

Does an ecological model explain self-report motorcycle use and injuries among early adolescents?

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Abstract:

Serious injuries result from motorcycle crashes among adolescents (Cassell et al., 2006). Psychological and social factors that might explain the likelihood of motorcycle use and motorcycle related injuries among early adolescents are relatively unexplored particularly within the Australian context. In this study an ecological approach was taken to understand such factors including individual characteristics, perceived peer behaviour, relationships with parents and connection to school. These risk and protective factors were examined in relation to on-road motorcycle riding and injuries related to general motorcycle use by 13-14 year olds. In the study of more than 500 Grade 9 South-East Queensland students, sixteen percent indicated that in the past three months they rode a motorcycle on the road. Further sixteen percent of the entire sample also indicated that they had been injured while riding a motorcycle in the previous three months. The aim of this study was, from an ecological perspective, to examine factors that explained on-road motorcycle use and factors that explained injuries related to general motorcycle use. The results are discussed in terms of the implications and directions for future regarding research and policy, in particular with regard to interventions. That one-eighth of the sample engaged in this illegal and dangerous behaviour indicates a timely need to understand motorcycle use among adolescents.

Introduction

Relative to other road users, motorcyclists are among those most likely to suffer serious injuries in the event of a crash (Langley & Marshall, 1994). In 2006, there were 58 deaths in Queensland and 238 deaths in Australia from on-road motorcycling (ATSB, 2006). Aside from physical and social costs associated with motorcycle-related injuries, there are financial costs associated with treatment, rehabilitation, and repairs associated with the vehicle. Taken together, these costs indicate a need to further understand motorcycle crashes and the individuals involved.

There is evidence that adolescents are being injured riding motorcycles. Cassell, Clapperton, O'Hare and Congiu (2006) outlined the motorcycling injuries for

those under 18 years in Victoria over a three-year period (2002-04). The researchers found that there were nine deaths, 1570 hospitalisations and 2097 emergency department (ED) presentations¹. The study found that seven of the nine deaths were from on-road use, 73% of hospitalisations were from off-road use and 81% of the ED presentations were associated with off-road motorcycling. According to the authors, males were over-represented in fatalities and hospitalisations and females over-represented in ED presentations. Additional Victorian research has indicated that the hospital admission rates for children (0-14 years old) experiencing motorcycle injuries increased significantly from 1996 to 2005 (Cassell & Clapperton, 2007). For 10 to 14 year olds the rate increased at an estimated annual change of 4.6% per year with an overall increase of 57% over the ten years. In New Zealand, around one-quarter of the motorcycle crashes of young riders involved persons less than 15 years of age and males comprised 87% of cases² (Langley, Marshall, Begg, & Reeder, 1995). While the data is not comprehensive, it does indicate a need to better understand adolescent motorcyclists.

In addition to evidence of adolescent motorcycling injuries from hospital records, there is some evidence from self-report data. A study in Western Australia purposely sampling a high risk group (agricultural college students) found that of the Grade 11 and 12 students sampled around half reported having been injured from motorcycling in the past 12 months with a third of those injured reporting medical treatment for the injury (Lower, Egginton, & Owen, 2003). Further a study by Chapman and Sheehan (2005) found 18.1% of their high school student sample self-reported that they had been injured riding a motorcycle in the past six months³.

However, despite the evidence of injuries being experienced by adolescents from motorcycling there is very little information regarding the number of adolescents who ride motorcycles or the number who ride motorcycles illegally⁴. There is thus a rationale for understanding these adolescents. Further support for a need to understand young motorcyclists is highlighted in a case-control study by Haworth and colleagues (1997) who identified a number of factors associated with motorcycle crashes. These factors included (but were not limited to) being younger than 25 years (compared with being older than 35 years), experience with off-road

¹ For those in control of the motorcycle, at this age and in this jurisdiction, legal riding was only allowed on private property.

