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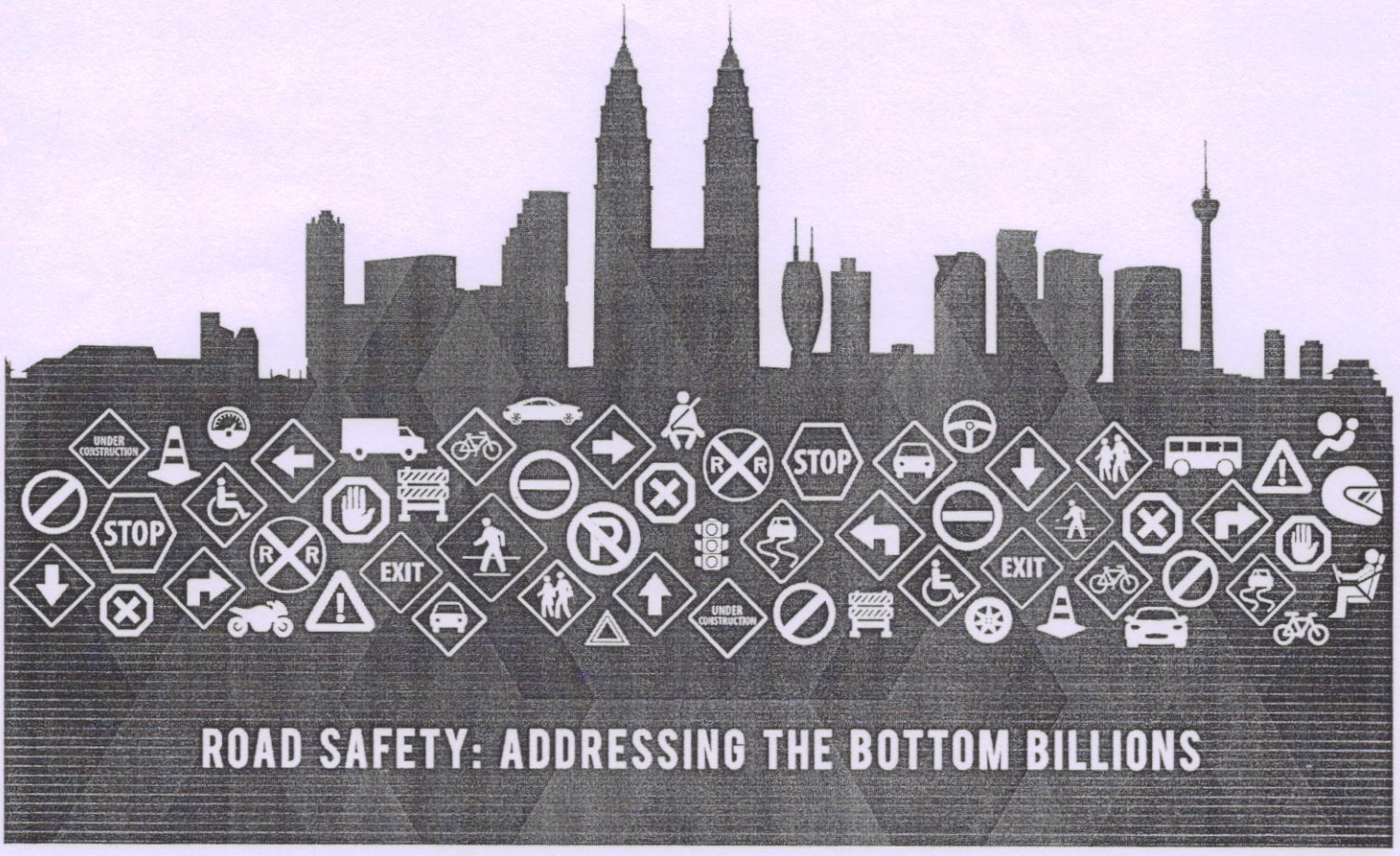

ROAD SAFETY: ADDRESSING THE BOTTOM BILLIONS

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TRAFFIC VIOLATIONS BY YOUNG MOTORCYCLISTS IN INDONESIAN URBAN ROADS

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ABSTRACT

It is already understood that road users have differences in capability and limitations in driving their car or motorcycle. As a fact, most studies regarding road users were conducted using data from developed countries. It is argued that there are differences in characteristics and consequences of road accidents in developed and developing cities as the impacts of road users' attitudes and behaviors. This study aims to investigate the factors underlie traffic violation behaviours and the type of traffic violations by young motorcyclists in urban roads in developing cities. Data were gathered using questionnaire survey in three major cities. Structural equation modeling has been performed to analyse the significant factors influencing young motorcyclist in commiting traffic violations including to analyse the causal relationship between influencing factors, characteristics of young motorcyclist, and type of violations. Analyses found young motoryclists were encouraged by different magnitude of influencing factors in violating the traffic regulation compared to the more mature group of motorcyclists, while a general causal relationships were found in these three cities. This highlights the needs to design specialised behavioural change policy to reduce traffic violations among young motorcyclists.

