Models of Driving Behavior and Personality on Toll Roads

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Abstract

Belmera Toll Road (Belawan Medan Tanjung Morawa) is one of the toll roads in North Sumatra. Accidents on the Belmera toll road still occur frequently. The number of accidents in 2018-2022 involved single accident types with details of 120 single accident cases (63.16%), hitting fixed objects 48 cases (25.26%), hitting obstacles 1 case (0.53%), and hitting other vehicles 20 cases (10.52%). Accident-causing variables continue to be found along with the rapid research. The driving behavior and personality model is a model that continues to be developed. In this study, a driving behavior and personality model was developed using the associative research method, namely research that has a problem formulation regarding the relationship between two or more variables with a causal relationship. The development of the model obtained is that driving behavior has a significant relationship indicator to accidents, where the most influential indicators are fatigue, driving violations, and deviant behavior, which are respectively valued at 0.919, 0.867, and 0.861, while driving personality has an indicator with a significant relationship to accidents. The highest r value is an independent attitude with a value of r = 0.839, an indicator of the level of aggression with a value of r = 0.784, and anxiety with a value of r = 0.707. Driving behavior and personality are proven to have an influence on accidents. The results of the study are the development of a model that shows the relationship between driving behavior and personality to accidents. Indicators of driving behavior are deviant behavior, driving violations, alcohol users, driving speed, and fatigue. Likewise, for indicators of driving personality, there are indicators namely independent attitude, anxiety, level of aggression, personality traits, use of mobile phones, driving knowledge, and driving style. The relationship between these indicators is a novelty from the research conducted.

Keywords: driving personality, driving behaviour, kecelakaan di jalan tol, driving behaviour model, development of driving behaviour model, human error.

According to Law of the Republic of Indonesia Article 1 No. 22 of 2009, an accident is an unexpected and unintentional event that occurs on the road (Republic of Indonesia, 2009). The number of accidents on toll roads continues to increase every year; this is due to the imbalance between regulations and practices in society.

The policies and regulations have been regulated as in Law No. 22/2009 concerning LLAJ, PP No. 30/2021 concerning the implementation of LLAJ, PP No. 37/2017 concerning LLAJ safety, Presidential Instruction

No. 4/2013 on the decade of road safety action, Permenhub No. 26/2015 on LLAJ safety standards, Pergubsu No. 15/2019 on RAK-LLAJ in North Sumatra Province, and DoA for Road Safety 2010-2020.

The Belmera Toll Road (Belawan-Medan-Tanjung Morawa) is one of the toll roads in North Sumatra, where PT Jasa Marga is one of the companies that manages and is responsible for activities on the Belmera toll road. Accidents on the Belmera toll road still occur frequently, where the number of accidents seen from the type of accident from 2018-2022 is known that the highest is the type of single accident with the accident itself, a total of 120 accident cases amounting to 63.16%, 48 cases of accidents hitting fixed objects (25.26%), 1 case of obstacle collision (0.53%), the remaining 20 cases of multiple accidents, namely pile-ups (10.52%) and 1 case of front-side collision (0.53%), with a total of 190 cases of accidents (PT Jasa Marga Belmera Branch).

The highest factor causing accidents is the human factor, namely 128 cases. According to the results of research in Indonesia, there are three factors causing accidents on toll roads. The first factor is humans (human error), the second factor is vehicles (machine error), and the third factor is the road and environment (road and environment error). Among the three factors, human error is the highest factor in accidents [1], [2].

Human error can be defined as an inappropriate human decision or behavior that reduces or has the potential to reduce the effectiveness, safety, or performance of a system [3], [4], [5], [6], [7], [8] Several accidents on toll roads can be seen in Figure 1.

Figure 1. Several accidents on toll roads

Literature Review

The cause of the incident was human error, which is classified as driving behavior, which is the cause of the accident, in his research reporting that more than 95% of accidents can be attributed to driving behavior factors [9], [10], [11], [12].

Driving behavior is defined as a form of driver response due to external or internal influences of the driver while driving [5], [13]. This driving behavior model has been developed, and the results of a comprehensive meta-analysis related to its relationship with accidents (measured by the DBQ (Driver Behavior Questionnaire)) show that there is a relationship between driving behavior and accidents that has a correlation value of $r = 0.13$, namely the presence of driving violations that have a positive relationship with accidents [12], [14], [15].

The relationship between driving behavior and the causes of accidents needs to be considered in research, thus raising the question of how are the indicators of driving behavior related to accidents on toll roads? Driving personality is a person's style or behavior when driving a vehicle. This reflects the driver's attitudes, habits, and emotional responses while on the road. Basically, there are five major dimensions of personality, namely openness, conscientiousness, extraversion, agreeableness, and neuroticism. These dimensions show that

personality has a significant relationship with driving behavior that can cause accidents, with a correlation value of 0.3 indicating a statistical relationship [16], [17], [18].

Literature Model of driving behavior and personality theory

Several studies have been conducted related to the development of driver behavior models to evaluate the influence of variables such as driving personality. The complete development of the research model can be seen in Table 1.

