The effect of car drivers risk perception and driving behaviour towards accident risk: a case study

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Abstract. A traffic accident is an unexpected and unintentional event on a road involving vehicles with or without other road users resulting in human casualties and/or property losses. Traffic accidents generally occur due to various factors such as the user's inadvertent actions, violations, road conditions, vehicle conditions, weather, and obstructed views. Medan City has a high accident rate of 5,686 cases caused by driver factors. The problem under study is the alleged relationship between risk perception and driving behavior. The purpose of this study is to look at the relationship between driving behavior and risk perception that can cause traffic accidents. Data collected using the instrument in the form of a driving behavior questionnaire and risk perception questionnaire. The analysis is done by statistical analysis through SPSS software to test the validity and reliability of the data, radar map analysis to see the attributes of driving behavior with the highest mode, the analysis of the correlation of driving behavior and risk perception with the SPSS software as a whole, and to analyze the Structural Equation Model path (SEM) to see the partial relationship between variable attributes in a multivariate manner. The results of this study indicate that there is a significant relationship between 3 (three) driving behaviors that are using a cell phone, violating traffic rules, and overtaking other vehicles to the driver's risk perception so that it has the potential to cause a traffic accident and it can be concluded that the hypothesis the researcher accepted (H0).

1. Introduction
A traffic accident is an unexpected and unintentional event on a road involving vehicles with or without other road users resulting in human casualties and/or property losses. Traffic accidents generally occur due to various factors such as the user's inadvertent actions, violations, road conditions, vehicle conditions, weather, and obstructed views. Accidents can occur due to several factors including road conditions, vehicle factors, and driver factors. The rapid development of transportation can lead to the risk of growing traffic problems [1]. Medan City has 5,688 cases of accidents caused by driver factors [2], which can be seen in Figure 1.
Figure 1. Accident case data caused by driving behavior.

In previous studies by Robert Ngueutsa, et al, explains the relationship between driving behavior (driving behavior) and risk perception of the driver. The research method was carried out by distributing questionnaires regarding risk perceptions and driving behavior, then carried out a statistical analysis of reliability using Alpha Cronbach, then testing the risk perception and driver behavior with a linear regression model. Problem-solving carried out in this journal produces a model that shows positive driver risk perception of driver safety behavior [3].

Research by Torbjørn Rundmo, et al, regarding the influence of risk perception and driver behavior for driving safety. The method used is by distributing questionnaires to people who have driving experience, then a statistical analysis is performed using Reliability Cronbach Alpha, then a Structural Equation Model (SEM) path analysis is made to see the relationship between risk perception and driver behavior. The conclusion of this journal is based on the path analysis conducted, that there is a weak relationship between risk perception and driving behavior, this is because the driver already understands the dangers that will occur if a dangerous driving behavior occurs, but the driver continues to do so [4].

Research by Dianne Parker, et al, conducted research related to driving errors, driving violations on involvement in accidents. [5]. Research by Prathurung Hongsranganagon, et al, conducted an investigation of motorists in Thailand related to risk behavior and the driver's perception of risk behavior. [6]. Research by Syed Hasan Nawaz Zaidi, et al, conducted a risk perception study on traffic safety. The method used is the distribution of questionnaires and then analyzed with SPSS Software. The results show that alcohol consumption increases accidents while driving. [7]. Research by Moataz Mohamed, et al, conducted a study of the relationship between the association of accidents, driving behavior, and the driver's personality on traffic safety in Saudi Arabia by creating an SEM model on personality, driving behavior, and accident linkages [8]. Research by Pal Ulleberg, et al, conducted research related of personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers [9]. Research by Ma, Ming, et al, found that driver attitudes toward rule violations and driving high speed vehicles had a significant impact on risky driving behavior. Furthermore, two risk perception scales, namely the likelihood of accidents and awareness of accidents have a significant indirect effect on risk driving behavior [10].

Risk perception is a subjective assessment of the likelihood that an accident will occur and how concerned the drivers with the consequences. The dimensions of risk perception can be seen in the explanation of Table 1.
Table 1. Dimension of risk perception.

| No. | Dimension of Risk Perception |
|-----|-----------------------------|
|     | Dimension 1: Emotion-based risk perception: |
|     | Worry and insecurity |
| 1.  | Feeling unsafe that you yourself could be injured in a traffic accident |
| 2.  | Worried for yourself being injured in a traffic accident |
| 3.  | Feeling unsafe that an adolescent in general could be injured in a traffic accident |
| 4.  | Worried for an adolescent in general could be injured in a traffic accident |
|     | Dimension 2: Cognition-based risk perception: |
|     | Probability assessments |
| 1.  | How probable do you think it is in general for an adolescent to be injured in a traffic accident |
| 2.  | How probable do you think it is for yourself to be injured in a traffic accident |
|     | Dimension 3: Concern |
| 1.  | How concerned are you about traffic risks and are thinking on the risks for an adolescent in general |
| 2.  | How concerned is you about traffic risks and are thinking that you yourself could be victimized |

Based on the reference explanation above, it can be seen that there is a link between driving behavior and risk perception that can cause traffic accidents. In Medan, many accidents occur due to poor driving behavior, for example, the actual cases that occur can be seen in Figure 2 and Figure 3.

