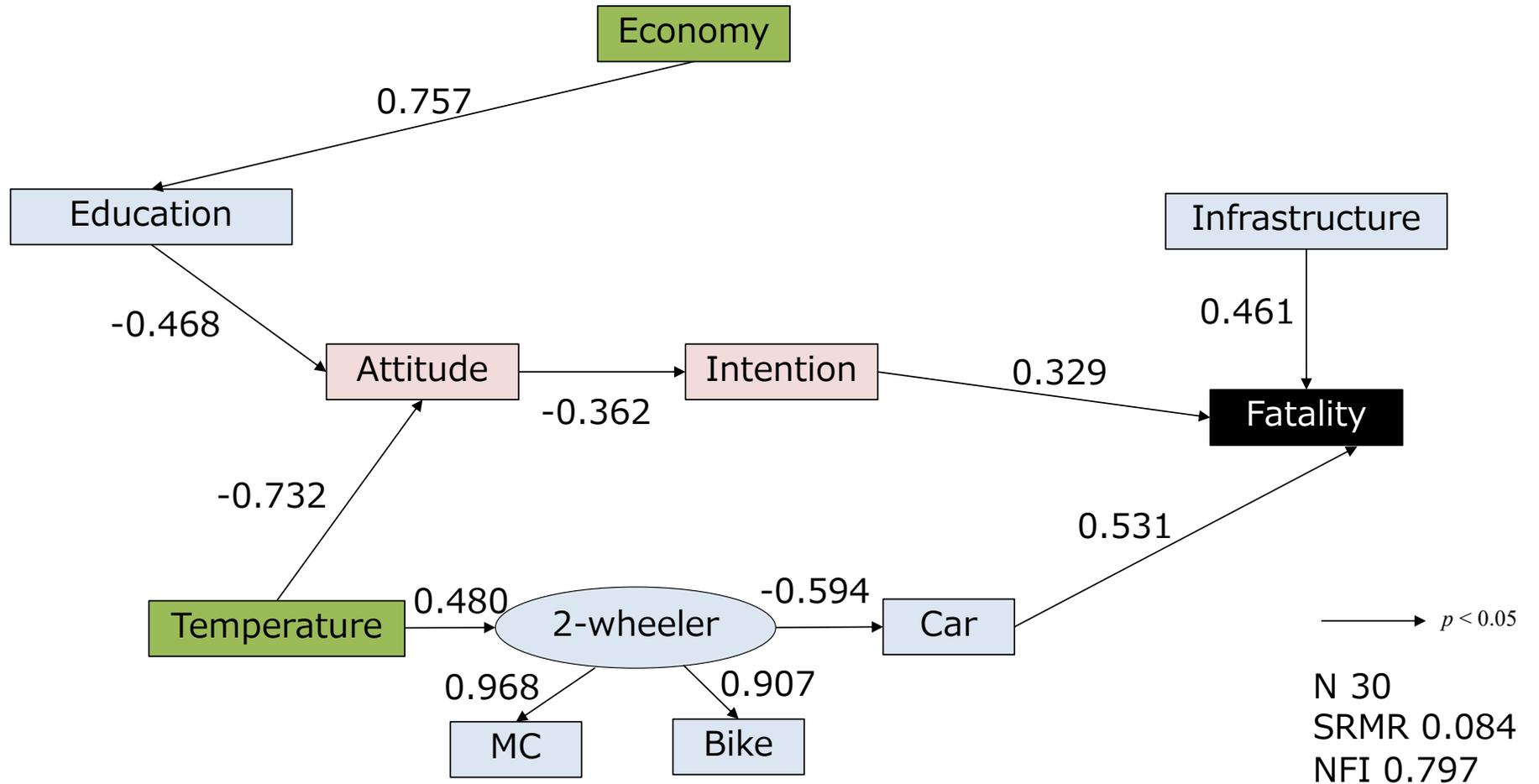
\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.10$

