RESEARCH ARTICLE   OPEN ACCESS

Trace Analysis of Driver Behavior on Traffic Violator by Using Big Data (Traffic Program) in Korea

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ABSTRACT

This study aims to prove the effectiveness of traffic safety education program for traffic violators. Traffic violators who finished the traffic safety education programs were tracked down. In order to analyze the effectiveness of traffic safety education program, traffic violator's data during ten-year period were used. This study analyzed how traffic violators changed their attitudes about traffic law abidance. Also predicted social benefits from traffic safety education program for traffic violators. Effectiveness of traffic accident prevention through traffic safety education program is approximately 93%. In terms of social benefits, it shows more than $12 billion Even though the effectiveness of traffic safety education program represents remarkable results, but this program is made for traffic violators who have already committed traffic offenses in the past. So in order to prevent traffic violations in advance, specific education program for potentially risky drivers is necessary.

Keywords - Traffic Safety Education Program, Traffic Violators, Traffic Accident, Social Benefits.

I. INTRODUCTION

Recently, Korea has been devoting to focus on prevention of traffic accidents through traffic safety facilities improvement and enforcement. However, the driver's road safety awareness is equally as important as the improvement of traffic safety facilities. In traffic accidents, 95% of all accidents are known as human factors (Sabey & Taylor, 1980). Among human factors, the driver who does not have a good driving habits can cause a traffic accident through failure of safe driving. Since traffic accidents are primarily caused by the negligence of the driver, driver's safety awareness will be able to cultivate with education for factors such as drunk driving and failure of traffic light which could cause a traffic accident. Therefore, the role of road safety education which can prevent the car accident in advance can be so important.

So far, even emphasizing traffic safety education, the case demonstrating a quantitative level of the education effect is insufficient, because there are significant difficulties to show the effects of transportation safety training visibly. Training effects are not response immediately right after training, but gradually changing and because changes in the level of traffic safety is different for each individual, changes in attitudes and behavior by individuals occurring after a period of time are difficult to investigate.

However, recognizing the importance of safety and doing efforts to reduce accidents are sympathetic to the people. Thus, through quantifying research about the effect of education to persuade members of society and the attempt to pull up traffic safety culture in Korea to the level of developed countries is needed. With these background and purpose, this study has tracked drivers' changes who were educated by traffic violations during the past 10 years (2003~2012). Comparison of the lead-time by each education, comparison of educational reasons, analysis of re-violation within 10 years after completion of education, and accident occurrence likelihood were analyzed.

II. LITERATURE LIVIEW

2.1 Human Factors of Drivers

1) Mental Load and Stress

Load means the outward force exerted on the structure and thus, psychological load refers to forces outside environment applied to mental abilities such as cognition, memory, and judgement. And stress is defined as the following three methods by the load.

- Physiological responses such as blood pressure rises, the heart beats, and the headache (stress is response)
- External stimuli such as testing, closure, war, and natural disasters (stress is stimulation)
- By the definition of stress in terms of an inappropriate relationship between the individual and the environment, threat to their welfare and well-being to be assessed and burden on their resources or the rated condition to exceed the resource, and the inappropriate relationship among person

According to Kim H. T, et al (2003), experiencing stress results to the following negative consequences. First of all, cognitive function and

normal social relationship can be damaged, and psychological problems and mental disorders often cause and the resulting impacts on traffic violations and accidents. However, stress is not necessarily result in negative consequences only. Some degree of stress caters our needs and with stress experience, the personal growth can be promoted, and today's stress can raise immune system about tomorrow 's similar stress. Küting (1976) concluded that the factors of load/burden on the driving activity refers to the load/burden from traffic conditions (traffic density, running speed), situation (overtaking, curves, diverging, and intersections), driving duration time, driving with drugs. In particular, actions-cell phone calls, food intake, smoking which are not related with driving, results in the dispersion of caution and the increasing psychological load which affect traffic violations and accidents.

