Risky-driving behavior and its relation with eco-driving behavior based on an adapted Manchester Driving Behavior questionnaire

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Abstract. Eco-driving behavior can be influenced by technical aspect, environment, how people perceived it as a need, and how people acted while they driving. Driving style not only relates to a risk that people may involve but it also may relate to preserving the eco-driving behavior. This study proposed a quantification of the behavior along with risky drivers’ behavior. The study involved a number of residents in some cities in Indonesia and conducted using a translated Manchester Driving Behavior questionnaire (MDBQ). About 89 collected filled questionnaire (68.5% male, 31.5% female) analyzed in this study. Based on reliability and validity test, questions Q2, Q3, Q8, Q10, and Q15 removed from further analysis, with final Cronbach’s alpha value = 0.946. There were 12 questions that similar with an eco-driving behavior on the adapted MDBQ (as variable 1), and the remaining 33 questions treated as variable 2 which represented a risky driving behavior. This study showed that the participants has low to medium level of risky behavior and medium eco-driving behavior. The statistical test revealed a significant correlation between those variables ($r = 0.727; p<0.01$). It confirm that less eco-driving behavior (indicated by higher answer’s score) has a close relation with risky driving behavior. Increasing awareness of safe driving during eco-driving behavior training is suggested, and hopefully, it will increase the training success rate in long-term in the formed the expected behavior.

Keywords: driving behavior, risky driving, eco-driving behavior, MDBQ

1. Introduction
An eco-driving behavior nowadays is an option for reducing vehicle energy consumption [1], but maintain this behavior is not that simple [2]. Some effort such as a training and campaign carried out to form the new behavior [3][4][5] by company or government. Based on previous research, the effort did have an impact to increase the behavior adoption. Unfortunately, in some case, the new behavior was degraded after a while [2]. A long-term support after completing training for the driver is necessary to reinforce changes in the driver behavior [4] as well as pre-intervention motivation or supervisor support [1].

How an eco-driving perceived also draw the attention of the researchers [1][6][7]. Other researcher seeing the psychological aspect as a study’s point of view [8], or technologies aspect which is closely related to energy efficiency itself in eco-driving [4][9][10]. Other research emphasized driving behavior (eco and non-eco) and how the behavior induce the risk during driving [11-12]. At some
point, the risky driving behavior itself can cause energy wastage such as the act when brake too quickly, steer the wrong way in a skid, not really pay attention to the road and missed the exit/entrance, etc. Even though eco-behavior is the last priority consideration after safety and time savings [13], in contrary a risky behavior is persistent and relatively difficult to change. The behavior (non-eco driving) may also have similar persistent to change and it suspected has relation with daily style in driving.

Eco-driving is the name of driving techniques that intended to reduce economic and environmental costs, and the strategy to aim it namely cussing and coasting [14]. The first strategy involves a low number of changes in traction settings and less braking that leads to lower maintenance costs. The second strategy has the lowest energy usage when a significant fraction of the braking power is recuperated and no traction resistors are used [14]. While drive safely belongs to a low-risk driver with good observation, speed management, and road positioning skills which similar with a description of the action in reducing fuel consumption in driving or eco-driving behavior.

Generating an eco-driving style could be difficult. Non-eco driving style may associate with the risky driving style. Understanding the similarity between eco-driving and risky driving can be used to formulate some action to develop the habit. This study tried to focus on how risky the driving behavior of some Indonesian citizen and analyze it relation with eco-driving style. In this study a translated Manchester Driving Behavior Questionnaire (MDBQ) was adopted. This questionnaire widely used in driving behavior assessment, and in the MDBQ the driving behavior measures thoroughly [15].

2. Subject and methods

2.1. An Adapted MDBQ
An original MDBQ that consists of 50 questions was translated into Bahasa. This adapted questionnaire use 1-6 Likert scales to measure how often the behaviors carried out by participants. The questionnaire distributed online using social media to an online-taxi-driver community, automotive-community (employee) and distributed directly to taxi/public transportation drivers.

2.2. Participants
The questionnaire circulated in Mei-June 2018. There are 89 participants filled out the questionnaire (68.5% male, 31.5% female). Among them 35.7% of participants are under 30 years old, 27.1% between 30-39 years old, 24.3% between 40-49 years old, and 12.9% older than 50 years old. About 45 participants are taxi /public transport driver (as Group1), and the rest are employee (as Group2).