Keywords: motorcyclist, youngsters, traffic violations, urban roads, road accidents, road safety.

INTRODUCTION

Motorcyclist has been one of the main focus of safety researchers for decades, especially in the South East and Far East Asian regions [1]. The main reason for this interest is because, despite motorcycle has enjoying termendous growth and has becoming the most popular transport mode in the major Asian cities, motorcyclists are essentially the traveller group with the high(est) probability of serious injuries and fatalities when they involve in accident. A study in Taiwan shows that on average, motorcyclists have approximately three times the risk of fatality than non-motorcycle drivers after adjusting for mileage [2]. In 2012, motorcyclists were involved in 72% of all accidents in Indonesia, where a significant proportion of these accidents are fatal [3]. Tagel's [4] study in Bali shows that motorcyclists were responsible for 87% of traffic violations recorded in 2011 where the proportion of motorcycle was only 82% of the total mode share [5]. At the same time, private cars (14% of the mode share) were responsible for 6% of the traffic violations and the goods vehicles (4% of the total mode share) responsible for 3% of the traffic violations. This, however, is not by any mean a unique fact for developing countries since many studies in developed countries also have shown similar findings. In the UK, for example, DETR [6] shows that the probability where motorcyclists killed or sustaining serious injuries, per million vehicle kilometres, is approximately twice that of pedal cyclists and over 16 times that of car drivers and passengers. A similar proportion is also found among Swedish motorcycle and moped riders, compared to car passengers per distance travelled [7].

Dandona et al. [8] argued that the reason that motorcyclists in India have a high level of risk of road injuries is because many of them frequently ignore traffic rules, in addition to a significant proportion being unlicensed drivers, shunning use of helmets and driving vehicles in poor condition. Among this traveller group, Chang and Yeh [2] and Wong et al. [9] found that younger motorcylists are the most likely group disobey traffic regulations. Musselwhite et al. [10] note that this group are aware that being on a motorbike exposes them to greater danger. However, they tend to view safety in terms of being able to handle the bike, knowing its limitations and capabilities, without having to lose the thrill of riding. They highlight the need for an in-depth study going beyond impacts and attitudes towards behaviours to investigate motives and decision-making processes behind risky behaviours and attitudes of motorcyclists. In line

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with this, Steg and van Brussels [11] noted that violations are deliberate actions that result from social and motivational factors.

A review of literature which were carried out by Musselwhite et al. [12], and subsuquently discussed deeper in Musselwhite et al. [10, 13] highlight that research investigating the social nature of road user safety highlights the importance of three key areas, i.e. attitudes towards road user safety, social norms and perceived behavioural control. However, most of these studies were carried out in developed countries context. Little is understood about the impacts of motorcyclist attitudes and social norms on their habit of violating traffic rules in developing countries. Given that social and cultural characteristics of developing countries are different to developed countries, it is important to understand the impacts and interactions of these attitudes and sensation-seeking behaviour in the local context. This is the objective of this study, i.e. to investigate the factors underlie traffic violation behaviours and the type of traffic violations by young motorcyclists in urban roads in developing cities, which in cases, are three Indonesian metropolitan areas.

MATERIALS AND METHOD

Data was collected using questionnaire survey to motorcyclist in three cities. The survey was carried out between 20 and 29 September 2010 (Bandung) and between 22 September and 1 October 2010 (Yogyakarta and Surabaya). A preliminary report related to this work can be found in Joewono [14]. The questionnaire form consisted of demographic characteristics, travel characteristics, internal and external factors influencing violations, and types of violations. A total of 3000 motorcyclists (1000 respondents per city) were recruited from three cities, i.e. Bandung, Yogyakarta and Surabaya, to participate in this study. After reviewing the completeness of the collected questionnaires, it was found that 983, 980, and 978 samples can be used for analysis to represent Bandung, Yogyakarta, and Surabaya, respectively. Previous results of this study including several statistics can be found in Joewono et al. [15], Joewono et al. [16], Susilo et al. [1].