2) Factors which affect the Violation of Drivers

According to Road Traffic Safety Association (1998), maturity, patience, impulse control characteristics, attention concentration, driving attitude, and integrity are defined as human factors which affect to driver violations and accidents. Maladaptive aspects of the drivers that human factors explains are represented by antipathy for institutions, desire satisfy and the lack of social adaptation. In Park. J. H., et al. (1997) research, characteristics of schizophrenia, paranoia, scleronychia were highly related with psychological factors involved in a traffic accident by bus drivers among integrity, compliance attitude, responsibility. Moreover, in the same study, drivers who have low levels of integrity and responsibility and negative thinking to driving rules had more accident experiences relatively. In addition, drivers with the high score in schizophrenia, paranoia and hypomania scales were identified to have more violations. Specially, in terms of drinking and driving behavior, Chae. G. M, et al. (2002) reported drivers who had high levels of impulsivity, lack of ability to discriminate the objectivity risk, and social resentment had tried a lot of drinking and driving resulting to accident experiences. Choi. S. J. et al. (2001) showed that overly driving confidence, low risk sensitivity level and characteristics of short-term profit made drivers drunk driving. Human factors related with drunk driving by Choi. M. H. et al. (2004) were identified as impulsivity, non-compliance, lack of patience for the frustration, rule ignoring preference and indifference to their action. In other words, a number of researchers concluded the common factors to drunk driving attempts were low levels of impulse control ability, risk sensitivity, and a spirit of obeying laws.

With respect to speeding and reckless driving, Song. H. S. et al. (2005) suggested driver's anger level was presented as an important cause. That is, drivers with high levels of driving anger attempted to leave the roadway to escape road congestion which leads to increase the likelihood of intervention of car crashes. Based on the simulation results, drivers with high level of anxiety relative to other drivers showed a faster traveling speed and in congestion situation, plenty of attempts of leaving roadway to escape the situation from the result of the large steering wheel deviation and speed deviation. Vingilis, Stoduto, et al. (1994) reported that the level of anger and neurotic of drivers experienced drunk driving accidents was higher than that of drivers experienced no accidents, so that anger and neurotic were the major factors to explain the drunk driving behavior. In terms of certain psychological factors related with dangerous driving behavior in Miles, Johnson (2003)'s research, low level of patience and potential aggression called Type A personality and drivers with strong Type A showed the driving pattern characteristic that 'driving as fast as possible if he/she has a fixed destination or passengers need to calm driver often, or speed of his/her driveway is the slowest'

3) Relation between Violation of Drivers and Human Factors

Lee. S. C. (2006) showed on his research that if age is increasing, levels of violation behavior reduced dramatically. However, the level of errors and error behavior is decreasing and the confidence level of their driving skills and behaviors the elderly thinking was lower than those of young people. Based on the result about elderly driver confidence level by Lee. S. C. et al. (2006), older drivers were confirmed that subjective confidence level was relatively low in terms of physical external environmental (poor weather, the lighting condition driving at night, traffic volume increase, etc.). On the other hands, Parker, et al. (1995) argued that when there was a problem at thoroughness of decision making state, the likelihood of accident increased, and explained that mistaking action was increasing when drivers had no plan or logical thinking.

4) Cause of Accident and Risky Driving Behavior

According to Rotter (1966)'s concept, locus of controls means causal beliefs which individuals percept on the result of their actions and causes and this could be divided by internal control and external control. Abramowitz (1969) showed according to the consequences of the act over control person perceived, generally, people-oriented internal locus of control appeared to be favorable in terms of mental health and stress.

2.2 Traffic Safety Education Program
1) South Korea

South Korea's traffic safety education (in charge of Road Transport Corporation) applies segmental education courses depending on the education target and each course has a different education time and educational contents. When training is completed, certain benefits such as reducing license suspension period and demerit are given, however, education to drivers with license cancellation is a required course to re-acquire the license, which is composed of lecture and audio-visual education. Education time of special traffic safety education consists of at least 4hrs (16hrs at most) and as the reason for education is worsen, education strength is harder. Especially, in the case of 3times drunk driving, lecture and audio-visual education are needed at first and then 12hrs another education including driving simulator will be planed.

2) USA

Driver's education in USA is carried out by Highway Safety Program Manual which is different in each state. In Massachusetts, an education called ASAP (Alcohol & Substance Abuse Program) is proceeded to a first offender. This program is composed of various treatment plans and 32hrs psycho-educational session for a first offender and for two times loser, additional outpatient treatment and probation process are added. In California, laws offender needs to complete specific training in Traffic Violator School instead of monetary penalty and as occasion demands, practical education process is conducted at the facility where the department of motor vehicles set. In addition, a variety of license cancellation education programs such as CRASH in Vermont, DWI program in Texas, and NCADD in North Carolina exist.

3) Germany

Transportation Safety Board carries out improvement programs for young drivers with illegal career in terms of driving. According to the related laws, drivers need to prove their driving abilities through the fact that they are not relevant to accidents and violations during 2years grace periods. Beginning drivers who experienced accidents or violations are assessed with highly dangerous likelihood of accidents.

Group of driver's improvement program consists of 6~12 people and includes debates about 4 subjects and 1-time driving practice, which supports the opportunity for participants to observe their driving behaviors. Especially, inexperienced drivers with DUI are allowed to attend special alcohol safety program to prevent the future DUI.