# Structural Equation Model

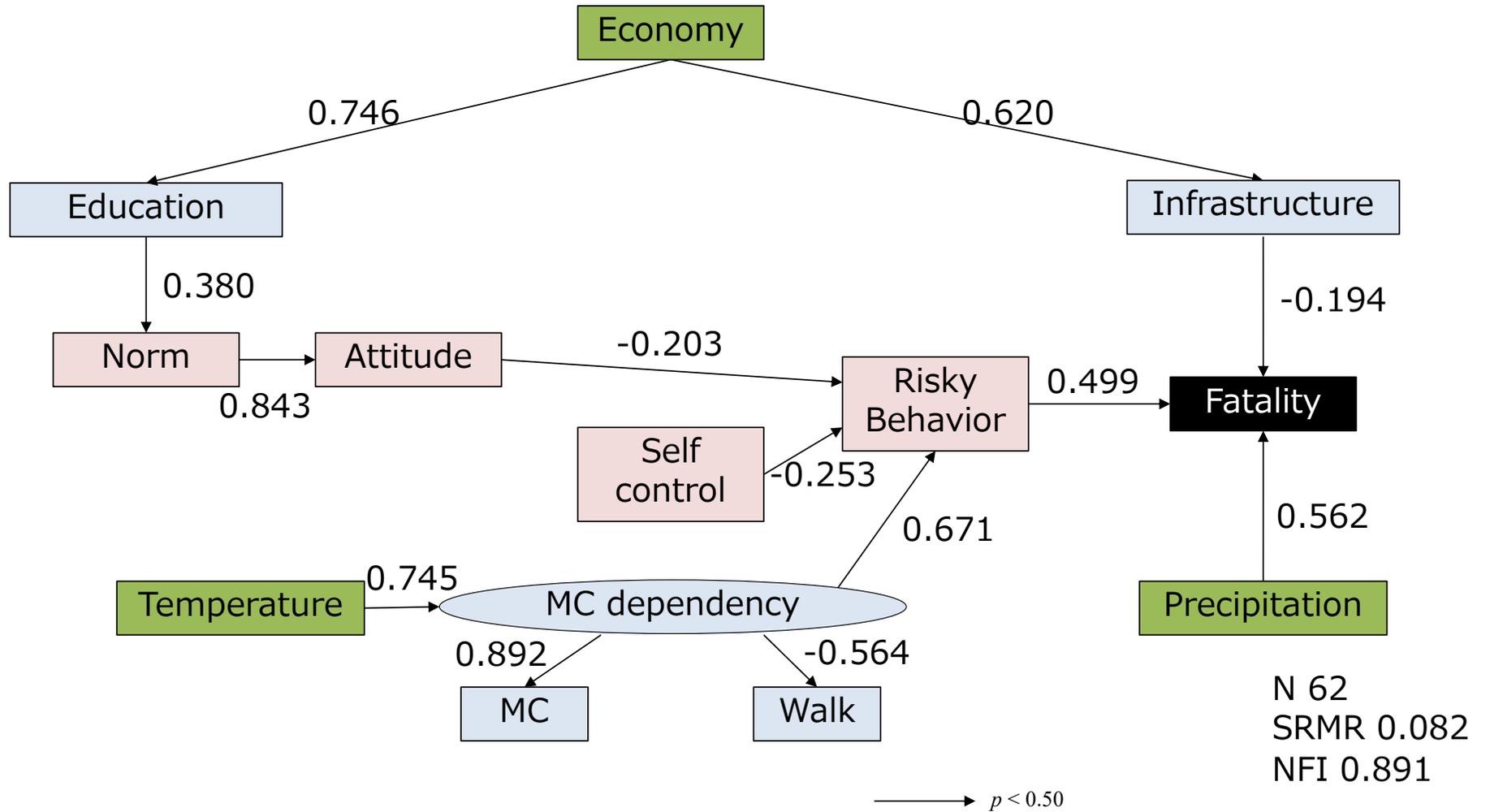
- Explore the significant paths which provides such fitting values, SRMR < 0.1 or NFI > 0.8 with keeping the base structure.



