The differences of workload, fatigue, emotional intelligence and driving behavior based on age, experience, time on task per trip among Indonesian inter-city bus drivers

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Abstract. One of the factors affecting road accidents is driving behavior. The driving behavior influences by demographic aspects, fatigue, work condition, and others. To correct a behavior tendency, it is important to enhance the understanding of the influence of the demographic aspect to some factors related to the behavior tendency. This study was intended to measure the effect of age, driving experience, and time on task per trip to the workload (WL), fatigue (F), recovery needs (KP), and emotional intelligence (EI) as factors that influence driving behavior (DD). A set of questions as a research instrument was composed based on various literature. The instrument distributed to inter-city bus drivers from several bus companies. A total of 201 respondents to questionnaires were obtained, but only 167 data processed further. The reliability of this instrument is quite good as indicated by the Cronbach alpha of 0.733 and the significant internal consistency result. The Kruskal Wallis test result showed that there were no differences among the above variables based on age groups (<35 y, 35-45 y, and >45 y). However, emotional intelligence differed between driving experience groups (<5 y, 5-10 y, >10 y) and between time on task per trip (<3 hr, 3-5 hr, >5 hr). The fatigue level also expressed differently of times on task per trip. Based on the result, it suggested to include emotional intelligence assessment in a corrected tendency behavior. The result also emphasized on time on task as a primary factor in fatigue mitigation to minimize risk accident.

Keywords: workload, fatigue, emotional intelligence, driving behavior, bus drivers

1. Introduction

The studies that discussed driving behavior were motivated by behavior complexity and its effect on road accident risks [1]. Measuring behavior is critical to building a system that attempts to correct or minimize the risks. The behavior can be measured using a questionnaire or other technology that records driving activities. Among another measurement, the questionnaires are the most common tools to assess behaviors and emotions associated with driving such as Driver Behavior Questionnaire (DBQ) and the Dula Dangerous Driving Index (DDDI), Multidimensional Driving Style Inventory (MDSI), Propensity toward Angry Driving (PAD), and others [2-7]. Driving activities that common measures using technology such as speed/speeding, lane driving, steering wheel tendency, and other driving performance. Compare to another measurement, the questionnaires relatively easy to use, inexpensive and less time-consuming. However, considering that driving behavior is not only seen as an independent action when it performed but also influenced by other factors, it's important the questionnaire not only measures the tendency behavior itself but also the factors that...
The behavior can be influenced by age, experience, gender, health, personality, fatigue, stress, and others [4, 8, 9, 10, 11]. The age differences imply the factors of emotional maturity, lack of experience, the presence of a peer, and the search for excitement as contributory factors to the risky behavior [11-12] Work stress and psychosocial factors were also mentioned as contributory factors to certain behavior [4,9,13]. Driving behavior also shaped by a type of personality that not related to age [12]. Some people have less fear and seek excitement in the street and tended towards very risky driving behavior. Other factors such as fatigue and need for recovery may induce careless behavior and an increased risk of accidents [9,14].

Among those factors mentioned above, emotional intelligence has been discussed less by researchers. Emotional intelligence itself is often associated with the ability to understand oneself, emotional management and empathy. Emotional intelligence determines our potential to learn practical skills based on self-awareness, self-regulation, motivation, empathy, and social skills [15].

To date, studies that explored and combined factors such as workload, fatigue, emotional intelligence and driving behavior and its relation with age, year of experience, and time on task are still limited. This study aimed to address this gap by evaluating similarities and differences dimension that measures by most commonly used-questionnaire including the most factors related to the behaviors. By this study a build-up comprehending factors that specify certain behavior that increasing accident-risks hopefully can be captured. Age, year experience and time on task were considered as differentiating factors to the behavior.

2. Methodology

2.1. Contribute factors and item test

To develop the research, a literature study was conducted to list contributing factors for driving behavior. In this research, several factors were chosen to confirm previous findings. The factors in several studies that related to personal and demographics aspects were presented in Table 1 as follows:

| Influenced factor | Useche 2017 [8] | Mekonnen 2019 [16] | Lancaster & Ward, 2002 [17] | Ouimet 2015 [9] | Fountas 2019[8] | Bates 2014 [18] | Focus on this study |
|-------------------|----------------|-------------------|-----------------------------|----------------|----------------|----------------|-------------------|
| Age               | -              | √                 | √                           | -              | √              | √              | √                 |
| Gender            | -              | -                 | √                           | -              | -              | -              | -                 |
| Education         | -              | -                 | √                           | -              | -              | -              | -                 |
| Personality       | -              | -                 | √                           | -              | -              | -              | -                 |
| Aggression        | √              | -                 | √                           | -              | -              | -              | √                 |
| Experience        | -              | √                 | √                           | -              | √              | √              | √                 |
| Decision-making ability | -        | -                 | √                           | -              | √              | -              | -                 |
| Driving skills    | -              | -                 | √                           | -              | -              | -              | -                 |
| Attitude          | -              | -                 | √                           | -              | -              | -              | -                 |
| Risk perception   | -              | -                 | √                           | -              | -              | -              | -                 |
| Social deviance   | -              | -                 | √                           | -              | -              | -              | -                 |

