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Personality Traits Affecting Risky Riding Behavior: An Application of an Extended Theory of Planned Behavior

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Abstract: The primary objective of this study is to investigate the influence of personality traits such as anxiety, sensation seeking, altruism, anger, and normlessness on young powered two-wheeler riders' risky riding behavior. The theory of planned behavior (TPB) is extended to include personality traits forming an extended TPB (ETPB). The ETPB model is used to examine how personality traits directly influence risky riding behavior and indirectly influence risky riding behavior through latent mediating factors. The secondary objective is to examine the differences in interactions between personality traits, mediating factors, and risky riding behaviors of those who have been and have not been involved in traffic accidents. The study sample included 535 high school students in Phu Yen, Vietnam. The results showed that personality traits, directly and indirectly, influence risky riding behaviors through the mediating construct. Young riders with sensation-seeking, anger, and normlessness have a higher frequency of risky riding behavior than those with anxiety and altruistic personality traits. Sensation seeking, anger, and normlessness indirectly influence risky riding behavior through risk perception and subjective norms. In addition, the results also show a clear difference in the relationship between the personality and behavior of people who have been involved in traffic accidents and those who have never been involved in accidents.

Keywords: personality; risk perception; theory of planned behavior; structural equation modeling

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1. Introduction

As a south-central coastal province, Phu Yen suffers serious consequences from traffic accidents every year, with a higher number of deaths and injuries than other provinces and cities such as Hanoi and Ho Chi Minh City [1]. Causes of traffic accidents are determined by riding on the wrong side of the road, not yielding to other drivers in traffic, not paying attention to other vehicles, etc. It is worth mentioning that the majority of traffic accidents are committed by young, powered two-wheeler riders whose ages range from 16 to 23 [1]. This age group directly causing traffic accidents accounts for a higher rate than the remaining age groups (Figure 1).

The Big Five personality traits model (openness, conscientiousness, extraversion, agreeableness, neuroticism) has been used by previous studies to study individual behavior [2]. In traffic psychology, this trait is not yet widely used. Meanwhile, the five personality traits of sensation seeking, normlessness, anxiety, altruism, and anger have been conducted by many studies [3–8] to study relationships between personality traits and risky riding behavior. Therefore, within the scope of this study, the five personality traits are considered the original variables leading to risky driving behavior among young people.

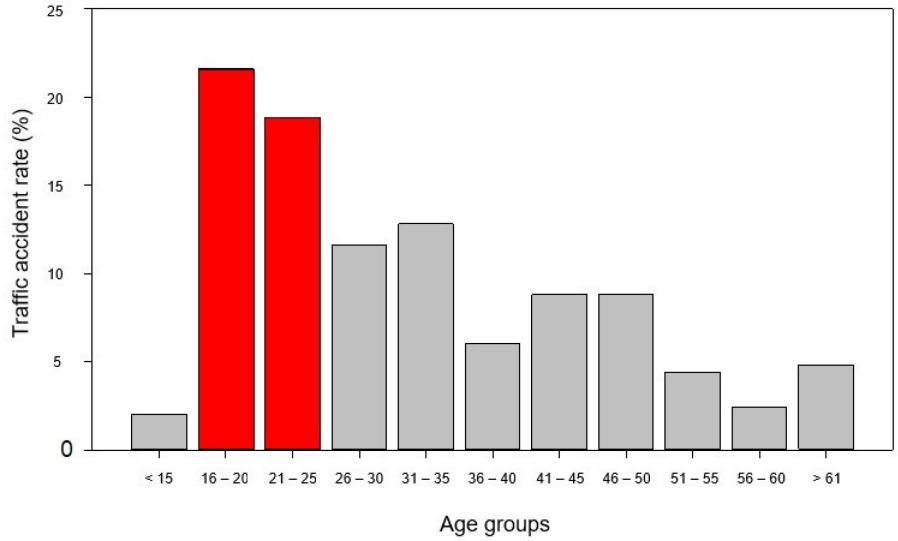

Figure 1. The traffic accident rate for powered two-wheeler riders in Phu Yen by age (2018–2019).

Concerning human factors, there has been much research on the influence of personality traits on risky behaviors causing traffic accidents. Individuals with sensation-seeking characteristics have a higher tendency to speed, avoid wearing seat belts, and engage in risky riding behaviors [9–11]. Sensation seekers are well aware of the surrounding traffic environment, which can reduce the risk of an accident that can be extremely serious if it were to occur. Individuals with sensation-seeking, normlessness, and anger frequently violate speed limits [12]. Those offenders are less likely to obey traffic rules than individuals with more altruism and anxiety. In addition, sensation-seeking traits have a more substantial influence on reckless riding behaviors than anger [13]. Personality traits directly and indirectly affect risky riding behaviors [5,12,14,15].

