SAFETY IMPLICATIONS OF YOUNG DRIVERS' ATTITUDES, PERCEPTIONS AND BEHAVIOR IN KOREA

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ABSTRACT

The main objective of this study is in-depth investigation of the attitudes, perceptions and behavior of Korean young drivers aged between 18 and 24 years old. Overall 188 survey questionnaire responses were collected to find out significant factors for involvement in crashes and citations in Korea. Binary logistic regression models were constructed to explain young drivers' involvement in at-fault crashes and violations, respectively.

The models' results showed that the involvement in at-fault crashes is positively associated with the annual mileage and dangerous behavior such as running the red light at intersections, using cell phone and exceeding speed limits, but is negatively associated with a desirable behavior, e.g., yielding for pedestrians/bicycles to pass first. It is interesting to note that there were no significant differences in crash involvement between hand-held and hand-free phone usage. Meanwhile the citation model showed that the average car use frequency and risky actions such as adjusting car audio, smoking, eating or drinking while driving, and using the mobile phone while driving are significant factors in increasing the probabilities of traffic violations (citations).

It is concluded that there are several dangerous actions and attitudes that increase the possibility of involvement in crashes and also violations for young drivers in Korea. These results can be used for municipal government's officials, police and driving school instructors to focus on specific items to ameliorate the driving behavior and attitudes which have effects on traffic crashes as well as traffic violations occurring by young drivers.

Keywords: young drivers, driver behavior questionnaire, DBQ, traffic violations, traffic crashes, binary logistic model, Korea

INTRODUCTION

Numerous previous studies have been conducted to identify the young drivers' characteristics that affect the involvement in traffic crashes or traffic violations. However, not many efforts have been conducted to gain in-depth understanding of the specific behavioral problems of young drivers in a rapidly developing country like Korea. According to Korea Transportation Safety Authority and Korea Insurance Development Institute (2006), the crash rate of young drivers is 0.14 and 0.10 per the number of the insured for the 18 to 20 and 21 to 25 years old age groups, respectively. This is far larger than average crash rate of 0.054 in Korea. This high crash rate decreases continuously and converges to the average after the age of 30 years. Thus, it is thought that the higher crash rate of young drivers is one of serious problems in Korea.

The outcomes of major studies on the relationship between age and crash occurrence have shown that young drivers are more likely to be involved in traffic crashes (Broughton, 1988; Williams and Carsten, 1989; Macdonald, 1994; OECD, 2006). The lack of experience, risky behavior, in-vehicle distractions, attitudes towards over-speeding and driving under the influence were found to be among the main reasons for young drivers' crashes (Broughton, 1998; Simons-Morton et al., 2005; NHTSA, 2008; Cooper et al., 2005; Lee and Abdel-Aty, 2008). In Korea, Lee et al. (2005) conducted a questionnaire survey and showed that the driving confidence level of Korean young novice drivers has an effect on their dangerous driving actions. They asserted that 22% of the over-speeding and 12% of the driving under the influence of alcohol related crashes involve young drivers. They also attributed traffic crashes of novice drivers to the driving confidence level. Nevertheless, Peck (1985) and the Office of Road Safety in South Australia (1990) found that drunken driving in the young drivers group was not over-represented compared to the other age groups.

In this study, a driver behavior questionnaire (DBQ) was used. The DBQ questionnaire was first developed by Reason et al. (1990). They used it to test and validate the applicability of the distinction between errors and violations on aberrant driving behavior. Many recent studies have used the DBQ (Davey et al., 2007; Musicant, 2011; Zhao et al., 2012).

SURVEY DESIGN AND ADMINISTRATION

A questionnaire survey was carried out among young drivers aged between 18-24 years old in South Korea in December 2011. The demographic part in the questionnaire includes driver's age, gender, education, driving experience, annual driving mileage, at-fault crash and traffic citations history and types of traffic violations. Number of young drivers' behavior/habits while driving was measured on a five-point scale. These behavior/habits include risky and aggressive violations; in-vehicle distractions; driving under the influence; obeying the law; and driving behavior under adverse weather conditions. Furthermore, self-reported risk perception and risk-taking attitudes were measured on a five-point scale.

