The Impact of Social Norms, Personality, and Time Perspective Factors On Indonesian Highways Safety Driving Behavior

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Abstract. The number of traffic accidents per year increases in proportion to the number of drivers. The higher traffic accident in particular on highways is due to speeding behavior. Traffic accidents are caused by the environment, the vehicle, and the driver factors. The purpose of this study is to incorporate driver personality, time perspective, and applicable norms, on the speeding behavior model and design proposals for intervention policies, and improve current policies on driving behavior to maintain and increase safety driving the highways speed limit. Personality (BFI-10) was incorporated into the model to investigate which personality types that often speed, time perspective (ZTPI-18) was use to understand the current driver behavior from past experience and the driver will likely take in future, while the theory of normative social behavior (TNSB) was incorporated to enhance the theory of planned behavior (TPB) model used in previous studies. The method used in this paper is the PRISMA framework. Result of this study is a conceptual model that incorporates variables of TPB, TNSB, BFI-10 personality inventory, and ZTPI-18 and consists of 23 variables. Further study will be conducted to prove the conceptual model by using the method of self-report questionnaires, field observations, and driving simulations.

Keywords: Driving behavior, Norm, Safety Driving, TPB, BFI-10, Time Perspective, TNSB.

1 Introduction

In the last decade, Indonesia has been carrying out infrastructure development. One of the infrastructures that have been built in recent years is the highway. Unfortunately, besides the positive impact on economic development and smooth transportation, the development of highway infrastructure also has a negative impact, namely the number of high accidents on the highway.

A total of 1,099 cases of accidents occurred on highways from January to September 2022, with 109 fatalities [1]. The fatality rate on all Jasa Marga highway is 14% higher than the fatality rate in 2021, which is 1.03 people per 100 million vehicles per kilometer of highway [1]. Accidents and fatalities on highways are influenced by many factors.
Three main factors cause accidents and fatalities on highway, namely environmental factors (road curves and the length of the road curve [2] and weather [3]; vehicle factors (the age of the vehicle and the type of vehicle [2], [4]; and driver factors (lack of anticipation, drowsiness, carelessness, drunkenness, disorder, and the behavior of driving above the speed limit [1]. Driver factors cause 85% of traffic accident cases on highway, vehicle factors cause 15% of traffic accident cases on highway, and the rest are caused by environmental factors [1].

Research regarding the relationship between driving speed and traffic accidents was carried out by, among others, Aarts & Van Schagen [5] and Pérez-Marín et al. [6] who found that driving speed was the main factor causing the severity and risk of traffic accidents. Yu & Abdel-Aty [7] found that the magnitude of the change in speed before an accident occurs increases the chance of a serious accident. Existing research has found several factors that influence driving behavior above the speed limit, including Afghari et al. [2], Ge et al. [8], Qaid et al. [9], and Singh & Kathuria [10]. Afghari et al. [11] found that vehicle, road, and driver factors influence the choice of speed when driving. Road factors that influence driving behavior over the speed limit are the curve of the road and the length of the road curve [2], [12], [13]. Afghari et al. [12] added that a 1% increase in the diameter of the road curve will increase 1.49% of violations of driving over the speed limit.

Vehicle factors that influence driving behavior over the speed limit are vehicle size, vehicle type, and vehicle age [2], [14], where the larger the vehicle size and the smaller the vehicle's age, the driver will tend to violate the limit. speed [14]. Driver factors that influence driving behavior over the speed limit are age, gender, education level, and perceived risk [2], [15], [16]. Meanwhile, Qaid et al. [9] found that adult drivers, on average, drive faster than both young and old drivers. Furthermore, Ge et al. [8] found that female drivers were significantly more careful than men, but in the study of Qaid et al. [9], the driving behavior of women and men is not significantly different.

