

Proceedings of the Eastern Asia Society for Transportation Studies, Vol.8, 2011

Factors affecting motorcyclists' speeding behavior in different types of motorcycle lanes: a study from psychological perspectives

Nur Sabahiah ABDUL SUKOR
Faculty of Civil and Environmental
Engineering
University Tun Hussein Onn Malaysia
86400, Parit Raja, Batu Pahat, Johor,
Malaysia
Fax: +607- 4536070
Email: sabahiah@uthm.edu.my

Satoshi FUJII
Professor
Graduate School of Engineering
Kyoto University
C1-2-432, Nishikyo-ku, Kyoto
615-8540, Japan
Fax: +81- 075-383-3236
E-mail: fujii@trans.kuciv.kyoto-u.ac.jp

Abstract: Segregating motorcyclists is one of the practices that used to reduce motorcycle collisions with other road users. Malaysia has three common types of motorcycle lanes; the exclusive motorcycle lane, the inclusive motorcycle lane and the paved shoulder. This study examined the impacts of these types of motorcycle lanes on motorcyclist psychology and speeding behaviors by using questionnaire survey that carried out in Malaysia. The psychological variables investigated in this study are based on psychological theories that related with risky behavior which are attitude, perceived behavior control, perception of danger, fear of being caught, moral obligation and perception on others' speeding behavior. Structural equation modeling (SEM) analysis revealed that exclusive motorcycle lane give direct impact on motorcyclists' speeding behavior compare to other type of lanes. Psychological factors such as perception of others' behavior, attitude and perceived behavior control show the significant influence toward motorcyclists' speeding behavior in the motorcycle lanes.

Key Words: *motorcyclists' risky behavior, motorcyclists' psychology, motorcycle lane*

1. INTRODUCTION

Motorcycles are the most common mode of transportation in Malaysia, Taiwan, Thailand and Vietnam. The relatively low price of motorcycles and their low fuel consumption are among the reasons why motorcycles are so popular in these countries (Hsu *et.al*, 2003). Due to increasing usage, the number of motorcycle accidents and related fatal injuries in these countries are also increasing. Therefore, many previous studies have indicated that segregation using motorcycle lanes is the best method for reducing motorcycle collisions with other road users (Hsu *et.al*, 2003; Umar *et.al*, 1995; Mohan, 2002).

In Malaysia, the usage of motorcycle segregated lanes started in the 1970s and was upgraded for safety purposes in the 1990s. Based from A Guide on the Design of Cycle Track (1986) as guideline, the width of an exclusive motorcycle lane is normally range between 2.0m to 3.5m and it was suggested that not appropriate to suits the intention of overtaking behaviors in exclusive motorcycle lane (Law and Radin Umar, 2005). In order to achieve comfortable riding side by side at 70km/h, the exclusive motorcycle lane should have 3.81 meters width. This type of motorcycle lane is completely segregating motorcyclists from other road users and reported as successfully reduced 39% of the motorcycle accidents per year (Radin Umar *et al*, 1998; Mustafa and Highway Planning Unit, 2005). In light of this success, the

construction of other motorcycle lanes has become one of the primary road safety enhancements in Malaysia.

Another type motorcycle lane that usually constructed in Malaysia is non-exclusive motorcycle lane which built on the left side of the existing road on federal or state roads. Physical barrier or pavement marking formed in order to define the corridor as a set aside for motorcyclists. Nowadays, 11 sites within federal road have been constructed with non-exclusive motorcycle lanes and several more are in construction progress with cost RM36 million. According to A Guide on the Design of Cycle Track (1986), the speed limit that appropriate for both exclusive and inclusive lanes is 60km/h,

Meanwhile, paved shoulder is another type of non exclusive motorcycle lane that does not have designated pavement marking and barrier that actually functions as lateral support for the pavement. The use of the paved shoulder by motorcyclists is made mandatory by law and other motorists are prohibited from using the paved shoulder except in an emergency. According to A Guide on Geometric Design of Roads (1986), the width of the paved shoulder is variable (1.5 to 3.0 meters) and it is depending on the standards of the attached roads.