In this study, the respondents were grouped into two, namely youngsters and matures motorcyclist. The youngsters were motorcyclist who were younger than 30 years old, while motorcylist with 30 years old or olders were grouped as mature motorcyclist. The number of youngster respondents of Bandung, Yogyakarta, and Surabaya were 670, 524, and 510, while for mature were 313, 456, and 468, respectively

This study employed a causal model as proposed by Joewono et al. [16] as shown in Figure 1. The constructs are depicted in large ovals, while the hypotheses are symbolised using arrows. The hypotheses in word form are [16]:

H_1: the construct of influencing factors is built by four, i.e. road environment, vehicle conditions, physical conditions, and attitudes.
H_2: the construct of type of violations is built by three constructs, i.e. regulations, habits, and norms.
H_3: the construct of violations is positively influenced by influencing factors.
H_4: the construct of violations positively influences the impacts and decisions.

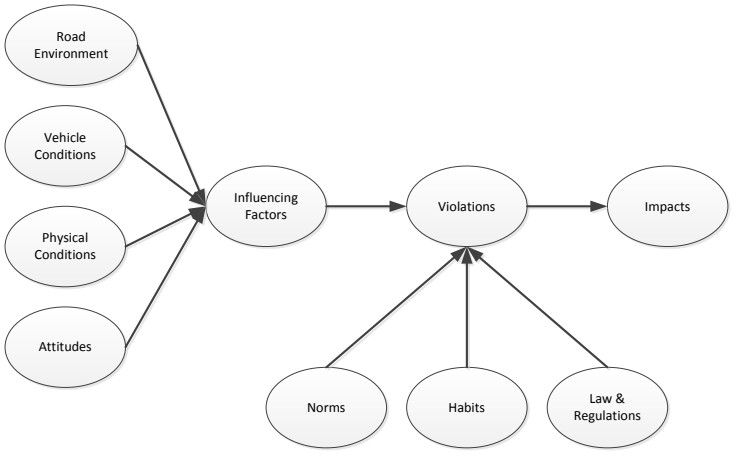

Figure 1. Hypothesized Model of Influencing Factors and Types of Violations [16]

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RESULTS AND DISCUSSION

To evaluate the difference between youngsters and mature in involving traffic rules' violation, six models using the structural equation modelling have been estimated, namely unconstrained and constrained model for each city. Table 1 presents the invariance testing between youngster and mature for the three cities. The analyses show that some equality constraints do not hold across youngster and mature. Thus, it revealed that there are significant evidence to state that the two groups (youngster and mature) have different location of the non-invariance. This finding is the case for all three cities. Detail discussion about this invariance testing can be found in Byrne [17].

From now on, it can be judged that further analyses are intended to evaluate the difference. In this study, the result of unconstrained mode for the three cities were evaluated. The overall fit of the three models are presented in Table 2. All three models have very high chi-squares values with large degree of freedom, which result in very low p-value. While it is common in model with large degree of freedom, thus it is common to evaluate the ratio between the chi-squared value and the degree of freedom. All models have a ratio far lower than 5, where Arbuckle and Wothke [18] stated a ratio below 5 indicates a reasonable fit. Moreover, Hair et al. [19] suggested a rule of thumb to rely on at least one absolute fit index and one incremental fit index, in addition to the chi-squared value. The values of RMSEA (Root Mean Square Error of Approximation), an absolute fit index, for all three models are lower than the threshold value 0.08, and indicate an acceptable error of approximation. The values of CFI (Comparative Fit Index), as incremental fit index, are around 0.6 suggesting that the estimated models provide a medium reasonable good fit. Further, RMSEA and the CFI satisfies the rule of thumb that both a badness-of-fit index and a goodness-of-fit index be evaluated. Other index values are also supportive, i.e. RMR (Root Mean Square Residual) which is around 0.08 and GFI (Goodness-of-fit Index) that is around 0.65. Thus, it can be concluded that the hypothesis imbedded in the models are supported by data which were derived from relevant measurements.