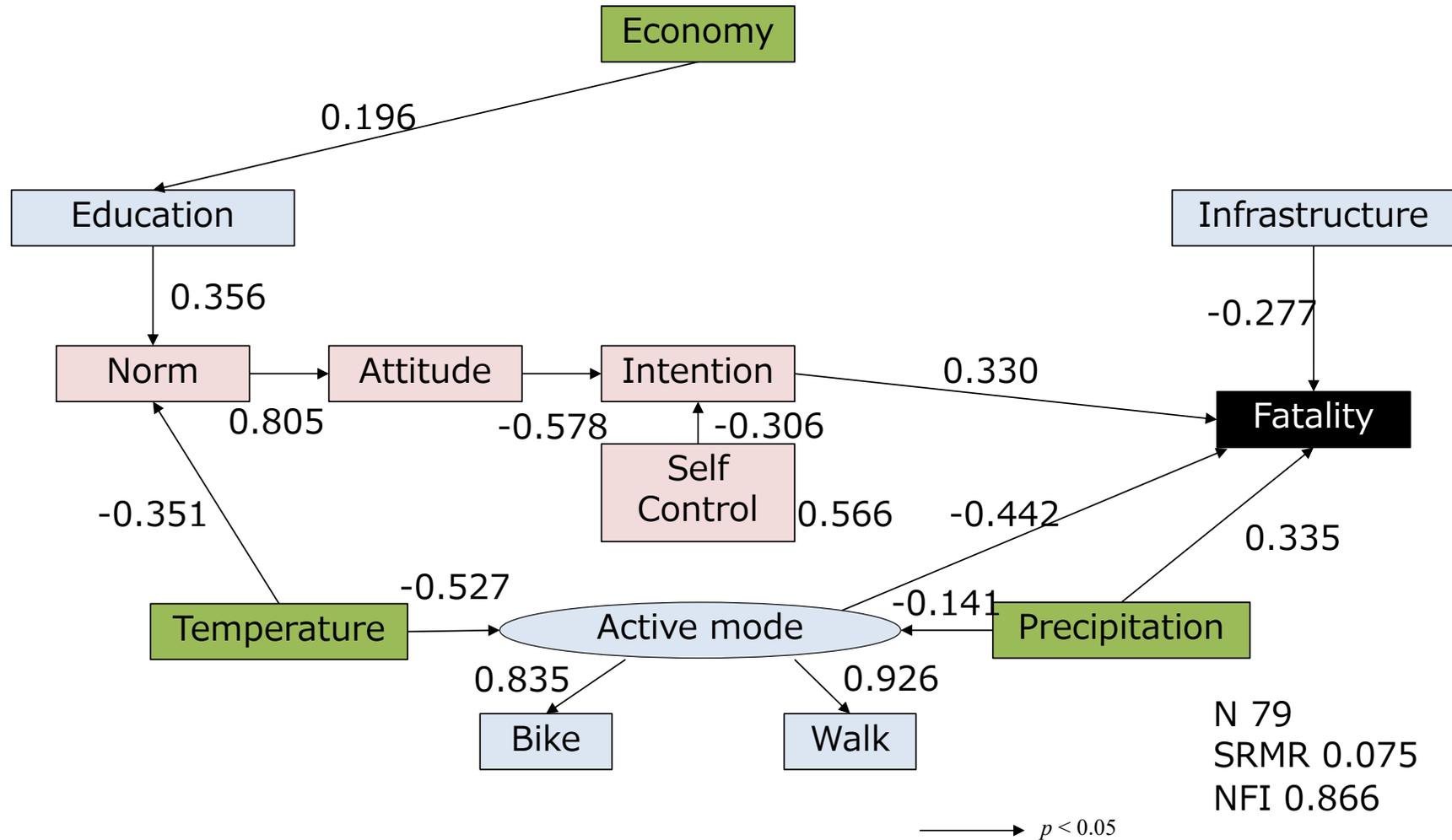
# Group 1: Pre-motorization



# Group 2 : High enforcement

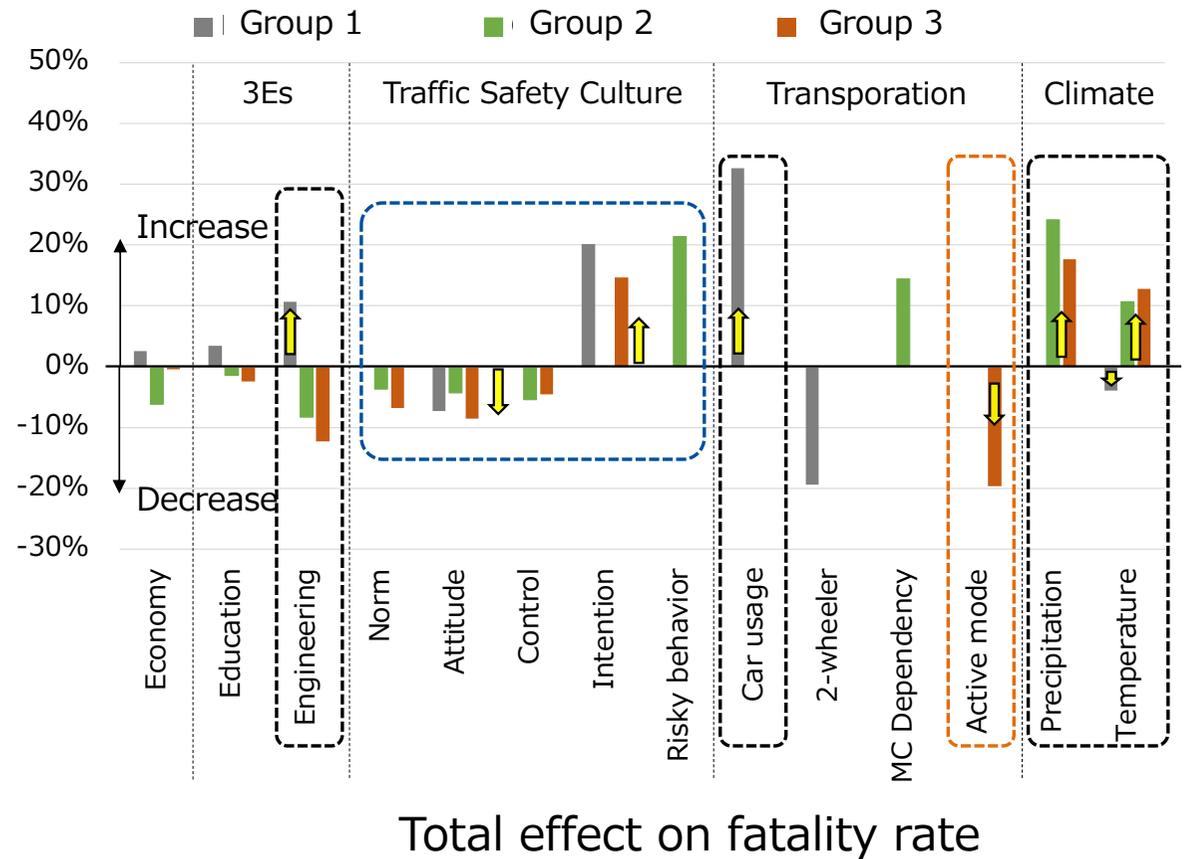


# Group 3: Low enforcement



# Discussions

- Compare the relative influences of each variable on the number of fatalities.
  - Regardless of countries, structures of traffic safety culture are common.
  - The impact of climate is less significant in pre-motorization countries.
  - In pre-motorization countries, motorization worsen the traffic safety.
  - Promoting active modes contributes to reduce the traffic fatalities in self-disciplined safety countries.



