

A Longitudinal Analysis of Traffic-Violation Behaviours among Two Groups of Motorcyclist in Bandung, Indonesia

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Abstract – *The capability and limitations of car drivers or motorcyclists are believed to change over time as a response to external and internal triggers. As a fact, studies regarding behaviour of young motorcyclists from developing countries are very rare while motorcyclists from developed and developing are believed as different. This study aims to explore the change of behavior of young motorcyclists in committing traffic violations in urban areas from experience in developing countries. Analyses employed datasets collected using questionnaire survey from Bandung, Indonesia from two periods, namely 2010 and 2017. Comparison analyses were completed to compare traffic violations attributes between the two datasets. Two causal models from two data collections were estimated using structural equation modelling to analyse the influencing factors to traffic violations as well as to analyse the relationships of influencing factors, characteristics of motorcyclist, and type of violations. Between the two datasets it is found the difference of the type of violations which implies the change of attitudes in committing traffic violations, while the change of causal relationships is not found in the models. This study confirms the flexibility of behavior change in riding motorcycles between young motorcyclists, while relationships among constructs seem more stable.*

Keywords: Change of behavior, traffic violations, motorcyclist, youngsters, urban roads, road safety

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1.0 INTRODUCTION

Despite its rapid growth, motorcyclists are essentially the traveller group with the highest probability of serious injuries and fatalities when they involve in accident (Joewono & Susilo, 2015). Data provides strong evidence where many studies have analysed using data from developed and developing countries as well. Since 1997 motorcycle rider fatalities in the US have increased by 89 percent from 2,116 to 4,008 in 2004 according to National Highway Traffic Safety Administration (NHTSA) (webbikeworld, 2017). In 2012, motorcyclists were involved in 72% of all accidents in Indonesia, where a significant proportion of these accidents are fatal (Badan Pusat Statistik Indonesia, 2012). In 2016, motorcyclist fatalities in the US occurred 28 times more frequently than passenger vehicle fatalities in motor vehicle crashes when accounting for vehicle miles travelled (VMT) (Governors Highway Safety Association, 2018; National Center for Statistics and Analysis, 2018). Data from Statistical Bureau reported the share of motorcycle accidents in Jakarta, Indonesia, was 75% from total accidents (detikOto, 2018). Similar data were reported by insurance agency, PT Jasa Raharja, that number of accidents was 70% out of total accident in 2017 with number of total victims were 121,085 people (Kompas.com, 2018), where 57% of the victims were in productive age, i.e. 20-50 years old.

Young road users, especially young motorcyclists, have also been known as the riskiest actors. The reasons for this risky behavior have been investigated by many scholars. Ulleberg and Rundmo (2003) argued that the risky-driving behavior mechanism among young drivers is unique and found that personality may indirectly influence risky driving behaviours via attitude. Many previous studies (e.g., Chang & Yeh, 2006; Dandona et al., 2006; Wong et al., 2010a; Wong et al., 2010b) have found that younger motorcyclists are the group most likely to disobey traffic regulations. Musselwhite et al. (2012) noted that younger motorcyclists are aware that being on a motorbike exposes them to greater danger. Joewono and Susilo (2017) found that young motorcyclists were influenced by different magnitudes of influencing factors in violating traffic regulations compared to more mature motorcyclists.

Observing risky behavior especially involvement in traffic violations is important, as stated by Joewono et al. (2015) that most traffic crashes have a connection to human factors. Studies have accumulated knowledge that drivers regularly deviate from safe operating practices for various reasons (Rothengatter, 1997). Disobedience, driving errors, and road traffic violations are the main reason for traffic crashes pointed out by many researchers (Yagil, 1998; Rimmö & Åberg, 1999; Forward, 2006; Forward, 2009).

By observing data of road accident and its actors in the last two decades, it can be hypothesized that the young motorcyclists are consistently the most actors with risky behaviours. The trend as the riskiest road actors seems as consistently existed in many places, whether developed and developing countries. Literature in the field of psychology has investigated the consistency of attitude, i.e. the strength of attitude. Prislin (1996) explained that strong attitudes are stable over time, resistant to change, and exert strong influence on information processing, overt behaviour, and formation of new attitudes. The persistence of an attitude over time is positively associated with amount of experience with the attitude object, the certainty with which the attitude is held, the importance of the attitude, the internal consistency of the attitude, and the affective extremity of the attitude.

