

Analysing local motorcyclists' perception towards road safety

Dewa Made Priyantha Wedagama^{1,*} and *Darren Wishart*²

¹Department of Civil Engineering, Universitas Udayana, Denpasar, Indonesia

²CARRS-Q, Queensland University of Technology, Q 4059 Brisbane, Australia

Abstract. This study sought to investigate differences in local motorcyclists' perception towards road safety in Bali. The independent variables consisted of socio-demographic characteristics containing gender, age, marital status, education levels, riding license ownerships, exposure measured by estimates of distance travelled, future riding purposes in the next year, self estimation in riding skill and in being safer motorcyclists, experiences of minor motorcycle crashes, and casualties in the last three years. Two models were developed which consisted of Principal Component Analysis (PCA) and Structural Equation Model (SEM). This study found that sensation seeking significantly influences on attitudes towards risky riding indicating motorcyclists in Bali are more likely to undertake risky riding behaviours on the road as long as they believe there is some degree of control. Interestingly, female motorcyclists involving local residents have low perceptions towards road safety. Further studies on the gender of motorcyclists therefore, are required to provide more information for more target specific and effective road safety campaign.

1 Introduction

Motorcycles are the predominant mode of transportation along with local road users in Bali because of the flexibility in overcrowded traffic and simplicity with which they can be placed on limit spaces on the road. Also, this mode of transport is progressively prominent in Bali because of different elements related to transportation, for example, the deficiency of public transportation system, the straightforwardness and high adaptability of purchasing a motorcycle and the capacity of motorcycles to get to isolate parts of the urban and provincial zones not generally got to by other transport modes. Furthermore, in line with a previous study indicating that motorcyclists have less expense in relation to out of pocket money and travel time than public transport [1]. In Bali, motorcycles are additionally the favored mode of transportation because of lessened travel times and the low expenses related to fuel utilization.

The high frequency of motorcycle traffic accidents and injuries in Bali has been ascribed to their domination within urban transportation systems. In addition, the possible damage connected to traffic accident is regularly more noteworthy for motorcyclists and their pillions, basically because of insufficiency of safety offered by the structural integrity

* Corresponding author: priyantha@civil.unud.ac.id

of a motorcycle. As anyone might expect, past road safety researches carried out in Bali demonstrate that motorcyclists influenced road accidents and fatalities. Several recent studies show that motorcyclists' behavior and factors related with age are influencing factors to road accidents and injuries in Bali [2, 3]

In endeavoring to comprehend better factors affecting motorcyclist' behavior and accidents afterward, a past study has examined a scope of psychological and psychosocial factors impacting motorcyclists' behavior, for example, attitudes, sensation seeking, intentions, and aggression [4]. Another study has proposed that distinguishing and deciding the impact of different motorcyclists' perception is pivotal to creating and planning successful countermeasures to enhance motorcycle safety [5].

Given that motorcycles are an extremely popular and preferred method of transport in Bali and that motorcycles over-represented in accidents, research is certainly required to improve motorcycling safety in Bali by investigating the psychosocial factors influencing motorcycle riding and behavior. Taking into account the extensive use of motorcycles as a means of transportation by locals, it is imperative to investigate these factors in samples of local residents with a vision to advising the enhancement of future motorcycle safety strategies particular to these in Bali.

The aim of this research, therefore, is to investigate model and analyze motorcyclists' perception towards motorcycle safety in samples consisting of local residents in Bali This study incorporates socio-demographic characteristics of motorcyclists specifically in terms of gender, age, marital status, education levels, riding license ownerships, exposure in terms of distance travelled, future riding purposes in the next year, self estimation in riding skill and in being a safer motorcyclist, experiences of minor accidents, and casualties in the last three years.

2 Research methodology

2.1 Data collection

This study was a cross-sectional survey using a self-reported questionnaire for local residents. This methodology is consistent to previous research [6] demonstrating that it was suitable to count on self-reported driving/ riding behavior as it showed a consistent behavior pattern and also estimated a reliable sign of future intentions of driving/riding behavior.