The five personality traits, including sensation seeking, normlessness, anxiety, altruism, and anger, have been chosen by many authors worldwide to conduct their research [4,5,8,14,15]. Personality traits such as sensation seeking, anger, normlessness, anxiety, and altruism indirectly influence risky riding behavior through attitudes toward risky riding behavior [5]. Sensation-seeking personality indirectly affects risky riding behavior through attitudes toward traffic safety [6–8]. Personality traits indirectly influence risky riding behavior through effective risk perception [7]. This finding is consistent with the study of [8]. The results of these studies mainly indicate that personality traits indirectly influence risky riding behavior through attitudes toward traffic safety or practical risk perception. Some of these studies have not clarified the relationship between personality and risky behavior in groups of people who have and have not experienced accidents. Furthermore, other riding behavior influences, such as subjective norm, perceived behavioral control, and behavioral intention, have not been studied at all.

The work of [16] may be considered the first to study the relationship between personality and driving behavior. This research indicates that personality traits can be the leading cause of risky driving behavior. Other research [6] discovered that the driver's psychological characteristics strongly influence driving behavior that causes traffic accidents. These exploratory studies have laid the foundation for further research into personality and driving behavior [7,17,18]. Further studies have determined that personality traits directly and indirectly influence risky driving behavior [19]. The theory of planned behavior (TPB) posits that an individual's behavior is determined by their personality traits and attitudes [20]. More specifically, human behavior is motivated by intention; intention is formed from attitudes, subjective norms, and perceived behavioral control. Many studies have used the TPB to explain risky riding behaviors. The work of [21] used TPB to predict young drivers' behavior. The study results show that attitudes and perceived behavior control significantly directly impact the intent to use alcohol. The article of [22] applied

TPB and concluded that subjective norms are social factors and strongly influence the intentions of unsafe riding behavior more than attitudes and perceived behavior control. The paper of [23] also used TPB to determine risky riding behavior, and the results showed that subjective norms strongly impact the intention to perform risky riding behaviors. The TPB has been widely developed to study the relationship between factors and risky riding behaviors in recent years. However, integrating latent factors in the TPB with personality traits to predict behaviors has not yet been performed. Therefore, our study framework uses personality traits combined with TPB to provide an integrated model to identify riding behaviors that cause traffic accidents.

TPB theory shows the correlation between factors of an individual, belief factors related to attitudes, and behavioral performance. Typically, beliefs about aggression can lead to behaviors that threaten others, and beliefs about important people and loved ones affect how we carry out that behavior. However, to expand on other factors leading to risky riding behavior, it is necessary to identify many other factors, such as traffic environment, traffic laws, and vehicle quality. Incorporating personality traits into the TPB is a positive and appropriate solution to explain young people's riding behavior.

The primary objective of this study is to investigate the influence of personality traits on young, powered two-wheeler riders' risky riding behavior. The secondary objective is to examine the differences in interactions between personality traits, mediating factors, and risky riding behaviors of those who have been and have not been involved in traffic accidents.

2. Methodology

The research was carried out using the flowchart below (Figure 2).

