Identify factors that caused false and violation by motorcycle rider

Lovely Lady$^{1}$, Teguh Try Mulyo$^{2}$, Kulsum Kumino$^{3}$

$^{1,2,3}$Industrial Engineering Department-Engineering Faculty, University of Sultan Ageng Tirtayasa, Indonesia

*e-mail: lady1971@gmail.com

Abstract. A motorcycle is a vehicle that is widely used by Indonesia community. However, increasing of motorcycle users were not followed by a good driving behaviour, the increasing was directly proportional to increase in the number of traffic accidents. The motorcycle is one of the dominant causes of the traffic accident in Indonesia. This research aims to identify the causes of the deviation and violation in driving that conducted by motorcyclists. The characteristics of driving and the type of deviation committed by motorcyclists collected using Driver Behavior Questionnaire (DBQ). The respondents were motor drivers who have a motorcycle driving license (SIM) in 8 districts in Cilegon. The data processing used the factor analysis method to identify the factors that caused traffic deviation by the motorcyclists. This research find seven factors that caused the deviation and violation by drivers, the dominant factor that explained 16.857 % deviation in riding is lack knowledge of traffic rules. Next factors were vehicle speed exceeds the threshold, the emotions, hasty, careless, not paying attention to the health, and not focus in driving.

1. Introduction

Motorcycles are private vehicles that are widely used by Indonesian people. Based on data from the central Bureau of Statistics (BPS) Indonesia in 2016, the development of the motorcycle rider in Indonesia was very high. The number of motorcycle was 105,150,082 units while the car was 14,580,666 units, truck was 7,063,433 units and bus was 2,486,898 units. Many people choose to ride a motorcycle because it is easy to drive, light and agile so it can easily overtake on the highway, and the price is affordable. However, the increasing of motorcycle rider is not followed by good driving behaviour. The increasing was directly proportional to the increasing of road accidents. Based on data from the Central Bureau of Statistics Indonesia in 2016, motorcycles were one of the factor that caused of high traffic accidents, it is demonstrated by 106,129 total accidents that involving motorcycles versus cars as number 98,021 from total highway accident in 2016.

The traffic accident was the culmination of a series of events, which in its last condition was shortly before the accident was preceded by the failure of the driver in anticipation of his surroundings including himself. Based on data from the World Health Organization (WHO) in 2004, there are three factors causing the traffic accident that endangers individuals. The first factor is human error, the second factor is the vehicle (machine error), and the third factor is the path (manufactured error). Among the three factors, human error is the greatest factor in the occurrence of traffic accidents. Human error is an unnecessary decision by someone that can reduce or potentially reduce the effectiveness, security, or performance of a system. The possibility to make mistakes or human errors
in a job will always exist and cannot be eliminated completely. This is due to human limitations. The occurrence of human error can be influenced by several factors including poor lighting, insufficient exercise or skills, poor machine design, high temperature in the work area, high noise level, no layout appropriate, too narrow distances, poor motivation, unsupportive equipment, poor machine operating and maintenance procedures, the degree of complexity of the work performed, and poor verbal communication. Pulat (1992) also presents several reasons for human errors such as bad behaviour, the provision of work over workers ability, the work stress, workplace and work methods that do not consider the factors of human beings, and the insufficient the training or skills. Human error can be derived from the behaviour of riders or drivers on highways, perception, cross-patterns, driving skills, attention/concentration on highways, social problems, as well as the emotional problems of riders and drivers on the highway.

Unsafe actions are primarily caused of deviant mental processes such as underprivileged, lack of attention, poor motivation, carelessness, neglect and frivolity. System approach on the accidents is known error and human error can be predicted. Mistakes are seen as consequences not as causes [1]. Unsafe actions such as driving over speed limits (traffic speeds of more than 40 km/h) relate to high levels of accidents in Indonesia [2]. There are deviation performed by motorists Indonesia while riding using electronic map, it caused 9.6% human error [3]. Research on truck accidents in America showed interference during driving on the driver increased the chances of involved in a truck crash. The results of other the study also showed that when a truck increased it speed it was more likely to suffer severe injuries even death [4].

