The accident risk of motorcyclist perception and driving behaviour: a case study

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Abstract. A traffic accident is an incident that is unexpected and involves a vehicle with or other road users resulting in human casualties or property losses. Accidents are caused by several factors including environmental factors, vehicle factors, and driver factors. Traffic police noted that in 2017 there were 91,371 traffic accidents caused by driver factors. Bad driving behaviour causes driving distraction which is an important risk factor in traffic accidents. This happens because the driver perceives a risk that is smaller than the actual risk. The purpose of this study was to see the existence of a significant relationship between risk perception and driving behaviour towards the risk of motorcycle accidents (H0). Case study took place in Industrial Engineering Department, Faculty of Engineering, University of Sumatera Utara. Data were collected using research instruments in the form of driving behaviour questionnaires which consists of two indicators namely obedience and pride, risk perception questionnaires which consists of two indicators namely worry and social pressure, and traffic accident risk questionnaires which consists of three indicators namely declaration rate, response to accident, and braking distance. Then a Structural Equation Model (SEM) was made. The results of the Structural Equation Model (SEM) show a significant relationship between risk perception and driving behaviour with a t-value of 1.98. This indicates that worry and social pressures have a significant direct effect on drivers' behaviour.

1. Introduction

Every year there is an increase in the population in Indonesia. An increase in population results in an increase in the number of needs and activities of the community that are synergistic with the increasing need for transportation to meet community needs. Increased activity and transportation needs certainly result in an increased potential for accidents.

Data from the Central Statistics Agency (BPS) states that in 2015 in Indonesia, the number of traffic accidents reached 98.9 thousand cases. This figure increased 3.19 percent compared to the previous year which reached 95.5 thousand cases. The number of traffic accidents in the last 10 years has fluctuated, the highest increase occurred in 2011, which reached 108 thousand cases. In fact, in 2010 there were only 66.5 thousand cases. Whereas the most cases occurred in 2012 with 117.9 thousand cases. This number continues to fluctuate from year to year. This shows that the number of traffic accidents in Indonesia is in dire conditions. [1] The World Health Organization (WHO) states that every year 1.3 million of the 50 million people die in traffic accidents. Accidents are caused by several factors including environmental factors (such as weather, road conditions, traffic), vehicle factors (such as types and conditions), and drivers (such as driver's ability and driver's behaviour). Studies from a number of countries show that the proportion of motorists who use cellphones while driving has increased over the
past 5-10 years, from 1% to 11%. Using a cell phone can cause the driver to look away from the road, hands from the steering wheel, and thoughts from the road and the surrounding situation. This is a type of disorder known as cognitive impairment that has the biggest impact on driving behaviour [2]. Bad driving behaviour causes driving distraction which is an important risk factor in traffic accidents [3]. POLANTAS records that there are around 90,000 accident cases caused by driver behaviour factors. Close distance behaviours, not wearing a helmet, being disorganized, and exceeding the speed limit were the highest contributors with 15,000 to 20,000 accident cases. [4]

According to Zendrive, a mobile software provider company for driving safety, shows that of 10 trips, 9 of them must involve motorists who use cellphones. The data was compiled from 570 trips carried out by 3.1 million motorists in the United States. Another finding that is no less surprising is that, on average, motorists use cellphones for 3.5 minutes on the way. Data from the US National Traffic Safety Agency said, there was an increase in cellphone accidents by 50 percent since 2010 [5].

Ma Ming reported that the driver's attitude towards violating rules and driving vehicles at high speed had a significant impact on driving risky behaviour. [6] Furthermore, two scales of risk perception, namely the possibility of accidents and concern for accidents have significant indirect effects on driving risky behaviour. Strayer [7] further said, driving while having a conversation using a cellphone or handsfree resulted in a doubling of increased failure and a slower reaction to traffic signals. This can cause accidents.

