

Intervention to Minimize Car Accident Involving Teenagers: Learn from Indonesian Case

Ari Widyanti, Zakiyah Ash-Shofi and Indriyati Sunaryo
Department of Industrial Engineering, Bandung Institute of Technology (ITB),
Ganesa 10, 40132 Bandung, Indonesia

Abstract: This research is conducted to implement behavioral interventions in reducing the number of accidents involving Indonesian teen drivers. Research has been conducted in three steps that are an identification of teen driving behavior, driver behavior intervention in the form of safety driving education program based on risky behavior identified and simulator-based intervention. In the first step, manchester driver behavior questionnaire is used to identify teen's driving behavior involving 292 participants with driving experience at least 1 year. Based on behavior identified in the first step, safety driving education program was given for 27 teens in which pre and post intervention of knowledge and intention were assessed. Post knowledge and intention is assessed right after and after 2 weeks of campaign. In the third step, 30 teens were asked to perform task driving in simulator about 1 h. Penalty point regarding violation committed and feedback regarding safe driving is given after the simulation. Participants were conducting the second simulation after 2 months of the first simulation. Pre and post-knowledge and intention were assessed as well. The result shows that most teens has aggressive behavior violation and ordinary violation. Education program only changes the level of knowledge about safety driving behavior whereas test driving in simulator changes the willingness or intention to drive safer as well as changes behavior as shown in penalty point of simulator driving. Findings from this study can contribute as a reference for future studies investigating behavior intervention in driving in Indonesia as well as in other countries.

Key words: Behavior, intervention, teenagers, education program, simulation-based

INTRODUCTION

Human factor is estimated to be responsible for 85-90% of the traffic accident (Conrad *et al.*, 1996; Lewin, 1982; Rumar, 1985). One aspect of human factors that contribute to the accident is behavior. Researches have been conducted to observe risky driving behavior and theory behind it. The most used theoretical taxonomy of aberrant driving behaviors has been developed by Reason (1990). The taxonomy describes different classes of behavior that are errors and violation. Errors were defined as the failure of planned actions to achieve the intended consequences or the unwanted result of involuntary actions. Violations were defined as deviations from those practices believed necessary to maintain the safe operation or deviations from rules.

Furthermore, researchers divided violations based on the reason why drivers violate: aggressive violations (which contain an interpersonally aggressive component) and ordinary violations (which contain deviations from safe driving without a specifically aggressive aim)

(Reason, 1990). Understanding of risky driving behavior among teenagers and recognizing big loss because of teenager's traffic accidents, many countries launched programs in reducing traffic accidents involving teenager through behavioral approach. For example, Gillan (2006) described behavioral approach through legislative advocacy in the US, Zampetti *et al.* (2013) stated about driver education program in Italy. In the global area, World Health Organization also launched a 'Decade of Action for Road Safety 2011-2020' which followed launch by many countries.

In Indonesia, similar pictures about traffic accident have also been found. In fact, Indonesia own 5th place in the highest traffic accident in the world after China, India, Nigeria and Brazil (WHO, 2013). In the last 2 years, traffic accidents in Indonesia are the third biggest killer as stated by the World Health Organization. Indonesian police release stated that in 2013, 100.106 traffic accidents happened in Indonesia with 26.416 people died in those accidents (BPS Indonesian Statistical Bureau, 2013). The 60% of those accidents is involving teen drivers. Even

more, one national newspaper in Indonesia (Tempo, 2014) reviewed that traffic accidents are the most killing factor for Indonesian teenagers.

To date, attempts have been made by not only Indonesian government but also nongovernment organization to reduce the number of Indonesian teen road accidents. The Indonesian government has a program following WHO program “The decade for road safety 2011-2020” which was launched by vice president of Indonesia in June 2011. Within this program, the Indonesian government has fatality reduction target to 50% by 2020. There are also rules and regulations set by Indonesian government for traffic safety in Indonesia. In the other side, private companies or institutions also participate in reducing teenager’s traffic accident in Indonesia through safety driving campaigns (e.g., safety campaign driving, <http://otomotif.liputan6.com>). It is important to note, however that result of the movement conducted by both the Indonesian government and NGO was not as expected the number of teenager’s traffic accident in Indonesia has not been reduced not to say even increased. It is likely that reason for this unsuccessful of the program may due to its unfit content of education program or campaign and absent of identifying of behavior to be intervened (Widyanti *et al.*, 2013a, b, 2014).