## Policy recommendation

- **In Pre-motorization countries**, where the transition from motorcycle use to car use is expected in the future, there is concern about the deterioration of traffic safety environments. **It is necessary to promote traffic safety awareness and improve the quality of roads rather than simply extending them.**



<https://www.google.com/url?sa=i&url=https%3A%2F%2Famanaimages.com%2Finfo%2FinfoRM.aspx%3FsearchKey%3D20062077933&psig=AOvVaw23OpXfe5M2rBsVwuH57N9r&ust=1749612293668000&source=images&cd=vfe&opi=89978449&ved=0CBQjRqFwoTCIDktu3z5Y0DFQAAAAAdAAAAABAE>

## Policy recommendation

- **In high-enforcement countries**, there is a tendency for a higher accidents risk in countries with high temperatures and heavy reliance on motorcycles with high rainfall. Since the modal split of motorcycles are stable, **traffic safety measures specifically targeted at motorcycles and bicycles which are more vulnerable than cars in terms of traffic safety are required.**



[https://www.google.com/url?sa=i&url=https%3A%2F%2Fnews.imotorbike.com%2Fen%2F2025%2F04%2Fworks-ministry-malaysia-motorcycles%2F&psig=AOvVaw2L0nRnf1DjiN3-GyXYj5cV&ust=1749614844634000&source=images&cd=vfe&opi=89978449&ved=0CBQjRqxqFwoTCKC92q\\_95Y0DFQAAAAAdAAAAABAM](https://www.google.com/url?sa=i&url=https%3A%2F%2Fnews.imotorbike.com%2Fen%2F2025%2F04%2Fworks-ministry-malaysia-motorcycles%2F&psig=AOvVaw2L0nRnf1DjiN3-GyXYj5cV&ust=1749614844634000&source=images&cd=vfe&opi=89978449&ved=0CBQjRqxqFwoTCKC92q_95Y0DFQAAAAAdAAAAABAM)

## Policy recommendation

- **In low-enforcement countries**, countries with suitable climate conditions for active modes, such as walking or cycling, tend to have higher levels of traffic safety. **Promoting the development of walkable and bikeable cities and shift from car use would be effective in further reducing accidents.**



<https://www.google.com/url?sa=i&url=https%3A%2F%2Fnote.com%2Fmachizukuroi%2F%2Fn158b599fb61c&psig=AOvVaw2ktvGikBSfhCyShh1e6Yc&ust=1749612386695000&source=images&cd=vfe&opi=89978449&ved=0CBQjRxqFwoTCKctopn05Y0DFQAAAAAdAAAAABAv>

Thank you for your attention.

---

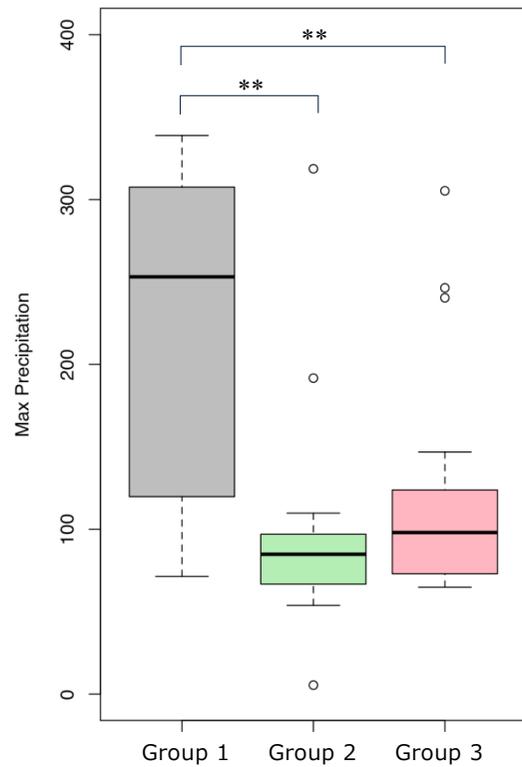
Yasuhiro Shiomi  
shiomi@fc.ritsumei.ac.jp