Risk Perception is a subjective assessment of the occurrence of an accident and how much the individual's attention to the consequences [8]. Budiastomo [9] explained that motorists would not make a decision to take an act (behaviour) that was perceived as high risk, even very high so that it would have an impact on the threat of safety. But not infrequently the perception of motorists is wrong. The driver perceives a smaller risk than the actual risk. As a result, motorists make high-risk decisions that can endanger safety. This means that the higher the perceptions of the driver's risk towards a behaviour will make the behaviour has a lower probability of appearing Finn and Barry [10] reptrted that the risk perception of young drivers is lower than old drivers, which causes more even some young drivers have accidents. This is influenced by three factors, among others: (1) Young drivers are more willing to take risks than old drivers, (2) Young drivers fail to consider a dangerous situation as dangerous for old drivers, (3) Combination of these two factors.

In the city of Medan, there are many accidents that occur due to the driver's driving behaviour that is very bad. BPS noted that in 2016 there were 1,574 cases of accidents in the city of Medan with 213 victims died and 832 seriously injured. The formulation of the problem from this study is that there is a presumed significant relationship between risk perception and driving behaviour towards accidents risk which causes high rates of motorcycle traffic accidents in Medan, North Sumatra. Case study took place in Industrial Engineering Department, Faculty of Engineering, Universitas Sumatera Utara.

2. Method
The method will be discussed in 3 subsections, they are subjects, questionnaire, processing and analyse data procedure.

2.1. Subjects
The study analyzes the relationship of risk perceptions to driving behaviour towards the risk of accidents of survey research. This research was conducted in several places related to research topics in Medan City, Sumatra Utara. The research was conducted from February to July 2019. The research subjects were students from the Industrial Engineering Department, Faculty of Engineering, University of Sumatera Utara, 2015-2018 who were active in riding motorbikes as evidenced by having SIM C totaling 215 people aged 16-24 years.

2.2. Questionnaire
The questionnaire used is a likert questionnaire with a rating scale that strongly agree, agree, less agree, disagree, and strongly disagree. Scores given in a row from 5 to 1.
Risk perception can be measured from an indicator of worry taken from one of the scales of risk perception assessment by Rundmo and Iversen [11]. Worries of the driver to an accident arising from how much the driver thinks about the chance of an accident that might occur, and the readiness of the driver and the vehicle used before traveling. Next is social pressure indicators. Aji Setyo [12] explain social pressure can make motorists become impatient and tend to violate traffic rules easily. That is because the driver no longer thinks about the risks. As a result, drivers perceive something at high risk to be low risk. The risk perception questionnaire can be seen in Table 1.

### Table 1. Risk perception questionnaire.

| No. | Risk perception | Strongly Agree | Agree | Less Agree | Disagree | Strongly Disagree |
|-----|-----------------|----------------|-------|------------|----------|------------------|
| Worry: | | | | | | |
| 1. | I am very concerned about the risk of accidents that I will experience every time I drive | | | | | |
| Social Pressure: | | | | | | |
| 2. | Social pressure factors are always my concern for the risk of accidents that I will experience every time I drive | | | | | |

Driving behaviour of motorcyclist can be measured through driving behaviour indicators, namely motorists' obedience to traffic rules (obedience), and behaviour that shows ability to make others proud (pride). POLANTAS records that there are at least 90,000 motorcycle accident cases that occur due to driver behaviour factors. Factors that contribute to the highest number are the distance that is close, not wearing a helmet, not orderly, exceeding the speed limit, and going against the flow. These behaviours are a form of motorist non-compliance with traffic regulations. Sarwono [13] explains that young motorists have not been able to think ahead about the logical consequences of decisions taken. Aully and Ummu [14] explain the dangerous behaviour that is often carried out by young riders such as speeding, wild racing, riding in accordance with the capacity of a motorcycle is an example of behaviour sensation seeking behaviour or can be referred to as behaviour that aims to gain experience new that is thrilling and fun and attracts the admiration of others. The indicators are then compiled into the driving behaviour questionnaire. The driving behaviour questionnaire can be seen in Table 2.