1.1 Motorcycle lanes and speeding

Even though the motorcycle lanes was reported to be successful in reducing the collision involving motorcyclists and other road users, the motorcycle crashes still occurred in motorcycle lane involving the roadside objects (Tung *et al*, 2008). Guardrails have been identified as the most struck object; representing 32.7% of all roadside object-related motorcycle crashes and contribute 23.5% of all fatal related to roadside object crashes. The possibility to be involved with the collision with guardrail is might be caused by motorcyclists' speeding action in the exclusive lanes. The increasing of speeding behavior in motorcycle lane was reported to cause high vaulting of rider and resulting of no potential for motorcyclists' head to be hit against the ground. However, it still caused high severity and injuries for the other parts of body (Ibitoye *et al*, 2007).

Actually, speeding has been widely noted in previous research as one of the potential risky behaviors that could cause an accident (Fell, 1976; Aarts and Schagen, 2006). Bellaby and Lawrenson (2001) interviewed riders and most of them claimed that their driving speed did not exceed the limits that they could safely handle given their riding abilities. However, Elliot *et al*. (2007) by using his Motorcycle Risk Behavior Questionnaire (MRBQ) figured out that speed was a crash liability to the motorcyclists. The desire to speed on motorcycles was found to be similar to the desire to speed in cars. However, motorcycle crashes were more fatal.

There is substantial information about the effects of road and road environment on speed choice. Several previous studies revealed the implication of road width, road furniture and type of roads toward drivers' perception and speed preference. Fildes *et.al* (1991, 1993) found that road width and number of lanes have the greatest influence on speed choice by car drivers. Meanwhile, other studies stated that speed choice is affected by road width, road surface, road curvature, the number of carriage lanes, and road markings (Elliott *et.al*, 2003; Martens *et.al*, 1997) However, the implications of the road environment factors to motorcyclists' perception and speeding behavior are actually less discussed.

While the motorcyclists were segregated in a special lane, they actually feel more secure and safe. However, the feeling of safe is usually attached with the desire to accelerate in the

motorcycle lanes. This situation is called as risk homeostasis theory (Wilde, 1990) or risk compensates theory (Adam, 1980). The theories indicate that people actually have a certain target level of risk which may vary according to given situation or environment. For example, if the motorcyclists' perceived that they are safe while riding in motorcycle lanes, they actually prepared to engage in extra risk such as speeding. However, in the knowledge of the authors, there is still no study that confirms this hypothesis regarding the motorcycle lanes in Malaysia.

1.2 Motorcyclists and psychology.

In order to identify the causes of the speeding behaviors among the motorcyclists, the understandings of their psychology are required. In the other hand, Groeger and Rothengatter (1998) claimed that the application of psychological understanding about road users is needed to overcome the complexity of human behavior. The paragraphs below give brief explanation on the psychological predictors that have linked with behavioral studies.

1.2.1 Attitude and Perceived Behavior Control

Attitude and perceived behavior control have been proven in many studies to have link toward the occurrence of intent behaviors. Ajzen (1991) through his Theory of Planned Behavior strongly recommended attitude and perceived behavior control (with the association of subjective norms) as the main components that lead to intention of performing the behavior. Meanwhile, perceived behavior control has been described in Theory of Planned Behavior as a person's capability to perform a behavior. It is also suggested that the high level of perceived behavior control should strengthen a person's intentions to perform the behavior.

1.2.2 Moral obligation

Another important psychological variable for this study is moral obligation effect towards the formation of behaviors. Moral obligation in this study is defined as altruism that has been deeply discussed in Norm Activation Theory by Schwartz (1977). The theory defined altruism as a motivation for behavior that performed for others' benefit rather than for self-administered and rewards. Previous studies by Ullberg and Rundmo (2003) and Chen (2009) assessed altruism as factor in human personality that influences the formation of risky behaviors. Based on this theory, those who have strong moral obligation to not perform risky behavior would be less engaged in risky behavior.

1.2.3 Perceived behavior of others

Asch (1951) in his Normative Social Influence theory had discussed the process on how the behavior of other people could affect beliefs, personal norms and influenced the out coming behavior. This theory defined conformity as the process by which an individual's attitudes, beliefs and behaviors are influenced by other people's pressure and actions. The perceived behavior of others variable in this study was adapted based from the understanding of this theory and was hypothesized to be a determinant for the occurrence of risky behaviors.

1.2.4 Fear of being caught and perceived danger

Other psychological factors that were hypothesized as determinants in this study were fear of being caught and perceived danger. Fear of being caught in this study was used to assess how enforcement could influence the traffic offense behavior. Whereas, the perceived danger is believed to has linked with the perception of risk (Slovic *et al*, 1982). It was hypothesized that persons with low perceived danger would have a higher tendency to be involved in risky behaviors rather than persons who have high perceived danger.