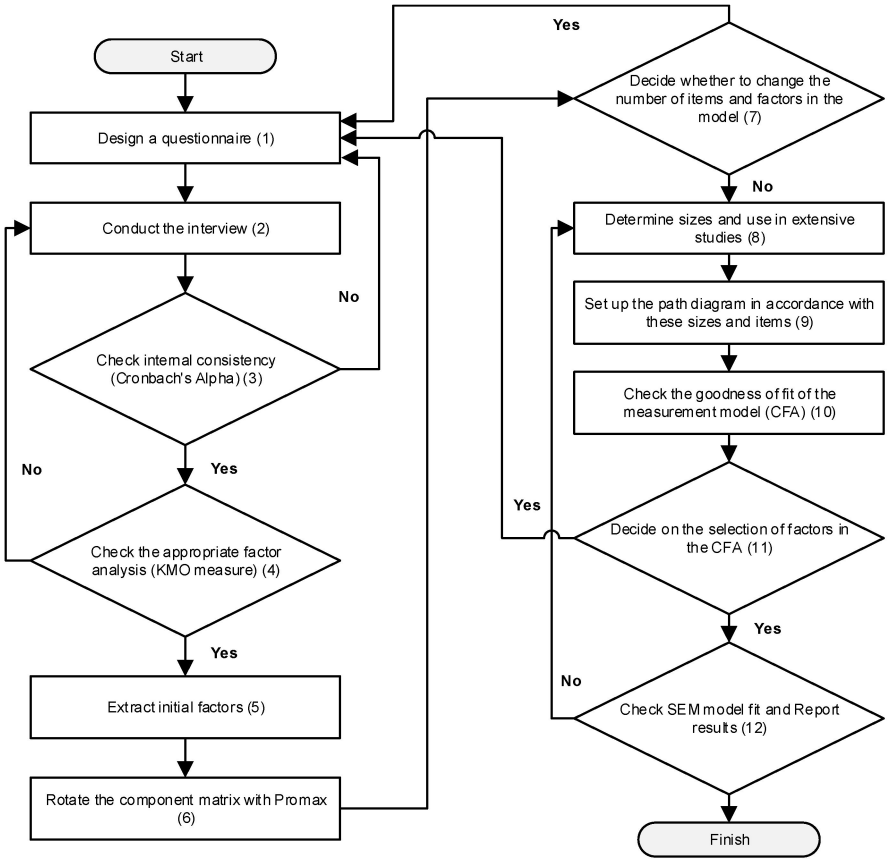

Figure 2. The flowchart of the research process.

(1) Design a questionnaire

This study proposes a model that integrates personality traits and the TPB to explain the risky riding behavior of young, powered two-wheeler riders. In this model, risky riding behavior, such as not-giving-way behavior, lacking observation behavior, and reckless riding behavior, are dependent variables explained by a combination of independent and mediating variables. The independent variables include five personality traits: sensation seeking, altruism, normlessness, anger, and anxiety. Risk perception, attitude towards traffic safety, subjective norms, perceived behavioral control, and behavioral intention are mediating factors. These mediating factors are the explanatory variables for the behavior and are assumed to be influenced by independent variables. The independent and dependent variables were developed from previous studies, including [4,7,8,11,13,24]. Although the research model differs, the authors consider the personality trait variables independent variables. In contrast, variables such as risk perception and the theory of planned behavior variables are considered dependent variables.

- Measure personality traits: Personality reflects an individual's internal character traits and is expressed through behavioral performance [7]. Personality traits of research subjects considered in this study include altruism, anger, sensation seeking, normlessness, and anxiety. These traits, directly and indirectly, influence risky riding behavior [7,13]. Most previous studies have also shown that people with solid anger, normlessness, and sensation-seeking have a higher frequency of risky riding behaviors [4,7,8,13,24]. Meanwhile, those with strong altruism perform safer riding behaviors [6,7]. Individuals with solid anxiety can either positively or negatively influence behavior [7]. The personality scale was measured by 36 items in total and consisted of altruism (8 items), anxiety (8 items), sensation seeking (8 items), and anger (8 items). These items were adapted from the International Personality Item Pool [3]. Normlessness was measured by four items [25]. All items of the personality scale were estimated based on a five-point Likert scale, in which responders revealed their level of agreement, ranging from (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.
- Measure risk perception: Risk perception is essential in mediating personality and risky riding behavior [4,7], as measured by two items. Firstly, interviewees were asked to complete a subjective assessment that rates their probability of being involved in possible future accidents (e.g., probability of being involved in a traffic accident). Values are measured on a Likert scale ranging from 1: Not probable at all to 7: Very probable. Next, the interviewees were asked to express their worries and concerns about being injured from a traffic accident (e.g., Worry and anxiety of yourself being hurt in traffic), measuring values for this scale starting from 1: Not worried at all to 7: Very worried.
- Measure attitudes towards unsafe riding: Attitude is a vital factor in the TPB. As one concentrates more on one's attitude, there is a higher tendency for one to act on this attitude in tangible actions [20]. An unsafe riding attitude is reflected in the risky riding behavior of young powered two-wheeler riders. Altruism, anxiety, sensation seeking, and anger directly affect risky riding behavior [5–7]. Personality traits also indirectly affect risky riding behavior through attitude toward traffic safety [6]. Therefore, the attitude towards traffic safety in this study was measured by 17 items that involve traffic flow versus abiding by the rules (9 items, e.g., There are certain traffic rules which cannot be obeyed to keep up with the traffic flow), speeding (5 items, e.g., Speeding is acceptable as long as the driver has good riding skills), fun- riding (3 items, e.g., Adolescents need fun and excitement in traffic). The attitude scale value is measured on the 5-point Likert scale starting from 1: Strongly agree to 5: Strongly disagree. Higher scores on the attitude scale for traffic safety correlate to safe riding, whereas those who score lower indicate unsafe riding.
- Measure subjective norms: Subjective norms in the TPB refer to the belief that an important person or group will approve and support a particular behavior [20]. The