Cognitive failure is an error that occurs in a simple task which usually a person does it without mistakes. Statistical analysis show that the average cognitive level significantly contributes to occupational safety. Increased cognitive failures led to an increase in accidents. The score of cognitive failure is correlated with the level of error in driving, but not with the accident that someone suffered [5].

Warren Horison [6] researched drivers behaviour, he obtained the average score of false and violation that made by a person during the driving change between surveys. The research suggested that some aspects of the driver's behaviour change. There were no statistically significant changes of score on the Lapses and Error scales, but the Violation and Aggressive scores increased significantly. Based on Ali Tavakoli Kashani et al. [7] is known the frequent violations that drivers have done were ignored the restricted speed and overtook another ride unconsciously.

With regards to the high level of motorist accident and violation, this research aims to identify irregularities and violations carried out by motorists and identify the causal factors. The Manchester Driver Behaviour Questionnaire (DBQ) used to collect motorcycle rider. DBQ is a self-report questionnaire developed by Reason in 1990 as a measure of aberrant driving behaviours. This questionnaire have used by Matus Sucha [8] in determining factor that affect driver behaviour. Martinussen [9] applied the DBQ in order to assess the problem areas within a driving population in Denmark.

2. Literature Review

Statistically data can be summarized into some significant factors that affect a system. Factor analyzing have used Principal Components Analysis (PCA), this is a tool to extract factors. Data from questionnaires were condensed and summarized into more defined data sets using Principal Components Analysis (PCA). The general purpose of this step was to identify the common factor and explain their relationship to the observed data. Next steps had conduct to interpret Principal Components Analysis (PCA).

1. Conducting assumption tests to make sure that PCA can be used to analyze the data. The tests included: (a) Reliability test was performed and assessed by calculating Cronbach’s alpha, which was a coefficient of reliability (internal consistency); (b) Sampling adequacy Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was used to find out there is no uncertainty due to the prediction of communality problems; (c) Bartlett’s Test of Sphericity,
with this test will get significant of confident base on α. Variables are ready to conduct PCA after pass three tests above.

2. Communalities. This is the proportion of each variable’s variance that can be explained by the factors. Communalities explain how much factor which built can explain the variable. All of variables can be explained by the factors with value more than 0.5.

3. Extraction. Output of the extraction indicated the proportion of each variable’s variance that can be explained by the retained factors. Variables with high values were well represented in the common factor space. However factors will be retained as we requested based on eigenvalue-greater-than-one.

4. Rotated Component Matrix was used to determine the member variable of any factors that are constructed. For ease of interpretation of the factor extracted, the principal components matrix often rotated with goal to achieve a simple structure. Varimax exploratory principal factor analysis method was conducted to assess the underlying structure for the original 29 variables of the questionnaire into small set of construct factors with minimum loss of information.

3. Methods
   3.1 Questionnaire
   Driver Behaviour Questionnaire (DBQ) is a questionnaire used to determine driving behaviour. Questions in the DBQ use a four-level violation approach that covers the error, lapse, ordinary violation and aggressive aspects of violation. The questionnaire was developed by Reason, Manstead, Stradling, Baxter and Campbell (1990) as a tool for assessing deviant driving behaviour. The questionnaire has 28 questions of behavioural items. Respondents were asked to respond to each question by choice a point that appropriate with they behave. Respondents were asked to assess using a Likert scale of six points (1 = never; 2 = hardly ever; 3 = sometimes; 4 = quite often; 5 = often; 6 = most of the time).

