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Evaluation of Driver Behavior when Crossing Unsignalized Intersection from Minor Road to Major Road

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Abstract

An example of aggressive driving behavior is the driver who immediately commits a violation when passing through an unsignalized intersection. Aggressive driving behavior may endanger other road users. Numerous studies have demonstrated that lowering aggressive driving behavior should lower the number of fatal and serious traffic accidents. Therefore, it is crucial to concentrate on the significance of driver behavior, especially at unsignalized intersections. The purpose of this study was to investigate drivers' understanding of appropriate behavior when crossing an unsignalized intersection from a minor road to a major road, to investigate the reasons for driver violations at such intersections, and to determine the relationship between cognitive and affective factors and drivers' behavior at such intersections. This study used observation, questionnaires, and interviews as the primary data-gathering methods. While the findings of the interviews were processed using Milles Huberman's theory, the questionnaire data were examined using multiple linear regression. The study's findings suggest that most drivers understand appropriate behavior while maneuvering from a minor to a major road; however, observational data reveals that 46.38% of drivers do not act on their understanding. Additionally, the driver's actions, such as feeling safe and being too indolent to stop the car, contributed to the infraction. The analysis's results also show that cognitive and affective elements favorably influence drivers' decisions at unsignalized intersections.

Keywords: *Driver Behavior, Unsignalized Intersection, Crossing, Minor Road, Major Road*

INTRODUCTION

A variety of factors contribute to traffic accidents, the most common of which is human error, followed by road conditions, vehicle conditions, weather, or obstructed views. According to studies, there is a strong direct relationship between driver behavior and accidents. Following other vehicles, breaking through traffic lights, violating stop signs, and speeding are all examples of aggressive driving (Abojaradeh, 2015). Humans cause accidents due to physical factors such as fitness, psychological factors such as driving while exhausted, sleepy, or careless, and the influence of alcohol on driving ability (Tahir, 2006). The most lethal factor is human error, which includes disregard for traffic regulations, a lack of knowledge of road conditions, a lack of driving skills, poor awareness, and an inability to react to and adjust to varying road conditions (Christie, 2010). Accidents may also occur due to traffic congestion caused by traffic conflicts on roads or unsignalized intersections (Firdausi et al., 2021).

Semarang City had 939 traffic accidents in 2020, with material losses totaling 427,950,000, the highest loss among Central Java cities. Between 2018 and 2020, traffic accidents in Semarang City killed 503, seriously injured 8, and lightly injured 3,059 citizens (BPS, 2020). In a study based on 28 statements from Driver Behavior Questionnaire (DBQ), beeping the horn, overtaking vehicles

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from the left, and not recognizing the road were the top three behaviors of teenage drivers in Semarang City. According to the study, teenage drivers will exit quickly for other drivers to yield when approaching an intersection leading to a major road. (Suwarto et al., 2019).

Previous research has revealed numerous transgressions of driver behavior that can cause accidents when crossing intersections from a minor road to a major road. As a result, the purpose of this research is to assess drivers' understanding of the procedures for crossing an unsignalized intersection from a minor road to a major road, as well as to investigate the causes of driver violations when crossing an unsignalized intersection and to correlate cognitive and affective factors to driver behavior at an unsignalized intersection.

LITERATURE REVIEW

The theory of reasoned action explains how attitudes and behaviors interact in human action—individual, social, and informational backgrounds all impact the factors that cause behavior. Both internal and external factors influence behavior-related factors. Personality, religion, age, gender, mood, emotions, self-worth, general attitudes, perceived risk, and past behavior are examples of internal/individual factors. In contrast, income, culture, knowledge, media, and socio-cultural factors are examples of external factors (Fishbein & Ajzen, 2009). Figure 1 illustrates these elements.