2.3. Statistical Analysis
Internal consistencies of the questionnaire were calculated using Cronbach’s alpha coefficients. Five questions removed and resulting final Cronbach’s alpha 0.946 for the adapted questionnaire. Student t-test was used to ascertain the significance of differences between mean values of two group participants (commercial driver and citizen). The level p<0.05 was considered as the cut-off value for significance.

Among 45 questions, there were 12 questions that similar with an eco-driving behavior on the adapted MDBQ (as the variable 1), and the remaining 33 questions treated as the variable 2 which represented a risky driving behavior. Variables 1 consist of Q5, 9,13,14,17, 21, 30, 33, 36, 38, 40, and 49. The simple correlation between the variables is measured using Pearson product moment.

3. Result and discussion

3.1. Result
The MDBQ was designed to measure how often certain behavior carried out from never to nearly all the time (1-6). Each question describes how often the negative behavior occurred. The high score reflected a higher driving risk. Internal consistencies of the questionnaire result were calculated using
Cronbach’s alpha coefficients. Question 2, 3, 8, 10, and 15 removed after Bivariate Pearson conducted. The final Cronbach’s alpha coefficients of 45 questions were 0.946. The removed questions are:

- Q2: Check your speedometer and discover that you are unknowingly travelling faster that the legal limit
- Q3: Lock yourself out of your car with the keys still inside
- Q8: Forget where you left your car in a multi-level car park
- Q10: Intend to switch on the windscreen wipers, but switch on the lights instead, or vice versa
- Q15: Forget which gear you are currently in and have to check it

Average score and standard deviation (s) of 45 questions for each group per variable shown at Table 1 below:

| Eco-driving | Group1 (x ± SD) | Group2 (x ± SD) | Risky driving | Group1 (x ± SD) | Group2 (x ± SD) | Risky driving | Group1 (x ± SD) | Group2 (x ± SD) |
|-------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|----------------|
| Q5          | 2.59±1.18      | 2.59±1.21      | Q1           | 2.58±1.21      | 1.68±0.94      | Q29          | 3.29±1.22      | 1.79±1.04      |
| Q9          | 3.21±1.09      | 2.53±0.90      | Q4           | 3.00±1.37      | 2.94±1.07      | Q31          | 2.06±0.85      | 1.82±1.44      |
| Q13         | 2.5±1.23       | 2.03±1.34      | Q6           | 2.76±1.18      | 1.97±1.14      | Q32          | 1.41±0.49      | 1.44±0.56      |
| Q14         | 3.09±0.90      | 2.18±0.94      | Q7           | 2.73±1.35      | 2.79±1.32      | Q34          | 1.86±0.82      | 2.06±0.81      |
| Q17         | 2.79±0.98      | 2.53±1.16      | Q11          | 2.41±0.96      | 1.53±0.66      | Q35          | 3.26±1.26      | 2.74±1.21      |
| Q21         | 2.85±1.49      | 2.62±1.33      | Q12          | 2.11±1.03      | 1.62±0.78      | Q37          | 2.97±0.99      | 1.79±0.73      |
| Q30         | 2.71±1.17      | 2.15±0.89      | Q16          | 3.38±1.37      | 3.56±1.21      | Q39          | 2.91±1.14      | 1.76±0.70      |
| Q33         | 2.44±1.16      | 2.56±0.99      | Q18          | 3.44±1.31      | 2.41±0.86      | Q41          | 1.79±0.85      | 1.53±0.71      |
| Q36         | 2.62±0.95      | 1.76±0.70      | Q19          | 2.76±1.33      | 2.62±1.13      | Q42          | 2.32±1.01      | 2.00±0.92      |
| Q38         | 2.73±0.89      | 2.00±0.74      | Q20          | 2.42±1.26      | 1.76±0.85      | Q43          | 3.17±1.21      | 1.41±0.74      |
| Q40         | 2.24±1.07      | 1.44±0.74      | Q22          | 2.26±1.13      | 1.76±1.16      | Q44          | 3.09±1.64      | 2.00±1.21      |
| Q49         | 1.53±0.75      | 1.56±0.61      | Q23          | 1.86±1.07      | 1.76±0.92      | Q45          | 2.41±0.89      | 2.12±0.95      |
| Q42         | 3.09±0.87      | 2.24±1.21      | Q24          | 2.29±0.97      | 1.85±0.93      | Q46          | 2.21±0.77      | 1.76±0.74      |
| Q25         | 2.08±0.96      | 1.29±0.72      | Q26          | 2.08±0.96      | 1.29±0.72      | Q48          | 1.97±0.94      | 1.97±1.00      |
| Q27         | 2.35±1.15      | 2.00±1.15      | Q28          | 2.42±0.89      | 1.59±0.61      |