² Participants were under licensing age in the jurisdiction

³ This study preceded the current research and used a different cohort in many of the same high schools

⁴ In Queensland at the time of data collection it was illegal under any circumstances to ride a motorcycle on the road under the age of 16.5 years (as of July 1, 2007 this was increased to 18 years).

motorcycling before on-road motorcycling, being unlicensed, and being less experienced. Further Reeder and colleagues (1997) found that motorcycle use at age 13 years increased the likelihood of motorcycle use four fold among 18 year old New Zealand males. Thus early riding increased the likelihood of riding as a young adult and as Haworth showed early riding increased crash risk.

Although there is some evidence for adolescent motorcycle crashes there is still very little published literature about adolescent unlicensed riders or factors associated with adolescent riders who are injured from motorcycling. Reeder and colleagues (1997) examined motorcycle use at age 18 years (three years after minimum licensing age) and tested the association of a number of psychosocial factors at age 13 and 15 years. Early motorcycle use at 13 and 15 years was the strongest predictor of motorcycling at 18 years with the strongest psychosocial predictors including having fought in public and a below average reading level. Lower, Egginton and Owen (2003) examined Grade 11 and 12 students of agricultural colleges and found that the participants who were injured were more likely to have sped at greater than 100km/ hour, sometimes wear a helmet (rather than always, never or rarely) and approaching significance was being a self-taught rider (compared with being taught by family or by friends). The authors suggested that their research indicated that motorcycle crashes were associated more generally with risk-taking.

The literature regarding early motor vehicle driving or risky driving among adolescents has examined some psychosocial risk and protective factors. These factors span a wide ecology in the adolescent's life. For example, with regard to experiencing peer pressure, Shope, Raghunathan and Patil (2003) examined 5th through 10th Grade US students' susceptibility to peer pressure and found it predicted risky driving behaviour. Living with both parents is a protective factor for less risky driving (J. T. Shope, Waller, & Lang, 1996). Further, protective factors against the likelihood of involvement in motor vehicle crashes and driving related offences have been shown to include more positive parental influences such as monitoring, nurturing and family connectedness (J. Shope, 2001). Adolescent bonding or connectedness to the school has also been associated with greater traffic violations (Bingham, 2006). Further, adolescents' relationships with peers have long been linked to engagement in risk-taking behaviour. Friends' involvement with substances was predictive of high risk driving outcomes among females (Shope et al., 1997).

The research indicates adolescents experience crashes from motorcycle use yet little is known about these adolescents. The paucity of research on the factors that are associated with motorcycle use by adolescents and the evidence of injuries

associated with riding indicates a need for research in this area. This research along with research on driving by young people suggests a wide ecology of possible risk and protective factors, including being male, having a higher susceptibility to peer pressure, having a poor relationship with parents, having limited school connectedness, and having peers who engage in risk-taking behaviours. From this research, it was hypothesised that similar risk and protective factors would predict illegal on-road motorcycling and injury associated with motorcycle use among early adolescents.

Method

The methods used for this study were initially selected to meet the aims of another research project which was to evaluate a newly developed intervention program (SPIY Program) to reduce risk-taking behaviour among adolescents. The participants in the present report represented the baseline sample of the original project.

Participants

A total of 934 participants were enrolled in the five, conveniently sampled Education Queensland schools. Parental consent was obtained for 678 students (73%) and 540 (80%) of these students provided written consent prior to participation. There were two students who refused consent. The Index of Relative Socio-Economic Advantage/Disadvantage, as derived from the 2001 Census was obtained for the five schools. The Index, is constructed from attributes of the population in the area, such as educational attainment, income, occupation, and is scored with a range from 1-10, with low values indicating disadvantage and high values indicating advantage. Three of the schools are located in relatively advantaged areas (Index scores of 7-8) and the other two schools are located in disadvantaged areas (Index scores of 1) (Australian Bureau of Statistics, 2005). Further details of demographic characteristics of the participants are outlined in the results section.

Measures

Demographics

Students were asked to provide demographic information including age, sex, and ethnic background.

Temper

The Temper subscale of the Measures of Self-Control (Grasmick, Tittle, Bursik, & Arneklev, 1993) was selected to understand adolescents' self-control of

temper. The four-items (scale range 1-4 per item) were summed to produce a total score. The measure had good internal consistency, Cronbach's alpha = .79.