The survey targeted a random sample of young drivers in South Korea: Respondents were limited to adults between the ages of 18 to 24 years who have a valid driver's license. Two approaches were used for the survey; the first survey approach was hand-out questionnaires. Two hundred forms were printed and distributed randomly in December 12-16, 2011 among undergraduate students at Ajou University. A total of 158 completed forms were collected. However, 5 forms were disregarded since they had many missing or improper responses. Therefore 147 hand-out surveys' forms were used in the analysis. Also 37 responses were received on-line by the survey's website. Two responses were removed because they were filled out by drivers older than 24 years old. The majority of the responses (81%) were collected by hard copies and 19% of responses were gathered on-line.

DISTRIBUTIONS OF SURVEY DATA

The distributions of the survey data are presented in Table I to show the demographic characteristics, travel patterns, involvement in at-fault crashes and violations, and their reasons.

Table I – Distributions of survey data

Variables	**Categories**	**%**	**Variables**	**Categories**	**%**
Age	19-20 21-22 23-24	12% 43% 45%	Gender	Male Female	78% 22%
Daily transport mode	Car Public Walk/Bike	23% 57% 20%	Car use freq. per week	Daily 4-5 days 2-3 days 0-1 day	3% 7% 29% 61%
Method of learning driving	Driving school Parents Other	92% 6% 2%	Involvement in at-fault crash	Yes No	19% 81%
Reasons of at-fault crash	Lack of experience In-vehicle distraction Other	68% 18% 14%	Traffic violation	Yes No	26% 74%
Types of traffic violation	Over-speeding Red light running Other	68% 10% 22%	Using cell phone while driving	Do not use it Hand-held Hand-free	45% 28% 27%
Dialing while driving	Never When stopping Speed ≤ 50 km/h Speed > 50 km/h	21% 56% 16% 7%	Texting while diving	Never When stopping Speed ≤ 50 km/h Speed > 50 km/h	30% 61% 8% 1%
Following Speed Limits	Follow Exceed	73% 27%			

Regarding the age groups, only 12% of participants were younger people aged 19-20 years old. Meanwhile the 23-24 years old group was 45%, which is the largest proportion. There were no respondents aged 18 years old since most of the freshmen start their undergraduate courses when they are 19 years old in Korea. About 78% and 22% of participants were males and females, respectively. In addition, it was found that public transportation such as bus and subway was the daily mode for the majority of participants (57%), while 23% of the respondents indicated that the private vehicle was their daily travel mode. Furthermore, most of the respondents (90%) use their private cars less than 3 days per week and only 3% of the respondents use their car on a daily basis. The results revealed that the majority of participants (92%) attended a driving school and only 6% of the respondents were taught how to drive by their parents.

With respect to the involvement in at-fault crashes, 19% of the participants were involved in at-fault crashes. The main reasons for these crashes were the lack of driving experience (68%), in-vehicle distractions (18%) and risky or aggressive driving behavior (11%). Concerning the traffic violations, 26% of the respondents indicated that they had received at least one traffic citation. The main types of violations were over-speeding (68%) and red light running (10%).

Furthermore, 55% of the respondents stated that they use the mobile phone while driving: 28% of them use hand-held phones and 27% use hand-free. This result makes sense because hand-held use of cell phone while driving is strictly prohibited in Korea whereas the hand-free is allowed. More than half of the respondents (56%) dial the cell phone and 61% text when stopping at a traffic signal. Regarding how young drivers follow speed limits, the result show that approximately 65% of the participants drive at speed limit.

