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Why Riders Perform Risky Riding Behavior in Jakarta: The effects of Hazardous Situations and Gender on Risk Perception

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Dewi Maulina, Keyni Regina Danilasari, Fara Nazhira, and Satara Samia Jufri
Faculty of Psychology, Universitas Indonesia

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Abstract
The relationship between risky riding behavior and traffic accidents has been identified in previous research. However, there is limited research that focuses on the interaction between internal and external factors and the effect this has on riders' risky riding decisions. The aim of this study is to examine the effect of hazardous situations and gender on risk perception and risky riding behavior among motorcyclists. We focus on lane-splitting behavior as one of the most common risky riding behaviors among motorcyclists in Jakarta. A 2×2 mixed-groups factorial ANOVA (hazardous situation × gender) was conducted with 72 participant riders, male as well as female. Participants were asked to read different scenarios and watch six video clips that showed pro-risk and anti-risk hazardous situations. At the end of each clip, participants answered questions related to risk perception and lane splitting decisions. Results show that hazardous situations have a significant effect on each dimension of risk perception and on risky riding behavior. However, results suggest that gender has a significant effect only on two dimensions of risk perception, namely, efficacy and worry and insecurity. We also found a significant effect of the interaction between hazardous situations and gender on risk perception, which is the dimension of the likelihood of an accident. Based on the results of this study, it can be concluded that it is important for law enforcement to consider the role of risk perception when granting motorcycle licenses.

Keywords
Gender, lane splitting, risk perception, hazardous situation, motorcyclists

Jakarta and the cities that surround it (Bogor, Depok, Tangerang, Tangerang Selatan, Karawang, and Bekasi) constitute the second largest urban area in the world, second only to Yokohama, Japan (Demographia world urban areas, 2017). In 2016, the approximate population was 31,760,000 in an area of 3,320 km², a number that continues to grow. Population density in Jakarta has reached 9,600 people per km². The population increased by 7,000,000 people between 2000 and 2010 (Cox, 2016). If population growth continues to occur this way, Jakarta will be the largest urban area in the world by 2030. With the population rapidly growing, the citizens of Jakarta face a number of problems; one such problem is traffic accidents.

According to The Indonesian Central Bureau of Statistics (2015; 2016), the prevalence of traffic accidents in Jakarta in 2015 to 2016 increased from 3,344 to 3,786. The vehicles most often involved in traffic accidents were motorcycles,

Corresponding Author:
Dewi Maulina
Department of Research Method in Psychology
Faculty of Psychology, Universitas Indonesia
Jl. Lkr. Kampus Raya, Depok, Jawa Barat
Indonesia, 16424
Email: dewi.maulina@ui.ac.id

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accounting for a total of 3,231 accidents (The Indonesian Central Bureau of Statistics 2016). Factors that cause traffic accidents can be classified into three categories, namely, human factors, environmental factors, and vehicular factors (Institute for Research in Public Safety Indiana University, 1979). The Institute for Research in Public Safety, Indiana University (1979), found that 70% of traffic accidents were caused by human factors, which included all possible mistakes that a person could make. One example of a human factor that could affect the likelihood of a traffic accident was risk-taking behavior, which is often referred to as risky riding behavior (Petridou & Moustaki, 2000).

Risky riding behavior was defined as a form of behavior that could increase the risk of traffic accidents that result in serious injury or the death of the rider, passenger, or other road users (Eby, 2004). Risky riding behavior can be divided into two categories: errors and violations. Errors refer to behaviors caused by the incompetence and mistakes of riders, while violations are defined as offenses committed due to non-adherence of traffic laws (Useche, Ortiz, & Cendales, 2017). An example of an error would be riding a motorcycle with one hand and splitting lanes, whereas a violation would include riding without a license and running through traffic lights.

Chang and Yeh (2007) investigated seven erroneous behaviors that were commonly found within the motorcycling community. The results showed that lane splitting was one of three mistakes that were committed the most. Lane-splitting behavior is exhibited when motorcyclists attempt to pass through a small gap between two vehicles that are moving in the same direction so as to shorten their trip duration (Chang & Yeh, 2007; FEMA, 2009). This type of behavior is common among motorcyclists and is currently legal (Beanland, Pammer, Śledziowska, & Stone, 2015). Lane-splitting behavior is commonly found in Asian countries, in particular when traffic is heavy as is often the case with Jakarta. According to Tunnicliff (2006), motorcyclists often perceive lane splitting as something that is safe and low-risk, allowing them to avoid traffic jams.