Peer Pressure

The 8 items of the peer pressure subscale of the Peer Pressure, Conformity, and Popularity Questionnaire (Santor, Messervey, & Kusumaker, 2000) were summed to produce a total score with a higher score indicating greater susceptibility. The measure had good internal consistency, Cronbach's alpha = .80.

Risk-taking Behaviour

The measure of risk-taking behaviour was based on the Australian Self-Report Delinquency Scale, ASRDS (Mak, 1993) and adjustments made by Western and colleagues (2003). Each item was the description of an act and participants were asked to respond as to whether or not they had engaged in the act during the past three months. The co-efficient alpha for the 25-item measure was found to be acceptable at .88. The computation of total delinquency score was developed using reported prevalence rates of the entire sample on the ASRDS which enabled weighting for the more serious items. The prevalence rate of each item across the entire baseline sample was inversed and inversed scores were then summed across all items for each individual. For students with less than one third missing data, their total inverse ASDRS score was scaled up. Those with more than one third missing data were excluded from the analysis. The item on riding motorcycles was excluded from the summed score.

Mother and father bonding (care)

To measure adolescent bonding or attachment to mother and father an amended version of the 'care' subscale from the Parental Bonding Instrument was used. Items (scaled, 1 to 4) were summed to produce a total score with a higher score indicating less care from parents. The measures had adequate internal consistency, (Mother bonding, Cronbach's alpha = .93 and Father bonding, Cronbach's alpha = .94). In later analyses, a measure of parental bonding was also calculated with three levels; those with high parental bonding to two parents, high parental bonding to one parent and low parental bonding to both parents.

School bonding

To measure school bonding a shortened version (8-item) of the School as a Caring Community Profile-II (Lickona & Davidson, 2003) was used. The items (scaled, 1 to 10) were summed to produce a total score with a higher score indicated a greater bonding to the school. The measure had adequate internal consistency, Cronbach's alpha = .71.

Friends' Risk-taking Behaviour

To assess perception of friends' risk-taking behaviour participants were asked how many of their good friends had done several risk-taking behaviours in the past 3 months. Friends' risk-taking behaviour included drinking alcohol, taking part in fights, and four transport-related risks (driven a car or motorbike, ridden with a dangerous driver and ridden a bicycle without a helmet). Participants were given four possible options of, 1 '*none*', 2 '*few*', 3 '*some*' and 4 '*most*'. Item responses were summed to produce a total score of perceived friends' involvement in risk-taking behaviour. The measure had good internal consistency, Cronbach's alpha = .80.

Motorcycle injuries

Self-report injury associated with motorcycle use was assessed from a single item taken from the Adolescent Injury Checklist (AIC, Jelalian et al., 1997). Participants were asked to identify how many injuries they had experienced from riding a motorbike, moped or quadbike in the previous three months. Responses were dichotomised into those that had at least one injury and those with no injuries from motorcycle use.

Motorcycle use (on-road)

To assess motorcycle use a single item from the modified ASRDS (Mak, 1993) was used. Students were asked to report whether they had ridden a motorbike on the road in the past three months.

Procedure

Ethical approval was first obtained from the University Human Research Ethics Committee and from the relevant State Education board. Students were offered a movie voucher if they returned their parental consent form (regardless of whether consent was provided or refused). Students were given one week to return consent forms and at this time the option was available for the research project to fund a school representative to phone and inform parents of students who had not returned their consent forms about the study.

The self-report questionnaire booklet was administered in one class lesson of 45 minutes duration. One researcher read a standardised instruction sheet prior to providing an information sheet and consent form. An additional support researcher was present for any questions of students. Once all students had read the information sheet and given their consent, the questionnaire was provided along with further instructions. The AIC was administered at a separately in two of the schools.

Results

Preliminary examination of the data

To undertake a preliminary examination of the sample, percentages were calculated for demographic characteristics as a proportion of the total sample, as a proportion of on-road motorcyclists and as a proportion of those who reported being injured from motorcycle use (see Table 1).