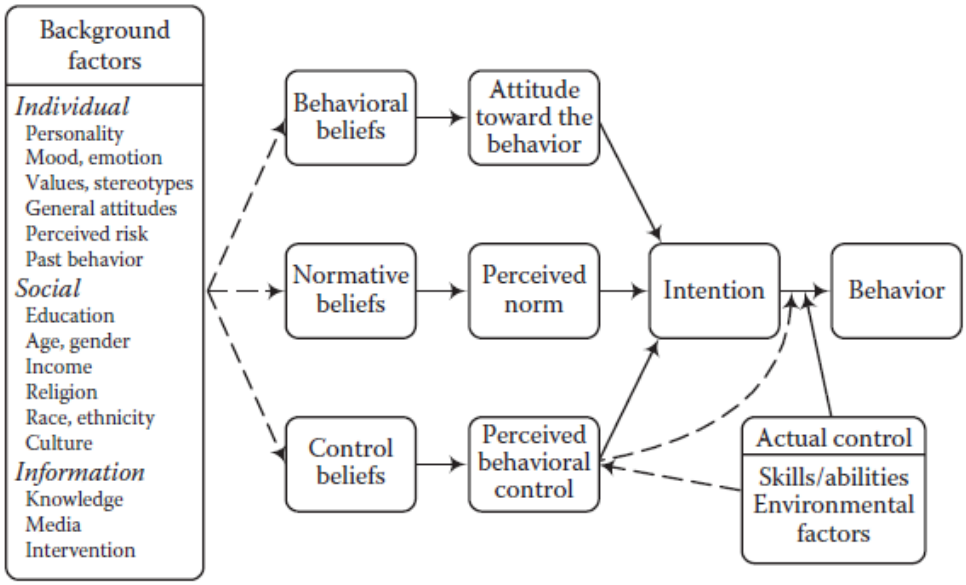

Figure 1. Reasoned Action Scheme (Fishbein & Ajzen, 2009)

The scheme in Figure 1 shows that a person's intention to perform an act is the most important factor in determining whether a behavior is performed. Furthermore, behavioral beliefs, normative beliefs, and control beliefs affect whether a person engages in the behavior. The intention to engage in a particular behavior stems from a belief that doing so will result in a specific outcome. When people determine their intentions, they are also influenced by actual control factors such as self-skills and environmental factors. This theory will be a foundation for understanding the factors influencing driver behavior when crossing intersections from small to large roads.

Incorrect driver behavior at unsignalized intersections can impact vehicles on main roads and interfere with efficiency and safety (Zhang et al., 2016). A recent study using the Driver Behavior Questionnaire (DBQ) discovered that road users' personal characteristics and driving experience significantly influence offense, fault, and ignorance (Gupta et al., 2021). Farooq et al. (2020) examine driver behavior in various countries using the Fuzzy Analytic Hierarchy Process (FAHP), concluding that violations are the most significant driver behavior in Turkey, Pakistan, and China. According to an analysis of driver behavior at intersections in India, 57% of drivers violate red lights (Ingale et al., 2020). A study in Indonesia discovered that adolescent drivers' fear perception could not necessarily reduce error rates but could reduce the driver's intention to commit traffic violations (Suwarto et al., 2019). All these studies demonstrate that questionnaires can be used to examine driver behavior. Gupta et al. (2021) proposes that qualitative studies be used in future research to understand drivers' thoughts and motivations better. As a result, field observation, questionnaires, and interviews will be used in this study to obtain an in-depth analysis of driver behavior in Indonesia. The multiple linear regression method will examine the impact of education, age, gender, work type, and cognitive and affective knowledge on driver behavior. To conclude the study, the triangulation method will be used to obtain driver behavior matrix data.

RESEARCH METHOD

A. Location of Study

The research was carried out at Alam Asri and Klipang Raya intersection in Semarang, Indonesia. Alam Asri is a minor road, and Klipang Raya is a major road. This study observed all users who passed through the Alam Asri - Klipang Raya intersection.

B. Data Collection

This study's primary data collection methods were observation, questionnaires, and interviews. Observations are made during peak hours by looking at the type of vehicle used, whether or not the driver is wearing driving gear, and the driver's behavior. A questionnaire method was used to collect road user knowledge and demographic data. A total of 100 road users were given questionnaires. The slovin formula was used to calculate the number of samples for a population of 10,789 total vehicle owners in Semarang's Tembalang sub-district. In addition, interviews were conducted to examine drivers' understanding of traffic behavior when transitioning from a minor road to a major one at an unsignalized intersection, as well as the causes of violations. The sampling technique employed is a non-probability sampling of the accidental variety. The number of samples is five people based on the characteristics or range of demographic status.

C. Data Processing and Analysis

Data collection and analysis were conducted using Miles and Huberman's interactive method. Miles and Huberman's interactive model analysis consists of four steps: data collection, data reduction, data presentation, and conclusion (Sales, 2016). The questionnaire instrument was tested for validity and reliability in the questionnaire approach. Before distributing the questionnaire to a predetermined sample, the

questionnaire was tested for validity and reliability on a smaller sample. This test was repeated twice. Table 1 and Table 2 show the questionnaire and variable blueprints.