Research on driving behavior above the speed limit has been widely carried out to reduce traffic accidents and fatalities, in which most of the research uses the theory of planned behavior (TPB) model; such as research [9], [17], [18]. Jovanović et al. [18] investigated insights in TPB models to predict driving behavior. Etika et al. [17] used the TPB model to examine compliance with speed limits at work and outside work. While Qaid et al. [9] used the TPB model to predict the intention to drive over the speed limit and its intervention. The previous study conducted by Qaid et al. [9] combines the research model of Jovanović et al. [18] and Truelove et al., [19] to identify factors and interventions that can influence the intention to drive over the speed limit. However, the research by Qaid et al. [9] is still limited to driving intention. Furthermore, out of eight constructs that were tested only five constructs significantly affected the driving intention.

The TPB model used as the basis in Qaid et al. [9] research also has limitations. The limitation of using the TPB model is that part of the motivation to adhere to a norm that contributes greatly to subjective norms is rarely included in research using the TPB model [20]. Based on these limitations, Gauld & Reeves [21] identified factors that moderate descriptive norms on the intention to behave using a mobile phone while driving by using the theory of normative social behavior (TNSB) model.

TNSB is a theory that distinguishes between descriptive and injunctive norms; explains the basic cognitive mechanisms that moderate the relationship between descriptive norms and the intention to behave; conceptualizes descriptive norms as primary drivers of normative influence; and stated that the influence of descriptive norms on behavior will increase with the presence of a moderator [22], [23]. The use of TNSB compared to the TPB model may be useful for testing and developing norm-oriented theories. Furthermore, Gauld & Reeves [21] found that several factors moderated the variable descriptive norm on the intention to
behave, including factors of subjective norms, injunctive norms, and results that were expected. Behavior-related research is not only related to norms, but is also often associated with the personality of the driver himself, including Ge et al. [8], Haustein et al. [24], and Xu et al., [25]; which measures driver personality using the Big Five Inventory (BFI) personality traits and the HEXACO personality inventory. Furthermore, the applicability and reliability of the BFI personality traits has been proven [26]. Therefore, this research will also integrate BFI personality traits. However, it will not use the full version (BFI-44), but the shortened version BFI-10. This is done to ensure the quality of the data obtained, because the more questions in a questionnaire, the lower the quality of the data obtained from the respondents. Studies using BFI-10 include Hussain et al. [26], Park et al. [27], and Rammstedt and John [28].

Research related to behavior is also related to the perspective of time, including Fekih-Romdhane et al. [29], Kocayoruk and Simsek [30], Košťál et al. [31], Linkov et al. [32], Orosz et al. [33], Peng et al. [34], Sircova et al. [35], Temple et al. [36], and Lemarié et al. [37]; which measures a person's time perspective, including using the Adolescent Time Attitude Scale (ATAS) and the Zimbardo Time Perspective Inventory (ZTPI). ZTPI is more often used in research related to time perspectives because it is more general in nature than the AT which focuses on adolescents. Furthermore, ZTPI has proven to be reliable [33], used globally, and has been adapted into a shorter version [31], [36]. Thus, this study will integrate ZTPI-18 from the research of Košťál et al. [31]. This is because apart from being proven reliable ZTPI-18 has fewer questions but also examines more fully than other versions which only examine five variables.

This research is a continuation of Qaid et al. [9] research, where the novelty of the research is the research model of Qaid et al. [9] will incorporate the TNSB model to further refine the TPB that use in Qaid et al. [9] research as well as including time perspective and personality to investigate the relation between speeding behavior and time perspective and personality trait using BFI-10 personality inventory and Zimbardo Time Perspective Inventory 18 (ZTPI-18) (first stage). Furthermore, this research will conduct observation (naturalistic study) as the second stage and simulation using a driving simulator as the final stage of this research. The observation and simulation will be conducted to prove the result of speeding behavior modelling from the first stage of this research.

Furthermore, based on the results to be obtained from the three stages of the research, it is possible to design proposals for intervention policies and improve the current policies on driving behavior above the highways speed limit. The policy design could sustain traffic safety and reduce the number of accidents [38]. Besides policies, to intervene with the driver speeding behavior, maintain and increase driver safety behavior and traffic safety; the driver can be trained early by using virtual reality (VR) technology [39] or using an in-vehicle HMI [40], [41], conducting campaigns and using automatic speed cameras [42], supporting drivers to comply with traffic rules by using help sheets. The help sheet will later present conditions that encourage drivers to drive over the speed limit and strategies for dealing with these conditions as in the research of Brewster et al. [43] and Tekeş & Özkan [44].