   Some aspects that affect the driver/rider behaviour are:
   1. Lapse, it is a mistake that is not apparent when it behaves, associated with loss of concentration when setting the path to be taken to achieve a goal while driving.
   2. Error, it is a distorted behaviour or mistakes made accidentally. According to Reason et al. (Stradling & Meadows, 2001), error is one example of the driver's fault in its execution even though it was previously planned by the driver.
   3. Ordinary Violation, Driver made mistakes deliberately with the intention of law violating. According to Reason (2001) an ordinary violation is a form of behaviour that typically leads to aggressive driving.
   4. Aggressive violation, driver make mistakes deliberately with the intent of breaking the law and can cause harm to other riders.

   3.2 Respondents
   The respondents of this research are motorcyclists in the Cilegon city area and they already have a driver's license. The study uses respondents with aged 17 – 55 years. When the questionnaire be spread to the respondents, the researchers accompanying them to ensure that the respondents can fill the questionnaire without any mistakes and according to the rules given by the researcher. The number of respondents in this study was 100 people. A total of 74 were male respondents and 26 female respondents. Based on the age, a total of 22 respondents were at age of 17-21 years, 31 respondents were at age of 22-24 years, 35 respondents were at age 25-48, 4 respondents were at age of 49-51 years, and 8 respondents were at age of 52-55 years.

   3.3 Location
   This research was conducted in the city of Cilegon, Banten, and the research time was in March-April 2018. The spread of questionnaires was conducted in 8 sub-districts in Cilegon city, they are Cibeber, Jombang, Citangkil, Purwakarta, Ciwandan, Grogol, and Pulomerak

3
3.4 Data Processing

After the dissemination of questionnaires, the first phase of data processing is to identify the type of human error and violations that motorcyclists often do when driving. Then the data will be processed using factor analysis method to get the factors that affect the traffic violation on the motor driver. The following is steps of the data processing using factor analysis method.

1. Formulating correlation matrix, in using method of factor analysis, the first decision to be taken by researchers is analyzing whether the existing data is sufficiently qualified in factor analysis. This first step is done by finding the correlation between the observed indicators.

2. Factor Extracting. The factor extraction is a method used to reduce data from some indicators to produce some factors that can explain the correlation between observed indicators.

3. Rotating. The factor rotation is done in order to obtain a simpler factor structure and to be easily interpreted.

4. Interpreting the factors. Interpreting the factors through knowing the variables that built it. Interpretation have used judgement, because of their subjective characteristic, the result can be different if done by others.

4. Result and Analysis

4.1 Research Variables

The variables in this study were formulated as factors or constructions. Construction is variables formed through the observed dimensions or observed indicators. Questions in the DBQ questionnaire use a four-level violation approach that covers the error, lapse, ordinary violation and aggressive aspect of violation. The four aspects of the offense is spelled out into indicators, and then referred as variables in the questionnaire, outlined in Table 1 as follows.

| No | Aspects     | Indicators                                                                 |
|----|-------------|-----------------------------------------------------------------------------|
| 1  | Error       | a) Ignore the speed when overtaking  
b) Not seeing mirrors before moving  
c) Forgot giving sign  
d) Overtaking another driver  
e) Almost bumped into another vehicle while turning  
f) Unaware of pedestrians  
g) Braking too fast  
h) Wrong turn |
| 2  | Lapse       | a) Drive with wrong gear vehicle  
b) Enter the wrong path  
c) Forget where to park your vehicle  
d) Recognizing mistakes during driving  
e) Powering something else  
f) Wrong reading mark  
g) Can’t remember the way  
h) Crashing during rewind |
| 3  | Ordinary    | a) Ignoring speed on public roads  
b) Riding ahead when traffic lights turning red.  
c) Overtake rider from the left  
d) Drunk driving  
e) Ignoring the speed on highways  
f) Drive close to the car in front |
### Table 1. List of variables in the driver behaviour questionnaire (Continue)

| No | Aspects          | Indicators                                                                 |
|----|------------------|-----------------------------------------------------------------------------|
| 4  | Aggressive       | a) Showing pique by honking                                                |
|    |       | b) Entering the closed track                                               |
|    | Violations      | c) Exit the crossroads                                                     |
|    |                  | d) Angry against other riders/drivers                                      |
|    |                  | e) Chasing other riders in an angry state                                  |
|    |                  | f) Race away from red lights to beat other riders                           |