Concerning participants' behavior/habits while driving, Table II shows that the majority of respondents (approximately 96%) always or often fasten the seat belt while driving. This result is reasonable because using seat belt is mandatory by law. About 7% of the participants indicated that they always or often become angered by another driver and give chase. Moreover, 19% of the respondents stated that they always or often disregard the speed limit on a residential road. Generally, the width of residential roads in Korea is narrower than those in the United States, and the illegal on-road parking in residential areas is one of the serious problems in Korea. Considering that Korea has predominantly mountainous terrain, it is thought that disregarding the speed limit on a residential road is dangerous.

About 12% of participants revealed that they always or often stay in a roadway/lane that they know will be closed ahead until the last minute before forcing their way into another lane. Additionally 5% of the respondents always or often drive so close to the car in front that it would be difficult to stop in an emergency. Moreover, 16% of participants always or often disregard red light on an empty road or late at night. Furthermore, only 2% of respondents always or often drive the wrong way down a one-way street. Although percentages of these five aforementioned behaviors are relatively small they are very risky and may lead to traffic crashes.

Table II – Frequency of driving behavior/habits

Driving Behavior/Habits	**Always or Often**	**Sometimes**	**Rarely or Never**
Use seat belt while driving	96%	2%	2%
Become angered by another driver and give chase	7%	24%	69%
Disregard the speed limit on a residential road	19%	27%	54%
Drive so close to the car in front that it would be difficult to stop in an emergency	5%	27%	68%
Stay in a roadway/lane that you know will be closed ahead until the last minute before forcing your way into the other lane	12%	31%	57%
Disregard red light on an empty road or late at night	16%	28%	56%
Drive the wrong way down a one-way street	2%	9%	89%
Drive in the presence of teen passengers	27%	43%	31%
Yield for other drivers to pass first	46%	41%	13%
Yield for pedestrians/bikes to pass first	72%	24%	4%
Slow down when driving in adverse weather conditions (i.e. reduced visibility due to fog, heavy rain or snow)	81%	15%	4%
Overtake the car in front when it is driving at the speed limit	21%	37%	42%
Slow down at school zones	67%	24%	9%
Accept short gaps while driving (i.e. to change lanes or to merge with traffic)	7%	29%	64%
Drive on a yellow light when it is about to turn red at an intersection	30%	40%	30%
Adjust radio, cassette, or CD while driving	33%	35%	32%
Cross an intersection when the signal just turned red	6%	22%	72%
Adjust a GPS device while driving	26%	34%	40%
Smoke, eat, or drink (not necessary alcohol) while driving	17%	38%	45%
Use cell phone while driving (calling, texting, or using internet, etc.) at normal weather conditions	18%	35%	47%
Use cell phone while driving at adverse weather conditions (i.e., heavy rain, fog, smoke)	10%	20%	70%
Drive under the influence of alcohol	3%	4%	94%
Get involved with unofficial races with other drivers	7%	20%	73%
Drive more cautiously at night	69%	19%	12%
Drive more cautiously in bad weather	80%	16%	4%

In addition, 46% and 72% of respondents always or often yield for other drivers to pass first and yield for pedestrians/bicycles to pass first, respectively. The result shows that the majority of respondents always or often slow down at school zones (67%). Also 81% of respondents always or often slow down when driving in adverse weather conditions such as reduced visibility due to fog, heavy rain or snow. Moreover 69% and 79% of the respondents

stated that they always or often drive more cautiously at night and in adverse weather conditions, respectively.

With respect to aggressive driving behavior of young drivers, 21% stated that they always or often overtake the car in front when it is driving at the speed limit and 7% always or often accept short gaps while driving. Young drivers who always or often drive on a yellow light when it is about to turn red at an intersection was 31%, this proportion is relatively higher than that of the other aggressive behaviors because it is likely perceived that this behavior is not much hazardous. On the other hand respondents who always or often cross an intersection when the signal turned red, which is considered very risky behavior, was 6%. Meanwhile 7% of respondents stated that they always or often get involved in unofficial races with other drivers.