Many studies have investigated and experimented with attitude stability, attitude-behavior consistency, or attitude change. Some of the studies can be mentioned, such as

experiment of attitude stability (Sia et al., 1997), attitude change and its relation with age (Krosnick & Alwin, 1989), moderation of attitude strength with attitude stability (Prislin, 1996), the spontaneous and consistency effect of beliefs to people's attitude (Ajzen & Fishbein, 2000), and the influence of attitude in guiding future behavior (Glassman & Albarracín, 2006). As a matter of fact, studies about attitude stability in the field of road users are quite limited. It becomes more limited when discussions focus on empirical evidence from developing countries. Some studies about traffic violations in developing can be named, such as Dandona et al. (2006). Studies using data from Indonesia cities have been reported by Joewono (2010), Joewono et al. (2012), Joewono et al. (2015) and Susilo et al. (2015), while studies about violation by young motorcyclist have been reported by Joewono and Susilo (2015) and Joewono and Susilo (2017). Those studies employed data from survey in 2010.

This study has a motivation to test the hypothesis that road users, i.e. young motorcyclists, are in nature as having the tendency to involve in risky behavior as well enjoying to involve in sensation seeking by violating traffic rule. The result of this nature manifests in consistency to involve in traffic rule violations. In other words, young motorcyclists tend not to change in attitude in obeying traffic rules. The hypothesis will be tested using two datasets of traffic violations by young motorcyclists in Bandung, Indonesia from the year of 2010 and 2017. The analysis aims to test whether there is a difference in causal relationships among constructs, as well as whether there is a change of significant attributes in explaining the constructs.

2.0 METHODOLOGY

Data for these analyses were collected using questionnaire survey in two phases. The first phase of survey covered three cities that were conducted on the 20th and 29th of September 2010 (Bandung) and between the 22nd of September and 1st of October 2010 (Yogyakarta and Surabaya). The second phase was collected from Bandung responses only from the 13th until 22nd of November 2017. Detail information regarding the first phase study can be found in Joewono (2010). A thousand questionnaires were distributed in the first phase and able to collect 983 samples for Bandung. In the second phase, 550 questionnaires were distributed and 513 samples can be used for further analyses.

Like the previous study, the respondents were grouped into two, namely youngsters and matures motorcyclist (Joewono & Susilo, 2015). The youngsters were motorcyclists who were younger than 30 years old, while motorcyclists with 30 years old or older were grouped as mature motorcyclists. The number of youngster and mature respondents of Bandung in the first phase was 670 and mature was 313. In the second phase, the distribution of youngster and mature respondents were 244 and 269, respectively.

This study employed just the same causal model as already tested in previous analyses (Joewono & Susilo, 2015; Joewono & Susilo, 2017). The model is shown in Figure 1. The constructs are depicted in large ovals, while the hypotheses are symbolised using arrows. Four hypotheses want to be tested are:

- H1:** the construct of influencing factors is built by four, i.e. road environment, vehicle conditions, physical conditions, and attitudes.
- H2:** the construct of type of violations is built by three constructs, i.e. regulations, habits, and norms.
- H3:** the construct of violations is positively influenced by influencing factors.
- H4:** the construct of violations positively influences the impacts and decisions.