### Table 2. Driving behaviour questionnaire.

| No. | Driving behaviour | Strongly Agree | Agree | Less Agree | Disagree | Strongly Disagree |
|-----|-------------------|----------------|-------|------------|----------|------------------|
| Obedience: | | | | | | |
| 1. | Obedience of traffic regulations has always been my concern | | | | | |
| Pride: | | | | | | |
| 2. | I am always motivated to do driving behaviour that attracts others admiration to me | | | | | |

Accident risk is a danger or consequence that arises from an accident. The risk of accidents can be measured through indicators by Da Costa and Siti Malkhamah [15], they are:

1. Declaration rate
2. Response to accident risk
3. Braking distance

Declaration rate is the ability of the driver to slow down speed as a form of driver control to reduce the possibility of the risk experienced. Response to accident risk is used to measure a driver's reaction
to possible hazards. And braking distance is the ability of the driver to estimate the braking distance just before the danger. The indicators then compiled into the accident risk questionnaire. Accident risk questionnaire can be seen in Table 3.

| No. | Accident risk | Strongly Agree | Agree | Less Agree | Disagree | Strongly Disagree |
|-----|---------------|----------------|-------|------------|----------|------------------|
| 1.  | Declaration rate: | Speed control is always my concern to reduce the risk of accidents |        |            |          |                  |
| 2.  | Response to accident risk: | I always believe that I can respond to danger quickly |        |            |          |                  |
| 3.  | Braking distance: | I am always sure I can estimate the braking distance just before it hits the danger |        |            |          |                  |

2.3. Processing and analyse data procedure
There are 3 steps on processing and analyse the data, they are:
- Statistical test
- Questionnaire result analysis
- Structural Equation Model (SEM) analysis

3. Results and Discussions
The results will be discussed in 3 subsections, they are statistical test, questionnaire results and Structural Equation Model (SEM) result.

3.1. Statistical test
Statistical tests include validity and reliability tests performed on each variable data using Product Moment by Pearson and Alpha Cronbach reliability test by SPSS. The $r_{table}$ value is obtained from Table R (Pearson) where for $n = 215$ respondents with a significance level of $5\%$, $r_{table} = 0.1338$. The results of the validity test by SPSS indicate that the $r_{count}$ of each attribute of risk perception data is greater than $r_{table}$, which are 0.780 and 0.715, therefore the data is said to be valid. While the reliability test results obtained $r_{count}$ of 0.215, which is greater than the $r_{table}$ value. The data indicates reliable.

The results of validity test by SPSS of the driving behaviour data show that the $r_{count}$ value is 0.701 and 0.800. While the reliability test results are 0.233. These values are greater than $r_{table}$ so the driving behaviour data is said to be valid and reliable. The data of accident risk have a validity test results by SPSS are obtained $r_{count}$ of 0.663, 0.564 and 0.681 respectively. While the reliability test results obtained $r_{count}$ of 0.270. These values are greater than $r_{table}$, therefore the accident risk data is said to be valid and reliable.

3.2. Questionnaire result
The results of the risk perception questionnaire are shown in Table 4.
Table 4. Risk perception questionnaire result.

| RP                    | Strongly Agree (5) | Agree (4) | Less Agree (3) | Disagree (2) | Strongly Disagree (1) | Total | Average |
|-----------------------|--------------------|-----------|----------------|--------------|-----------------------|-------|---------|
| Worry                 | 17                 | 92        | 78             | 20           | 8                     | 735   | 3.42    |
| Social pressure       | 0                  | 21        | 95             | 77           | 22                    | 545   | 2.53    |

Total 1280

Based on Table 4, it can be seen that worry has an average of 3 to 4, which is 3.42. This number indicates the level of driver's concern arising from concern and the possibility of accident risk felt by motorists in the medium to high category. This level of concern means that motorists have good risk perceptions. The social pressure factor has an average of 3 to 2, which is 2.53. This figure indicates that the social pressure factor that influences the perception of motorists' risk on accident risk is in the medium to low category. Motorists tend to be able to override social factors so as not to influence the perception of motorists about the risk of accidents while driving. Thus, it can be concluded that perceptions of motorists' risk of accident risk is in the good category.