# Appendix

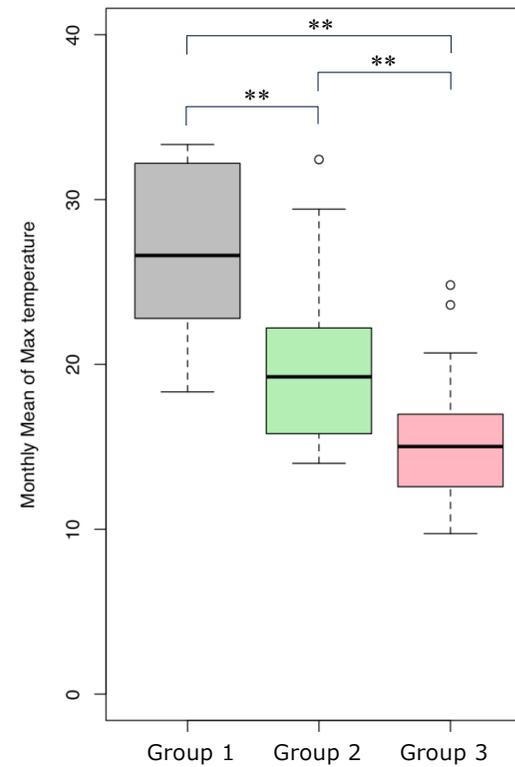
---

# Comparison of climate

- Precipitation



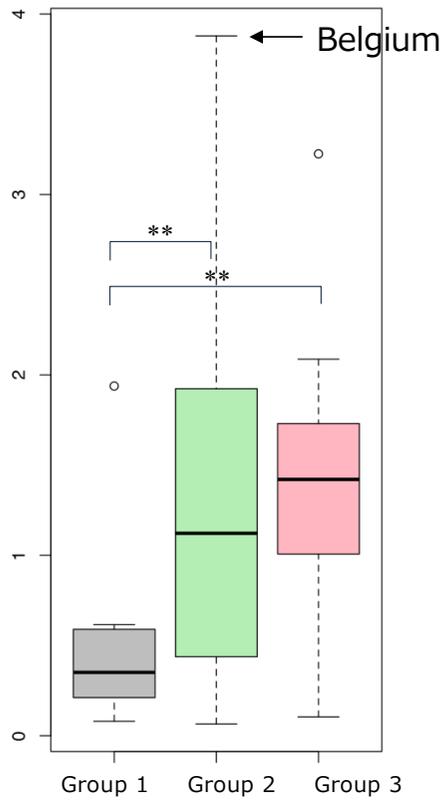
- Temperature



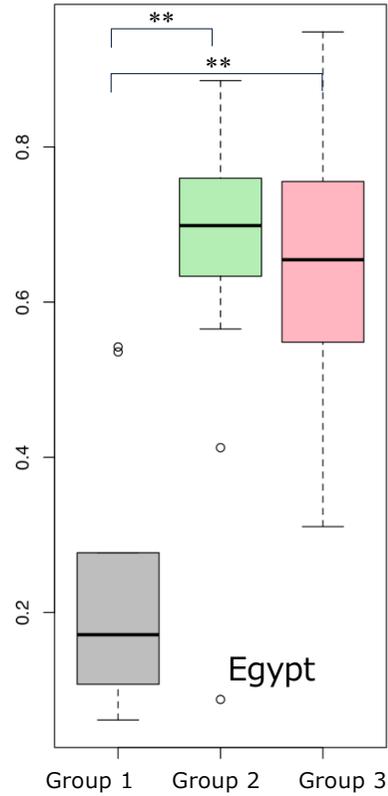
\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $< 0.10$