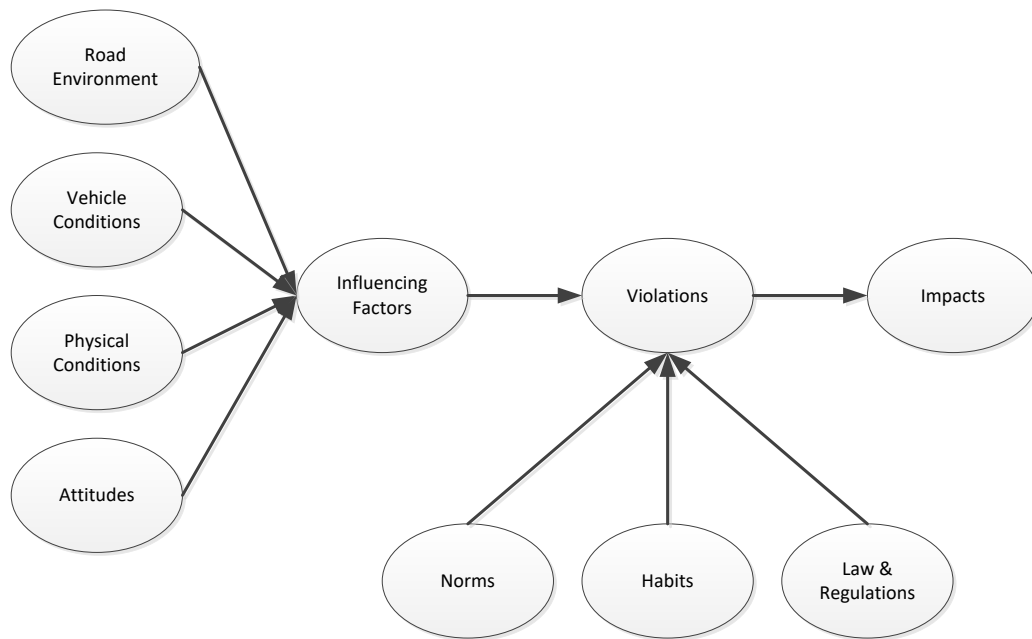


Figure 1: Hypothesized model of influencing factors and types of violations

3.0 RESULTS AND DISCUSSION

Following the discussion about invariance testing from Byrne (2001), in order to test the hypothesis that there is a significant difference between youngsters and mature in involving traffic rules' violation, two models for each year of 2010 and 2017 are estimated using the structural equation modelling, namely unconstrained and constrained model. Table 1 presents the result of invariance testing between youngster and mature for the two datasets. Since the result of analyses show that some equality constraints do not hold across youngster and mature, it can be concluded that there is significant evidence to state that the two groups (youngster and mature) have different location of the non-invariance. The same findings were found for both datasets, namely 2010 and 2017. Based on these results, further analyses will be completed to evaluate the difference between youngster and mature motorcyclists.

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
Data 2010	15030.57	4270	15669.88	4336	639.311	66	0.000
Data 2017	11604.13	4270	12427.67	4336	823.536	66	0.000

Further discussion will focus on the result of unconstrained mode for datasets from the two time of data collection. Table 2 shows the overall fit of the two models. The two models have very high chi-squares values with a large degree of freedom, which results in very low p-value. It is common in model with large degree of freedom to evaluate the model using 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 (1999) stated a ratio below 5 indicates a reasonable fit.

Following the suggestion of Hair et al. (2006), the goodness of fit of the models was evaluated using one absolute fit index and one incremental fit index as minimum indices. The two indices add the chi-squared value and the ratio. The absolute fit index is represented by the value of RMSEA (Root Mean Square Error of Approximation), where the values for the two models are lower than the threshold value of 0.08. It indicates the models have an acceptable error of approximation. The incremental fit index is explained by the value of CFI (Comparative Fit Index). The values around 0.6 are suggested with a meaning that the estimated models provide a medium reasonable good fit. While the two models have similar value of RMSEA, model using dataset of 2017 have a lower CFI. Another index value is also supportive, i.e. RMR (Root Mean Square Residual) which is around 0.08. The value of GFI (Goodness-of-fit Index) from 2017 dataset is lower than the suggested. From the indices of the two models, it can be concluded that the hypothesis imbedded in the models is supported by data.

Table 2: Goodness of fit indices for the unconstrained multigroups model

Indices	Statistics	
	Data 2010	Data 2017
χ^2	15030.57	11604.13
df (degree of freedom)	4270.00	4270
p-value	0.00	0.00
χ^2/df	3.52	2.72
RMR (Root Mean Square Residual)	0.09	0.10
RMSEA (Root Mean Square Error of Approximation)	0.05	0.06
GFI (Goodness-of-fit Index)	0.62	0.52
CFI (Comparative Fit Index)	0.65	0.43

Table 3 shows the standardized structural parameter estimates of the two models, where each model consists of youngsters and mature group of motorcyclists. All structural path estimates using data of 2010 are found significant and having an expected direction of influence. It means all four hypotheses are found significant and have an expected direction. Different results are found in the estimate using the 2017 dataset. Estimates using this new dataset show that almost all structural path estimates in the youngster group are significant,

while different results are found in mature group. Almost all direction is as expected, while some of them are found different.