The purpose of this research is to observe Indonesian teenager’s risky driving behavior as well as teenager’s experience with an accident and to conduct an intervention in reducing risky driving behavior among Indonesian teenagers. We compare Indonesian teenager’s risky driving behavior between ones having experience with a traffic accident and ones having no experience with traffic accidents. Based on behavior that is identified between subjects intervention was conducted in term of an education program and a simulation-based intervention.

MATERIAL AND METHODS

Two hundred and ninety two university students in Bandung city involved in the first study voluntarily (mean age = 19.9, SD = 1.4 years, 131 female with at least 1 year experience of driving). Among, 292 participants, 159 participants having at least once experience with traffic accidents. They were requested to fulfill Manchester Driver Behavior Questionnaire (MDBQ). Based on risky driving behavior identified through MDBQ questionnaire an intervention was developed in the context of an education program and a driving task in driving simulator. The 27 teenagers (mean age = 20.06 years, SD = 0.75, 12 female) with

average driving experience 3.48 years were involved voluntarily in the safety driving education program whereas 30 teenagers (mean age = 20.26 years, SD = 1.22, 23 female) with average driving experience 3.68 years involved voluntarily in simulation-based intervention.

Manchester driver behavior questionnaire (25) was used to identify risky driving behaviors of Indonesian teenager driver. MDBQ consist of 4 dimensions that are ordinary violation, aggressive violation, lapses and error. The version used here consist of 27 statements: 8 items related with the ordinary violation, 8 statements related with the errors, 8 statements related with the lapses and 3 statements related to the aggressive violation. Participants were asked to indicate how often they do each violation and error when driving. The responses were recorded on a likert scale ranging from 1 (never) to 6 (nearly all the time). The MDBQ was adapted into Indonesian following back translation procedure as such adaptation is needed when applying such measures in Indonesia (Widyanti *et al.*, 2013; Williams and Freguson, 2004; Sarkar and Andreas, 2004) for reviews.

Targeted behavior to be intervened was determined based on the result of MBDQ described above. Based on targeted behavior, safety driving education was conducted. The content of education was designed as friendly and tested as an easily to be understood. The education program was delivered by an expert in safety driving and ergonomics who has experience in a safety program. A session was run for about 1 h in the form of class and discussion session. To observe the effectiveness of the education program before and after the program, participant’s awareness and intention toward safety driving were assessed by giving 30 questions in which 15 questions related to knowledge about safety driving, 15 questions related to intention to driving safely. The assessment was also conducted 2 months after the educational program to observe the effectiveness of the program. Participants were given similar questionnaire and there was no time limit in answering the questions.

A simulation-based intervention was used as a second media. Participants were asked to participate in a first driving simulation task for 45 min. City car software was used and some variables were set to be similar with common traffic in Bandung City (i.e., traffic density 90%, pedestrian density 30%, rapid traffic, normal condition of weather). In the end of driving simulation task, penalty score based on the violence committed was recorded and presented to participants and then, feedbacks regarding the violence were given to participants to raising their awareness about violence they have committed. The penalty score was given by the city car software, the more the violation of the rule, the bigger penalty point was

given to the participants. The second driving simulation was conducted two months after the first with similar task driving. Penalty score in the second driving task simulation was recorded as well. Participant’s awareness and intention toward safety driving were assessed before the first simulation and after the second simulation.

RESULTS

Mann-Whitney test show that there were not significant differences between people having no experience with traffic accidents and people having experience with traffic accident (all $p > 0.5$) except for Lapses statement “Hit something when reversing that you had not previously seen” ($p < 0.05$) and error statement “Underestimate the speed of an oncoming vehicle when overtaking” ($p < 0.01$). This statistical test is extremely important to determine targeted behavior to be intervened. In addition, targeted behavior is also determined based on the average value of each statement. The average value in which participants having experience with traffic accident higher than people having no experience with traffic accident were determined as targeted behavior to be intervened that were 67% (18 from 27 statements).

The result of education program shows that average correct answer for knowledge pre, post and post 2 months were 8.96 (SD = 2.46), 13.07 (SD = 1.66) and 11.89 (SD = 1.85). The average correct answer for intention pre, post and post 2 months were 10.07 (SD = 2.38), 13.26 (SD = 1.51) and 12.78 (SD = 2.04). Out of 15 statements for assessing knowledge, ANOVA shows that there was significant difference among correct answer for pre-intervention, post-intervention, ad post 2 months intervention ($F(2, 80) = 29.70, p < 0.01, MSE = 4.97$). For intention, there was significant difference among correct answer for pre-intervention, post-intervention, ad post 2 months intervention ($F(2, 80) = 19.67, p < 0.01, MSE = 4.05$).