There are 11 factors mentioned in previous studies that categorized into personal and demographics aspects but only 4 factors consider in this study. The factors such as decision-making ability, driving skills, attitude, and social deviance were not including in this study because of those factors more
suitable to measures by other tools. Literature result about the other factors that affected the behavior, listed in Table 2 below:

| Influenced factor          | Useche 2017 [8] | Mekonnen 2019 [16] | Lancaster & Ward, 2002 [17] | Ouimet 2015 [9] | Fountas 2019 [9] | Bates 2014 [18] | Focus on this study |
|---------------------------|----------------|--------------------|-------------------------------|----------------|-----------------|-----------------|-------------------|
| Fatigue                   | √              | -                  | √                            | -              | √               | -               | √                 |
| Stress                    | -              | -                  | √                            | -              | -               | -               | -                 |
| Workload                  | √              | -                  | √                            | -              | -               | -               | √                 |
| Need for recovery         | √              | -                  | -                            | -              | -               | -               | √                 |
| Time of day               | -              | -                  | -                            | -              | √               | -               | √                 |
| Time on the road          | -              | √                  | -                            | -              | -               | √               | -                 |
| Environmental factors     | √              | √                  | -                            | √              | √               | -               | -                 |
| Social and situational    | √              | -                  | √                            | -              | -               | √               | -                 |

Note: √ = available /discuss in the study

There are 9 factors mentioned in the previous literature, however, the environmental, social and situational factors, didn’t measure in this study. To determine which tools should be used to measure the perception of how those factors affected driving behavior, a literature study was conducted. Several questionnaires which were quite widely used in research on driving behavior to obtain the dimensions of driving behavior summarized as shown in Table 3.

| Driving Dimension          | MDBQ | MDSI | DDDI |
|----------------------------|------|------|------|
| Aggressive violation       | √    | √    | √    |
| Ordinary violations        | √    | √    | √    |
| Errors                     | √    | √    | -    |
| Lapses                     | √    | √    | -    |
| Mistake                    | √    | √    | -    |
| violation                  | √    | √    | √    |
| Safe driving               | -    | √    | -    |
| Seeking for excitement     | -    | √    | -    |

*DBQ = Driving Behavior Questionnaire [5]; MDSI = multidimensional Driving Safety Index [6], DDDI = Dula Dangerous Driving Index [7]

A research instrument in this study consist of question items that compiled refer to various questionnaires widely used in other studies. The question items were measured workload perception, fatigue self-assessment based on Fatigue Assessment Scale/ FAS [19], work time as an indication of recovery needs (15 questions) based on the item on Fatigue likelihood scoring, emotional intelligence (25 questions) [20], and tendency of behavior using DBQ [5].

2.2. Participants
In this study, the bus driver was selected as participants to achieve the objectives of the study. A high accident number involving buses in Indonesia was the reason. On the other hand, construction of
highway infrastructure that continues to be carried out in Indonesia for at least the next 5 years causes the bus is still the best alternative transportation for Indonesian citizens. However, bus drivers tended to perform risky driving behavior that leads to fatal accidents.

About 201 male intercity bus drivers agree to join the study but only data from 167 participants were analyzed further. The participants' age was between 25-60 years (mean 44.72 ± 9.53). There are 18% of participants with age under 35 years, 35.8% between 35-45 years old, 48.7% with age over 45 years. There are 61.2% of them were driving 3-5 hours in one trip, about 34.8% were driving over 5 hours and only 4% drivers claimed were driving less than 3 hours. About 10% of participants have a driving schedule before 12 AM, 63.8% has scheduled between 12 AM – 6 PM, and the rest of the participants have a driving schedule after 6 PM to midnight.

2.3. Data collection
Drivers who agree to become participants in the study were asked to fill the questionnaire. They filled out a questionnaire accompanied by a data collector to ensure participants understand the questions asked. The collecting data was conducted from June to August 2019. The driver who asked to join the research was interviewed and asked to fill the questionnaire at their bus depot and the bus station during their break time.