Table 1. Invariance Testing for Youngsters and Mature Motorcyclists Model

Dataset	Unconstrained Model		Constrained Model		Difference		
	chi-square	df	chi-square	df	chi-square	df	p-value
Bandung	15030.57	4270	15669.88	4336	639.311	66	0.000
Surabaya	15308.92	4270	15660.31	4336	351.388	66	0.000
Yogyakarta	12508.33	4270	13096.12	4336	587.791	66	0.000

Table 2. Goodness of fit indices for Unconstrained Multigroups Model

Indices	Statistics		
	Bandung	Surabaya	Yogyakarta
χ^2	15030.57	15308.92	12508.33
df (degree of freedom)	4270.00	4270.00	4270.00
p-value	0.00	0.00	0.00
χ^2/df	3.52	3.59	2.93
RMR (Root Mean Square Residual)	0.09	0.08	0.07
RMSEA (Root Mean Square Error of Approximation)	0.05	0.05	0.04
GFI (Goodness-of-fit Index)	0.62	0.63	0.68
CFI (Comparative Fit Index)	0.65	0.62	0.69

Furthermore, Table 3 presents the standardized structural parameter estimates. The findings are estimated by three multigroup models, where each model have two groups, i.e. youngsters and mature. All structural path estimates are significant with a high degree of confidence, i.e. at 0.001 level of significance, and in the expected direction. Thus, it can be concluded that the hypothesised paths are supported for the thee multigroup models, i.e. youngster and mature models for each three cities. The structural equation models for all three cities explain that the construct of violations is positively influenced by the construct of influencing factors (Hypothesis 3). This construct is positively influenced by four constructs referred to as external and internal features, namely road environment, vehicle conditions, physical conditions, and attitudes (Hypothesis 1). Moreover, the construct of violations is positively influenced by three constructs, namely regulations, habits, and norms (Hypothesis 2). The models also show that the construct of violations positively influences the construct of the impacts including decisions motorcyclists make following incidents (Hypothesis 4). These relationships are found to be significant in the six models calibrated separately for each city. These causal relationships are similar across cities and between groups as well as with previous study [16].

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Even there is similarity of causal relationships, it should be noted the existence of invariance between the group of youngster and mature motorcyclists in each city. In those models, each construct is explained by several factors as appears in Table 4 and Table 5. All factors are found as significant in explaining the constructs. The difference between groups of youngster and mature exists in the regression weights or factor loadings as revealed using invariance testing. As the space of the article is limited, the loadings (weights) of each factor are not presented in this article.

Table 3. Standardized Regression Weights for Unconstrained Multigroups Model

Relationships between constructs	Bandung		Surabaya		Yogyakarta	
	Y	M	Y	M	Y	M
Violations ← Influencing factors	0.643	0.613	0.708	0.616	0.705	0.580
Regulations ← Violations	0.543	0.519	0.267	0.256	0.207	0.375
Habits ← Violations	0.927	0.949	0.890	0.706	0.850	0.896
Impact and Decisions ← Violations	0.684	0.824	0.675	0.803	0.506	0.724
Road environment ← Influencing factors	0.884	0.894	0.871	0.871	0.901	0.837
Vehicle conditions ← Influencing factors	0.750	0.863	0.850	0.846	0.856	0.727
Physical conditions ← Influencing factors	0.669	0.861	0.557	0.688	0.704	0.788
Attitude ← Influencing factors	0.908	0.962	0.941	0.979	0.947	0.989
Norm ← Violations	0.824	0.931	0.750	0.662	0.754	0.880

*Y = youngsters (younger than 30 years old); M = mature (30 years old or olders)

Table 4. Factors of Influencing Violation

Influencing Factors			
Road environment	Vehicle condition	Attitude	Physical
1. Passenger	1. Vehicle maintenance	1. Law obedience	1. Fatigued
2. Police inspection	2. Vehicle modifications	2. Environmental awareness	2. Physical ability (e.g. visual acuity)
3. Time of day	3. Vehicle age	3. Dress style	3. Intoxicated
4. Weather	4. Engine capacity	4. Driving manner	4. Body size
5. Roadside condition		5. Emotional stress	
6. Road sign			
7. Road surface condition			
8. Road geometric			
9. Road width			
10. Traffic condition			

This study revealed interesting findings. It is confirmed that the constructs of the influencing factors, the psychological constructs, and their relationships are valid for both groups as well as across cities. It implies the general pattern of the causal relationships of violations in urban areas, even between the youngsters and mature motorcyclists. Thus, it can be concluded that this causal relationships can be applicable for all groups of motorcyclists or cities. It also means that this finding is in line with previous studies in developed countries, even in some extent it strengthen the finding and contribute to the body of knowledge (see for example discussion by Jonah [20] that stated the need to explore the mediatory role of risk utility).