Due to the high volume of motorcyclists in Bali, potential respondents were drawn closer in the road at areas frequented by motorcyclists and requested to take an interest in the research. After getting an endorsement to take an interest, scientists at that point disclosed to respondents the idea of the research, confidentiality, and anonymity. All respondents were asked for to determine on a 7-point Likert scale running from 1 (strongly disagree) to 7 (strongly agree) to the survey items. A concise portrayal was given at each opening segment of the questionnaire to give the respondents the foundation of the inquiries being inquired. In total, 300 questionnaires were distributed, however, due to missing data, 283 questionnaires (94.3%) for local residents were included in the analysis.

As appeared in Table 1, the designed questionnaire comprised of three parts and included a sum of 64 questions. The questionnaire acquired information identifying with respondents' perception and self-reported riding behavior, sensation seeking, and propensity for aggression while riding, subjective and specific subjective norms and future riding purposes. Items in relation to socio-demographic characteristics and riding experience of respondents were also examined.

Table 1. Items in the questionnaire.

I. Perception on riding a motorcycle	
1. Five statements on the significance of skills in riding a motorcycle (1: Not important at all, 7: Very Important).	
2. Six statements on explanations for riding a motorcycle (1: Not important at all, 7: Very Important).	
3. Eight items estimating sensation seeking	
4. Seven items estimating motorcyclists propensity for aggression while riding (1: Never, 7: Always).	
5. Twenty two (22) items specifying participants attitudes towards traffic rule violations and risky riding behaviors (1: Strongly disagree, 7: Strongly agree).	
II. Psychosocial influences on riding intentions	
1. Subjective norm- four items estimating respondents perception of family and friends' influences (1: Strongly disagree, 7: Strongly agree).	
2. Specific subjective norm- four items estimating the respondents perception of influence of the people I ride with (1: Strongly disagree, 7: Strongly agree).	
3. Eight items estimating future risky riding intentions (1: Strongly disagree, 7: Strongly agree).	
III. Respondents' socio-demographic characteristics and riding experiences	
1. Gender and Nationality	7. Motorcycle types
2. Age	8. Future riding purposes in the next year
3. Marital status	9. Self estimation in riding skill
4. Education levels	10. Self estimation in safer riding skill
5. Riding licence ownership	11. Experiences of minor accidents in the last 3 years
6. Kilometers travelled	12. Experiences of minor injuries in the last 3 years

For participants' perception and self-reported riding behavior, the participants were required to demonstrate their perception to the significance of particular motorcycle riding skills and explanations. Sensation seeking was estimated with utilizing an adjustment of an eight substance thrill seeking scale. A case of sensation seeking is I would enjoy riding a motorcycle on the road with no speed limit with scores varying from 1 (strongly disagree) to 7 (strongly agree). The propensity for aggression was estimated with utilizing seven items and consisted items such as Ridden especially close to the vehicle in front as a signal to its rider/ driver to go faster or get out of the way with answers varying from 1 (never) to 7 (always).

Motorcyclists' attitudes towards traffic rule violations and risky riding behaviors were estimated with utilizing twenty-two statements requesting motorcyclists to specify their level of agreement or disagreement on it items such as It's ok to ride over the speed limit as long as you don't get caught. Subjective norms and specific subjective norms were estimated with items which demonstrated that either relatives or individuals they ride with

would never need them to ride in an unsafe way such as Push myself and or the bike to the point where handling becomes unpredictable on a scale varying from 1 (strongly disagree) to 7 (strongly agree). In addition, the survey results indicate that most local residents motorcyclists described themselves as being average competent and being safe motorcyclists.

Hypothesized models are firstly needed to verify the relationships of the measures shown in Table 2 and Fig. 1 as below:

H1: personal characteristics are expected to contribute motorcyclists' perception and attitudes towards risky riding.

H2: motorcyclists' perception of fun riding and sensation seeking are expected to influence attitudes towards risky riding.

H3: accident and injury experiences are expected to affect motorcyclists' perception and attitudes towards risky riding.