Based on the reviews of the motorcycle lanes and psychological theories that linked to speeding behavior on the paragraphs above, this recent study is designed to unravel several inquiries. First objective of the study is to explore the motorcyclists' speeding behavior in the different type of motorcycle lanes. Secondly, the study is aimed to investigate potential psychological factors that affecting the motorcyclists' speeding behaviors while riding in the different types of lanes. Third, the objective of the study is to investigate the effect of motorcycle lanes to motorcyclists' speeding behavior and psychological factors.

2. METHODOLOGY

2.1 Survey and measures

From June to August, 2009, a self-reported survey was conducted on motorcyclists that used exclusive motorcycle lanes, inclusive motorcycle lanes and paved shoulders in Malaysia. This survey was designed to examine the psychological influence on risky motorcycling behaviors. Motorcyclists were randomly selected and 600 questionnaires were distributed in three specific locations. Each motorcyclist was asked to answer the questions and 595 questionnaires were returned for a respondent rate of 96%. However, after excluding missing data, only 575 complete sets of answers were available. Table 1 below shows the descriptive analysis for the respondents in this study.

Table 1 Descriptive analysis for respondents

Motorcycle lane users	Age	Gender
Paved shoulder (N=265)	15-20 years (34%)	Male (78.4%)
Inclusive lane (N=159)	21-25 years (29%)	Female (21.6%)
Exclusive lane (N=151)	>25 years (37%)	

The main dependent variable that focused in the questionnaire was motorcyclists' speeding behavior. The respondents were asked to answer the questions according to their involvement with the risky behaviors for past a month (Table 2). In order to fulfill the objectives of the study, the questionnaire was designed based on previous research on psychological studies of attitude, perceived behavior control, perceived danger, fear of being caught, moral obligation and perception of others' behaviors.

Table 2 Question for motorcyclists speeding behavior.

Question	Answer scale
My frequency of riding with speed exceeding speed limit for past a month is	① Never ② Seldom ③ Always ④ Every time

To acquire information regarding psychological indicators, attitudes toward speeding was measured by asking whether participants enjoy while engaging in speeding behaviors. The same condition was also used to measure motorcyclists' perceived behavioral control toward speeding. The question asked whether the respondent felt that it was hard to comply with the speed limit. In addition, to gain an understanding of motorcyclists' perspectives of the dangers toward speeding, they were asked whether they felt that riding over the speed limit was dangerous for them.

The questionnaire also asked about their fear of being caught by police while speeding.

Meanwhile, moral obligation was measured by asking the motorcyclists whether they felt morally obligated to comply with the speed limit. In order to measure riders' perceptions of other peoples' behaviors, the respondents were asked to estimate the percentages of other motorcyclists that were involved in speeding behavior. The response for the questions were answered using the Likert Scale of strongly agree to strongly disagree. The descriptions of psychological variables in the questionnaire are shown in Table 3.

Table 3 Descriptions and questions for psychological variables

Psychological variables	Description	Questions
Attitude toward speeding	Respondents' likeliness of speeding over the speed limit.	I enjoy riding over the speed limit <i>Answer scale</i> ① Strongly agree, ② Agree, ③ Disagree, ④ Strongly disagree
Perceived behavior control	Respondents' perception on their ability either hard or easy to carry out the speeding behavior.	It is hard to control myself from ride exceeding the speed limit <i>Answer scale</i> ① Strongly agree, ② Agree, ③ Disagree, ④ Strongly disagree
Perceived danger of speeding	Respondents feeling of being threaten while speeding over the speed limit.	For me it is dangerous to ride over the speed limit <i>Answer scale</i> ① Strongly agree, ② Agree, ③ Disagree, ④ Strongly disagree
Fear of being caught	Respondents' fearfulness of being caught by police while speeding over the speed limit.	I fear to be caught by police while I speed excessively <i>Answer scale</i> ① Strongly agree, ② Agree, ③ Disagree, ④ Strongly disagree
Moral obligation	Respondents' recognition that not rides over the speed limit is their responsibility.	For me it is a moral obligation to ride not over than the speed limit <i>Answer scale</i> ① Strongly agree, ② Agree, ③ Disagree, ④ Strongly disagree
Perceived others' behavior	Respondents' perception on other people speeding behavior.	In my opinion, the percentages of motorcyclists speeding over the speed limit is <i>Answer scale</i> ① 10-20% , ① 30-40% , ② 50% , ③ 60-70% , ④ 80-100%