Hypothesis 3, i.e. the construct of violations is positively influenced by the construct of influencing factors, is supported for youngsters while it is not the case for the mature group. This construct is positively influenced by only three constructs referred to as external and internal features (Hypothesis 1), namely road environment, vehicle conditions, and attitudes. Negative relation is found for physical condition where it is not significant as well. The three influencing factors are found significant for youngster dataset, while only two are found significant in mature group. In the group of youngster, the construct of violations is positively influenced by two constructs, namely habits and norms (Hypothesis 2). The construct of regulations is found as having negative significant influence in youngster group. In contrast in the group of mature, only the construct of norm is found significant but having negative influence.

Hypothesis 4, i.e. the construct of violations positively influences the construct of the impacts including decisions motorcyclists to make following incidents, is significantly supported in the group of youngster and having positive influence. It is not the case of mature group. It is found negative and not significant. Up to this point, it is found a different result with previous results (Joewono & Susilo, 2015; Joewono et al., 2015; Joewono & Susilo, 2017) during this decade (2010 and 2017). From these results, it shows a strong indication of change of behaviors and attitude of motorcyclists from time to time, as well as between the groups (youngsters and mature). The number of changes in the relation is found more obvious on mature group.

Table 3: Standardized regression weights for unconstrained multigroups model

Relationships between constructs	Data 2010		Data 2017	
	Y	M	Y	M
Violations $\leftarrow$ Influencing factors	0.643 ⁺	0.613 ⁺	0.920 ⁺	-1.005
Regulations $\leftarrow$ Violations	0.543 ⁺	0.519 ⁺	-0.289 ⁺	0.029
Habits $\leftarrow$ Violations	0.927 ⁺	0.949 ⁺	0.307 ⁺	0.642
Impact and Decisions $\leftarrow$ Violations	0.684 ⁺	0.824 ⁺	0.705 ⁺⁺	-0.780
Road environment $\leftarrow$ Influencing factors	0.884 ⁺	0.894 ⁺	0.860 ⁺	0.914 ⁺
Vehicle conditions $\leftarrow$ Influencing factors	0.750 ⁺	0.863 ⁺	0.712 ⁺	0.773 ⁺
Physical conditions $\leftarrow$ Influencing factors	0.669 ⁺	0.861 ⁺	-0.134	-0.079
Attitude $\leftarrow$ Influencing factors	0.908 ⁺	0.962 ⁺	1.032 ⁺	0.966
Norm $\leftarrow$ Violations	0.824 ⁺	0.931 ⁺	0.703 ⁺	-0.561 ⁺⁺⁺

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

⁺p-value <1%; ⁺⁺ p-value <5%; ⁺⁺⁺ p-value <10%

After comparing the two estimates results, it is found a different causal relationship as an indication of change of attitudes. From the previous analysis, it should also be noted the existence of invariance between the group of youngsters and mature motorcyclists. Thus, further investigation will be conducted by exploring the loadings (weights) of each factor as appears in Table 4.

Analysis using data of 2010 shows that all factors are found as significant in explaining the constructs (Joewono & Susilo, 2015), while several attributes change to be insignificant in 2017. For the explaining attributes of the road environment as the reason to violate, it is found one variable becomes insignificant, namely police inspection. All attributes in the factor of vehicle condition do not change its significance, even the weight of influence tends to decrease. It is also the case for attributes of the factor of attitude. One attribute of physical condition as the reason to violate is found to be insignificant in 2017 for youngster group.

While all attributes are significant in both groups for 2010 data, seven and four out of 17 attributes of violations to rules are turning to be insignificant in youngster and mature group for 2017 data, respectively. Three out of four of those attributes are the same for both groups. In the factors of violations related to habit, only three and seven out of 15 attributes are changing to be insignificant in youngster and mature groups, respectively. For the attributes of violations related to norms, all attributes are found stable as significant in both groups and both datasets. In the attributes of impacts and decisions in the event of a breach, only one and two attributes are changing for youngster and mature groups.