These measures, however, are normally considered as appropriate to characterize the existing motorcyclists' perception and attitudes in Denpasar, regardless of some typical riding styles in Denpasar have been observed differently to those in the developed countries. For instance, motorcyclists in Denpasar are regularly running among static or moving vehicles to step ahead of the congested traffic [7].

2.2 Model construction

Perception data was analyzed using Principal Component Analysis (PCA) while the reliability analysis was conducted using Cronbach's Alpha. PCA is employed to distinguish uncorrelated linear combinations of covariates from the correlated ones to avoid multicollinearity. In addition, PCA is used to certify that the selected linear combinations are having maximum variance [8].

The perception data (as shown in Table 1, part I. Perception on riding a motorcycle and part II. Psychosocial influences on riding intentions) are ordinal variables, which were coded on a 7-point Likert scale. In this study, the conditions for performing the PCA were met in which Eigenvalues more than 1, rotated principal component loadings and reliability values more than 0.7 with 20 % or more explained variances [9]. Eigenvalues are useful to determine the number of factors included in the analysis while, the Cronbach's alpha coefficient of 0.7 or greater is typically considered as the minimum acceptable [10, 11]. In addition, an alpha value of 0.8 indicates the scales have high levels of internal consistency [12]. This coefficient stands for internal consistency level of items within a test. Further, a Cronbach's alpha is a coefficient of consistency quantifying the goodness of variables or objects in assessing a single and unidirectional latent variable (construct) [11].

As shown in Table 2, four components were retained in motorcyclists' perception involving local residents towards road safety. These four components explained 39.56%, 50.15%, and 21.07% of the variances of fun riding, sensation seeking and attitudes or were this propensity towards aggressive behavior respectively. The items of attitudes towards dangerous riding have a high level of consistency of 0.810 respectively, while items of the component of fun riding and sensation seeking demonstrate levels of consistency of 0.772 and 0.790 respectively.

The motorcyclists consisting of local residents were associated with attitude toward dangerous riding consisting of statements "It's OK to ride without a license", "Bending road rules to get through traffic is OK", and "It's OK to ride over the speed limit as long as you don't get caught". Local residents were found to be strongly correlated with a statement "Bending road rules to get through traffic is OK" with a loading factor of 0.818. In general, this component of attitudes towards dangerous riding indicates that motorcyclists involving

local residents tend to participate in a range of unsafe behaviors while on the road as long as they are kept in control.

Local residents have the reasons for riding motorcycles primarily consisting of fun riding and sensation seeking, which specified with a statement of “riding a motorcycle because of social reasons (meeting new people, mates)” with a factor loading of 0.817. Local residents are also significantly associated to seek sensation while riding motorcycles which indicated with a statement “I get a real thrill out of riding fast” with a loading factor of 0.874. This is similar to a previous study [6] which found that high scores on sensation seeking and attitudes towards risky riding. This indicates motorcyclists perceived the lower risk of road accidents and showed a negative attitude towards road safety such as riding fast and tailgating. Motorists related to risk-taking in traffic conditions are assumed to have low respect for law and authorities [6].

3 Results and discussion

As shown in Fig. 1 the Structural Equation Model (SEM) was developed with regards to the hypothesized model, the correlations between observed and latent constructs, as well as correlations among latent constructs. The validity criteria [13] employed to assess the goodness of fit of SEM is presented in Table 3. Measures containing NFI, CFI, PNFI, /df, and RMSEA values are acceptable fit. The developed models, therefore are statistically acceptable.

Table 3. Model validation.