2.2 Statistical method

In this study, structural equation modeling (SEM) in LISREL 8.53 (Joreskog and Sorbom, 2001) was used for statistical analysis. Several goodness-of-fit statistics were used to judge the fit and validity of the estimated model. The goodness-of-fit index (GFI) and the root mean

square error of approximation (RMSEA) were evaluated as absolute fit measures, while the normed fit index (NFI) and the comparative fit index (CFI) were taken as incremental fit indexes. As a rule of thumb, a model with NFI and CFI values greater than 0.090 is considered satisfactory, whereas the conventional values of RMSEA are below 0.10 for most acceptable models (Hair, 2006) However, RMSEA below 0.08 would indicate a good fit of the models. The conceptual diagram for structural equation model in this study is shown in Figure 1. In addition to the psychological determinants and motorcycle lanes, the influence of other demographic factors, such as age and gender, were also included in the analysis.

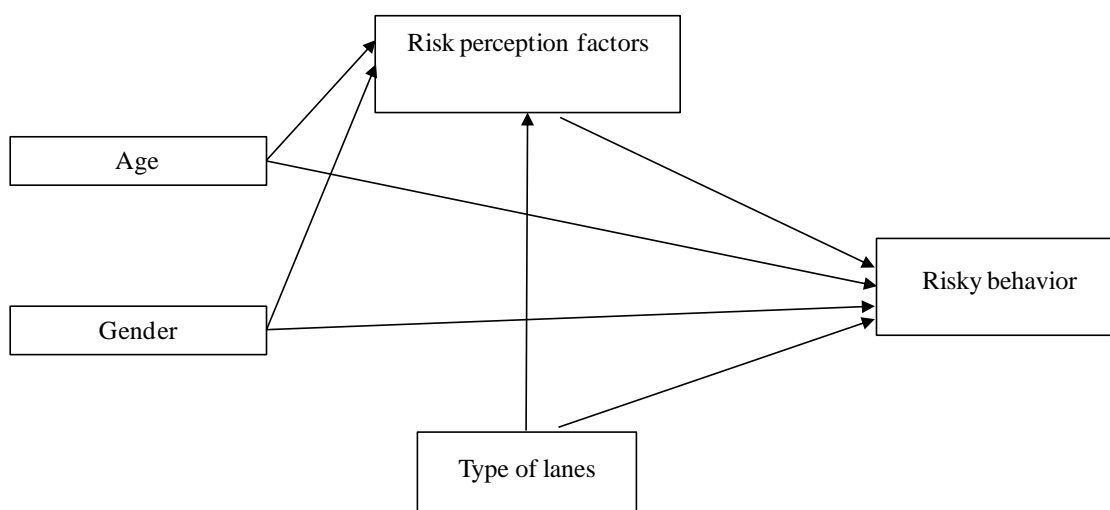


Figure 1 Conceptual path diagram

3. RESULTS

3.1 Descriptive analysis

Table 4 presents the proportion analysis for self-reported speeding behavior in motorcycle lanes that had been focused for this study. The mean value for speeding behavior revealed that the respondents who riding in exclusive lane were tended to ride over the speed limit rather than in inclusive lane ad paved shoulder.

Table 4 Distribution scores, means and standard deviations of speeding

Risky behavior	Type of lane	Distribution of scores (%)				M/SD
		Never	Seldom	Usually	Always	
Speeding	Exclusive	11	34	29	26	2.81/0.97
	Inclusive	10	28	33	19	2.71/0.98
	Paved shoulder	13	46	31	10	2.39/0.84

Meanwhile, Table 5 presents the proportion scores, means and standard deviations for psychological determinants of motorcyclists' behavior. For attitude, the mean for paved shoulder shows the highest value indicating that motorcyclists that using the paved shoulder were more likely to disagree that they enjoyed the acceleration in the lanes. It is similar to perceived behavior control which also indicates motorcyclists in the paved shoulder tended to disagree that they hardly control their speed while riding. This situation is vice versa to exclusive lane where the motorcyclists tended to agree that they enjoyed the riding and hard to

reduce their speed while riding in the lane.