# Comparisons of 3Es

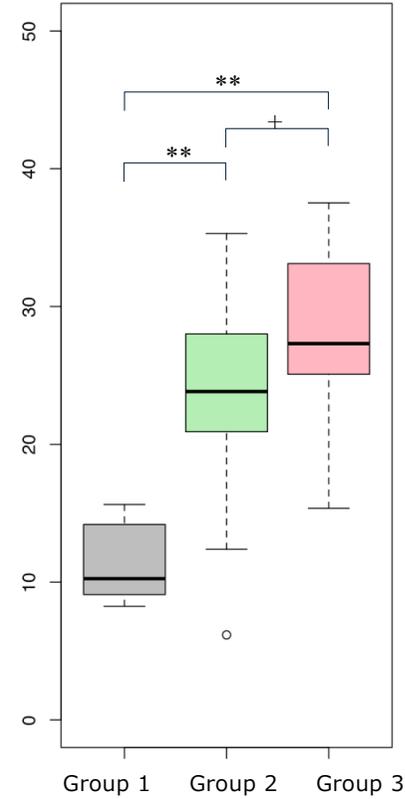
Road length



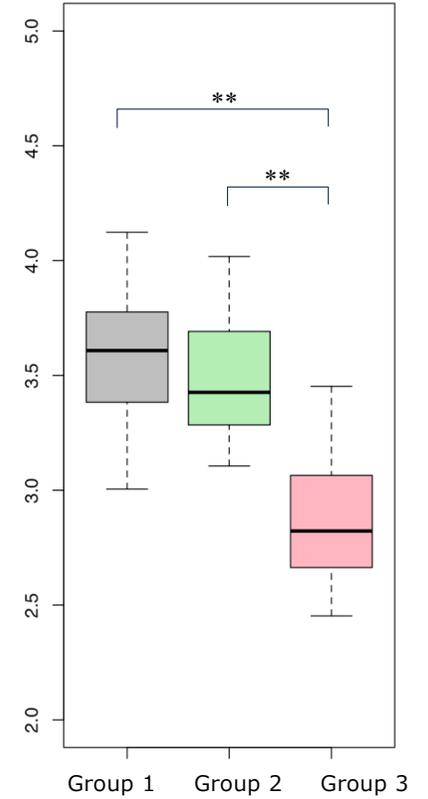
Registered vehicles



Higher education rate

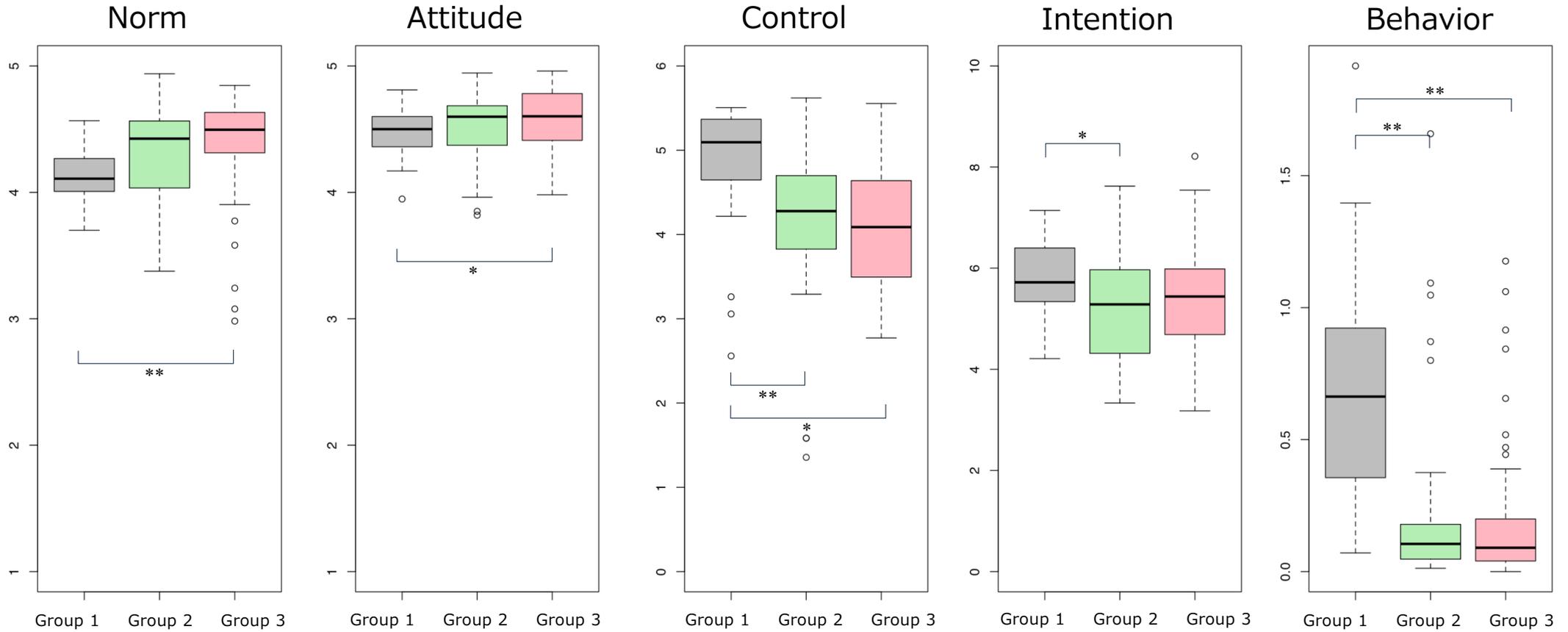


Enforcement



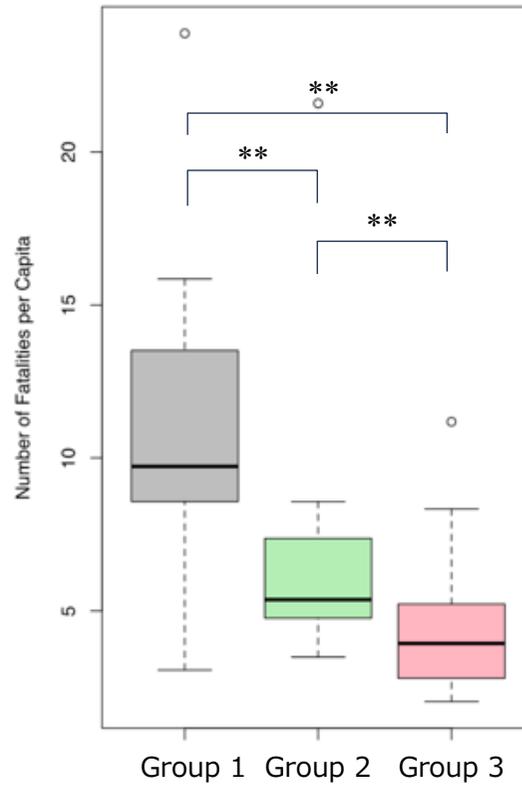
\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $< 0.10$

# Comparisons of TPB variables



\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $< 0.10$

# Fatality rate



\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $< 0.10$

\*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $< 0.10$

## Characteristics of groups

	Group 1	Group 2	Group 3
Economy	Low ~ Upper middle	Upper middle ~ High	High
Köppen index	A, B, C	B, C	C, D
Traffic safety	Low	Middle	High
3E	Low	High	High
Enforcement	High	High	Low
Norm and Attitude	Low	High	High
Control	High	Low	Low
Motorization	Low	High	High
2-wheeler usage	High	Low	Low
	Pre-motorization	Motorization	Post-motorization