Table 1. Development of a Driving Behavior and Personality Model

Author	Nama Model
Taylor (1964)	Drivers'galvanic skin responses and the risk of accidents
Naatanen and Summalas, H (1974)	Zero-Risk Model
Ajzen and Fishbeins'(1980)	Theory of Reasoned Action
Wilde's (1982)	Theory of Risk Homeostasis
Fuller (1984)	Driver behaviour as threat avoidance
Evan's (1985)	The role of feedback
Ajzen's (1985)	Theory of Planned Behaviour
Rothengatter (1988)	Motivational approach to modelling: The role of pleasure, Risk and the absence of pleasure
Michon (1989)	Production-rule models/Rule-based models" "Explanatory pitfalls and rule-based models"
Shinar, D (2017)	Personality and Behavior Models

Source: Journal data

In Table 1, the development of the driving behavior model, the Drivers' Galvanic Skin Responses and the Risk of Accident Model, discusses the assessment of the driver's personality, namely the driver's emotional state, associated with the driver's behavior, Taylor said that a relationship was found between behavior and driving personality with environmental factors, namely road conditions and the driver's actions on the road, namely how to drive well and correctly. The driver's emotional state affects the response to the reaction of driving conditions when driving, especially when stopping/braking [19].

From the studied driving behavior and personality models, this study examines

incidents that demonstrate a relationship between the local environment, driving behavior, and demographics that affect risk perception and highway accidents. It is possible to improve driver behavior to learn more about an individual's traits, perception of risk, and involvement in collisions. The findings indicate that the primary causes of accidents are human factors, specifically failing to maintain a safe distance. Using the analyzed data, one may forecast the likelihood of accidents depending on individual characteristics like age, driving experience, personality, and driving style [2], [5], [20], [21].

Several indicators used to measure driving personality are taken from previous research, namely:

a.   Independence attitude, which is related to accidents, where this independence attitude is the tendency of a person to act independently, making their own decisions regarding their behavior on the road [17].

b.   The effect of anxiety has a significant relationship with the causes of accidents; anxiety has a positive relationship with accidents and can also cause accidents [10].

c.   This aggressive behavior tends to lead to several dangerous actions such as speeding, overtaking, driving in an emotional state, ignoring signs and other warnings, and performing dangerous maneuvers [18], [22], [23].

d.   Personality traits with driving behavior and accident risk. Personality traits while driving reflect the psychological characteristics of individuals that influence their behavior on the road, such as overconfidence, a tendency to try new things, anxiety, anger, and emotions [24].

e.   The use of mobile phones while driving has been studied, where the variable of mobile phone use is considered a severe form of distraction while driving. This research identifies the extent to which mobile phone use while driving is considered distracting for drivers [25], [26].

f. Knowledge of driving, related to accidents on highways, is a complex topic and has been the subject of various studies. The correlation will be negative if driving knowledge increases, which reduces the risk of accidents [27].

g. Driving style is related to the causes of accidents. Driving style has several dangerous behavior patterns such as aggressive, reckless, hurried, emotional, tired, and insecure driving [16], [28].

These studies show the relationship between driving personality and the causes of driving accidents. The differences in several research results have various outcomes with indicators that have the highest correlation related to driving accidents, and these indicators differ from the findings of different researchers.

Methodology

This research is associative research, namely research that has a problem formulation that asks about the relationship between two or more variables with a form of causal relationship, namely cause and effect, so that in this research there are independent variables (variables that influence) and dependent variables (influenced) [29], [30].

Knowing the level of relationship between several indicators of driving behavior variables is important. Knowing how strong the relationship between indicators is will help researchers prepare further research. The indicators found are the development of existing models of driving behavior variables in accordance with the hypothesis analysis obtained [31], [32], [33].

Conceptual Development Model

This study uses a conceptual model, which is a model that defines certain factors that have an impact on a target research condition developed from various previous studies and analyzes the results of previously obtained research according to driving behavior and driving personality. The relationship between behavior, personality and causes of accidents has been conducted and has

a positive relationship with a value of r1 = 0.29 and r2=0,50, according to Figure 2. Research concept proposal model
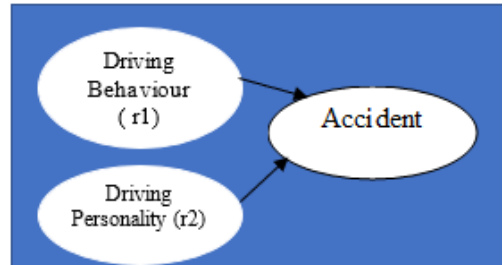

Figure 2. Research concept proposal model

The driving behavior model is a framework that can be used to identify indicators that cause accidents. Research conceptual framework seen in Figure 3.
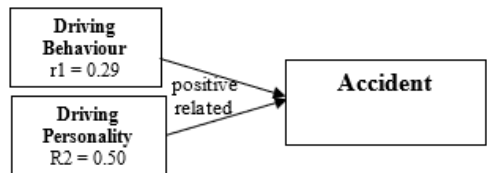

Figure 3. Research conceptual framework

The conceptual framework in which independent variables of driving personality and driving behavior affect the causes of driving accidents is shown in Figure 3 [34], [35], [36], [37], [38], [39].