There are several factors that influence decisions to engage in risky riding behavior either by the rider or by other parties. Risk perception was a cognitive factor that was consistently found to be related to riders' decisions to indulge in risky riding behavior (Falco, Piccirelli, Girardi, Dal Corso & De Carlo, 2013). Risk perception is a subjective experience for each rider, which allows them to assess the risks of a potentially hazardous situation (Deery, 1999). Ram and Chand (2016) found that riders who have high risk perception ride more carefully, obey traffic laws, and tend to have a positive attitude toward road safety. Riders with a lower risk perception are more likely to engage in risky riding behavior (Machin & Sankey, 2008; Ullerberg & Rundmo, 2003).

External influences, such as the level of traffic, also had an influence on how a rider perceived risk and whether or not they decided to engage in risky riding behaviors such as lane splitting. The risk that was perceived varied according to each situation. Taylor and Snyder (2017) found that a person's perceived risk is influenced by their surroundings. For example, a worker perceives a higher risk when they see their superior doing something that puts their safety at risk; they are more likely to consider their workplace to be unsafe. Taylor and Snyder (2007) also found that risk perception is higher when they understand the negative consequences of an action. Perceived risk rises when there is an authority figure present and lowers when there are none. In the context of driving, traffic situations that can influence risk perception and impact a decision to engage in lane splitting are known as hazardous situations. Maulina (2015) studied the impact of hazardous situations on cognitive factors in male riders aged 18–35, i.e., riding script-a number of action sequences which are used as a guide to individuals in riding, risk perception, distance perception, and risky riding decisions. Hazardous situations can be separated into two categories: pro-risk and anti-risk. Pro-risk and anti-risk situations are different situations that elicit different probabilities of risky riding behaviors. Pro-risk situations increase the likelihood of engaging in risky riding behaviors, while anti-risk situations inhibit engagement in the said behaviors. A wide gap between vehicles, sunny weather, riding during daytime, and heavy traffic are a few examples of pro-risk situations. A narrow gap between vehicles, slippery road conditions, riding during nighttime, and carrying a female

pillion rider are a few examples of anti-risk situations.

Previous researchers have shown that gender has an effect on risky riding behavior. Females were negatively correlated with the number of either active or passive accidents and positively correlated with safety skills in driving, while males were positively correlated with perceptual motor skills (Özkan, & Lajunen, 2006). A telephone survey conducted by Rhodes and Pivik (2011) found that male drivers indulged in risky riding behaviors more often than female drivers. Similarly, Lonczak, Neighbors, and Donovan (2007) stated that males were more likely to commit violations and be involved in traffic accidents than females. The same study also suggested that females tended to be more likely to adhere to traffic laws, while males tended to choose which rules they would follow and which they would ignore.

Maulina (2015) found that risk perception was a significant factor influencing the decision to perform lane splitting in pro-risk and anti-risk situations. However, the research was limited to male riders. Since gender has also been shown to be an important factor in risky riding decisions among motorcyclists, further research is still needed to compare male and female riders. Therefore, the current study aimed to examine the effect of hazardous situations and gender on risk perception and risky riding behavior, notably lane splitting behavior. We hypothesize that riders who perceive lower risk are more likely to perform lane splitting in pro-risk and anti-risk situations. We also predict that male riders perceive lower risk and are more likely to perform lane splitting than female riders. Finally, we hypothesize that there exists an effect of the interaction between hazardous situations and gender on risk perception and lane splitting.

Methods

Participant. The sample consisted of 72 undergraduate students, 40 males and 32 females, who rode around the Jakarta, Bogor, Depok, Tangerang, and Bekasi area. Participants ranged in age from 18 to 25 years (male, M = 20.28, SD = 1.679; female, M = 19.91, SD = 1.058). They were selected using convenience sampling. Participants were active motorcyclists who rode an average of five days a week. The average riding mileage per day ranged from 2 km to 80 km (M = 21.75, SD = 18.31). A total of 90.3% of the participants had a driving license, and 37.83% of them had been riding a motorcycle for 2–4 years. Forty-eight of the participants had been involved in a motorcycle accident.