Table 4: Regression weights for factors of influencing violation, type of violations and impacts

Factor	2010				2017			
	Youngsters		Matures		Youngsters		Matures	
	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.
Road environment								
Passenger	0.572		0.671		0.445		0.447	
Police inspection	0.469	***	0.553	***	0.115	0.106	-0.052	0.432
Time of day	0.590	***	0.582	***	0.469	***	0.441	***
Weather	0.613	***	0.583	***	0.553	***	0.517	***
Roadside condition	0.623	***	0.680	***	0.455	***	0.523	***
Road sign	0.669	***	0.722	***	0.607	***	0.565	***
Road surface condition	0.688	***	0.750	***	0.458	***	0.478	***
Road geometric	0.718	***	0.782	***	0.396	***	0.296	***
Road width	0.666	***	0.698	***	0.668	***	0.705	***
Traffic condition	0.663	***	0.672	***	0.713	***	0.787	***
Vehicle condition								
Vehicle maintenance	0.733		0.768		0.564		0.486	
Vehicle modifications	0.723	***	0.759	***	0.653	***	0.569	***
Vehicle age	0.747	***	0.828	***	0.375	***	0.419	***
Engine capacity	0.766	***	0.745	***	0.404	***	0.476	***
Physical								
Fatigued	0.762		0.747		0.704		0.813	
Physical ability (e.g. visual acuity)	0.790	***	0.758	***	0.639	***	0.654	***
Intoxicated	0.767	***	0.740	***	0.918	***	0.817	***
Body size	0.497	***	0.641	***	0.047	0.497	0.275	***
Attitude								
Law obedience	0.546		0.734		0.314		0.301	
Environmental awareness	0.515	***	0.707	***	0.465	***	0.398	***
Dress style	0.685	***	0.698	***	0.531	***	0.478	***

Factor	2010				2017			
	Youngsters		Matures		Youngsters		Matures	
	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.
Driving manner	0.790	***	0.775	***	0.673	***	0.728	***
Emotional stress	0.678	***	0.588	***	0.359	***	0.228	0.005
Violations related to road rules								
Not bringing correct document	0.587		0.704		0.673		0.567	
Not wearing regular helmet	0.661	***	0.727	***	0.836	***	0.891	***
Disobeying traffic signs and signals	0.743	***	0.789	***	0.885	***	0.862	***
Stopping beyond stop lines	0.627	***	0.633	***	0.641	***	0.660	***
Illegal crossing at traffic signals	0.393	***	0.372	***	0.010	0.888	0.166	0.011
Using illegal short cuts	0.427	***	0.380	***	-0.046	0.494	0.007	0.919
Not parking in appropriate places	0.294	***	0.331	***	-0.233	***	-0.192	0.003
Illegal contraflow	0.299	***	0.298	***	-0.041	0.545	0.112	0.083
Not installing rear-view mirror	0.623	***	0.736	***	0.534	***	0.405	***
Unstandardized lamp	0.347	***	0.395	***	-0.052	0.444	0.129	0.047
Switching off the turn signal	0.659	***	0.700	***	0.430	***	0.412	***
Switching off headlight during the day	0.144	***	0.300	***	0.357	***	0.441	***
Failure to correctly display registration number plate	0.640	***	0.707	***	0.392	***	0.516	***
Using unstandardized exhaust	0.251	***	0.335	***	-0.077	0.256	-0.031	0.633
Illegal modifying the motorcycle	0.210	***	0.253	***	-0.237	***	-0.043	0.504
Failure to give right of way	0.345	***	0.375	***	-0.055	0.414	0.098	0.129
Overweight loading	0.293	***	0.191	0.001	-0.074	0.272	-0.174	0.008
Violations related to habits								
Overtaking on the wrong side	0.667		0.740		0.753		0.115	
Pushing motorcycle between vehicle lanes	0.723	***	0.746	***	0.823	***	0.185	0.139
Speeding and street racing	0.656	***	0.625	***	0.784	***	0.320	0.100
Riding reckless	0.673	***	0.706	***	0.464	***	-0.051	0.483
Riding slow in in-appropriate lanes	0.373	***	0.428	***	-0.023	0.741	-0.224	0.121
Sudden turning movement without signalling	0.635	***	0.609	***	0.342	***	0.202	0.130
Blocking the road lane	0.653	***	0.771	***	0.318	***	-0.090	0.285
Hearing music while riding	0.365	***	0.536	***	0.382	***	-0.286	0.105
Smoke while riding	0.475	***	0.535	***	0.192	0.006	-0.711	0.084
Making phone while riding	0.485	***	0.560	***	0.207	0.003	-0.460	0.090
Chatting while riding	0.420	***	0.390	***	0.150	0.030	-0.472	0.089
Not wearing safety equipment	0.467	***	0.494	***	-0.050	0.467	-0.684	0.085
Not wearing body equipment	0.431	***	0.418	***	-0.009	0.896	-0.771	0.084
Riding in man bridge	0.315	***	0.349	***	-0.157	0.023	0.087	0.296
Riding in sidewalk	0.574	***	0.617	***	0.176	0.011	-0.464	0.090
Impacts and decisions in the event of breach								
Escape from the location when violate	0.657		0.807		0.227		0.183	
Take a responsibility when violate	0.195	***	0.235	***	0.267	0.015	0.218	0.046