*Note: group (1=taxi/public transportation driver; 2=citizen/employee)*

Most answers of each question are 2 (hardly ever) to 3 (occasionally) as table 1 shown. It can be concluded that level driving risk among them is relatively medium. The average scores of variable 1 and variable 2 of Group 1 relatively higher than Group 2. This indicates that Group 1 has less eco-driving behavior and higher risky behavior compare to Group2. This indication confirmed by two question with average answer > 3 by Group 1 for variable 1 which is Q9 (Distracted or preoccupied, realize belatedly that the vehicle ahead has slowed, and have to slam on the brakes to avoid a collision) and Q14 (Miss your exit on a motorway and have to make a lengthy detour). While the answered for variable 2 by Group 1 consist of eight questions with average answer > 3, and only one question (Q16) with similar average answered by Group 2. The 8 questions are:

- Q4 : Become impatient with a slow driver in the outer lane and overtake on the inside
- Q16 : Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances
- Q18 : Take a chance and cross on lights that have turned red
- Q24 : On turning left, nearly hit a cyclist who has come up on your inside
- Q29 : Park on a double-yellow line and risk a fine
- Q35 : Overtake a slow-moving vehicle on the inside lane or hard shoulder of a motorway
- Q43: Deliberately drive the wrong way down a deserted one-way street
- Q44: Disregard red lights when driving late at night along empty roads

A significant of difference between two-group and their behavior tested using t-test as shown in next table (Table 2).

| Comparison test                      | t value | Sig. (2-tailed) |
|--------------------------------------|---------|-----------------|
| Eco-driving behavior Between Group   | 4.505*  | 0.000           |
| Risky Behavior between Group         | 2.185*  | 0.036           |

* p value < 0.05

Significant differences exist between Group 1 and Group 2 related to Eco driving behavior and Risky Behavior. The result confirmed that taxi/public transportation’ driver (Group 1) has difference behavior compare to the employee (Group 2) based on items test of eco-driving (variable 1) and items test of risky behavior (variable 2). Group 1 relatively has less eco-driving behavior and more risky behavior compared to Group 2 as seen in Figure 1a–b.

![Risky behavior level comparison](image_url)

Figure 1.a Comparison between groups: Risky behavior
As mentioned before, drive safely are able to minimize risks in the road and also has similar activity with eco-driving, thus the association between them may stand. In this study relation between variable 1 with variable 2 estimated using Pearson correlation. The test revealed a significant correlation between two variables ($p$ value $< 0.01$) with Pearson product-moment correlation value 0.795. The value is higher than 0.7 which means the correlation is categorized as a strong relation (see Figure 2). This result verifies the initial hypothesis that eco-driving has a correlation with risky driving behavior. In addition, test between gender showed there is no differences behavior among them ($t$-value: 0.045). The significant differences also exist between the age group of under 30 years old with the age group 40 to 49 years old, and with age group over 50 years old. However, risky level of their behavior can be categorized into medium or similar for all group.

Figure 2. Plot Diagram of total score risky and eco behavior
3.2. **Study limitation**

This study gives strong result about the correlation between risky behavior and eco-driving behavior. However, the analysis does not cover 50 items test on MDBQ. The 5 questions excluded from analysis can be due to lack of proper language used or conditions/activities that are considered irrelevant. For further research, the revised version of the questionnaire is suggested.

4. **Conclusion**

The driving behavior of participants can be categorized into medium level risk, and when comparison conducted between two groups, the taxi/public transportation driver has higher risky behavior compared to the employee who drives a vehicle. The participants’ eco-driving behavior is in the medium level with the employee as a group with the higher level of behavior. A strong relation between this two behaviors is confirmed in this study. Thus the efforts to improve driving safely can be joint with an improvement of eco-driving behavior. The differences among gender also should take into consideration to increase the impact of the program.

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