Research Design. This study employed a 2×2 mixed-groups factorial ANOVA design, including gender and hazardous situations, with traffic conditions as the within-subject variable. Hazardous situations consisted of pro-risk and anti-risk situations (Maulina, 2015). Pro-risk situations were defined as traffic situations that enhanced the likelihood of an individual engaging in lane-splitting behavior. Anti-risk situations referred to traffic situations that reduced the likelihood that an individual would engage in lane-splitting behavior. In each gender group, participants were given three pro-risk situations and three anti-risk situations in a counterbalancing sequence.

Measures

Scenarios and Video Clips. Hazardous situations were presented through written scenarios and video clips of various traffic situations to give a clearer description of traffic situations to the participants. All the scenarios and video clips were developed by Maulina (2015). Scenarios consisted of descriptions that included commuting purposes, time, and traffic conditions. After the participants had read the scenario, a video clip that illustrated the scenario would be played. The video clips described the daily traffic situation around Jakarta. The average riding speed (in km/hour) was also shown in each clip. The duration of each video clip was approximately 21 seconds.

Risk perception. The measurement of risk perception was adapted from Maulina (2015), which consisted of cognitive and affective dimensions. Measurements of the cognitive dimension were adapted from the Learner Driver Experience Questionnaire by Dorn and Machin (2004), which was used by Machin and Sankey (2008). The scale consisted of three dimensions: the likelihood of an accident, efficacy (confidence), and aversion to risk taking. In the likelihood of an accident, participants were asked to rate the probability that they would be

involved in a traffic accident if they decided to perform lane splitting. The efficacy dimension measured the perceived confidence of the participants in performing lane splitting in certain situations. In the dimension of aversion to risk taking, participants were asked to rate how they perceived the danger in performing lane splitting in certain situations. The technique of measuring the affective dimension was adapted from Rundmo and Iversen (2004), measuring worry and insecurity in this case. In this dimension, participants were asked to rate the extent to which they would feel unsafe when splitting lanes in that situation. Each dimension was measured on a 0–100 scale, from 0 (lowest) to 100 (highest).

Risky Riding Behavior. This behavior was measured using a questionnaire from Maulina (2015). In each scenario and video clip, the decision to split lanes was measured by one item that asked participants to rate the probability of engaging in risky riding behavior on a scale of 0 (very low) to 100 (very high). Participants were also required to write down possible reasons for their decision.

Procedure. In the preparation phase, we conducted a pilot study with six riders. The aim of the pilot study was to predict the amount of time that participants would take to complete the experiment and gain feedback on the experiment as a whole. It was evident from this pilot study that the experiment would take approximately 30 minutes. Consequent to feedback from these participants, there were also some changes made to the wording of questions.

The experiment was conducted in a computer laboratory on a 17-inch Lenovo monitor. Each participant took part in the experiment individually and was accompanied by a facilitator who helped operate the computer. All participants were asked to sign their informed consent form before the experiment began. The facilitator then gave instructions for the task. Before the experiment began, the facilitator guided the participant through an example scenario, video clip, and question. When the participants fully understood the task, the facilitator began the experiment. First, the participant was required to read a scenario describing a hazardous situation, followed by the facilitator playing a video illustrating the exact situation. At the end of the video clip, participants were asked to answer questions regarding their risk perception and decision to perform lane splitting. All clips would be paused at the 21-second mark, when an arrow would appear showing the distance between the two vehicles in front of the rider. After the participants had completed all six scenarios, they were asked to supply demographic data and answer a few manipulation check questions. The experiment ended with a debriefing from the facilitator.

Data Analysis. We used the 2×2 mixed-groups factorial ANOVA method to test the hypothesis, using IBM SPSS Statistics version 21. The first analysis examines the effect of hazardous situations and gender on risk perception, while the second analysis tests the effect of hazardous situations and gender on risky riding behavior.

Results

Hazardous Situation, Gender, and Risk Perception

The 2×2 mixed-group factorial ANOVA method showed that hazardous situations had a significant effect on all four dimensions of risk perception: likelihood of an accident ($F(1,70) = 106.365$, $p < 0.0001$, $\eta^2 = 0.603$); efficacy ($F(1,70) = 171.622$, $p < 0.0001$, $\eta^2 = 0.710$); aversion to risk taking ($F(1,70) = 143.581$, $p < 0.0001$, $\eta^2 = 0.672$); and worry and insecurity ($F(1,70) = 156.622$, $p < 0.0001$, $\eta^2 = .691$).