4) Japan

Japan has a total of 13-segment driver training courses under Road Traffic Act 108. Among courses, traffic safety educations are divided by a short course (6hrs), a middle course (10hrs), and a long course (12hrs) for drivers with suspension from violations or accidents.

2.3 Summary

According to the literature reviews, there are characteristics as follows. In most countries, educations for drivers with accident or violation are not for a punishment, but for a responsibility that drivers could feel about what they did. This way allows them to predict the future consequences of their actions objectively, and is focused on the prevention of accidents. In addition, most of traffic safety training program includes volunteer motivations such as lecture and audio-visual education, and small group discussion and counseling for behavior change. Also, in most developed countries, control of hazard driving behavior is not affected by not only traffic-related knowledge and rational judgment, but also emotional state of drivers. On this basis, we can know the research results related to 'human factors' previously described. Since the greater part of driver's dangerous behavior and violations is related with human factors, systematic approach in terms of human factors is necessary for the traffic safety education. Therefore, the traffic safety education for accident prevention needs to develop diverse programs for drivers to understand the traffic situation correctly and to prepare countermeasures to correct drivers' hazard actions in variety circumstances.

III. DATA ANAYSIS

3.1 Summary of Analysis

To analyze the impact of special traffic safety education supported by Road Transport Corporation for drivers with suspension and cancellation, drivers' data who completed the educations from 2003 to 2012.

Among 3,712,479 cases of education from 2003 to 2012, 20,000 cases were extracted randomly and through the process deleting the case of same driver, total 14,059 cases were chosen as the final dataset, enough for the sample number to represent the number of drivers with completing traffic safety training courses.

Based on the extracted data, a variety of analyses such as personal characteristics, reason for training (violation), and re-education were performed.

3.2 Analysis

1) Persons of Different Sexes

In data used in the analysis, male drivers account for 89.6% (12,591cases) and female drivers do for 10.4% (1,468cases) out of 14,059 cases mentioned previously (Table 1).

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ISSN: 2248-9622, Vol. 6, Issue 1, (Part - 5) January 2016, pp.65-70

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Table 1. Gender of Traffic Safety Education Program Participants

Gender	Frequency	percentage
Men	12,591	89.6
Women	1,468	10.4
Total	14,059	100

2) Percentage of Age

In terms of the age distribution, the mean age based on the 1st special traffic safety training is 40.86 years (S.D=10.36) and all ages are distributed from min. 18 to max 82.

The 30s and 40s drivers have the highest rates of 31.3% and 32.3%, respectively, and 20s and 50s show a similar percentage as 15.0% and 16.9%. In case of over 60s, 4.3% is shown (Table 2).

Table 2. Age of Participants

Age	Frequency	Percentage (%)
10	64	0.5
20	2,111	15.0
30	4,369	31.1
40	4,538	32.3
50	2,371	16.9
60	553	3.9
More than 70	53	0.4
Total	14,059	100.0

3) Educational Experience (Past 10Year)

According to the past 10 years education experience, the number of people with one time education experience is 13,665 (97.2%), those with two-times education experience is 370 (2.6%), those with three-times is 17 (0.1%).

4) Reasons of Traffic Safety Education Program

The result of 1st special traffic safety education analysis shows that the largest proportion of reason for violation is drinking and driving (34.09%) with blood alcohol content 0.05~0.1%. The second largest reason is drunk driving over 0.1% BAC, and signal violation (7.71%), violation of safe driving duties (5.33%), midline involvement (4.95%) in a row (Table 3).

Table 3. Reasons of Traffic Safety Education Program (First) Participation

Reasons	Frequency	percentage
Drunk Driving (0.05%~0.1%)	5,108	34.09
DIW (more than 0.1)	3,747	25.01
Traffic Signal	1,155	7.71
Violation		
Traffic Safety Obligation Violation	799	5.33
Central line Violation	741	4.95
Drunk Driving Offenders	580	3.87
Non-Renewal of Regular Aptitude Test	572	3.82
The Others	2,280	15.22
Total	14,982	100.00

The result of two-times special traffic safety education analysis shows the similar distribution with the one-time's case. The largest proportion of reason for violation is drinking and driving (36.41%) with blood alcohol content 0.05~0.1%. The second largest reason is signal violation (22.79%), violation of safe driving duties (12.73%), midline involvement (10.06%) in a row. The largest proportion of reason for violation in three-times special traffic safety education distribution is signal violation 35.14%), violation of safe driving duties (21.62%), and midline involvement(21.62%), which are similar violation pattern except drinking driving behavior. Finally, in case of four times education, although cases are rare, signal violation (41.67%), and violation of safe driving duties (16.67%) have a higher rate than others, which is similar with the other cases. Based on the results above, the biggest reason for special traffic safety education is drunk driving and the violation rate is decreasing as the education repeats. On the other hands, the frequency of signal violation, violation of safe driving duties, midline involvement are reducing, however, continuous small occurrence happens.