Table 1

Percentage of the sample, of on-road motorcyclists and of those injured riding a motorcycle according to demographic and parent bonding factors

	% of sample (n=540)	% of on-road motorcycle riders	% of those injured riding a motorcycle ^a
Ride motorcycle on road	15.6	-	50.7
Injured riding a motorcycle	16.2 ^b	58.6 ^a	-
Male	49.3	75.6	65.7
Ethnic background			
Pacific Islander	7.6	4.9	10.4
Aboriginal or Torres Strait Islander	4.4	7.3	9.0
Asian	8.9	6.1	3.0
Other	74.5	72.5	70.1

^a Not specified on- or off-road, smaller sample size as survey administered to some students at a separate time point and then matched with unique identifier code (n=439) ^b n=475, survey administered at separate time point – no matching required

The means and standard deviations were calculated for other factors where appropriate and are presented in Table 2.

Table 2

Means and standard deviations for predictor factors

	n	Score range	Score mean (standard deviation)
Temper	524	4-12	9.67 (3.23)
Risk-taking	528	0-25	3.02 (4.10)
Susceptibility to peer pressure	536	8-80	27.93 (13.30)
Mother bonding	535	8-32	15.33 (6.08)
Father bonding	518	8-32	16.82 (6.82)
Peer risk-taking behaviour	525	6-24	10.86 (4.19)
School bonding	534	10-80	46.71(10.67)

Note. Higher score equals greater endorsement of measure except mother bonding and father bonding.

An ecological model of motorcycle use and injury

Two logistic regression analyses were conducted to explain (i) participants who engaged in on-road motorcycle use and (ii) participants who reported motorcycle crashes. The independent variables used to predict these constructs included individual factors (sex, Caucasian ethnic background, temper, engagement in other risk-taking behaviour and susceptibility to peer pressure), parental bonding (this was separated into maternal and paternal bonding), peer risk-taking behaviour, school bonding and SES. Variables at different proximities to the individual were entered at a new step in the regression model such that there were five steps.

The strongest predictors of on-road motorcycle use was being involved in other risk-taking behaviours and being male whereby the likelihood of riding increased around threefold with the presence of either factor (see Table 4). There were other significant predictors including higher risk-taking of peers (OR = 1.108), stronger bonding with their father (OR = .947) and reacting with less self-control of temper (OR = 1.121). In this final model, Nagelkerke's $R^2 = .33$.

Table 3.

Logistic regression model showing predictors of self-report on-road motorcycle use.

Variable	OR (95%CI)
Individual Factors	
Sex (male)	3.051 (1.622 - 5.740)**
Risk-taking	3.098 (1.587 – 6.232)**
Temper	1.117 (1.001 - 1.245)*
Caucasian [^]	1.556 (.731 – 3.315)
Peer pressure	.997 (.973 – 1.022)
Parental Factors	
Mother bonding	1.032 (.978 - 1.088)
Father bonding	.943 (.898 - .991)*
Peer behaviour	1.110 (1.025 - 1.203)*
School bonding	.989 (.961 - 1.018)
SES	.663 (.357 – 1.229)

*p<.05 **p<.01

[^] The variable was dichotomised into majority other group which were likely primarily Caucasian background and from defined ethnic backgrounds (Aboriginal, Torres Strait Islander, Asian, Pacific Islander). There were insufficient numbers in cells to specify more detail in ethnic background.

Note. Model correctly classifies 84.9%, Nagelkerke R Square = .32

The model for motorcycle injury (see Table 4) correctly predicted 85% of cases and Nagelkerke's $R^2 = .164$. The only significant predictor was having peers who engage in higher risk-taking behaviours (OR = 1.098).

Table 4

Logistic regression model showing predictors of self-report on-road motorcycle use.

Variable	OR (95%CI)
Individual Factors	
Sex (male)	1.789 (.977 – 3.274)
Risk-taking	1.585 (.753 – 3.337)
Temper	1.061 (.948 - 1.188)
Caucasian [^]	.878 (.428 – 1.807)
Peer pressure	.991 (.966 – 1.017)
Parental Factors	
Mother bonding	.999 (.944 - 1.058)
Father bonding	.988 (.942 – 1.037)
Peer behaviour	1.098 (1.008 - 1.196)*
School bonding	.978 (.950 - 1.007)
SES	.661 (.356 – 1.225)

*p<.05

[^] The variable was dichotomised into majority other group which were likely primarily Caucasian background and from defined ethnic backgrounds (Aboriginal, Torres Strait Islander, Asian, Pacific Islander). There were insufficient numbers in cells to specify more detail in ethnic background.