Regarding the in-vehicle distractions while driving, 26% of participants answered that they always or often drive in the presence of teen passengers. It was revealed that the proportion of using the mobile phone while driving depends on the weather conditions. At normal weather conditions, 18% stated that they always or often use the mobile phone while driving whereas only 9% responded that they use the mobile phone while driving in adverse weather conditions. With respect to distractions by in-vehicle devices, 33% indicated that they always or often adjust a car audio while driving and 26% stated that they always or often adjust a GPS device while driving. Seventeen percent of the respondents stated that they always or often smoke, eat or drink (not necessary alcohol) while driving. The results indicated that only 3% of respondents always or often drive under the influence of alcohol. Since alcohol can severely impair a driver's driving ability, this small portion should be considered seriously.

Table III – Descriptive statistics for items measuring risk perception and attitudes

Measuring Item	**Strongly disagree or disagree**	**Neither agree nor disagree**	**Strongly agree or agree**
Risk Perception Scales			
Your probability to be involved in a traffic crash is high.	56%	35%	9%
You are concerned about traffic risks and are thinking that you could be victimized.	13%	23%	63%
Risk-Taking Attitude Scales			
Speed limits may be exceeded to get ahead in traffic	18%	26%	56%
When road and weather conditions are good and no police and no enforcement camera are around, exceeding speed limits is OK	30%	36%	34%

Table III shows measures for the self-reported risk perception and risk-taking attitudes of the respondents. Regarding risk perception, the results indicated that only 9% of respondents stated that they agreed that their probability to be involved in a traffic crash is high whereas more than 60% of respondents are concerned about traffic risks and are thinking that they

could be victimized. Concerning risk-taking attitudes, the results revealed that about 56% of the sample agreed that speed limits may be exceeded to get ahead in traffic and 34% of participants agreed that exceeding speed limits is okay when road and weather conditions are good and no police or no enforcement cameras are around.

METHODOLOGY

In order to explain young drivers' involvement in at-fault crashes and traffic violations, a binary logistic regression model was estimated with the consideration of statistically significant factors.

The formula of the logistic model is as follows (Greene, 2003):

$$Prob(Y = 1|x) = \frac{exp^{X\beta}}{1 + exp^{X\beta}}$$

where β is a vector of the coefficient estimates of the parameters and X is a vector of independent variables. Odds ratio is a measure of association which approximates relative risk or in other words, how much more likely it is for the outcome to be present among those with $x = 1$ than among those with $x = 0$. (Hosmer and Lemeshow, 2005)

DISCUSSION OF RESULTS

Binary Logistic Regression Model for At-fault Crashes

In the model, drivers who were responsible for the crashes (at-fault crashes) versus drivers were not responsible for the crashes were used as a binary outcome. Table IV and Table V summarizes the model results. Three measures of goodness-of-fit of the model, likelihood ratio, score and Wald Chi-square, show the statistical significance of the model at significance level less than 0.001. Regarding predictive power, since c-statistic, the area under ROC curve, has a value of 0.844, it has an excellent predictive ability of discrimination from the random prediction (Hosmer and Lemeshow, 2005). With respect to the significant factors in the model, annual mileage has a positive effect on at-fault crashes. It was found that both yielding for pedestrians/bikes to pass first and following speed limit decrease the probability of involvement in at-fault crashes. Risky behavior of crossing an intersection when the signal just turned red is positively associated with the at-fault crashes. It is interesting to note that both hand-held and hand-free cell phone use while driving are dangerous and no significant differences were found between them. It implies that it is dangerous to use cell phones while driving in all situations. It is thought that using hand-free devices also distract drivers and finally increase the chance of a traffic crash. This result is also consistent with the study of To¨rnros and Bolling (2005).