For simulation-based intervention, the average correct answer for knowledge pre, post and post 2 months were 8.70 (SD = 2.18), 10.87 (SD = 1.72) and 11.07 (SD = 1.41). The average correct answer for intention pre, post and post 2 month were 9.00 (SD = 2.35), 12.73 (SD = 2.10) and 12.70 (SD = 1.53). Penalty point before and after 2 months driving task in the simulator are 49230 (SD = 24010) and 27300 (SD = 14120). Out of 15 statements for assessing knowledge, ANOVA shows that there was a significant difference among correct answer for pre-intervention, post-intervention and post 2 months intervention ($F(2, 89) = 15.96, p < 0.01, MSE = 51.68$). For

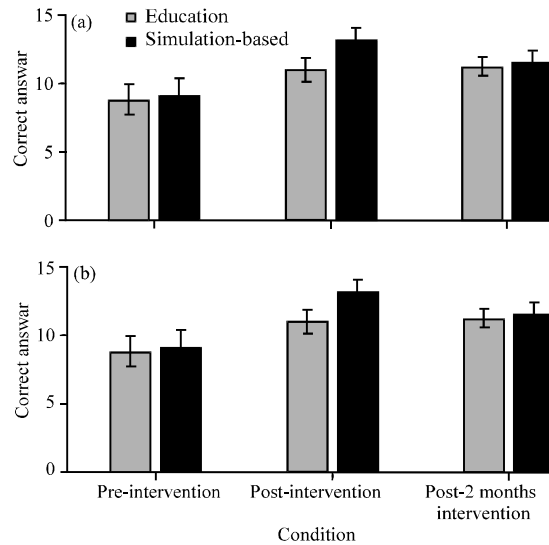


Fig.1: Average correct answer for pre, post and post 2 months-intervention of education program (upper) and simulation-based intervention (lower), both for knowledge and intention. Error bars represent standard deviation: a) Knowledge level and b) Intention

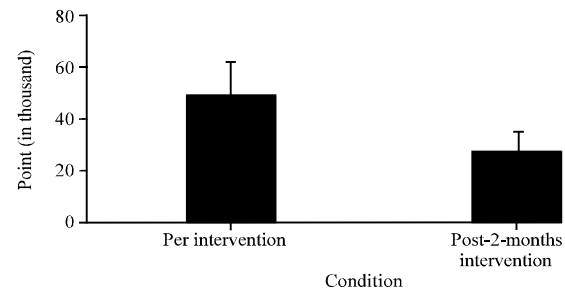


Fig. 2: Penalty point pre and post-2-months in simulation-based intervention. Error bars represent standard deviation

intention, there was significant difference among correct answer for pre-intervention, post-intervention, ad post 2 months intervention ($F(2, 89) = 33.74, p < 0.01, MSE = 138.14$). Paired sample test shows that there was significant difference between penalty point before and 2 months after simulation ($t(29) = 7.70, p < 0.01$). Figure 1a and b show the correct answer for pre, post and post 2 months intervention for intention aspect both for the education program and the simulation-based intervention. Whereas Fig. 2 shows the penalty point during the simulation-based intervention and 2 months after the intervention.

To observe the different effectiveness of the method of intervention between the educational program and the

simulation-based intervention, separate mixed ANOVAs with method of intervention (education program or simulation-based intervention) as a between subjects factors and condition (pre, post and after 2 months post) as a within-subjects factor were carried out for knowledge and intention. The effect of the intervention was significant for knowledge score ($F(2,110) = 78.09, p < 0.01, MSE = 2.07$) in which the educational program give an average score higher than the simulation-based intervention however, the intervention effect was not significant for intention score. The intervention x condition interaction was significant for knowledge ($F(2,110) = 6.87, p < 0.01, MSE = 14.24$), however was not significant for intention.

DISCUSSION

The aim of this study is to observe teenagers driving behavior in Indonesia as well as traffic accident experience and to implement an intervention in the form of the education program and feedback in simulation-based intervention. Results show that there were no significant differences between behavior of teenager (in which assessed using Manchester Driver Behavior Questionnaire/MBDQ) who have experience with traffic accidents and behavior of teenager who have no experience with traffic accidents, except for lapses statement "Hit something when reversing that you had not previously seen" and error statement "Underestimate the speed of an oncoming vehicle when overtaking". It is likely that teenagers with no experience with traffic accident took extra caution about the estimation of speed. The fact that risky driving behavior of participants having experience with traffic accidents were higher than participants having no experience with traffic accident is in line with other studies. For example, a study conducted by West and Hall found that drivers who were more accepting of risky driving behaviors were more likely to engage in dangerous driving and were involved in more accidents.