Table 1. **Mean and Standard Deviation of the Likelihood of an Accident Dimension (N = 72)**

Gender	*Hazardous Situation*				*Total M (SD)*
	Pro-risk		*Anti-risk*		
	N	*M (SD)*	*N*	*M (SD)*	
Male	*40*	*27.22 (17.06)*	*40*	*54.61 (15.75)*	*40.91 (13.98)*
Female	*32*	*38.39 (20.90)*	*32*	*55.72 (14.06)*	*47.05 (14.88)*
Total	*72*	*32.18 (19,54)*	*72*	*55.10 (14.93)*	

Table 2. Mean and Standard Deviation of the Efficacy Dimension (N = 72)

Gender	Hazardous Situation				Total *M* (*SD*)
	Pro-risk		*Anti-risk*		
	N	*M* (*SD*)	*N*	*M* (*SD*)	
Male	40	32.79 (18.33)	40	61.55 (19.98)	47.17 (16.54)
Female	32	42.78 (23.76)	32	65.49 (17.25)	55.63 (17.79)
Total	72	37.23 (21.36)	72	63.30 (18.79)	54.13 (19.08)

Table 3. Mean and Standard Deviation of the Aversio Risk Taking Dimension (N = 72)

Gender	Hazardous Situation				Total *M* (*SD*)
	Pro-risk		*Anti-risk*		
	N	*M* (*SD*)	*N*	*M* (*SD*)	
Male	40	81.62 (16.96)	40	51.53 (25.43)	66.57 (19.19)
Female	32	69.41 (20.10)	32	41.85 (19.19)	55.63 (17.79)
Total	72	76.19 (19.28)	72	47.23 (23.23)	

Table 4. Mean and Standard Deviation of the Worry a Insecurity Dimension (N = 72)

Gender	Hazardous Situation				Total *M* (*SD*)
	Pro-risk		*Anti-risk*		
	N	*M* (*SD*)	*N*	*M* (*SD*)	
Male	40	29.33 (21.28)	40	54.52 (22.89)	41.93 (20.52)
Female	32	43.07 (27.04)	32	68.39 (18.70)	55.73 (21.48)
Total	72	35.44 (24.80)	72	60.68 (22.10)	

We also found that gender had a significant effect on the efficacy dimension ($F(1,70) = 6.163$, $p = 0.015$, $\eta^2 = 0.081$) and the worry and insecurity dimensions ($F(1,70) = 7.716$, $p = 0.007$, $\eta^2 = 0.099$). However, there was a nonsignificant effect of gender on the likelihood of an accident dimension ($F(1,70) = 3.235$, $p = 0.076$) and the aversion to risk taking dimension ($F(1,70) = 2.728$, $p = 0.102$). Male riders tended to have a higher perception of their confidence than did female riders. Female riders reported greater concern about being injured than did male riders.

Results also showed that the interaction between hazardous situations and gender had a significant effect on the likelihood of an accident dimension ($F(1,70) = 5.379$, $p = 0.023$, $\eta^2 = 0.071$) only. However, we found a nonsignificant effect on the efficacy dimension ($F(1,70) = 0.333$, $p = 0.566$); the aversion to risk taking dimension ($F(1,70) = 1.985$, $p = 0.163$); and the worry and insecurity dimension ($F(1,70) = 0.001$, $p = 0.975$).

Hazardous Situation, Gender, and Risky Riding Behavior

Mean and standard deviation figures for risky riding decisions from all experimental groups are presented in Table 5.

Table 5. Mean and Standard Deviation of the Risky Riding Decision (N = 72)

Gender	Hazardous Situation				Total *M* (*SD*)
	Pro-risk		*Anti-risk*		
	N	*M* (*SD*)	*N*	*M* (*SD*)	
Male	40	79.03 (15.65)	40	38.16 (19.98)	58.75 (15.51)
Female	32	70.15 (23.87)	32	36.17 (17.97)	53.16 (18.66)
Total	72	75.08 (20.08)	72	37.45 (19.02)	

Our risky riding behavior analysis showed that there was a significant effect of hazardous situations. ($F(1,70) = 278.077$, $p < 0.0001$, $\eta^2 = 0.799$). Pro-risk situations led to a greater tendency among riders to perform lane splitting. However, there was a nonsignificant effect of gender ($F(1,70) = 1.932$, $p = 0.147$) and of the interaction between hazardous situations and gender ($F(1,70) = 2.156$, $p = 0.147$) on risky riding behavior.