Table 1. Blueprint of the questionnaire

Variable	Number of Questionnaires		Total
	Favorable	***Unfavorable***	
Cognitive	1,2		**2**
Behavior	3,4,6,8	5	**5**
Affective	11	7,9,10	**4**
Total	**9**	**2**	**11**

Table 2. Variable Rubric

Objective	Data analysis	Variable			Explanation
		Dependent	**Independent**	**Controlled**	
Cognitive and affective relationship to driver behavior	Multiple linear regression	Driver Behavior	Cognitive	Age	Driver behavior was obtained from 5 items in the questionnaire, cognitive indicators from 2 items, affective indicators from 4 items, and indicators from control variables from 4 statements in the questionnaire.
			Affective	Gender	
				Type of work	
				Level of education	

Descriptive statistics and multiple linear regression were used to analyze the driver's behavior, with the multiple linear regression having to pass the classical assumption test. Normality, heteroscedasticity, multicollinearity, and autocorrelation tests are classical assumption tests. Following the receipt of the results, triangulation is performed to double-check research findings to determine whether the data obtained accurately describes the phenomenon in a study (Bachri, 2010). The driver's knowledge and behavior, such as reducing speed, stopping the vehicle, paying attention to major roads, and immediately merging and not paying attention to the situation, will be triangulated.

FINDINGS AND DISCUSSION

A. Observation Approach

In this approach, the researcher observed the driving behavior that crossed the Alam Asri Road to Klipang Raya. Observations were conducted during two peak hours, yielding the results in Table 3.

Table 3. Comparison of observation result

Statement	Peak Hour 1		Peak Hour 2	
	Motorcycle		Motorcycle	
	Using driving gear	Not using driving gear	Using driving gear	Not using driving gear
X1	73	38	37	40
X2	59	27	47	34
X3	2	5	2	1
Total	134	70	86	75
	Car		Car	
X4	1		4	
X5	16		9	
Total	17		13	

whereas:

X1: Paying attention to major roads and slowing down

X2: Not paying attention at all

X3: Stop the vehicle and pay attention to major roads

X4: Stop

X5: Reduce speed

Figure 2 depicts the percentage of motorcyclist behavior when approaching a major road. The difference between the correct behavior (looking right and left) and the incorrect behavior (driving without paying attention) is not significant. The most appropriate behavior (stop and look) has the lowest percentage. It could be argued that a large number of drivers disregard road safety.

B. Interview Approach

Drivers' understanding of traffic behavior at unsignalized intersections, and the causes of violations were investigated through interviews. As shown in Figure 2, the researcher conducted interviews to produce a summary of the themes or words frequently spoken by the interviewees.

According to the interview results, the resource person understands how to behave when crossing an unsignalized intersection, such as being cautious, looking right and left, and stopping the vehicle. However, the interviewees felt that other drivers were not cautious, which made them angry and fearful.