3.3 Analysis of Traffic Violation and Traffic Accident Recurrence

In order to examine the ratio of violations again after the previous education, cross analysis was conducted. In this analysis, traffic violation, drunk driving, and accident offend were divided in terms of classes, because many details existed in violations.
First of all, the result between 1st and 2nd education shows out of 394 people, 104 people undergo retraining with the same violations, 144 does with drunk driving, and 8 does with accident offend (Table 4). That is, out of 394 people in 2nd education, 64% of people (256) undergo training again with the previous violations.

Table 4. Cross-section Analysis of Reasons of Traffic Safety Education Program Participation (First-Second)

Type	Second	Total

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ISSN: 2248-9622, Vol. 6, Issue 1, (Part - 5) January 2016, pp.65-70

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		Traffic Violation	Drunk Driving	Accident Offend	
First	Traffic Violation	104	38	20	162
	Drunk Driving	43	144	7	194
	Accident Offend	20	10	8	38
	Total	167	192	35	394

3.4 Traffic Violation after Traffic Safety Education Program within 10 Years

The data used in this analysis are the education information from 2003 to 2012 so that there was a difficulty to analyze the inhibitory effect of recurrent in accordance with education due to different time of violation happening. Therefore, to analyze the likelihood of re-violation/accident after 10 years of education, driver's data who completed the 1st traffic safety education in 2003 only were used. Out of 1,057 drivers, 950 (89.9%) were male drivers and others (107, 10.1%) were female drivers, and 39.47years was the average age with standard deviation of 10.11. All data were from min. 18 to max. 72.

The average period between initial licensure and 1st education was 10.4 years (3808.9 days, s.d=2409.32) and between 1st and 2nd education was 6.1 years (2241.69 days, s.d=4413.70), and between 2nd and 3rd was 2.9 years (1065.75 days, s.d=798.66), finally, around 1.8 years (653 days) were spent between 3rd and 4th education. Similar average value is shown with those who completed the entire training during 10 years (2003~2012). Status of education completed is 972 (96.2%) at 1st education, 74 (7.0%) at 2nd education, 3 (0.3%) at 3rd education, and 1 (0.1%) at 4th education.
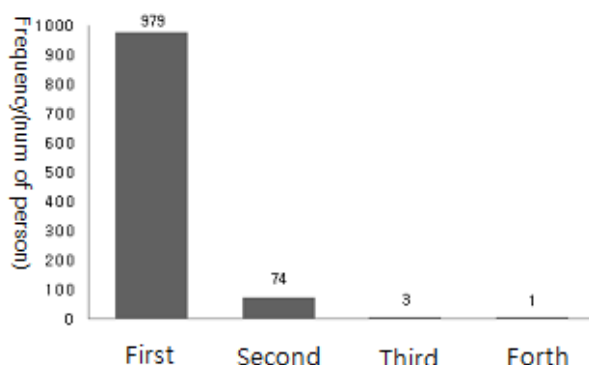

Figure 1 Fig. 1 Number of Traffic Safety Education Program Completion from 2003 to 2012 Year

Based on this result, effect of violation/accident again after 1st special traffic safety education explores that among 1,057 drivers, 78 drivers (7.3%) underg

o retraining after 1st education, and others (92.6%) are shown they did not experience violations or accidents which would be the reason of education.

IV. DISCUSSION AND CONCLUSION

In summary of the analysis on the special traffic safety education effect by Road Transport Corporation during 10 years (2003~2012), prevention effect of re-violations or accidents is around 92.6%. When prevention effect is equivalent to accident cost, huge effect could take place. However, when considering the size of the driver is relatively constant in each year and total accidents in Korea is declined, new influx into special traffic safety education will be continues by dangerous behaviors of those who did not complete the educations

That is, although special traffic safety education is excellent to prevent violation and accident, this program is for drivers who violated rules or committed accidents. On the other hands, those who do not have an experience of this program have a potential danger on the road. Consequently, road traffic corporation should be prepared for the effectiveness of accident prevention through education. Further studies can be needed to evaluate how traffic violators change their attitudes about traffic law abidance based on weather conditions, which is known for severity of car accidents, but very little is known of psychology reasons how affect driver's behavior in weather conditions.

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