Fit Measures	χ^2	df	p-value	χ^2 /df	RMSEA	NFI	CFI	PNFI
Motorcyclists' perception	780.193	282	0.000	2.767	0.079	0.738	0.806	0.512

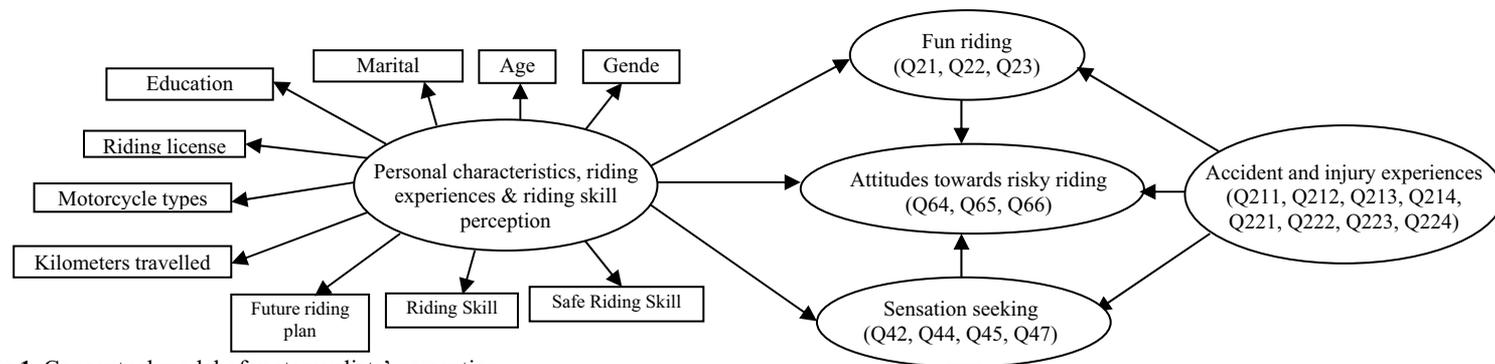
Fig. 1 presents a conceptual path model of motorcyclists' perception with two-level influential paths from personal characteristic and accident and injury experiences variables to three latent constructs consisting of fun riding and social activity, sensation seeking, and attitudes towards risky riding. For that reason, the levels of these latent variables of fun riding, attitudes towards dangerous riding and sensation seeking were identified as endogenous variables in SEM. Meanwhile, exogenous variables were indicated with latent variables of personal characteristics, riding experiences and riding skill perception, accident and injury experiences and also fun riding, and sensation seeking.

A latent variable of fun was riding, and social activity is determined by three observed variables of Q21 (riding because of the feeling of freedom/ no pressures), Q22 (riding for enjoyment/ fun) and Q23 (riding for social reasons, i.e., meet new people or friends). Sensation seeking is measured by four observed variables of Q42 (I enjoy the sensation of accelerating rapidly), Q44 (I get a real thrill out of riding fast), Q45 (I enjoy cornering as fast as I can), and Q47 (I like to raise my adrenaline levels while riding). Meanwhile, attitudes towards dangerous riding are measured by Q64 (it's OK to ride without a license), Q65 (bending road rules to get through traffic is OK), and Q66 (it's OK to ride over the speed limit as long as you don't get caught).

Table 4 presented the model results for which only significant at 0.1% and 5%. Based on the table, sensation seeking (estimate = 0.588) is a significant factor (significant at the 0.001 level) that having a positive influence on motorcyclists' attitude towards risky riding. In addition, Table 4 indicated that only one hypothesis (H2) for the developed model had been statistically accepted. More specifically, the SEM explains that motorcyclists' attitudes towards dangerous riding are influenced by their perception of sensation seeking.

Table 2. PCA for perception data of local residents.

	Items	Loading	Mean	S.D	% Variance Explained	Cronbach' Alpha
Fun riding	Riding motorcycle because of feeling of freedom/ no pressures (Q21)	0.728	4.240	2.045	39.556	0.772
	Riding motorcycle because of enjoyment/ fun (Q22)	0.816	4.050	1.948		
	Riding motorcycle because of social reasons (mates, meet new people) (Q23)	0.817	3.260	1.911		
Sensation seeking	I enjoy the sensation of accelerating rapidly (Q42)	0.845	2.670	1.817	50.152	0.790
	I get a real thrill out of riding fast (Q44)	0.874	2.250	1.741		
	I enjoy cornering as fast as I can (Q45)	0.823	1.690	1.317		
	I like to raise my adrenaline levels while riding (Q47)	0.849	1.970	1.608		
Attitude towards risky riding	It's OK to ride without a licence (Q64)	0.734	2.110	1.676	21.072	0.810
	Bending road rules to get through traffic is OK (Q65)	0.818	2.110	1.555		
	It's OK to ride over the speed limit as long as you don't get caught (Q66)	0.785	2.060	1.599		