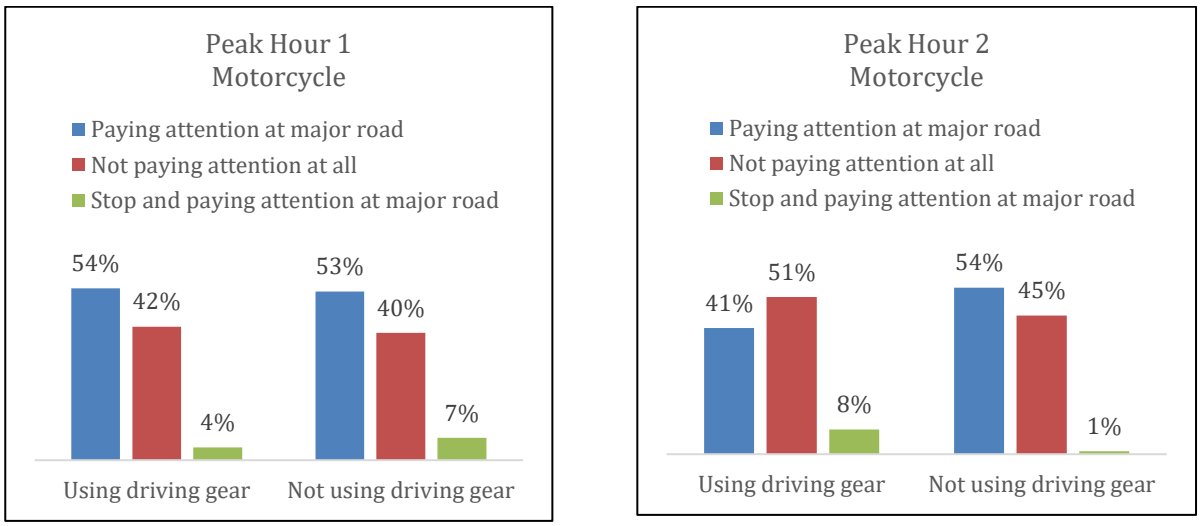

Figure 2. Comparison of driver behavior when maneuvering from minor to major road

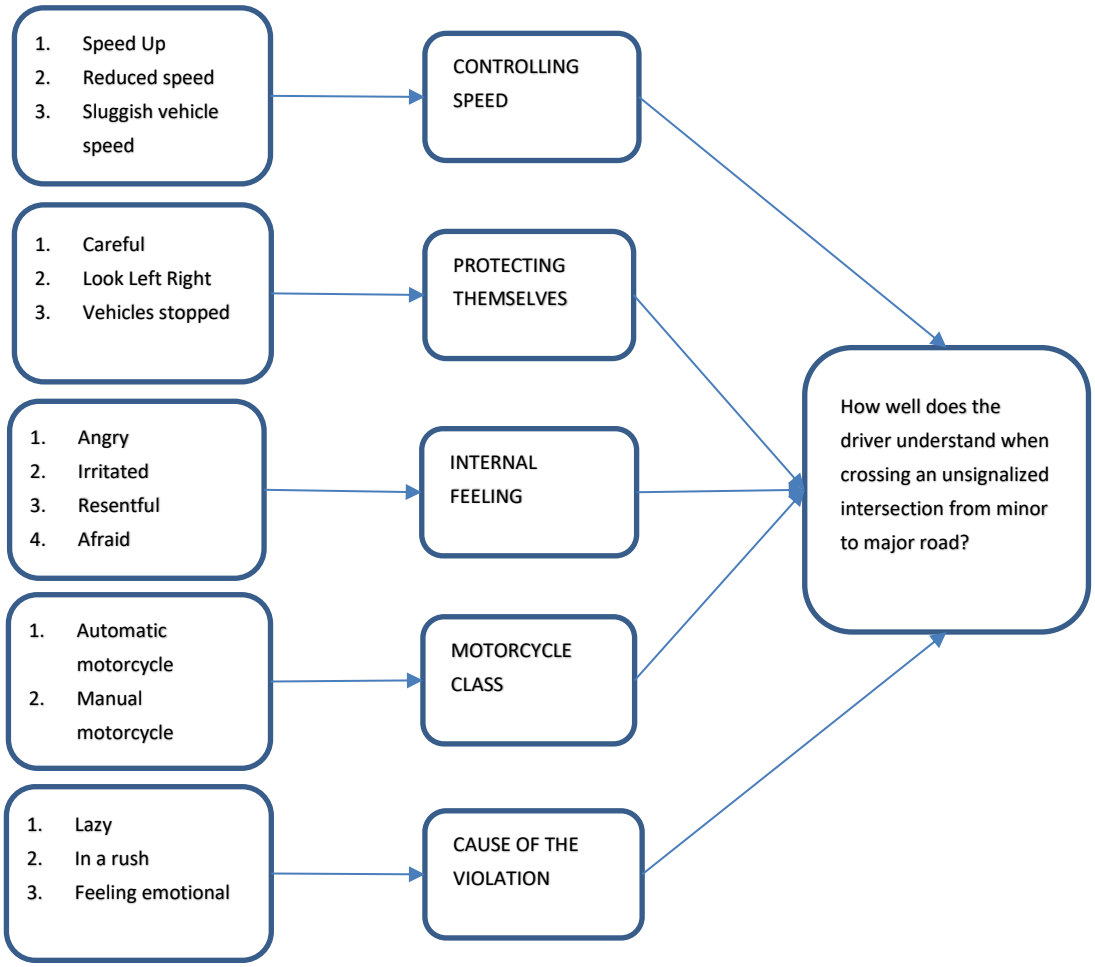

Figure 3. Interview Theme Diagram

C. Questionnaire Approach

Before distributing the questionnaire to a predetermined sample, it must be tested on a smaller scale for validity and reliability. After passing the validation and reliability tests, the questionnaire was re-distributed to the required sample size. A classical assumption test, which includes normality, heteroscedasticity, multicollinearity, and autocorrelation tests, is then performed as a prerequisite for performing multiple linear regression tests.