There are two variables that influence the occurrence of accidents, namely driving behavior and driving personality. The driving behavior variable was taken from previous research, which has a significant relationship with the occurrence of accidents (r = 0.290). Increasing positive driving behavior is a factor to consider in relation to driving accidents [34][40]. Driving personality also has a positive value related to accidents, r = 0.50.

Driving Behaviour And Personality Model

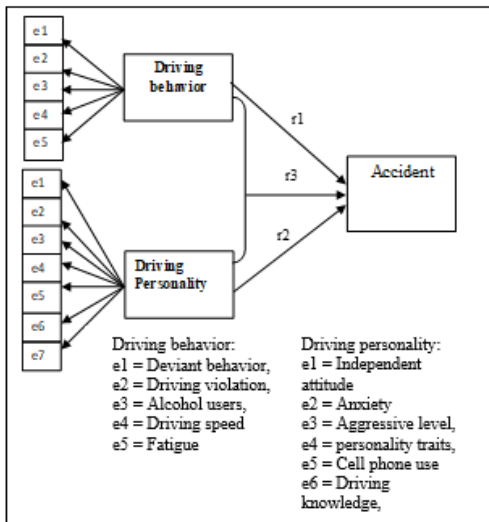The development of the research model can be seen in Figure 4.

Figure 4. The development of the research model

Results And Discussion

The results of the initial data collection of the questionnaire distribution for the driving behavior variable with results based on the r product moment table for 30 respondents with degrees of freedom (dk = 30), with a confidence level of 95% with an r value of 0.349 at a significance of $\alpha = 0.05$ (Two Tail) [23]. Validity is carried out for the accuracy of a measuring instrument in carrying out its measurement function. In this study, manual validity calculations were not carried out, and the calculations were carried out entirely with the SPSS version 26 program [25]. Table 1 is a summary of the validity test carried out.

Table 1. The validity test carried out.

Variabel	Indicator	r-count	r-table	summary
Driving	X_{11}	0,544	0,349	Valid
Behavior	X_{12}	0,968	0,349	Valid
(X_1)	X_{13}	0,719	0,349	Valid
	X_{14}	0,974	0,349	Valid
	X_{15}	0,974	0,349	Valid
	X_{16}	0,974	0,349	Valid
	X_{17}	0,468	0,349	Valid
	X_{18}	0,968	0,349	Valid
	X_{19}	0,719	0,349	Valid

	X_{110}	0,974	0,349	Valid
	X_{111}	0,974	0,349	Valid
	X_{112}	0,974	0,349	Valid
	X_{113}	0,645	0,349	Valid
	X_{114}	0,968	0,349	Valid
	X_{115}	0,974	0,349	Valid
	X_{116}	0,968	0,349	Valid
	X_{117}	0,719	0,349	Valid
	X_{118}	0,974	0,349	Valid
	X_{119}	0,974	0,349	Valid

Source: Data Processing (2024)

Based on the results of the validity of the questionnaire, the overall data is declared valid, and can be continued with further data collection, with the results of r count > r table which can be seen in Table 2.

Table 2. Reliability Test

Construct	Cronbach's Alpha	Description
- Driving Behaviour	0,736	Reliabel
- Accident	0,762	Reliabel

Hypothesis testing is carried out to verify the assumption, namely to test whether the initial assumption or assumption (hypothesis) made by the researcher is true or false based on evidence from the sample. The result of the calculation of the r value with N = 94 is 0.201, for which several hypotheses can be obtained, namely: Hypothesis test of driving behavior towards accidents

Hypothesis H0: There is a positive and significant relationship between driving behavior and accidents. Hypothesis H1: There is no positive and significant relationship between driving behavior and accidents. Hypothesis Results: The calculation results obtained that r = 0.714> r = 0.201, so the hypothesis is accepted, and it is proven that driving behavior and accidents have a significant relationship.

The development of the model based on the indicators obtained has a positive relationship value, where the value is obtained from statistical calculations using SPSS 26. The results show that there is a positive and significant

relationship between the indicators of driving behavior and personality and accidents.

These findings showed that, with a relatively little value of 0.091 the indicator of alcohol consumption had an impact on driving behavior. With positive values of 0.986 0.967, and 0.951, driving behavior, driving speed, and deviant behavior are the factors that have the greatest influence.

Conclusion

The most influencing indicators of driving behavior toward accidents are deviant behavior, driving speed, and driving violations. These three components have positive relationships with values of 0.986, 0.967, and 0.951. One indication does have some bearing, but it has a very weak association; specifically, the indicator of alcohol consumption and its impact on driving behavior has a very low value of 0.091.

Novelty

The new aspect of this research lies in the model that illustrates the correlation between driving behavior and accidents. Each variable has indications that indicate its significance and impact on the likelihood of driving accidents. Deviant behavior, moving offenses, drinking and driving, speeding, and exhaustion are some of the signs of driving behavior.

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