**Fig.1.** Conceptual model of motorcyclists' perception.

The findings also implied that gender, age, and annual kilometers traveled to have a significant influence on sensation seeking by -0.485, -0.016, and 0.166 respectively as shown in Table 4. Compared to females, males motorcyclists in Bali are less likely to be involved in sensation seeking (estimate = -0.485, significant at the 0.05 level). This indicates that male motorcyclists in Denpasar are less likely to commit risky riding. This result is in line with a past study conducted in other cities in Indonesia which found that males in Indonesia are less likely to disregard traffic rules than females [14].

Table 4. Regression weight of the motorcyclists' perception model.

Relationships between variables			Estimate
Sensation seeking	←	Gender	-0.485*
Sensation seeking	←	Age	-0.016*
Sensation seeking	←	Kilometers Travelled	0.166*
Fun riding & social activity	←	Motorcycle types	1.109*
Sensation Seeking	←	Motorcycle types	1.259**
Sensation Seeking	←	Perception on riding skill	-0.530**
Fun riding & social activity	←	Accident & injury experiences	0.929*
Attitudes towards risky riding	←	Sensation seeking	0.588**
Speeding as long as not get caught (Q66)	←	Attitudes towards risky riding	1.039**
Riding for social reasons (Q23)	←	Fun riding & social activity	0.657**
I get a real thrill out of riding fast (Q44)	←	Sensation seeking	1.006**
I enjoy cornering as fast as I can (Q45)	←	Sensation seeking	0.727**
Raising my adrenaline levels while riding (Q47)	←	Sensation seeking	0.876**
Minor accidents, respondent's vehicle (Q212)	←	Accident & injury experiences	0.735**
Minor accidents, ≥ 2 vehicles, motorcycle (Q213)	←	Accident & injury experiences	2.294**
Minor accidents, ≥ 2 vehicles, another vehicle (Q214)	←	Accident & injury experiences	0.973**
Minor casualties, a motorcycle (Q221)	←	Accident & injury experiences	1.019**
Minor casualties, respondent's vehicle (Q222)	←	Accident & injury experiences	0.536**
Minor casualty, ≥ 2 vehicles, motorcycle (Q223)	←	Accident & injury experiences	1.714**
Minor casualties, ≥ 2 vehicles, another vehicle (Q224)	←	Accident & injury experiences	0.584**

** and * : significantly different from zero at the 0.001 and 0.05 levels respectively.

In addition, Table 4 shows that age, gender, kilometers traveled, and motorcycle types are significantly associated with sensation seeking while subsequently local residents riding motorcycle to seek sensation are strongly linked with attitudes towards risky riding. In other words, variables of age, gender, and motorcycles below or equal to 150 cc may have indirect influences on attitudes towards dangerous riding. The further study, therefore, should be conducted on identifying age and gender differences in attitudes risky riding. This will provide relevant information for more target-specific and effective road safety campaigns. Meanwhile, motorcyclists riding a motorcycle (less than or equal to 150 cc) and those who assessed their riding skill of well below average have a significant influence on sensation seeking by 1.259 and -0.530 respectively. Consequently, this suggests that those motorcyclists riding motorcycles more than 150 cc and those who consider themselves having riding skill well below average were less likely to involve in attitudes towards risky riding. Meanwhile, accidents and injuries experiences have an essential influence on fun riding by 0.929. This indicates that those of motorcyclists who had previous experiences on accidents and injuries were more likely to do fun riding and social activity.