Behavior intervention, both the education program and simulation-based intervention were designed based on risky driving behavior as a result of MBDQ. Behaviors which were differentiating participants with and without an experience of a traffic accident and behavior with average value >3 were chosen as a focus of intervention, instead of trying to intervene all kind of driving behavior. Focusing behavior to be intervened is particularly important. As stated by William and Ferguson (2004) addressing behavior to be intervened is a part of successful factors in driver behavior approach in reducing traffic accident.

As expected, both the education program and simulation-based intervention give better knowledge and intention comparing with existing condition before the intervention. This result is supported result from the previous study that education program gives better knowledge of safety driving as well as simulator study (William, 2013). In addition, education program conducted in a session in the classroom shows a higher level of knowledge than the simulation-based intervention. It can be explained from experiment nervous point of view in which Indonesian participants usually feels unrelaxed during experiment or simulation study Johnson and Widyanti (2011), Widyanti *et al.* (2013), Johnson and Widyanti (2011) for a review so that result of post-assessment are not as expected.

For education program, knowledge and intention post 2 months is lower than knowledge and intention right after assessment. This can be explained that it seems that simply addressing traffic safety in a short-term education in class does not appear to be enough to curtail reckless driving behavior (Sarkar and Andreas, 2004). Time of assessment also plays an important role in this case since it is likely that what have been described during education program could not retrieve by participants after 2 months of education program similar to right after assessment, due to forgetting aspect in memory that gradual and continuously time by time after education program.

For simulation-based intervention, the level of knowledge in post 2 months simulator study is higher than in right after assessment. As stated by Williams (2004) comprehensive programs have worked better than those based on single approach. It is likely that simulation-based intervention that previously started by education programs work more effective as shown by the level of knowledge that higher in 2 months of intervention comparing with right after assessment.

The reason for using simulation-based intervention is that there are many studies using a driving simulator for driver behavior intervention and the result was promising in changing such behavior (Fricke *et al.*, 2015; Wang *et al.*, 2010). In addition while using self-report (e.g., questionnaire) may have weaknesses, simulation-based intervention are giving an objective result. Furthermore, in Indonesia the use of simulator for various purposes is gaining a big attention therefore, it is crucial to observe behavior and possible behavioral changing in simulator study.

Second simulation-based intervention has not been done right after feedback because it would be too long for simulation session. For a long simulation session, there is a possibility that performance as shown by penalty point, will be influenced by other uncontrollable factors such as

fatigue. In addition, 2 months interval of simulator task is designed to observe the effect of simulator study and the feedback on the knowledge, attention and behavior of participants. The result of task driving simulator shows that penalty point after 2 months intervention was significantly decreased, meaning that behavior of participants is safer.

CONCLUSION

In general, it can be concluded that interventions both education program and simulation-based intervention gave influence in increasing knowledge of participants about safe driving. In addition for simulation-based intervention, feedback mechanism give influence in safety behavior in which errors represent by penalty point is lower after feedback in simulator study than before the simulation-based intervention. The results are coherent with other studies (Sarkar and Andreas, 2004; Fricke *et al.*, 2015; Wang *et al.*, 2010). In particular, Zampetti *et al.* (2013) also stated that such campaigns or education program are important to raise awareness but that they should be supplemented with complementary activities in order to be really effective. Fyhri (2012) also stated that education program will not give an instant result. Improved behavior can only be achieved with interventions that quite resource demanding and extensive and must be fulfilling criteria for success that are challenge minds and not repeating.

This study has limitations worth noting. First, there is an unbalanced number between male and female participants in this study therefore, analysis based on gender has not been done. However, it is worth noting male driver having more risky driving behavior than female (Rhodes and Pivik, 2011). Secondly, intervention conducted in this study is only limited on an education program and simulation-based intervention. Despite the fact that some research proposes a new approach to reduce teenager's accident for example through parents and peer role than education program or campaign solely, however due to several limitation, the new approach is not applied in this study.