Table IV – Binary Logistic Regression Model for At-fault Crashes

Parameter	**Estimate**	**Std Err**	**P>ChiSq**
Intercept	-1.5510	0.6136	0.0115
Average mileage per year	0.000200	0.000062	0.0013
Yield for pedestrians/bikes to pass first (1: always or often, 0: other)	-1.3979	0.4637	0.0026
Cross an intersection when the signal just turned red (1: always or often, 0: other)	2.0827	0.7293	0.0043
Cell phone use while driving with hand-held (1: yes, 0: no)	1.0473	0.5992	0.0805
Cell phone use while driving with hand-free(1: yes, 0: no)	1.7313	0.5789	0.0028
Following the speed limit (1: follow, 0: exceed)	-0.8927	0.4642	0.0544*

Table V – Goodness-of-fit and Predictive Power for At-fault Crash Model

Goodness-of-fit Tests	**ChiSq**	**P>ChiSq**	**Predictive Power**	**Statistic**
Likelihood ratio	50.9624	<.0001	c (area under ROC curve)	0.844
Score	50.8372	<.0001		
Wald	29.5602	<.0001		

Binary Logistic Regression Model for Traffic Violations

Drivers who violated traffic regulations versus drivers who did not violate regulations were used as a binary outcome. Table VI and Table VII summarizes the model results. All measures of goodness-of-fit of the model are statistically significant at $\alpha < 0.001$. With respect to the predictive ability, since c-statistic is 0.811, it has predictive ability of the excellent discrimination from random prediction. Regarding parameters, it was found that the car use frequency is positively related to the traffic violation. Moreover, in-vehicle distractions as adjusting the car audio, using the mobile phone at adverse weather conditions and smoke, eat or drinking while driving increaseS the chance to violate the traffic rules for young drivers in Korea.

Table VI – Binary Logistic Regression Model for Traffic Violations

Parameter	**Estimate**	**Std Err**	**P>ChiSq**
Intercept	-2.6910	0.3689	<.0001
Car use frequency per week	0.4124	0.1260	0.0011
Adjust car audio while driving (1: always or often, 0: other)	1.0832	0.4331	0.0124
Smoke, eat, or drink (not necessary alcohol) while driving (1: always or often, 0: other)	0.9342	0.5212	0.0731
Use cell phone while driving at an adverse weather conditions (1: always or often, 0: other)	1.7035	0.6217	0.0061

Table VII – Goodness-of-fit and Predictive Power for Traffic Violations Model

Goodness-of-fit Tests	ChiSq	P>ChiSq	Predictive Power	Statistic
Likelihood ratio	51.4730	<.0001	c (area under ROC curve)	0.811
Score	52.5501	<.0001		
Wald	37.2214	<.0001		

CONCLUSION

The objective of this study is to find out detailed risky behavior, perceptions and attitudes that have effects on the at-fault crashes and traffic violations. Responses from 188 young drivers aged between 18 and 24 years were collected in Korea. Korea has a unique situation since it is one of the rapidly developing countries. Its infrastructure and vehicles are near the developed countries of the west, but the driver behavior and characteristics of the residential and rural areas might still be developing at a slower pace.

The at-fault crash model results revealed that the average mileage per year is positively related to the involvement in at-fault crashes. It is reasonable because the annual mileage is the measure for the driver's exposure and it increases the chance for crashes. On the other hand, it was found that young drivers who yield for pedestrians/bikes to pass first and follow the speed limit are less likely to be involved in at-fault crashes. On the contrary, risky behavior as crossing an intersection when the signal just turned red has a positive association with at-fault crashes. With regard to the mobile phone use, it was found that both hand-held and hand-free cell phone usage while driving are equally and significantly dangerous. Moreover the traffic violation model shows that the car use frequency increases the likelihood of traffic violations, which is reasonable since the car use frequency could also be considered as a measure of exposure. Three in-vehicle distraction factors: adjusting car audio, smoking, eating or drinking, and using mobile phones at adverse weather while driving were found significant for the increased possibilities to violate traffic rules.

It is concluded that there are several dangerous actions and attitudes that increase the possibility to be involved in at-fault crashes and also traffic violations for young drivers in Korea. These results can be used for municipal government officials, police and driving school instructors to focus on specific items to ameliorate the driving behavior and attitudes which have effects on traffic crashes as well as traffic violations by young drivers in Korea.