#### 4.2 Factor analysis

Data from the questionnaire of driving habits and deviations conducted by the respondent then be processed to obtain the factors causing deviations in riding. The stages of factor analysis are as follows:

1. Correlation test and feasibility of variables

This stage has tested the correlation of variables that have been defined using the Barlett test (Bartlett’s Test of Sphericity) and the Kaiser Meyer Olkin Measure of Sampling Adequacy (MSA). The Barlett test and MSA test were conducted to assess the feasibility of a variable that will be processed in factor analysis, the following criteria have used in analyze stage:

   a. Bartlett’s Test of Sphericity

   The Barlett test in factor analysis is to test the correlation between variables because the desired outcome in factor analysis is the presence of a high correlation between variables, has a high correlation if the value of Barlett calculated > Barlett table, or p-value (sig) < α = (0.05) indicates a high correlation between variables and the process can be resumed. The hypothesis for significance is:
   
   Ho = no correlation
   
   H1 = High correlation and sample is adequate for further analysis.

   The criterion for significance is: If the value of sig > α = (0.05) then Ho accepted, sig < α (0.05) then Ho rejected.

   In the first phase, have been collected 50 questionnaires from 50 respondents. This data was calculated to determine whether the data was decent or not. The results of Barlett test using this 50 samples got the value of KMO and Bartlett’s Test of sphericity = 0.280 so that the factor analysis process can’t be extended because it is not eligible because the value of KMO count < KMO table which 0.280 < 0.5. The data that have collected shows they have not correlation so cannot be processed further. Next step we collected 50 more samples, so we had 100 samples to determine the feasibility of data. By using this 100 data we got KMO value and Bartlett’s Test of sphericity = 0.515, so that the factor analysis process can be extended because it had qualified because the value of the KMO calculated > KMO table where 0.515 > 0.5 or significance value (α) < = 0.05. So variables are proven to be correlated and can be further processed.

   b. Measure of Sampling Adequacy (MSA) Test

   An MSA test is a test used to measure the homogeneity of the variables and select variables so that only eligible variables can be processed further. The MSA test is performed several times to release variables that have MSA values below 0.5. Once an MSA-eligible variable is issued one by one then formed a variable that has a loading value of > 0.5. At this stage a seven variables are issued from a questionnaire with a loading value of < 0.5 indicating the homogeneity of the low variable.
2. Grouping Factor

Data from questionnaire was condensed and summarized into more defined data sets using Principal Components Analysis (PCA). The general purpose of this step was to identify the common factor and explain their relationship to the observed data.

Grouping factor is an attempt to group variables to determine whether independent variables can be grouped into one or more factors. Grouping of factors is done by looking at whether to 28 independent variables can be simplified into one or several factors. After removing seven variables that have low homogeneity level in the MSA test, still remaining 21 variables that can be used to form the factor.

Communalities process got the proportion of each variable’s variance that can be explained by the factors. Communalities output explain how much factor which built can explain the variable. All of variables can be explained by the factors with value more than 0.5.

Extraction process was the next step after Communalities stage, output of extraction process indicated the proportion of each variable variance that can be explained by the retained factors. Variables with high values were well represented in the common factor space. However in this research only the first seven factors will be retained as factors that caused riders making false and violence. All the seven factors had an Eigen value more than 1. Output of extraction process is shown in next Table.

| Table 2. Factors output of extraction process |
|---------------------------------------------|
| Factor | Initial Eigenvalues |
|       | Total | Variance (%) | Cumulative (%) |
|-------|-------|--------------|----------------|
| 1     | 3.54  | 16.857       | 16.857         |
| 2     | 2.863 | 13.632       | 30.489         |
| 3     | 2.245 | 10.691       | 41.180         |
| 4     | 1.862 | 8.868        | 50.048         |
| 5     | 1.495 | 7.119        | 57.167         |
| 6     | 1.221 | 5.765        | 62.932         |
| 7     | 1.132 | 5.391        | 68.323         |