Reasons: The 'Why' in Their Choices

We classified the reasons behind participants' risky riding decisions and ranked the five main reasons, which are presented in Table 6.

Table 6. Five Main Reasons Why Riders Split Lanes (N = 72)

Pro-Risk Situation (Why they choose to **split lanes**)	***Anti-Risk Situation*** (Why they choose **not** to **split lanes**)
There seems to be enough space for them to split lanes	There seems not to be enough space for them to split lanes
They see another rider has successfully split lanes	There is a pillion rider on the vehicle
They are in a hurry	Slippery road
They feel as though the size of their vehicle is small enough to fit through the gap	Fear
Light traffic/vacant road	The movement of other vehicles make it less possible to proceed

Note. Frequency was calculated by using tallies for every appearance of similar reasons, with the number of tallies then being ranked.

We identified that riders tended to split lanes when they perceived that there was enough space, when they saw another motorcyclist splitting lanes, and when there was time pressure. Conversely, they tended to avoid lane splitting when the traffic was jammed, when there was a pillion rider, and when the road was slippery after rain.

Discussion

This study aimed to investigate the effect of hazardous situations and gender on risk perception and lane splitting behavior among motorcyclists. We have identified a significant effect of hazardous situations on risk perception and lane splitting. This is in accordance with Maulina (2015), who highlighted the influence of risky riding script, distance perception, and risk perception on lane splitting behavior among motorcyclists in pro-risk situations and anti-risk situations. The significant effect of hazardous situations on risk perception and lane splitting behavior is in line with situation awareness theory, which states that a person's interpretation, comprehension, and projection of their perception directly affects their decision making (Endsley 1995).

We also found a significant effect of gender on the worry and insecurity dimension, with female riders being more likely to feel anxious than male riders. This was in accordance with results of previous research by Robichaud, Dugas, and Conway (2003), who found that females have a greater tendency to be anxious than males. We also found that male riders were more confident in their ability to performing lane splitting than were female riders. This result was consistent with those of Chang and Yeh (2007), who found that male riders tended to have a higher sensation-seeking personality and overconfidence in their ability when compared with female riders. The lack of experience reported by female riders also contributed to their perceived confidence in riding. In this study, we also found a nonsignificant effect of gender on the other dimension of risk perception, namely, the likelihood of an accident and aversion to risk taking. According to Chang and Yeh (2007), the difference between male and female riders in risky behaviors and the likelihood of an accident was due to their riding experience, not how each group perceived risk in various traffic situations.

While previous research focused exclusively on male participants, this research included a gender variable. Therefore, it was possible to offer an explanation for the effects that gender has on risky riding behavior and risk perception. However, this research was a laboratory experiment, and therefore, we must consider the possibility that participants overestimated or underestimated their likelihood of engaging in risky riding behavior (Teigen & Brun, 1997).

To conclude, this study identified the influence of hazardous situations on risk perception and risky riding behavior. Hazardous situations play a crucial role in explaining how riders perceive the risk in various traffic situations. Gender only had a significant effect on some dimensions of risk perception but had no effect on risky riding behavior. We also found

that the interaction between hazardous situations and gender had a significant effect only on the likelihood of an accident dimension of risk perception. There was no effect of the interaction between hazardous situations and gender on risky riding behavior.

The study gives rise to several implications. The results of the study can aide the government in handling transportation, encouraging them to consider risk perception as one component to be tested as a requirement for driving license issuance. The existence of drivers who report an intention to split lanes in a risky situation proves that some motorcyclists lack awareness of the dangers of their actions. Therefore, further training or safety riding education for motorcycle riders should include more detailed advice and guidance about the potential danger of motor vehicle accidents. Furthermore, riders need to be better educated regarding the types of hazardous situations that can influence their risk perception and increase the likelihood of performing risky riding behaviors.

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Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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