**Figure 2.** Driving behavior using handphone.

**Figure 3.** Driving behavior overtake other vehicles.
Based on the problems that have been described above, researchers have a suspicion that there is a relationship between risk perceptions with driving behavior by the driver so that it can cause traffic accidents.

2. Method
Subjects involved in this study were students of the Department of Industrial Engineering, Faculty of Engineering, University of North Sumatra. Subject population numbered around 518 students with an age range 16 until 24 years starting from the batch of 2015 until 2018. The sampling technique used is Quota Sampling. The characteristics of the determined sample are: (1) Car drivers in Medan, (2) Active driving cars, and (3) Having a SIM C, so that the number of research samples are 106 people.

The method arrangement of this research are as follows.

a. Data collected by direct observation.

b. The method of data collection is using risk perception and driving behavior questionnaire, where the answers to each question on the questionnaire using Likert scale.

c. The need for literature studies is used for information other than research that is in the field and from books, journals, or other information.

d. Data Collection
   The data collected for use in this study is as the following:
   1) Primary data is driving distractions data from the results of risk perception and driving behavior questionnaire.
   2) Secondary data is data on traffic accidents caused by driving behavior.

e. Data processing is carried out as follows:
   1) Statistics Test
   2) Correlation driving behavior and risk perception
   3) Path analysis Structural Equation Model (SEM)

f. Analysis and Discussion
   The stages of this research can be seen in Figure 4.

From Figure 4 above, this research stage is still in the first stage, namely the engineering stage.

3. Results and discussions
The results will be discussed in 3 subsections, they are statistics test, correlation driving behavior and risk perception, path analysis Structural Equation Model (SEM).

3.1. Statistics test
3.1.1. Validity test
This validity test was carried out with SPSS software. The result can be seen in Table 2 and Table 3.
Table 2. Validity test driving behaviour.

| Dimension | \( r_{\text{count}} \) | \( r_{\text{table}} \) | Conclusion |
|-----------|----------------|----------------|------------|
| DB\(^a\)  | 0.657          | 0.191          | Valid      |
| DB\(^b\)  | 0.405          | 0.191          | Valid      |
| DB\(^c\)  | 0.513          | 0.191          | Valid      |
| DB\(^d\)  | 0.438          | 0.191          | Valid      |
| DB\(^e\)  | 0.543          | 0.191          | Valid      |
| DB\(^f\)  | 0.493          | 0.191          | Valid      |
| DB\(^g\)  | 0.204          | 0.191          | Valid      |
| DB\(^h\)  | 0.362          | 0.191          | Valid      |
| DB\(^i\)  | 0.449          | 0.191          | Valid      |
| DB\(^j\)  | 0.427          | 0.191          | Valid      |

DB = Driving behaviour
DB\(^a\) = Set the radio while driving
DB\(^b\) = Using a handphone while driving
DB\(^c\) = Eat or drink while driving
DB\(^d\) = Talk to other passengers while driving
DB\(^e\) = Driving over the speed limit (60 km/hr in the city, 80 km/hr between cities, and 100 km/hr on the highway)
DB\(^f\) = Use other electronic devices (other than mobile phones) while driving
DB\(^g\) = Breaking traffic rules (example: running a red light)
DB\(^h\) = Driving when you're drunk
DB\(^i\) = Overtake other vehicles
DB\(^j\) = Do not use a seat belt

Table 3. Validity test risk perception.

| Dimension | \( r_{\text{count}} \) | \( r_{\text{table}} \) | Conclusion |
|-----------|----------------|----------------|------------|
| RP\(^a\)  | 0.716          | 0.191          | Valid      |
| RP\(^b\)  | 0.588          | 0.191          | Valid      |
| RP\(^c\)  | 0.719          | 0.191          | Valid      |
| RP\(^d\)  | 0.552          | 0.191          | Valid      |
| RP\(^e\)  | 0.791          | 0.191          | Valid      |
| RP\(^f\)  | 0.799          | 0.191          | Valid      |
| RP\(^g\)  | 0.219          | 0.191          | Valid      |
| RP\(^h\)  | 0.530          | 0.191          | Valid      |