Table 5 Means and standard deviations of psychological factors for speeding

Risky behavior	Psychological variables	Exclusive lane M/SD	Inclusive lane M/SD	Paved shoulder M/SD
Speeding	Attitude toward speeding	2.15/0.96	2.63/1.01	3.12/0.74
	Perceived behavior control toward speeding	2.02/0.86	2.55/0.96	2.65/0.74
	Perception of danger toward speeding	1.99/0.96	1.81/0.94	1.56/0.74
	Fear of being caught while speeding	1.82/0.81	1.75/0.78	1.66/0.71
	Moral obligation toward not speeding	1.74/0.80	1.66/0.78	1.60/0.71
	Perception others' speeding	2.74/0.76	2.79/0.78	2.65/0.87

For other psychological variables such as perceived danger, fear of being caught and moral obligation, the exclusive lane shows the highest value compared to other lanes. The results indicate that the motorcyclists in exclusive lane tended to perceived less danger, less fear to be caught while speeding and less moral obligation toward speed limit. However, the mean value shows the highest rate of inclusive lane for perception others' speeding. This indicates that, compared to exclusive lane and paved shoulder, the motorcyclists that riding in the inclusive lane were more likely to perceive that many other motorcyclists involved with speeding action.

3.2 Factors affecting speeding by using SEM analysis

In this study, the overall goodness of fit for both SEM models were acceptable as suggested by Kline (1998) and Hu and Bentler (1999). For speeding behavior model the maximum likelihood estimation of the model yields a χ^2 value of 23.71 with 12 degree of freedom. The chi-square/d.f of 1.99 is well below the recommended value of 3.00 with RMSEA value of 0.04 is lower than the upper limit 0.10. The NFI and CFI values are acceptable and exceed the cutoff value of 0.90.

The path model for significant relationships of speeding behavior is shown in Figure 2. The result shows that the exclusive lane was significantly had a direct effect to speeding. Furthermore, the exclusive lane also had several significant indirect effects to speeding through the psychological variables such as attitude towards speed, perceived behavior control and perceived speeding behavior of others. This revealed that speeding in the exclusive lane was highly correlated with the motorcyclists' likeliness to accelerate and their difficulty to reduce the. In addition, the motorcyclists' high perception towards others' involvements in speeding action were also increased their tendency to speed.

Meanwhile, inclusive lane showed no significant direct effect to speeding behavior. To remind, type of lanes was analyzed as dummy variables where paved shoulder was chose as the control group. Thus, the negative sign from inclusive lane towards perceived danger implied that, motorcyclists that riding in the paved shoulder perceived higher danger of speeding behavior. However, this variable was not significantly affected the speeding action.

In addition, even though the path diagram shows that age and gender were not significantly affected the speeding behaviors, both variables were found to be significant for several

psychological factors. The results implied that younger motorcyclists were more likely to counterpart with enjoying speeding, felt hard to reduce speed, perceived less danger and felt fewer obligations towards speed limit. In addition, male motorcyclists were reported to favor speeding, felt hardly to control themselves from speeding while riding the motorcycle, perceived less danger, less fear of being caught and less morally obligated toward speed limit.