Multiple Linear Regression

Based on the analysis, the following equation results are obtained:

$$Y = 0.960 + 0{,}000X_1 + 0.088X_2 + 0.013X_3 - 0.049X_4 + 0.146X_5 + 0.610X_6 + \varepsilon$$

1. The regression coefficient value of education level, age, gender, and type of work has a sig value > 0.05, meaning that these variables are not significant to the y variable.
2. The value of the cognitive coefficient is 0.146, meaning that if the cognitive variable increases by 1 unit assuming the other variables are constant, then the correct driver behavior from the minor road to the major road in Semarang City increases by 0.146 units. In addition, the t table value is (0.05/2; 101-6-1) = (0.025; 94) = 0.677. It means that the value of t count > t table (2.869 > 0.677), then H0 is rejected, and Ha is accepted. So that the hypothesis which reads that there is a cognitive influence on the driver's behavior is partially accepted.
3. The value of the affective coefficient is 0.610, meaning that if the affective variable (x6) increases by 1 unit with the assumption that the other variables are constant, then the correct driver behavior from the minor road to the major road in Semarang City increases by 0.610 units. In addition, the t table value is (0.05/2 ; 101-6-1) = (0.025 ; 94) = 0.677. It means that the value of t count > t table (5.541 > 0.677), then H0 is rejected, and Ha is accepted. Therefore, the hypothesis which reads that there is an effective effect on the driver's behavior is partially accepted.

Table 4. Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.960	0.445		2.156	0.034
	Education (x1)	0.000	0.003	0.008	0.092	0.927
	Age(x2)	0.088	0.078	0.096	1.124	0.264
	Gender(x3)	0.013	0.019	0.060	0.675	0.501
	Occupation(x4)	-0.049	0.048	-0.092	-1.031	0.305
	Cognitive(x5)	0.146**	0.051	0.249	2.869	0.005
	Affective(x6)	0.610***	0.110	0.472	5.541	0.000
a. Dependent Variable: Driver_Behavior						

Coefficient of Determination Test

The value of the coefficient of determination is found in the Adjusted R Square value of 0.363. This means that the independent variable's ability to explain the dependent variable is 36.3%, and the rest is explained by other variables not discussed in this study.

Table 5. Model Summary

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.602[a]	0.363	0.322	0.37885
a. Predictors: (Constant), Affective, Age, Occupation, Gender, Cognitive, Education				
b. Dependent Variable: Driver_Behavior				

Triangulation

The triangulated research data was obtained by observing 204 drivers, interviewing five people, and distributing questionnaires to 101 people, as shown in Table 6. According to the findings of interviews and questionnaires, drivers understand appropriate behavior at unsignalized intersections, particularly when merging onto a major road from a minor road. However, observations show that many drivers are not paying attention to the major road situation. This occurs because the driver was in a hurry and was too lazy to look around and determine that it was already safe.

Table 6. Data Triangulation Matrix

Aspect	Observation (n = 204)	Interview (n = 5)	Questionnaire (n=101)
Reducing speed	51% of drivers reduce their vehicle speed before joining the major road	100% of drivers reduce their vehicle speed before joining a major road	92% of drivers stop their vehicles before joining the major road
Stopping the vehicle	2.65% of drivers stop their vehicle before joining the major road	60% of drivers stop their vehicles before joining the major road	88% of drivers stop their vehicles before joining the major road
Paying attention to major road	51% of drivers look at the major road before joining the major road	100% of drivers look at the major road before joining the major road	99% of drivers look at the main road before joining the main road
Did not pay attention to major road	46.38% of drivers immediately join the main road and do not pay attention to the road situation	0% of drivers immediately join the main road and do not pay attention to the road situation	25.75% of drivers immediately join the main road and do not pay attention to the road situation

Aspect	Observation (n = 204)	Interview (n = 5)	Questionnaire (n=101)
Driver knowledge	53.6% of drivers know the traffic rules at the intersection	86% of drivers know traffic rules at intersections	93% of drivers know traffic rules at intersections

CONCLUSION AND FURTHER RESEARCH

There are differences in driver behavior based on the three research methods used. Most drivers understand how to behave when trying to merge onto a major road from a minor road in terms of understanding and theory. However, in reality (observations), up to 46.38% of drivers do not behave by their understanding.