2 Methods

The methodology of this study began with a literature review, searching for relevant and recent articles on speeding in Indonesia. After identifying the real issue, we conducted a systematic literature review using the Priority Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. PRISMA consists of three phases.

The first phase is identification, where to identify relevant articles from various sources. The source could be form google scholar, Elsevier, Scopus, etc. In this phase must be mentioned the number of identified article form database, website, and other resource. The remove the
duplicate before screening. The phase is screening. In this phase is to see how many items were screened, excluded, retrieved, and not retrieved and the reason for the exclusion and not retrieved. The final stage is included, this phase is reporting the total number of papers used in the literature review [45].

The identification phase, Elsevier accessed via sciencedirect.com was used as a database, while Google, google scholar, and proquest.com were used as the other method. The number of articles collected through the database is 799, and articles collected by other means are 128 from Proquest.com, 32 from Google Scholar, and 3 from Google. The keyword used to filter the article is driving behavior, speeding behavior, speeding intervention, etc. The next phase is screening, where the article that is not suitable for the research is excluded. The number of articles that exclude is 924, the reason for these articles being excluded is old (more than 5 years ago) or generally relevant but not suitable for this research. The last phase is Include, where the total article used in this research is 49. Among this 49 article there about behavior model [9], [18], [19], time perspective [31], policies [38], and intervention [39]–[44].

Based on the reading and synthesizing conducted, it found that driving over the speed limit is a dangerous behavior that increases the chances of accidents, injuries, material losses (such as car damage and fines), and death [5], [19]. Furthermore, the applicable speed limit can be seen through written regulations in the area where the road is located [46]. Based on applicable regulations, Indonesia has a minimum speed limit on highway, which is 60 km/hour, and a maximum limit of 80 km/hour for inner-city highway and 100 km/hour for inter-city highway [47].

2.1 The factors considered in this study

There many factor that influence traffic safety, generally it categories as external and internal factors. Currently, there many study related toward internal factor such as driver personality and behavior, while the study about the external factors not as many. Because of that, this research will also be studying about external factor such as environmental and vehicle factors. Environmental factors that affect accidents on highway include road curves and the length of the road curve, which encourage drivers to increase vehicle speed due to reduced driving complexity [2]. In addition, weather factors also affect driving behavior, for example when the weather is rainy and foggy, drivers will tend to drive slower, so the chance of an accident is very small [3].

Vehicle factors that influence highways accidents include the age of the vehicle and the type of vehicle [2]. Kanitpong et al. [4] found that drivers who had new vehicles or high-performance levels were more likely to drive above the speed limit, however, Qaid et al. [9] found that the age of the vehicle did not affect driving behavior.

2.2 Approaches and behavior models of previous research

The theory of planned behavior (TPB) was developed to perfect the Theory of Reasoned Action (TRA), by integrating control variables on behavior [48]. TPB uses the assumption that humans behave logically, by processing information received explicitly and implicitly in taking action and its consequences [48]. TPB has four factors that are used to model human behavior, namely subjective norms, attitudes toward behavior, behavioral control, and a person's intention to behave.

Several previous studies have tried to model driving behavior and the factors that influence it, including Gauld & Reeves [21], Jovanović et al., [18], Qaid et al. [9], and Truelove et al. [19]. Jovanović et al. [18] examined driving behavior using the theory of planned behavior (TPB) approach; in which the basic TPB model was developed as can be seen in Figure 1.
In the development of the TPB model by Jovanović et al. [18] there are two; that is, clarifying the attitude towards variables behavior into cognitive attitude and affective attitude; and adding variable habit to the model. Based on Figure 1, the personal norm, cognitive attitude, affective attitude, and variable behavioral control moderate the relationship between subjective norm and descriptive norm variables on behavioral intention and behavior habits; where this moderation can strengthen and weaken the relationship between one variable and another [49]. Furthermore, all of the variables forming variable driving behavior above the speed limit have a significant effect, except for the relationship of habit that indirectly influence behavior.