2.4. Data Analysis
First, the obtained data were checked to ensure all questions have been answered by participants. All complete questionnaires recapitulated into an excel table and checked for any outlier based on unstandardized Z value. From 201 data, there were 34 outliers found and only 167 data are used in this study.

The next step was measuring the reliability and validity of the questionnaire by Cronbach alpha and item internal consistency using SPSS software. Item tests with low internal consistency values were removed, and some item test also removes to increase the Cronbach alpha value. For further analysis, the workload variable was measured by 3 questions (WL1-3), fatigue by 4 questions (F1-F4), and work as an indication of recovery needs by 6 questions (WH1-6), emotional intelligence by 20 questions (EI1-20), and the tendency of driving behavior measured by 10 questions from DBQ. The final Cronbach alpha value of the questionnaire was 0.733.

In this study, participants were divided into 3 age groups (under 35 y, 35-45 y, and over 45 years old), 3 groups of experiences year (less than 5 y, 5-10 y, and over 10 years), and 3 group of a daily time on task (less than 3 hour driving per trip, 3-5 hours per trip, and over 5 hours per trip), and 3 groups of a daily scheduled (morning, afternoon, and night).

3. Result and discussion

3.1. Result
Only 43 out of 73 items test were analyzed in this study. The questions reduced in the testing instruments phase. The mean value and standard deviation for workload and fatigue level questions can be seen in the following Table 4:

| Variable | Item test | Mean ±Stdev | Variable | Item test | Mean ±Stdev |
|----------|-----------|-------------|----------|-----------|-------------|
| Workload | WL5       | 3.09 ± 0.861| Fatigue | F6.       | 1.61 ± 0.685|
|          | WL8       | 2.54 ± 0.911|         | F7.       | 1.44 ± 0.527|
|          | WL10      | 2.88 ± 0.810|         | F8.       | 1.68 ± 0.677|
|          |           |             |         | F9.       | 1.73 ± 0.753|
The item test for a workload and fatigue variables presented in the Table 5 below:

**Table 5.** A questions list for workload and fatigue variables

| Item | Question |
|------|----------|
| WL5  | I don’t have difficulties to finish my tasks |
| WL8  | I often involve in other task outside my job |
| WL10 | I often feel exhausted in doing my job. |
| F6   | I have problems to start things |
| F7   | I have problems to think clearly |
| F8   | I feel no desire to do anything |
| F9   | Mentally, I feel exhausted |

Even though the workload perceived as moderate to high (scale 1-5), however, the participants perceived their fatigue level was low as can be seen in Table 4. The other factors result present in the following Table 6:

**Table 6.** Data collection result

| Variable                | Item test | Mean ±Stdv | Variable                | Item test | Mean ±Stdv |
|-------------------------|-----------|------------|-------------------------|-----------|------------|
| Recovery need           | KP3       | 2.47 ± 0.985 | Emotional Intelligence  | EI1       | 2.16 ± 0.684 |
|                         | KP6       | 3.67 ± 1.242 |                         | EI2       | 2.17 ± 0.636 |
|                         | KP10      | 2.26 ± 1.088 |                         | EI4       | 2.88 ± 0.959 |
|                         | KP13      | 2.62 ± 1.048 |                         | EI5       | 2.33 ± 0.688 |
|                         | KP14      | 2.35 ± 0.948 |                         | EI6       | 2.77 ± 0.770 |
|                         | KP15      | 2.29 ± 1.086 |                         | EI8       | 2.00 ± 0.779 |
| Driving behavior        | DB2       | 1.64 ± 0.678 |                         | EI9       | 2.09 ± 0.755 |
|                         | DB3       | 1.70 ± 0.794 |                         | EI10      | 3.08 ± 1.080 |
|                         | DB4       | 1.63 ± 0.751 |                         | EI11      | 2.10 ± 0.633 |
|                         | DB6       | 1.83 ± 0.851 |                         | EI12      | 2.47 ± 0.920 |
|                         | DB7       | 1.49 ± 0.708 |                         | EI13      | 2.43 ± 0.799 |
|                         | DB8       | 1.43 ± 0.634 |                         | EI15      | 3.40 ± 0.983 |
|                         | DB9       | 1.54 ± 0.690 |                         | EI16      | 2.18 ± 0.574 |
|                         | DB10      | 1.46 ± 0.626 |                         | EI17      | 2.30 ± 0.653 |
|                         | DB11      | 1.59 ± 0.791 |                         | EI18      | 2.80 ± 0.804 |
|                         | DB12      | 2.30 ± 1.079 |                         | EI19      | 3.95 ± 0.537 |
|                         |           |            |                         | EI21      | 2.32 ± 0.767 |
|                         |           |            |                         | EI22      | 1.89 ± 0.468 |
|                         |           |            |                         | EI23      | 2.18 ± 0.574 |
|                         |           |            |                         | EI24      | 3.12 ± 0.931 |