Note. Model correctly classifies 85%, Nagelkerke R Square = .16

Discussion

Sixteen percent of the 13 to 14 year olds sampled indicated that in the past three months they had ridden a motorcycle on the road, an illegal behaviour in Queensland. Further 16% of the Year 9 sample reported that they had been injured in the past three months from motorcycle use, although it is not known if this is on-road or off-road use. Predictors of on-road motorcycle use, included being male, engaging in a number of other risk-taking behaviours, reacting with less self-control of temper, having a higher number of peers who engage in risk-taking behaviour and stronger bonding or attachment to their father. The model for prediction of injuries associated with motorcycling accounted for less variance where it was estimated that around twice the variance was explained. The only significant predictor in this later model was peer engagement in risk-taking behaviour.

The results provided some preliminary data on the rate of on-road motorcycling and injuries among early adolescents over a three month period. Around one in six students indicated that they had ridden a motorcycle on the road in a three month period. In addition, around one in six also indicated that they had been injured riding a motorcycle in the three month period prior to the survey. These

injuries might have occurred from on- or off-road motorcycling. Whilst there is little comparative data from other samples and only a small selection of schools, the rates indicate the importance of understanding adolescent motorcycling and a need for future research regarding the prevalence of motorcycling and related injuries among early adolescents.

The results also provided a preliminary understanding of some factors associated with illegal motorcycling and injuries associated with motorcycling. The factors in the model that predicted on-road motorcycling included being male, engaging in more risk-taking behaviours, having less self-control of one's temper, stronger bonding to one's father and having peers who engage in more risk-taking behaviours. However having a stronger bond to the father is contrary to predictions and perhaps at this age the riding experience is shared with their father who might supply the motorcycle although this is an avenue for future research. The predictor factors do span a wide ecology and are somewhat consistent with the literature predicting adolescent risky driving. Such literature on driving indicates a wide ecology of factors predict the risky behaviour, although in this case it was primarily being male and engaging in other risk-taking behaviours that were most predictive. The presence of these factors increases the likelihood of having engaged in on-road motorcycling three-fold.

The model predicting adolescent injury was less strong and only a single predictive factor was evidenced, peer risk-taking behaviour. The perception of peer behaviour only increased the likelihood of experiencing an injury from motorcycling by 10%. This is somewhat inconsistent with the wide ecology of factors that predict driving risks and crashes however the short time frame and limited information on the seriousness of injuries suggests an avenue for future research.

There are a number of limitations to the present research. Firstly the cross-sectional design limits the explanatory power of the model. It can not be determined whether the factors are causal in nature. Another limitation to understanding the ecology of predictive factors is the lack of inclusion of broader cultural issues. The limited sample of schools restricted an assessment by location and cultural issues were not assessed. The present study was based entirely on self-report measures however it was not possible to use independent confirmation or external sources. Despite this, self-report data can be reliable (Harrell, 1985) particularly with reassurances of confidentiality and focus on recent events, such as the last three months (Nurco, 1985). The data is however limited to the individual's perception of the constructs.

The research design was initially selected to meet the aims of another research project and as such, the current paper is limited by the definitions already chosen. Future research might extend the current findings by examining on- and off-road motorcycle use as well as examining injuries associated with both on- and off-road use. The extension of this research to include an understanding of access to motorcycles, both on- and off-road and levels of exposure⁵ would also be of benefit.

Despite these limitations there is still evidence that early adolescents are engaging in the serious illegal behaviour of riding a motorcycle on-road. There is a clear need for a greater understanding of the adolescents who ride motorcycles and who are injured motorcycling. This study provided an initial indication of some ecological factors associated with these events. Potential interventions, including at a policy level, might be most effective if they address a wide ecology of risk and protective factors and understanding the peer relationship. Further there is preliminary evidence to suggest greater monitoring of motorcycle use at pre-licensing age is warranted.

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⁵ Anecdotal evidence suggested that some of these students may be riding on-road to get to off-road sites.

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