Factor	2010				2017			
	Youngsters		Matures		Youngsters		Matures	
	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.	Std. B.	Sig.
Experience no impact when violate	0.180	***	0.454	***	0.635	0.002	0.608	0.012
Attempted to hit and run	0.738	***	0.715	***	0.171	0.057	0.076	0.322
Arrested by police	0.719	***	0.534	***	0.107	0.182	0.080	0.304
Involved in a crash	0.747	***	0.546	***	0.816	0.002	0.700	0.012
Violations related to norms								
Speeding in residential areas	0.652		0.673		0.510		0.520	
Being inconsiderate to other road users	0.658	***	0.808	***	0.396	***	0.122	0.069
Turning headlight while riding in alley	0.541	***	0.504	***	0.418	***	0.494	***
Turning headlight while entering restricted area	0.467	***	0.423	***	0.658	***	0.754	***
Turning on beam in dense area	0.587	***	0.465	***	0.707	***	0.821	***
Horning in in-appropriate place	0.428	***	0.363	***	0.747	***	0.769	***

*** less than 0.001

4.0 CONCLUSION

Studies about the risky behavior of young motorcyclists become more important in recent decades as the technology and capacity of motorcycle is increasing. With higher capacity, the risk of riding motorcycle may need more attention. Higher capacity means higher fatality risk when it is operated without enough capability as well as suitable attitude and behavior. This fact underlines the need for deeper understanding regarding motorcyclist behavior and attitude, especially young users. The knowledge will be beneficial in developing measures to reduce the risk of accident.

This study tries to investigate whether there is a change of attitude in traffic violations of two groups of motorcyclists, i.e. youngster and mature, using two datasets collected in 2010 and 2017. Using two-panel data, this study contributes to seeding the light into the stability of attitudes of young motorcyclists, especially in developing countries like Indonesia.

Results of analysis found that there is stability in general pattern of the psychological constructs of motorcyclists between the two-decade of observation. Up to this point, this study confirms the validity of the relationships model as has been discussed in previous studies (Joewono & Susilo, 2015; Joewono et al., 2015; Joewono & Susilo, 2017). But, after observing detail relationships among constructs, then it is found the change of causal relationships between the two observations. It emphasized the findings in the literature that violations are not just a human error, but there are reasons to commit, where the decision-makers (in this case is motorcyclist) are in free condition to decide whether to violate or not (Joewono & Susilo, 2015).

The focus point of this study is the change of attitudes of the youngster, as well as mature, motorcyclists, which manifests in the causal relationships among constructs and the explaining attributes of each construct (factor). On one side, this study emphasized previous findings that there is significant difference between younger (younger than 30 years old)

motorcyclists and a more mature group regarding the influencing factors in the involvement in road rule violations. This involvement can be inferred as an indicator of the commitment to take risk. On the other side, this study also found a change of attitude in riding motorcycle, especially in committing to involve in traffic violations. As people will behave not just depends on their personal beliefs, but also as a manifestation to adjust with closest environment. When the road environment and its actors are changing, then individual will also behave accordingly. It is easy to understand, especially for motorcyclist in Indonesian cities, where number of motorcyclists are dominant in many urban roads (more than 70% of road vehicles).

Again, as previous studies (Joewono & Susilo, 2015; Joewono & Susilo, 2017), these findings highlight the need to design specialised behavioural change policies to reduce traffic violations among young motorcyclists. The results of this study emphasized the need to consider the implication of time to motorcyclists. It does mean that the policy should not be assumed road users will behave just the same time to time. It shows the need to regularly observe the impact of each measurement and made an adjustment time to time as well.

This study provides an indication of the change of behaviours as well as attitudes. It means further study is imperative. The investigation of the specific attributes in explaining each construct involved in the model that indicated as changing or stable is the closest further work.

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