This study is very important in order to minimize teenager traffic accident in Indonesia. As Rowe *et al.* (2013) stated driver learning period might be a particularly good time for an intervention. In addition, Jessor *et al.* (1997) stated that there is evidence that violations become less common with maturation, from adolescence to adulthood. Some studies also stated that violation frequency increased over the first three years of driving (Roman *et al.*, 2015). For all mentioned reasons, intervention for teenagers as conducted in this study is crucially important as an effort in reducing Indonesian

teenager traffic accident. This study gives significant contribution for stakeholder who have an interest in Indonesian teenager's safety program, in particular to make such efforts work more effective. Finding of this study also could give in-depth analysis of similar facts in other developing countries in particular in Asia who face the similar problem with teenager's safety driving behavior.

REFERENCES

- BPS Indonesian Statistical Bureau, 2013. Traffic accident in Indonesia. BPS Indonesian Statistical Bureau, Indonesia. www.bps.go.id/.
- Conrad, P., Y.S. Bradshaw, R. Lamsudin, N. Kasniyah and C. Costello, 1996. Helmets, injuries and cultural definitions: Motorcycle injury in urban Indonesia. *Accident Anal. Prevention*, 28: 193-200.
- Fricke, N., S. Griesche, A. Schieben, T. Hesse and M. Baumann, 2015. Driver behavior following an automatic steering intervention. *Accid. Anal. Prev.*, 83: 190-196.
- Gillan, J.S., 2006. Legislative advocacy is key to addressing teen driving deaths. *Inj. Prev.*, 12: 44-48.
- Jessor, R., M.S. Turbin and F.M. Costa, 1997. Predicting developmental change in risky driving: The transition to young adulthood. *Appl. Dev. Sci.*, 1: 4-16.
- Johnson, A. and A. Widyanti, 2011. Cultural influence on the measurement of mental workload. *Ergon.*, 54: 509-518.
- Lewin, I., 1982. Driver training: A perceptual-motor skill approach. *Ergonomics*, 25: 917-924.
- Reason, J., 1990. *Human Error*. Cambridge University Press, Cambridge, UK., ISBN: 0-521-31419-4, Pages: 305.
- Rhodes, N. and K. Pivik, 2011. Age and gender differences in risky driving: The roles of positive affect and risk perception. *Accident Analysis Prevention*, 43: 923-931.
- Roman, G.D., D. Poulter, E. Barker, F.P. McKenna and R. Rowe, 2015. Novice drivers individual trajectories of driver behavior over the first three years of driving. *Accid. Anal. Prev.*, 82: 61-69.
- Rowe, R., B. Maughan, A.M. Gregory and T.C. Eley, 2013. The development of risky attitudes from pre-driving to fully-qualified driving. *Inj. Prev.*, 19: 244-249.
- Rumar, K., 1985. The Role of Perceptual and Cognitive Filters in Observed Behavior. In: *Human Behavior and Traffic Safety*, Evans, L. and R.C. Schwing (Eds.). Springer, Berlin, Germany, ISBN: 978-1-4612-9280-7, pp: 151-170.

- Sarkar, S. and M. Andreas, 2004. Acceptance of and engagement in risky driving behaviors by teenagers. *Adolescence*, 39: 687-700.
- Tempo, 2014. Traffic accidents are the most killing factors in Indonesians teenagers. Tempo, Indonesia. <http://www.tempo.co/read/news/2014/01/23/063547539/Kecelakaan-Penyebab-Utama-Kematian-Remaja>.
- WHO., 2013. Global Status Report on Road Safety 2013: Supporting a Decade of Action. World Health Organization, Geneva, Switzerland, Pages: 237.
- Wang, Y., W. Zhang and G. Salvendy, 2010. Effects of a simulation-based training intervention on novice drivers hazard handling performance. *Traffic Inj. Prev.*, 11: 16-24.
- Widyanti, A., A. Johnson, D. de Waard, 2013a. Adaptation of the rating scale mental effort (RSME) for use in Indonesia. *Int. J. Ind. Ergon.*, 43: 70-76.
- Widyanti, A., D.D. Waard, A. Johnson and B. Mulder, 2013b. National culture moderates the influence of mental effort on subjective and cardiovascular measures. *Ergon.*, 56: 182-194.
- Widyanti, A., I. Sunaryo and A. Kumalasari, 2014. Reducing the dependency on rice as staple food in Indonesia-a behavior intervention approach. *J. ISSAAS.*, 20: 93-103.
- Williams, A.F. and S.A. Ferguson, 2004. Driver education renaissance?. *Inj. Prev.*, 10: 4-7.
- Zampetti, R., G. Messina, C. Quercioli, F. Vencia and L. Genco *et al.*, 2013. Nonfatal road traffic injuries: Can road safety campaigns prevent hazardous behavior? An Italian experience. *Traffic Inj. Prev.*, 14: 261-266.