Table 5. Driving behaviour questionnaire result.

| DB        | Strongly Agree (5) | Agree (4) | Less Agree (3) | Disagree (2) | Strongly Disagree (1) | Total | Average |
|-----------|--------------------|-----------|----------------|--------------|-----------------------|-------|---------|
| Obedience | 0                  | 25        | 87             | 0            | 16                    | 551   | 2.56    |
| Pride     | 12                 | 56        | 72             | 0            | 4                     | 646   | 3.00    |

Total 1197

Based on Table 2, the average of obedience indicator for motorcyclists is in the range of 2 to 3, which is 2.56. This number indicates the level of obedience of motorists to traffic regulations in the medium to low category. This means that motorists still tend to carry out driving behaviour that violates traffic rules such as not obeying signs, not using helmets, driving against the flow, and other violations, while the pride indicator has an average of 3.00 that is in the medium category. This indicates the factor shows the ability to attract the admiration of others such as spurring speed beyond the limit, competing with other vehicles, overtaking other vehicles, and other similar behaviour still in a moderate state. The results of the driving behaviour questionnaire are shown in Table 5.

Table 6. Accident risk questionnaire result.

| AR                    | Strongly Agree (5) | Agree (4) | Less Agree (3) | Disagree (2) | Strongly Disagree (1) | Total | Average |
|-----------------------|--------------------|-----------|----------------|--------------|-----------------------|-------|---------|
| Declaration rate      | 0                  | 0         | 1              | 0            | 0                     | 673   | 3.13    |
| Respond to accident   | 83                 | 10        | 47             | 83           | 10                    | 495   | 2.30    |
| Braking distance      | 78                 | 66        | 74             | 78           | 66                    | 599   | 2.79    |

Total 1767

Based on Table 3, it can be seen that the average of declaration rate is in the range of 3 to 4, which is 3.13. This number indicates the ability of the driver to control speed in order to avoid the risk of accidents in front of him in the medium to high category. This indicator is good for reducing the risk of accidents that can occur. Respond to accident has an average in the range of 2 to 3, which is 2.30. This number indicates the ability of the driver to respond to hazards quickly in the medium to low range. While the ability of the driver to estimate braking distance is in the range of 2 to 3, which is 2.79. This number indicates the ability of the driver to estimate the braking distance shortly before the danger in
the medium to low category. Thus, it can be concluded that the two indicators above adversely affect the risk of accidents that may occur.

3.3. Structural equation model
SEM (structural equation model) is a multivariate analysis technique that allows researchers to test relationships between complex variables. The SEM model was made to see the relationship between perceived risk, driving behaviour, and the risk of accidents. The results of SEM are shown in Figure 1.

**Figure 1. Structural Equation Model (SEM).**

Based on Figure 1 the chi-square value is 4.639 > 0.05 means that the SEM model is fit statistically. The value of the Root Mean Square Error of Approximation (RMSEA) is 0.000 <0.08, which means the model matches the actual model.

Risk perception has a t-value of 1.98 towards driving behaviour which means that the relationship between the two variables is significant because the value is above 1.96. This number indicates that worry and social pressure have a significant direct effect on driving behaviour. The better the risk perception of the driver, the better driving behaviour, and vice versa.

Driving behaviour has a value of 2.87 against accident risk, which means that the relationship between the two variables is significant because the value is above 1.96. This number indicates 2 things. First, obedience and pride have a significant direct effect on the risk of accidents. The driver's obedience to traffic rules and behaviours that show pride (pride) greatly determines the possibility of the risk of an accident that can befall a driver. Second, the perception of risk has a significant indirect effect on the risk of accidents.

Risk perception has a value of -2.62 against accident risk, which means the relationship between the two variables is significant because the value is above 1.96. While the negative sign (-) shows the opposite relationship. If the perception of a driver's risk of an accident is high, then the risk of an accident that might overtake him is low, and vice versa.

4. Conclusions
The conclusions of this research are:
- Risk perception has a significant direct effect on driving behaviour.
• Risk perception has a significant indirect effect on the accidents risk. A negative sign indicates the opposite effect.
• Driving behaviour has a significant direct effect on the accidents risk.

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