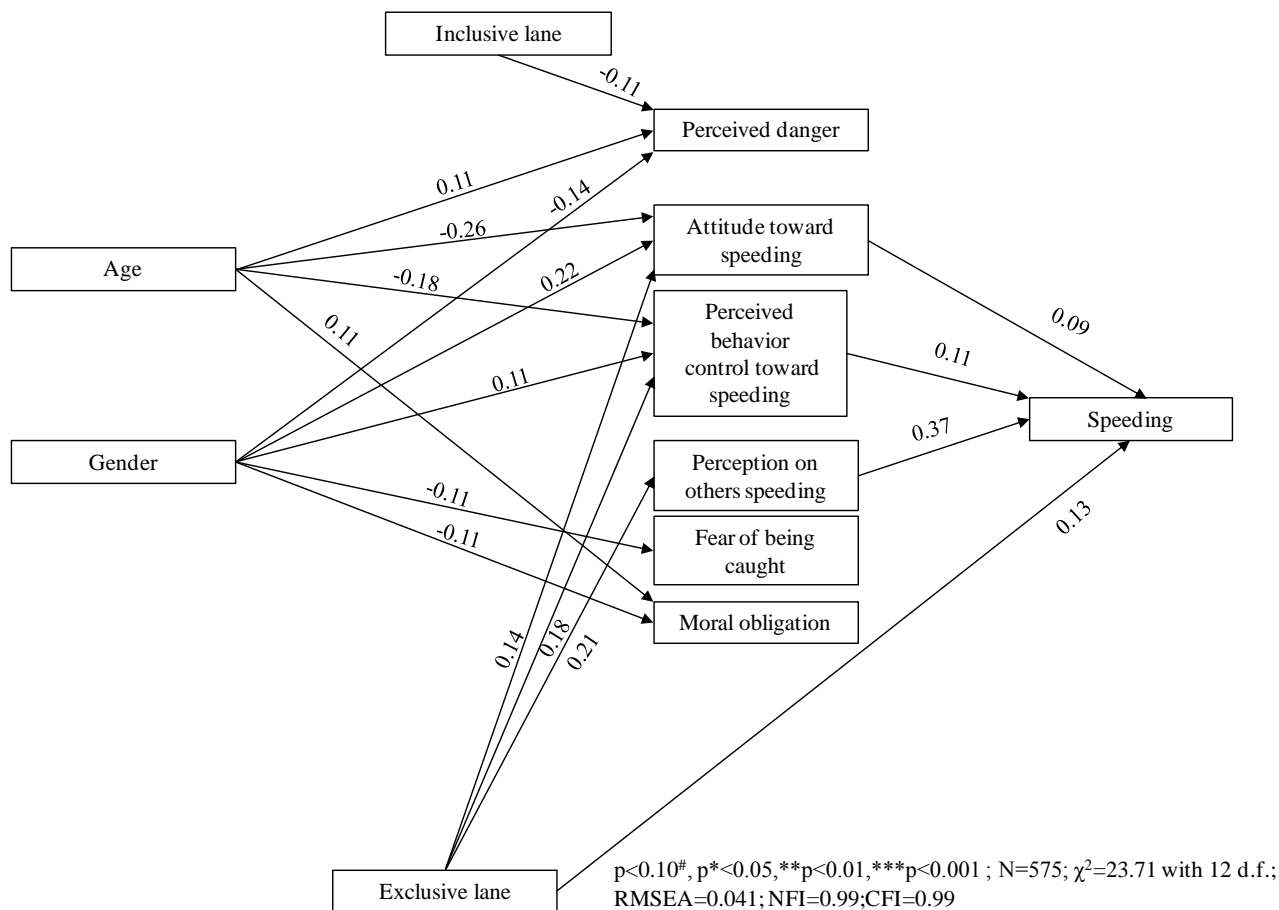


Figure 2 Path diagram for indicating the determinants for speeding behavior

4. DISCUSSION

In Malaysia, motorcycle lanes have been constructed to segregate motorcyclists from other motor vehicles. This study examined the effects of different types of motorcycle lanes on motorcyclists' speeding action and their psychological factors. Speeding behavior was chosen due to the increased risk of motorcycle fatality usually associated with speed action (Pang et.al, 1999; Haglund and Aberg, 2000; Lin et.al, 2003). The findings from this study demonstrated that the exclusive motorcycle lane has the highest impact on encouraging the speeding behavior, followed by the inclusive lane and then the paved shoulder.

The results from the structural equation model revealed that only the exclusive lane was found to significantly affect the speeding behavior directly. This finding indicated that when using the exclusive lane, the motorcyclists will tend to speed. This is congruent with a previous study that found speeding to be preferable in an environment where the road is straight, wide and perceived as safe (Goldenberg and Schagen, 2007). In addition, the exclusive motorcycle lane is totally separated from other motorists. This special condition might have increased

motorcyclists' perceptions of safety. In this study, perception of safety was explained by the perceived danger variable. Compared to the exclusive lane and inclusive lane, motorcyclists perceived more danger while speeding on paved shoulders. This might be because other vehicles can intrude on the paved shoulder.