Table 6 above showed that the level of recovery needs was moderate even though participants perceived their fatigue level relatively low. In this study, most of drivers as participants assessed the driving behavior not included in the aggressive or reckless category (the score less than 3). The emotional intelligence showed that the drivers had relevant emotional intelligence that match with their driving behavior scores. The questions for Recovery need, Driving behavior and Emotional Intelligence can be seen in the following Table 7.
### Table 7. Questions for need for recovery, driving behavior and emotional intelligence variables

| Item   | Question                                                                                       | Item   | Question                                                                                     |
|--------|----------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------|
| KP3    | Before driving I usually only sleep less than 8 hours in the last two days                   | EI1    | I realized my weaknesses and strengths                                                        |
| KP6    | I drive between 36 hours to 48 hours in 7 days                                                 | EI2    | I know what makes me angry                                                                   |
| KP10   | I have a chance to rest less than 8 hours before next driving tasks                            | EI4    | Feelings of pleasure that I experienced did not affect my behavior                           |
| KP13   | I get 1 or more days off in 7 days                                                            | EI5    | I am able to manage my emotions even under pressure                                          |
| KP14   | I get 1 day off in 2 weeks                                                                   | EI6    | I get angry easily even when things aren't really personal                                   |
| KP15   | I get 1 day off in 4 weeks                                                                   | EI8    | I vent my anger towards other people who are near me                                          |
| DB2    | Get into wrong lane when approaching roundabout/junction                                       | EI9    | When there are problems I feel stressed and don't want to solve them                         |
| DB3    | Disregard speed limit on residential road                                                     | EI10   | I don't want to work with people who have personal problem with me                            |
| DB4    | Misread signs and taken wrong turning off roundabout                                           | EI11   | I took the time to talk with friends / relatives                                               |
| DB6    | Have disregarded speed limit on motorway                                                      | EI12   | I know well the important people (people who have influence) in my environment               |
| DB7    | Raced away from traffic lights to beat other driver                                            | EI13   | It is not difficult for me to apologize / state that I have done something wrong             |
| DB8    | Become angered by driver and indicate hostility                                               | EI15   | When I have problems with other people, I tend to wait until the person who apologizes to me first |
| DB9    | When turning left have nearly hit cyclist on inside                                            | EI16   | I am willing to listen to my friend who has a problem                                         |
| DB10   | Attempt to overtake and hadn’t noticed signaling right                                         | EI17   | When my friends have a problem they ask me for the advice                                    |
| DB11   | Become angered by driver and given chase                                                      | EI18   | I am really interested if asked to provide an explanation about something to others          |
| DB12   | Sound horn to indicate annoyance                                                             | EI19   | I do not care about the problem that my friend have                                           |
|        |                                                                                             | EI21   | I believe I can do difficult tasks at work                                                    |
|        |                                                                                             | EI22   | The achievements made me happy                                                                |
|        |                                                                                             | EI23   | I try earnestly to achieve the target of the company                                          |
|        |                                                                                             | EI24   | There is no problem for me to increase work time, when the volume of work is large            |
In Table 4, the average score for workload was > 2.5 which was indicated that participants perceived their workload at a moderate level (scale 1-5). Fatigue level showed that all questions had a value less than 2, which can be interpreted that bus drivers ‘never-sometimes’ faced the situation that they had asked. Even though the drivers perceived the fatigue level was low, however, the score of need to recovery was over 2. This indicated that their current time to recover was not sufficient. In contrast to the previous estimation that driving behavior tends to be aggressive, the driver’s response to the DB variable was below 2 (scale 1-5). It can be said that any aggressive/error/violations tendency only happened occasionally. The item test of emotional intelligence showed that drivers have sufficient awareness of their emotions. In this study, a statistical test was run to find out if there are any differences between age, experiences, and time on task groups among the drivers for all variables. A Kruskal Wallis test was conducted and the result can be seen in Table 8 below:

| Table 8. A Kruskal Wallis result test |
|--------------------------------------|
| Age                                  |
| < 35 y                               |
| 2.785 ± 0.871                       |
| 1.6211±0.669                        |
| 2.414 ± 1.093                       |
| 3.178 ± 1.014                       |
| 1.719 ± 0.825                       |
| 35-45 y                              |
| 2.904 ± 0.917                       |
| 1.6212±0.676                        |
| 2.369 ± 1.104                       |
| 3.364 ± 1.079                       |
| 1.689 ± 0.807                       |
| > 45 y                               |
| 2.803 ± 0.886                       |
| 1.607 ±0.665                        |
| 2.378 ± 1.069                       |
| 3.277 ± 1.044                       |
| 1.645 ± 0.816                       |
| Chi-Square                           |
| 2.959                                |
| 0.288                                |
| 2.425                                |
| 2.532                                |
| 2.146                                |
| p-value                              |
| 0.228                                |
| 0.866                                |
| 0.297                                |
| 0.282                                |
| 0.342                                |

| Year Experiences                     |
| < 5 y                                |
| 2.817 ± 0.846                       |
| 1.637 ± 0.702                       |
| 2.527 ± 1.091                       |
| 2.166 ± 1.004                       |
| 1.626 ± 0.785                       |
| 5-10 y                               |
| 2.844 ± 0.926                       |
| 1.633 ± 0.702                       |
| 2.226 ± 1.048                       |
| 3.282 ± 1.057                       |
| 1.752 ± 0.792                       |
| >10 y                                |
| 2.839 ± 0.883                       |
| 1.599 ± 0.649                       |
| 2.411 ± 1.081                       |
| 3.467 ± 1.048                       |
| 1.666 ± 0.827                       |
| Chi-Square                           |
| 1.077                                |
| 0.333                                |
| 1.632                                |
| 9.957                                |
| 0.106                                |
| p-value                              |
| 0.584                                |
| 0.847                                |
| 0.442                                |
| 0.007**                              |
| 0.948                                |

| Time on task                         |
| < 3 hours/trip                       |
| 2.817 ± 0.911                       |
| 1.688 ± 0.805                       |
| 2.408 ± 1.096                       |
| 3.003 ± 1.039                       |
| 1.725 ± 0.879                       |
| 3-5 hours/trip                       |
| 2.808 ± 0.873                       |
| 1.615 ± 0.675                       |
| 2.395 ± 1.082                       |
| 3.246 ± 1.066                       |
| 1.645 ± 0.775                       |
| > 5 hours/trip                       |
| 2.909 ± 0.927                       |
| 2.409 ± 0.598                       |
| 2.355 ± 1.084                       |
| 3.743 ± 1.008                       |
| 1.661 ± 0.793                       |
| Chi-Square                           |
| 1.475                                |
| 9.898                                |
| 0.596                                |
| 6.197                                |
| 1.069                                |
| p-value                              |
| 0.478                                |
| 0.007**                              |
| 0.742                                |
| 0.045*                               |
| 0.586                                |

As can be seen at Table 8, WL, F, KP, EI, and DB was similar between age group of drivers. However, the EI level was different between group year experiences and time on task/trip and fatigue level also perceived differently by time on task/trip group.

3.2. Discussion
The workload that measures in this study emphasizing the symptoms related to the severity of the perceived workload. However, the differences workload between ages, time on task per trip and experience years’ group doesn’t show in this study. Based on the interview with the participants, it could be motivated by economic reasons so that workloads are not considered to be a burden for drivers. They grateful that they still have a job for a living compare to others. This reason relevant compare to participant marital status, there are about 90% of participants are married and have a family to support. Measurement of traffic density, road condition, environment, bus machine condition, and other conditions that faced daily by drivers could be more relevant to measure the level of workload in this case.

The fatigue level perceived differently by time on task per trip group, and it has estimated because time on task is the primary factor that increased fatigue [21]. The item tests on KP measures the potential need for rest based on work time and rests time, even though the fatigue level was different between time on task per trip group, however, the KP level was similar. This result can be driven by their driving schedule, which was about 63.8% were scheduled between 12 AM – 6 PM. The
emotional intelligence (EI) level was different among time on task group and years experiences. It indicated that a longer driving time and experienced years induced the level of patience, empathy, and self-awareness. This finding is important and needs to be considered to construct a safe driving character among bus drivers.

4. Conclusion
This study was conducted to find out the differences level of contributing factors to driving behavior among intercity bus drivers in Indonesia based on age, experience years and time on task per trip. Through a set of questionnaire that has been prepared based on various existing questionnaires, this study has obtained the expected results. Although the driving behavior was similar among the driver group of age, it found that emotional intelligence and perceived fatigue level was different. Based on this result, it can be concluded that in correcting a driving habit, the emotional intelligence factor should consider as a major variable.

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