Although we have found several significant dangerous driving behavior and attitudes, it would be beneficial if we extend our investigation to identify whether those actions originate from certain demographic, socioeconomic, cultural or educational groups within Korea or could be generalized to the whole country or similar rapidly developing countries in south east Asia. Also, whether some of these aspects are unique to the region or a common nature of young drivers worldwide.

REFERENCES

Broughton, J. (1988) The Variation of Car Drivers' Accident Risk with Age. Transport and Road Research Laboratory, Department of Transport.

Cooper, D., F. Atkins, and D. Gillen (2005) Measuring the Impact of Passenger Restrictions on New Teenage Drivers. Accident Analysis and Prevention, 37, 19–23.

Davey, K. J., D. E. Wishart, J. E. Freeman, and B. Watson (2007) An Application of the Driver Behavior Questionnaire in an Australian Organizational Fleet Setting. Transportation Research Part F, 10 (1), 11-21.

Greene, W. H., (2003) Econometric Analysis. Prentice Hall, New Jersey, 5th Edition.

Hosmer, D. G., and S. Lemeshow (2005) Applied Logistic Regression. Wiley, New York, 2nd Edition.

Korea Transportation Safety Authority and Korea Insurance Development Institute (2006), Analysis on Traffic Crash Trends and Countermeasures. Korea Transportation Safety Authority.

Lee, L., and M. Abdel-Aty (2008) Presence of Passengers: Does It Increase or Reduce Driver's Crash Potential? Accident Analysis and Prevention, 40, 1703–1712.

Lee, S., S. Lee, and S. Park (2005) The Effects of Driving Confidence Level on Dangerous Driving Behavior in the Novice Drivers: A Path Analysis Study. Korean Journal of Psychological and Social Issues, 13(3), 111-125.

Macdonald W. A. (1994) Young Drivers Research Program- A Review on Information on Young Driver Crashes. Federal Office of Road Safety, Australia.

Musicant, O. (2011) Measurement of Company Car Drivers' Aberrant Behavior, Safety Attitudes, and Safety Climate Perceptions. Journal of the Transportation Research Board, No. 2248, 21-29.

National Center for Statistics and Analysis (NHTSA) (2008), Traffic Safety Facts: Young Drivers.

Office of Road Safety, Department of Road Transport, South Australia (1990) Involvement of Young and Elderly in Road Crashes in South Australia, A Background Report for the Road Safety Advisory Council's 1990 Public Forum on Road Safety. Government of South Australia.

Organization for Economic Co-operation and Development (OECD) (2006). Young Drivers: The Road to Safety, OECD Publishing, Paris, France.

Peck, R. C. (1985) The Role of Youth in Traffic Accidents: A Review of Past and Current California Data. Alcohol, Drugs and Driving, 1 (1-2), 45-68.

Reason, J., A. Manstead, S. Stradling, J. Baxter, and K. Campbell (1990) Errors and Violations on the Roads: A Real Distinction? Ergonomics, 33, 1315-1332.

Simons-Morton, B., N. Lerner, and J. Singer (2005) The Observed Effects of Teenage Passengers on the Risky Driving Behavior of Teenage Drivers. Accident Analysis and Prevention, 37, 973-982.

To¨rnros, J. E. B., and A. K. Bolling (2005) Mobile Phone Use—Effects of Handheld and Handsfree Phones on Driving Performance. Accident Analysis and Prevention, 37, 902–909.

Williams, A. F., and O. Carsten (1989) Driver Age and Crash Involvement. American Journal of Public Health Briefs, 9 (3), 326-327.

Zhao, N., B. Mehler, B. Reimer, L. A. D'Ambrosio, A. Mehler, and J. F. Coughlin (2012) Exploring the Relationship between the Driving Behavior Questionnaire and Objective Measures of Highway Driving Behavior. In Transportation Research Board 91th Annual Meeting, Transportation Research Board of the National Academics, Washington, D.C.