On this step we have got the variance of rider false and violation can be explained by seven factors. The factor 1 explained 16.857% of variance, the factor 2 explained 13.632 % of variance, the factor 3 explained 10.691% of variance, the factor 4 explained 8.868%, the factor 5 explained 7.119 %, the factor 6 explained 5.765%, and the factor 7 explained 5.391%. The total of seven factors explained 68.323% variance in rider false and violation. Then factor loading determined each independent variable that fit into one of the 7 construct factors. Rotated Component Matrix was used to determine the member variable of any factors that are constructed.

3. Factor Rotation

The variables that have been extracted than will pass through the rotation process because the placement of the variables are usually not yet precise or there were some variables that have not conform to the factors. The rotation process using Varimax methods have be done on the variables that have passed through the MSA test. The following table figured some factors formed after rotation process. Each factor had some variables as members of the factor. The number in the cross cell between column ‘Factor’ and row ‘Variable’ indicated contribution value of each variable into the factor. All factors formed have some forming variables, its explain in Table 3. The factors are :

- Factor 1 has 5 forming variables
- Factor 2 has 3 forming variables
- Factor 3 has 3 forming variables
- Factor 4 has 2 forming variables
- Factor 5 has 3 forming variables
- Factor 6 has 1 forming variables
Factor 7 has 4 forming variables. Table 3 figured all factors as result of rotation process.

**Table 3. Factors as result of rotation process**

| Variable | Factor | 1  | 2  | 3  | 4  | 5  | 6  | 7  |
|----------|--------|----|----|----|----|----|----|----|
| X1       |        | 0.274 | | | | | | |
| X2       |        |       | 0.87 | | | | | |
| X5       |        |       | 0.845 | | | | | |
| X6       |        |       | 0.678 | | | | | |
| X7       |        |       | 0.699 | | | | | |
| X8       |        | 0.493 |       | | | | | |
| X9       |        |       | 0.338 | | | | | |
| X12      |        | 0.769 |       | | | | | |
| X13      |        |       | 0.259 | | | | | |
| X14      |        | 0.597 |       | | | | | |
| X15      |        |       | 0.829 | | | | | |
| X17      |        | 0.562 |       | | | | | |
| X19      |        | 0.694 |       | | | | | |
| X20      |        |       |       | 0.849 | | | | |
| X21      |        | 0.762 |       | | | | | |
| X23      |        | 0.719 |       | | | | | |
| X24      |        |       | 0.631 | | | | | |
| X25      |        | 0.326 |       | | | | | |
| X26      |        | 0.591 |       | | | | | |
| X27      |        |       |       | | 0.558 | | | |
| X28      |        |       |       | | 0.473 | | | |

The following table lists the factors causing deviation and violation of the motor riders in Indonesia that has been processed through factor analysis. Each factor has been given the name according to its constructor variables.

**Table 4. Factors caused deviation and violation of the motor riders**

| No | Factor                          | Variables                                                                 |
|----|---------------------------------|---------------------------------------------------------------------------|
| 1  | Lack of knowledge of traffic rules | Wrong turn  
Recognizing mistakes during driving  
Wrong riding mark  
Overtake rider from the left  
Exit the crossroads |
| 2  | Emotion                         | Ignoring speed on public roads  
Angry against other riders/drivers  
Race away from red lights to beat other riders |
| 3  | Vehicle speed exceeds safe limit | Ignore the speed when overtaking  
Ignoring the speed on highways  
Showing pigue by honking |
| 4  | Haste                           | Braking too fast  
Entering the closed track |
Table 4. Factors caused deviation and violation of the motor riders

| No | Factor                    | Variables                                                      |
|----|---------------------------|----------------------------------------------------------------|
| 5  | Careless                  | Almost bumped into another vehicle while turning               |
|    |                            | Unaware of pedestrians                                         |
|    |                            | Drive with wrong gear vehicle                                  |
| 6  | No attention to health    | Drunk driving                                                  |
| 7  | Not focus on driving      | Not seeing mirrors before moving                               |
|    |                            | Powering something else                                         |
|    |                            | Can’t remember the way                                          |
|    |                            | Chasing other riders in an angry state                         |