Truelove et al. [19] examined what factors could influence driving behavior over the speed limit using legal sanctions approaches (classical deterrent) and non-legal sanctions (Homeb's model). The model developed by Truelove et al. [19] can be seen in Figure 2. By Figure 2, it can be seen that the variables that are components of legal sanctions are general certainty, personal certainty, personal severity, and general and personal celerity. General certainty is defined as a high chance of being caught while driving over the speed limit; personal certainty is defined as the driver's anxiety when driving over the speed limit; personal severity is defined as the driver's anxiety about his future; and general and personal celerity is defined as the speed of the ticket process from the time of being caught to receiving the ticket [19].
Then the variables that make up the components of non-legal sanctions (Homel's model) are social sanctions, internal losses, material losses, and physical losses. Social sanctions are defined as loss of respect from friends; internal losses are interpreted as the driver's guilt; material loss is defined as the material consequences suffered by the driver (such as fines and revocation of driving licenses); and physical harm is defined as a risk to the driver's health [19]. Furthermore, the variables certainty of being personal certainty, personal severity, material loss, and physical loss significantly affect variable behavior of driving over the speed limit.

Qaid et al. [9] investigated the intention to drive above the speed limit by combining the research model of Jovanović et al. [18] and Truelove et al. [19]. The research model developed by Qaid et al. [9] can be seen in Figure 3. Based on Figure 3, the variables of norms, attitudes, and behavioral control moderate the effect of subjective norms and descriptive norms on variable intention to drive over the speed limit. Furthermore, in Figure 3, it can be seen that the adaptation of the research model by Truelove et al. [19] is to combine the constituent components into two variables, namely legal sanctions and non-legal sanctions, in which the development of the research model of Qaid et al. [9] because Indonesia is heavily dependent on sanctions to improve road safety [9].
Fig. 3. Research Model by Qaid et al. [9]

Qaid et al. [9] research showed that factors that significantly influence the intention to drive above the speed limit are the descriptive norm, subjective norm, affective attitude, cognitive attitude, and non-legal sanction; furthermore, legal sanction does not significantly affect driving intention over the speed limit because the application of legal sanctions in Indonesia is still weak [9].

Gauld & Reeves [21] examined the intention to use a smartphone while driving but used a theory of normative social behavior (TNSB) approach compared to the TPB approach that is generally used. This is due to the limitations of using the TPB model. The limitation is that the definition of subjective norms and injunctive norms in the use of the TPB model is often equated; and motivation to comply with what others (such as family and friends) consider important is rarely included in research using the TPB model [21]. Furthermore, TNSB in simple terms is a theory that explains that the influence of descriptive norms on the intention to behave is moderated by social approval [21]. The research model developed by Gauld & Reeves [21] can be seen in Figures 4, 5, and 6. Based on Figures 4, 5, and 6, Gauld & Reeves

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Theory of Planned Behavior

- Personal Norm
- Subjective Norm
- Cognitive Attitude
- Descriptive Norm
- Affective Attitude
- Perceived Behavioral Control
- Speeding Behavioral Intention
- Legal Sanction
- Non-Legal Sanction

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[21] research uses three variables to moderate the influence of descriptive norms on behavioral intentions while driving using a smartphone.

Fig. 4. The TNSB model is moderated by subjective norms Gauld & Reeves [21]

Fig. 5. The TNSB model is moderated by injunctive norms Gauld & Reeves [21]

Fig. 6. The TNSB model is moderated by outcome expectancies Gauld & Reeves [21]

2.3 Relationship between time perspective personality and behavior

Behavior-related research is often associated with the personality of the driver himself, which measures driver personality using the Big Five Inventory (BFI) personality traits and the HEXACO personality inventory. Furthermore, the applicability and reliability of the BFI personality traits has been proven [26]. Research related to behavior is also related to the perspective of time, and measures using the Adolescent Time Attitude Scale (ATAS) and the Zimbardo Time Perspective Inventory (ZTPI). ZTPI is more often used in research related to time perspectives because it is more general in nature than the AT which focuses on adolescents. Furthermore, ZPTI has proven to be reliable [33], used globally, and has been adapted into a shorter version [31], [36].
2.4 Approaches and behavior models of previous research

This research will develop a model that can describe the driving behavior of the Indonesian people on the highways based on the existing models in previous research. This conceptual model was developed by considering aspects that have not been considered in previous research models, so that the developed model can provide a better description of driving behavior over the speed limit than the model in previous research. The conceptual model for this research can be seen in Figure 7.