In addition, this recent study revealed that motorcyclists' tendency to engage in speeding action was also mediated by psychological factors. The path diagram shows that the perception of others' behaviors was the strongest confounding psychological factor for the speeding behavior. This finding revealed that motorcyclists were likely to perceive that other motorcyclists tended to speed while riding in the motorcycle lanes. This perception influenced the motorcyclists to engage in the same action. This finding is congruent with several previous studies regarding the influences of other peoples' behavior toward road users' action (Yechiam *et.al*, 2008; Rosenbloom, 2009; Fleiter *et.al*, 2010). In addition, attitude and perceived behavior control were also found to be significantly related to motorcyclists' speeding behaviors. Negative attitudes and perceived behavior control toward speeding were mediated between the exclusive lane and speeding behavior. Both factors are the elements in Theory of Planned Behavior, which has been proven to be the main factor influencing the existence of a behavior in many previous studies (Warner and Aberg, 2006; Elliot *et.al*,2003; De Pelsmacker and Janssens, 2007)

The other psychological variables such as fear of being caught and moral obligation were not found to be significantly affected the speeding action. However, the findings revealed that older motorcyclists tend to have higher obligation on reducing the speed while riding the motorcycle compared to the younger motorcyclists. This might be due to their experience of riding. Meanwhile, female motorcyclists were revealed to have high perception of being caught while speeding compared to male motorcyclists.

5. CONCLUSION

As a conclusion, this recent study revealed that the motorcyclists' tendency to speed was found to be strongest while riding in exclusive motorcycle lanes. In addition, the findings from this recent study also provide additional insight into the psychological perspective of motorcyclists in Malaysia. This may help researchers, authorities and policy makers figuring out the appropriate speed limit for motorcycle lanes by considering the motorcyclists' psychological influence toward their speeding action.

REFERENCES

- A Guide on the Design of Cycle Track: Arahan Teknik (Jalan) 10/86. Roads Branch, Public Work Department, Malaysia
- A Guide on Geometric Design of Roads: Arahan Teknik (Jalan) 8/86. Roads Branch, Public Work Department, Malaysia
- Aarts, L. and Schagen, V.I. (2006) Driving speed and the risk of road crashes: A review. **Accident Analysis and Prevention, Vol.38**, No.2. pp. 215-224.
- Adams, J.(1980) **Risk**. Taylor and Francis, London and New York
- Ajzen, I. (1991) The Theory of Planned Behavior, **Organizational Behavior and Human Decision Processes, Vol.50**, No.2, pp. 179-211.

- Asch, S.E.(1956) Studies of Independence and Conformity .1. A Minority of One against a Unanimous Majority, **Psychological Monographs, Vol. 70**, No. 9, pp. 1-70.
- Bellaby, P. and Lawrenson, D. (2001) Approaches to the risk of riding motorcycles: reflections on the problem of reconciling statistical risk assessment and motorcyclists' own reasons for riding, **Sociological Review, Vol 49**, No 3, 368-388.
- Chen, C.F (2009) Personality, safety attitudes and risky driving behaviors – Evidence from young Taiwanese motorcyclists, **Accident Analysis and Prevention, Vol 41**, 963-968.
- De Pelsmacker, P. and Janssens, W. (2007) The effect of norms, attitudes and habits on speeding behavior: Scale development and model building and estimation, **Accident Analysis and Prevention, Vol.39**, No.1, 6-15.
- Elliott, M.A., C.J. Baughan, and B.F. Sexton (2007) Errors and violations in relation to motorcyclists' crash risk, **Accident Analysis and Prevention, Vol.39**, No.3, 491-499.
- Elliot, M.A., C.J. Baughan, and C.J. Armitage (2003) Drivers' compliance with speed limits: Application of the Theory of Planned Behavior, **Journal of Applied Psychology, Vol.88**, No. 5, 964 - 972.
- Fildes, B. and Lee, S. (1993). The Speed Review: Road Environment, behaviour, speed limits, enforcement and crashes. Report CR, 127.
- Fildes, B., Rumbold, G. and Leening, A. (1991) Speed behaviour and drivers' attitude to speeding. Report, 16, Monash University Accident Research Centre.
- Fleiter, J.J., A. Lennon, and B. Watson (2010), How do other people influence your driving speed? Exploring the 'who' and the 'how' of social influences on speeding from a qualitative perspective, **Transportation Research Part F-Traffic Psychology and Behaviour, Vol.13**, No.2, 49-62.
- Fell, J.C.(1976), Motor Vehicle Accident Causal System - Human Element, **Human Factors, Vol 18**, No 1, pp. 85-94.
- Goldenbeld, C., and Schagen, V. I. (2007). The credibility of speed limits on 80 km/h rural roads: The effects of road and personality characteristics, **Accident Analysis & Prevention, Vol.39**, No 6, 1121-1130.
- Haglund, M. and L. Aberg (2000), Speed choice in relation to speed limit and influences from other drivers, **Transportation Research Part F: Traffic Psychology and Behaviour, Vol 3**, No.2, 39-51.
- Hair, J.F.(2006) **Multivariate Data Analysis** 6th Edition, Prentice Hall.
- Hsu, T.P., Sadullah, E.A.F.M., and Dao, I.N.X. (2003), Final Report; A comparison study on motorcycle traffic development in some Asian countries-case of Taiwan, Malaysia and Vietnam. The Eastern Asia Society for Transportation Studies, International Cooperative Research Activity
- Hu, L. and Bentler, P.M. (1999), Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. **Structural Equation Modeling, Vol. 6**, 1-55
- Ibitoye, A.B. and Radin Umar, R.S. and Hammoda, A.M.S.(2007) Roadside barrier and passive safety of motorcyclists along exclusive motorcycle lanes, **Journal of Engineering Science and Technology, Vol 2**, No 1, 1-20
- Joreskog, K. and D. Sorbom (2001) **LISREL : User's Reference Guide**. Scientific Software International (SSI), Chicago.
- Kline, R.B. (1998) **Principles and practices of structural equation modeling**. Guilford, New York