Seven factors formed as caused of deviations and violations by motorists. The first factor ‘Lack of knowledge of traffic rules’ can explain 16.857% of rider false and violation. The cause of this factor is the number of driving licenses that were got in a fraudulent manner by motorist. The drivers got the SIM by paying some money to a person without passing the driving practice test and writing test. They didn’t know about the traffic rules but already have got permit to drive. Many cases like cheating in getting the driving licenses resulted in the drivers did not read the theory about how to driving in highway, they did not understand the order in driving, so as not understand the rules in the cross and resulted in frequent irregularities in the way. This factor can be lowered by increasing the discipline in issue of the licence and removing the cheating in processing and issuing the licence.

Second, Third, and Fourth factor are influenced by the age of rider and culture. They are relatively young rider. There were 53% of respondents below 25 years old. Psychologically young age is still labile and emotional. This factor can be mitigated by enhancing the discipline on the highway and giving strict sanctions to disciplinary offenders. The sanctions rate also needs to be weighed down so that riders don’t easily commit violations.

The fifth and seventh factors caused riders not master the true driving practice and they do not know the rules in driving. This condition is caused the riders did not pass the driving test and the writing test because the driving licence was process fraudulently, so they drove in highway as they were.

5. Conclusion
Processing data of rider behaviour with a factor analysis method acquired seven factors causing deviations and violations committed by the rider. Using factor analysing have got the dominant factor caused deviations and violations is lack of knowledge of traffic rules, that explained 16.857% of violation. Next factors were emotion of rider, speed of vehicle exceeds the threshold, hasty, careless, not paying attention to health, and does not focus in driving.

References
[1] Reason J 2000 Human error: models and management BMJ 320 4–6.
[2] Sulistio H 2018 Effect of traffic flow, proportion of motorcycle, speed, lane width, and the availabilities of median and shoulder on motorcycle accidents at urban roads in indonesia The Open Transportation Journal 12 1–7.
[3] Lady L 2019 Effect of using electronic map while driving on human error probability Proceeding of the International Conference on Industrial Engineering and Operation Management 2019 (IEOM 2019)
[4] Mahdi M, Mashhadi R, Wulff SS, and Ksaibati KA 2018 Comprehensive study of single and multiple truck crashes using The Open Transportation Journal 701 43–56.
[5] Allahyari T, et al 2008 Cognitive failures, driving errors and driving accidents Int. J. Occup. Saf.
Ergon 14 2 149–158.

[6] Harrison, W 2009 Reliability of the driver behaviour questionnaire in a sample of novice drivers Australian Road Safety Research, Policing and Education Conference Sydney

[7] Kashani AT, Ravasani MS, Ayazi E 2016 Analysis of drivers’ behaviour using manchester driver behaviour questionnaire based on roadside interview in Iran International Journal of Transportation Engineering 4 1

[8] Matus Sucha M, Sramkova L, and Risser R 2014 The Manchester driver behaviour questionnaire: self-reports of aberrant behaviour among Czech drivers Eur. Transp. Res. Rev 6 493–502 doi 10.1007/s12544-014-0147-z

[9] Martinussen, Marianne L., Blomqvist H, Liisa, Mette M., Özkan, Türker, Lajunen, Timo 2013 age, gender, mileage and the DBQ: the validity of the driver behaviour questionnaire in different driver groups DTU Library Link to article, DOI:10.1016/j.aap.2012.12.036.