RP = Risk perception
RP\(^a\) = Feeling insecure if yourself will be injured in a traffic accident
RP\(^b\) = Feeling worried if yourself injured in a traffic accident
RP\(^c\) = An insecure feeling that someone else could be injured in a traffic accident
RP\(^d\) = Feeling worried if someone else will get hurt in a traffic accident
RP\(^e\) = Is it possible if you yourself will be involved in a traffic accident
RP\(^f\) = Is it possible if you yourself will be injured in a traffic accident
RP\(^g\) = Do you care about the risk of traffic that will happen to yourself
RP\(^h\) = Do you care about the risk of traffic that will occur to others

3.1.2. Reliability test

This reliability test was carried out with SPSS software. Alpha Cronbach Reliability Test is done by using the Alpha Cronbach method with the \( r_{\text{table}} \) value used is = 0.191 (based on the product-moment table). For \( n = 106 \). Based on the SPSS results if the calculated value > \( r_{\text{table}} \), the driving behavior
questionnaire is said to be reliable. If the calculated value < $r_{table}$, then the driving behavior questionnaire is said to be unreliable. To see the results can be seen in Table 4 and Table 5.

**Table 4. Reliability test driving behaviour.**

| Reliability Statistics | Cronbach's Alpha | N of Items |
|------------------------|------------------|------------|
|                        | 0.551            | 10         |

Based on the SPSS results above the calculated value (0.551) > $r_{table}$ (0.191), the driving behavior questionnaire is said to be reliable.

**Table 5. Reliability test risk perception.**

| Reliability Statistics | Cronbach's Alpha | N of Items |
|------------------------|------------------|------------|
|                        | 0.775            | 8          |

Based on the SPSS results above the calculated value (0.775) > $r_{table}$ (0.191), the risk perception questionnaire is said to be reliable.

3.2. Correlation driving behaviour and risk perception

$r$ correlation test can be done with the weight of both variables using Software SPSS. For the results of the $r$ correlation test can be seen in Table 6.

**Table 6. Correlation test driving behaviour and risk perception.**

| Correlations | Driving Behavior | Risk Perception |
|--------------|------------------|-----------------|
| Driving behaviour | Pearson Correlation: 1 | -0.118 |
| Sig. (2-tailed) | 0.227 |
| N | 106 | 106 |
| Risk perception | Pearson Correlation: -0.118 | 1 |
| Sig. (2-tailed) | 0.227 |
| N | 106 | 106 |

From table 6 above can be seen the correlation between the Driving Behavior Dimensions with Risk Perception yields -0.118. This number means that both variables have a weak correlation because it is below 0.5. A negative sign (-) indicates the opposite relationship, if driving behavior is high, the risk perception is low, and vice versa. Probability value of Driving Behavior with Risk Perception 0.227 > 0.05 then there is no significant correlation.

3.3. Path analysis Structural Equation Model (SEM)

Structural Equation Model (SEM) can be made using LISREL Software. Making the SEM pathway is done to see the alleged (hypothesis) research, namely:
H0 = There is a significant relationship between risk perception with driving behavior towards traffic accidents
H1 = There is no significant relationship between risk perception and driving behavior towards traffic accidents

The results of the Structural Equation Model (SEM) can be seen in Figure 5.

Figure 5. Path analysis Structural Equation Model (SEM).

Figure 5. shows that the risk perception dimension does not significantly influence traffic accidents because the t-value is below 0.196, this means that the driver does not care if a traffic accident affects him while driving, because the perception of the car driver thinks that because of the level of safety the car is higher than the motorcycle. But if he was hit by an accident, then the driver will be more concerned and careful with the behavior he does when driving the car, the result from path analysis Structural Equation Model (SEM) can be seen in table 7.

Table 7. Recapitulation of SEM path t-value values.

| Dimension | t-value (λ) | z-value | Conclusion          |
|-----------|-------------|---------|---------------------|
| DB1       | 0.51        | 0.196   | Not significant     |
| DB2       | 3.35        | 0.196   | Significant         |
| DB3       | 1.50        | 0.196   | Not significant     |
| DB4       | 2.32        | 0.196   | Significant         |
| DB5       | 1.81        | 0.196   | Not significant     |
Based on Table 7 DB2, DB7, and DB9 driving behavior that is using a handphone, violating traffic rules, and overtaking other vehicles has the greatest t-value from the other DB dimensions, namely regulating the radio while driving, eating or drinking, talking to other passengers, driving over the limit speed, using other electronic devices, driving while drunk, and not using a seat belt with t-values of 3.35, 3.38, and 3.42, respectively. T-value > 1.96, this indicates that there is an indirect significant relationship between risk perception with driving behavior that can cause accidents, based on these parameters explain that the hypothesis (H₀) is accepted.

4. Conclusions
1. Based on the results of the correlation test dimensions of driving behavior and risk perception obtained a relationship between the two including the weak correlation, but the relationship is opposite, if driving behavior is high then the driver's risk perception is low, and vice versa.
2. Based on SEM path analysis, it is found that hypothesis (H₀) is accepted, because there is a significant relationship between driving behavior and risk perception of traffic accidents.

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