Moreover, Table 4 shows that there are ten signficant attributes to explain influencing factors from the group of road environment and four attributes from the group of vehicle conditions. These two groups intend to explain external influencing factors. Besides that, there are five attributes in explaining attitudes and four attributes in explaining physical condition. These two groups intend to explain internal factors of motorcyclist in committing to violate road rules. Moreover, Table 5 presents significant attributes in explaing the construct of violations. There are three constructs, i.e. violations related to rules, habits, and norms, with 17, 15, and 6 explaining attributes, respectively. It also present six explaining attributes of impacts and decisions in the event of breach. Thus, while the general pattern was found, this study also confirmed the difference of psychological behavior between both groups as well as across cities. It answers the suggestion of Jonah [20] to explore the reasons for risk-taking by youth. It implies the unique characteristics of each group or city as well. Since this study employed a multigroup analysis, which means one model for two groups, the indication of invariance was detected by comparing the chi-square of unconstrained and constrained models. Thus, the source of difference cannot be found at this stage, whether it is in the number or type

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of influencing factors (attributes) or even in the loadings (weights) of the attributes. At this stage, at most, the conclusion is the existence of the difference, while the location of the difference is a further work.

Table 5. Type of Violations and Impacts

Type of violations	Type of violations
Violations related to road rules	Violations related to habits
1. Not bringing correct document	1. Overtaking on the wrong side
2. Not wearing regular helmet	2. Pushing motorcycle between vehicle lanes
3. Disobeying traffic signs and signals	3. Speeding and street racing
4. Stopping beyond stop lines	4. Riding reckless
5. Illegal crossing at traffic signals	5. Riding slow in in-appropriate lanes
6. Using illegal short cuts	6. Sudden turning movement without signalling
7. Not parking in appropriate places	7. Blocking the road lane
8. Illegal contraflow	8. Hearing music while riding
9. Not installing rear-view mirror	9. Smoke while riding
10. Unstandard lamp	10. Making phone while riding
11. Switching off the turn signal	11. Chatting while riding
12. Switching off headlight during the day	12. Not wearing safety equipment
13. Failure to correctly display registration number plate	13. Not wearing body equipment
14. Using unstandard exhaust	14. Riding in man bridge
15. Illegal modifying the motorcycle	15. Riding in sidewalk
16. Failure to give right of way	
17. Overweight loading	
Violations related to norms	Impacts and decisions in the event of breach
1. Speeding in residential areas	1. Escape from the location when violate
2. Beign inconsiderate to other road users	2. Take a responsibility when violate
3. Turning headlight while riding in alley	3. Experience no impact when violate
4. Turning headlight while entering restricted area	4. Attempted to hit and run
5. Turning on beam in dense area	5. Arrested by police
6. Horning in in-appropriate place	6. Involved in a crash

CONCLUSIONS

This study tried to investigate the difference of the behavior and psychological constructs in committing to violate road rules by young and mature motorcyclists. Using the evidence from the reported response of motorcyclist in urban areas in developing countries, this study partly support previous research from developed countries.

General pattern of the psychological constructs is confirmed in this study. It emphasized the findings in literatures that violations are not just an human error, but there are reasons to commit, where the decision makers (in this case motorcyclist) are in free condition to decide whether to violate or not. The point of this study is the evidence from developing countries, while at present most studies are empirically from developed cities. The other point is the finding that youngster and more mature groups have similar pattern, which explain the validity of the relationships model.

The other important finding of this study is that there is significant difference between younger (younger than 30 years old) motorcyclist and more mature group regarding the influencing factors in the involvement in road rule violations. This involvement can be inferred as an indicators to the commitment to take risk. Previous studies from developed cities already found that young motorcyclists tend to involve in greater risk, since they tend to take higher propensity to take risks while in road. Jonah [20] reviews the evidence relevant to the hypotheses that young (16-25) drivers are at greater risk of being involved in a casualty accident than older drivers and this greater risk is primarily a function of their propensity to take risks while driving. Musselwhite et al. [10] also noted that younger motorbike riders wer viewed as driving in a reckless fashion. DfT also reported that young riders are more likely to have accidents than their older counterparts [21] and ride more dangerously, deliberately showing more violations [22]. This findings highlight the needs to design specialised behavioural change policy to reduce traffic violations among young motorcyclists.

Even this study provides important findings, but this study is still in initial stage, which implies a need for further investigations. The investigation of the specific attributes in explaining each construct involved in the model is one closest further work. Another suggestion for further work is provided by Jonah [20] that research should determine

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whether driver risk-taking for some young drivers is merely one aspect of a general lifestyle characterized by risk-taking.

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