Motorcyclists scoring high on sensation seeking and attitudes towards dangerous riding are considered to be more likely to engage in future traffic rule violation. In general, this component of attitudes toward risky riding indicates that local motorcyclists tend to participate in a range of unsafe behaviors while on the road as long as they are kept in control. Further, Table 4 suggests that when the measures of sensation seeking increase by one unit, measures of involvement in a dangerous riding would increase by 0.59. This is consistent with a past study found that high scores on sensation seeking are associated with risk-taking in traffic [6]. However, results demonstrated that local male residents and local residents with riding skills well below average are negatively related to sensation seeking. In contrast, local residents riding motorcycles below or equal to 150 cc is positively and significantly associated with sensation seeking. In fact, motorcycles below or equal to 150 cc in Bali are mostly used by local residents for multipurpose trips including commuting, shopping, and going to school/universities.

This study is essentially limited to the use of self-reported perception and attitudes while riding on the road. In fact, motorcyclists may not accurately recall their involvement in attitudes toward risky riding. As mentioned earlier, self-reported technique make possible to conduct anonymous surveys that offer in-depth information about aberrant behavior and its motivational factors [6]. Motorcyclists involving local female residents in Bali are more likely to have a less safe attitude towards road safety. In addition, local residents who ride motorcycles below or equal to 150 cc consider traffic risk more while on the road. Road safety perception is to be of importance to female motorcyclists since they are more likely to underestimate the probability of traffic risk while on the road. To inform female motorcyclists consisting of local residents to change their perception and attitudes is possibly not an appropriate approach. A more suitable approach is to concentrate on dealing with the responses of female motorcyclists while riding on the road. For instance, observing motorcyclists' response while riding on the simulator on the assumption that simulator represents riding on the real way.

This study contributes to identifying a range of consistent factors influencing local motorcyclists' perception towards road safety. This supports the local government for more target specific and effective road safety campaign.

4 Conclusions

Components of sensation seeking were significantly related to motorcyclists' perceptions of road safety. Sensation seeking appears to be a common behavior for motorcyclists involving local residents to conduct attitudes towards risky riding. In addition,

motorcyclists involving local residents are more likely to participate in risky riding behavior while riding on the road providing there appears to be a degree of control.

Interestingly, motorcyclists involving local female residents in Bali are likely to have low perception towards road safety. Focusing more on educating and increasing safer behaviors with female motorcyclists in traffic is essentially required. Further studies, therefore, on the relationships between gender of motorcyclists involving local residents, their perception and attitudes towards traffic risk is importantly needed.

References

1. A.K.I. Sheikh, R.S.R Umar, M. Habsah, H. Kassim, M. Stevenson, A. Hariza, *Traffic Inj. Prev.* **7**, (2006)
2. D.M.P. Wedagama, D. Dissanayake, *Journal of EASTS*. **8** (2010)
3. D.M.P. Wedagama, *IATSS Research* **33(2)** (2009)
4. C. Seabra, S. Dolnicar, J.L. Abrantes, E. Kastenzholz, *Tourism Management*, **36** (2013)
5. P. Hongsrangon, T. Khompraty, S. Hongpukdee, P. Havanond, N. Deelertyuonyong, *IATSS Research* **35** (2011)
6. P. Ulleberg, T. Rundmo, *Safety Sci.* **41** (2003)
7. D.M.P. Wedagama, D. Dissanayake, *J. of EASTS* **8** (2010)
8. A.R. Lawson, V. Pakrashi, B. Ghosha, W.Y. Szeto, *Accid. Anal. Prev.* **50** (2013)
9. D. Hooper, J. Coughlan, M. Mullen, *EJBRM* **6**, 1 (2008)
10. A. Fyhri, A. Backer-Grøndahl, *Accid. Anal. Prev.* **49** (2012)
11. H.M. Hassan, M.A. Abdel-Aty, *Accid. Anal. Prev.* **50** (2013)
12. L.Y.L. Loo, J. Corcoran, D.Mateo-Babiano, R. Zahnow, *J. Transp. Geogr.* **46** (2015)
13. K. Schermelleh-Engel, H. Moosbrugger, *MPR-Online*. **8**, 2 (2003)
14. Y.O. Susilo, T.B. Joewono, U. Vandebona, U, *Accid. Anal. Prev.* **75** (2015)