- Law, T.H. and R.S. Radin Sohadi (2005), Determination of comfortable safe width in an exclusive motorcycle lane. **Journal of the Eastern Asia Society for Transportation Studies, Vol 6**, 372-3385.
- Lin, M.R., Chang, S.H., Pai, L. and Keyl, P.M (2003)., A longitudinal study of risk factors for motorcycle crashes among junior college students in Taiwan. **Accident Analysis and Prevention, Vol 35**, 243-252.
- Martens, M., Comte, S., Kaptein, N. (1997) The effects of road design on speed behaviour: a literature review. Deliverable D1. TNO-report TM-97-B021. TNO, Soesterberg.
- Mohan, D.(2002), Road safety in less-motorized environments: future concerns, **International Journal of Epidemiology, Vol 31**, No. 3, 2002, pp. 527-532.
- Mustafa, M.N. and Highway Planning Unit. (2005) Overview of Current Road Safety Situation in Malaysia, Highway planning Unit, Road Safety Section, Ministry of Works, Malaysia
- Pang, T.Y., Radin Umar, R.S., Azhar, A.A., Harwant, S., Sharom, A.W., Abdul Halim, M., Zahari, N. and Mohd Shafie, O. (1999), Non - fatal injuries in Malaysian motorcyclists, **International Medical Research Journal, Vol 3**, No 2, 111 -114.
- Radin Umar, R., Norghani, M., Hussain, H., & Shakor, H. (1998). Short and Long Term Plan of Action on Motorcycle Safety Programs. Research Report, 1, 98.
- Rosenbloom, T. (2009), Crossing at a red light: Behaviour of individuals and groups. **Transportation Research Part F-Traffic Psychology and Behaviour, Vol.12**, No.5, 389-394.
- Schwartz, S.H. (1977), Normative influences on altruism. In L. Berkowitz. (eds), **Advanced in experimental social psychology**, Academia Press, Inc: New York. p. 222-280.
- Slovic, P., Fischhoff, B., and Lichtenstein, S. (1982). Why study risk perception? **Risk analysis, Vol 2**, No 2, 83-93.
- Tung, S.H., Wong, S.H., Law, T.H. and Umar, R.S.R., (2008). Crashes with roadside objects along motorcycle lanes in Malaysia, **International Journal of Crashworthiness, Vol 13**, No. 2, 205-210.
- Ulleberg, P. and Rundmo, T., (2003) Personality, attitudes and risk perception as predictors of risky driving behavior among young drivers, **Safety Science, Vol 41**, 427-443.
- Umar, R.S., M.G. Mackay, and B.L. Hills (1995), Preliminary analysis of exclusive motorcycle lanes along the federal highway F02, Shah Alam, Malaysia. **IATSS Research, Vol 19**, No.2,
- Warner, H.W. and L. Aberg (2006), Drivers' decision to speed: A study inspired by the theory of planned behavior, **Transportation Research Part F-Traffic Psychology and Behaviour, Vol.9**, No.6, 427-433.
- Wilde, J.S., (1990). **Target Risk 2 : A New Psychology of Safety and Health** (2nd Edition). PDE Publications, Toronto, USA.