The cause of wrongs committed by drivers when crossing unsignalized intersections is due to being in a hurry and believing it is safe enough without looking at the major condition. This way of thinking will negatively impact them because it will lead them to believe it is safe to do so. Cognitive and affective variables influence driver behavior when crossing from a minor to a major road at unsignalized intersections. The greater the driver's understanding and knowledge, the greater the impact on the driver's right action. The more emotionally mature and patient a driver is, the more positive the driver's behavior will be.

Further research could be carried out by comparing drivers' behavior when moving from a minor road to a major road in various cities. This research aims to see if there are differences in driver behavior when crossing an unsignalized intersection and if there is a link between cognitive, affective, and driver behavior. Future research should look into the connections between driver behavior at unsignalized intersections and road accidents in that area.

REFERENCES

Abojaradeh, M. (2015). Evaluation of Driver Behavior Mistakes and Their Effects on Improving Traffic Safety in Jordan. *Civil and Environmental Research, 7*(3).

Bachri, B.S. (2010). Meyakinkan Validitas Data Melalui Triangulasi Pada Penelitian Kualitatif. *Teknologi Pendidikan 10*, 46–62.

BPS, P.J.T. (2020). *Jumlah Korban Kecelakaan Lalu Lintas di Wilayah Polda Jawa Tengah 2018-2020.* Statistics of Jawa Tengah Province (Badan Pusat Statistik Provinsi Jawa Tengah).

Christie, N. (2010). A review of accidents and injuries to road transport drivers. *Safety And Health*. https://doi.org/10.2802/39714

Farooq, D., Moslem, S., Tufail, R.F., Ghorbanzadeh, O., Duleba, S., Maqsoom, A., & Blaschke, T. (2020). Analyzing the importance of driver behavior criteria related to road safety for different driving cultures. *International Journal of Environment Research and Public Health, 17*(6). https://doi.org/10.3390/ijerph17061893

Firdausi, M., Kevin, A., & Dacosta, O. (2021). Kecelakaan Pada Simpang Tak Bersinyal (Studi Kasus : Persimpangan Jalan Raya Rungkut Menanggal – Jalan Kyai Abdul Karim Kota Surabaya) Jurusan Teknik Sipil , Institut Teknologi Adhi Tama Surabaya. *Seminar Nasional Sains dan Teknologi Terapan IX*, 186–192.

Fishbein, M., Ajzen, I. (2009). *Predicting and changing Behavior*. 1st Edition. ed. Taylor & Francis Group, New York. https://doi.org/10.4324/9780203838020

Gupta, L., Goswami, S., & Kumar, R. (2021). Analysis of driver behaviours towards road safety measures using DBQ in the Indian context. *Transactions on Transport Sciences 12*. https://doi.org/10.5507/tots.2021.001

Ingale, A., Sahu, P., Bajpai, R., Maji, A., & Sarkar, A. (2020). *Understanding driver behavior at intersection for mixed traffic conditions using questionnaire survey*, in: Lecture Notes in Civil Engineering. https://doi.org/10.1007/978-981-32-9042-6_51

Sales, S. (2016). *Analisis Data Kualitatif*. Pustaka Ramadahan. Bandung.

Suwarto, F., Hartono, H., & Lukman, L. (2019). Pengaruh Rasa Takut Terhadap Profil Perilaku Pengendara Usia Remaja - Studi Dengan Driver Behaviour Questionnaire (DBQ). *Jurnal Rekayasa Sipil (JRS-Unand) 15*, 129. https://doi.org/10.25077/jrs.15.2.129-139.2019

Tahir, A. (2006). Studi penyebab kecelakaan lalu lintas di kota surabaya. *Teknik Sipil*, 1–9.

Zhang, G., Qi, Y., & Chen, J. (2016). Exploring Factors Impacting Paths of Left-Turning Vehicles from Minor Road Approach at Unsignalized Intersections. *Mathematical Problems in Engineering 2016*. https://doi.org/10.1155/2016/1305890