The basic model that will be used in this research is the model developed by Qaid et al. [9]. This model was chosen because this model has mapped out the intention to drive above the speed limit of Indonesian highway. Furthermore, the research model of Qaid et al. [9] was developed by combining the research model of Jovanović et al. [18] and the model of Truelove et al. [19], so that the research model of Qaid et al. [9] not only examines the intention to drive over the speed limit but also what interventions can be used to limit the intention to drive over the speed limit on Indonesian highway.

The research model of Qaid et al. [9] will then be combined with the research model of Gauld & Reeves [21] which uses the TNSB approach. This merger was carried out because there were still limitations in the use of the TPB model in the research model of Qaid et al. [9], which has not considered the aspects of command norms and motivation in complying with applicable norms like most studies using the TPB model [21]. This model also using personality variable that based on five variables (Neuroticism, Extraversion, Agreeableness, Conscientiousness, and Openness to experience) of the BFI-10 personality traits to investigate the personality trait that affects driving behavior. This model also incorporates Zimbardo Time Perspective Inventory 18 (ZTPI-18) to understand the effect of driver time perspective toward driving behavior, in this case speeding behavior. This model will be using time perspective variable that combination of ZTPI-18 six variables (past negative, past positive, present fatalistic, present hedonistic, future negative, and future positive) to understand driver behavior and the likelihood the driver future behavior. Furthermore, the conceptual model of this research is not only limited to the intention to behave like the research model of Qaid et al. [9] and Gauld & Reeves [21], but to map the behavior of driving over the speed limit on Indonesian highway.
2.5 Future Research Stages

The research will be carried out in three phases. Phase I of this research was conducted to identify and examine the factors that influence driving behavior over the speed limit on highway. In phase I of this research a survey will be carried out using a self-report questionnaire; in which this questionnaire will consist of two parts, namely the demographic data section of the research subject and the section containing questions/statements related to driving behavior above the highways speed limit carried out by the research subject.
In phase II of this research, direct and indirect observations will be carried out. Direct observation will be carried out by involving the driver instructor and accompanied by the researcher when the research subject is driving on the highways. Driving instructors are involved to obtain comparative data in stage I. Driving instructors have better knowledge of the rules for driving on the road and this is expected to reduce bias in the questionnaire data filled out subjectively by research subjects in stage I.

Indirect observation will be carried out using a camera, Electroencephalogram (EEG), and a speed camera. The indirect observation section will use three tools, namely a camera that will be installed in the car; the use of a speed camera that will be installed in one of the rest areas on the highways; and EEG which will be attached to the research subject. The camera is used to record the actions of research subjects during the observation. The speed camera will be used to record the speed of cars passing on the highways. EEG will be used to see the brain activity (beta waves and gamma waves) of research subjects while driving on the highway.

Phase III of this research is a simulation using a driving simulator in the laboratory which will be carried out in several scenarios that will be adjusted to the results of the research in Phase I and Phase II. Phase III will use two tools during the simulation process, namely eye tracker and EEG. The eye tracker will be used to record what the research subject focuses on while using the driving simulator. Meanwhile, the EEG will be used to record the activities of the research subjects during the simulation. The EEG data obtained in stage III will be compared with the EEG data in stage II. This is intended to see differences in brain activity of research subjects when driving using a driving simulator compared to driving directly on the highway.

After the three research phases are carried the data will be analyzed in the direction of proposing an intervention policy and improvement of the current policies which will improve the highways traffic safety and sustain driver safety behavior. Maintaining traffic safety and driver safety behavior is expected to minimize the number of accidents on the highways.

References