subjective norm was used to measure the degree of perception from family about speed-riding behavior using two items (e.g., My family thinks that I should not exceed the speed limit) from surrounding close ones on the intake of alcohol before riding using two items (e.g., The people who are important to me would disapprove of my riding and drinking), and from friends regarding obeying traffic rules and regulations using two items (e.g., My best friends think that I should not break the rules and regulations in traffic). The questions used in this scale stemmed from previous existing studies [26–30]. The subjective norm scale value is measured using a 5-point Likert scale from 1: Strongly disagree to 5: Strongly agree. Scoring higher on the subjective norm scale implies that the subject is positively affected by the advice of relatives, surrounding close ones, and friends towards safe traffic practices. A lower score on the subjective norm scale indicates that interviewees are not welcoming to the advice on traffic safety.

- Measure perceptive behavior control: Perceptive behavior control in the TPB represents the ease or difficulty of performing a particular behavior based on available resources and opportunities to perform the behavior. The study uses four items to measure perceptive behavior control. The items are based on previous studies [22,23] that measure riding skills (e.g., I have reasonable control over the situation when I exceed the allowable limit) and riding experience (e.g., I always control my powered two-wheeler well when I pass another vehicle). Each item is rated on a 5-point Likert scale ranging from 1 to 5, starting from 1: Strongly disagree to 5: Strongly agree. Higher mean scores express higher perceived behavior control.
- Measure behavioral intention: Behavioral intention measures the subject's subjective ability to perform a behavior and can be viewed as a particular case of belief [20]. The behavioral intention in the TPB also uses six items to measure the intention to drink and drive (two items, e.g., I will tag along with someone else even though that person drank a lot), violation of traffic rules (two items, e.g., I will ignore the traffic rules to go faster), and speeding (two items, e.g., I will exceed the speed limit by 10 km/h on an empty road). The content of the questionnaire used to measure behavioral intention is based on previous studies [27–30]. The value of the behavioral intention scale is measured on a 5-point Likert scale ranging from 1: Strongly agree to 5: Strongly disagree. Scoring higher on the behavioral intention scale indicates that the subject is safe in traffic, whereas those who score low are unsafe in traffic.
- Measure risky riding behavior: According to the statistics of the authorities, the majority of traffic accidents are caused by vehicle drivers not obeying traffic rules, not giving way to vehicles that are allowed to go ahead, not giving way to pedestrians (not-giving-way behavior), not paying attention when turning or changing direction (lacking observation behavior), speeding, slamming brakes, running red lights (reckless riding behavior). A questionnaire was used based on previous studies [4–7,11,31–33] to identify the causes of risky riding behavior. These questions have been adjusted to the research environment in Vietnam. Therefore, the authors have selected and used three items to measure not-giving-way behavior (Ignoring 'Give Way' signs and narrowly avoiding colliding with traffic having the right of way), two items to measure lacking observation behavior (Not noticing that the light turns red), and nine items to measure reckless riding behavior (e.g., Almost riding off the road due to riding too fast when turning a corner). The value of the risk-riding behavior scale is used as a 5-point Likert scale ranging from 1: Very often to 5: Never. Scoring higher on the risky riding behavior scale proves that the subject is safe in traffic and vice versa for those who score lower.

(2) Conduct the interview

The interviewees were high school students in Phu Yen province, ages 15 to 17. Participants are riders using powered two-wheelers. They were asked whether or not they had been involved in a traffic accident within the past three years. Characteristics describing the study subjects are shown in Table 1. Interview participants received questionnaires

from teachers and volunteers in the safe riding team. After completing the questionnaire, candidates participated in a safe riding program. Those who scored high in these games would receive backpacks to use as school supplies. Those who did not achieve high rankings got free cakes and drinks. After collecting a complete set of interview questions, the next job was to select groups of questions that meet the requirements of interview participants. Question sets with less than 90% of the total answers were eliminated. Therefore, with 600 questions issued, only 535 questions met the requirements. These questions were imported into Excel before conducting quantitative research.

Table 1. Demographic characteristics of questionnaire respondents.

Category	Count (Percentage)		
	Involved	**Not Involved**	**Total**
Gender			
Male	99 (45%)	125 (40%)	224 (42%)
Female	122 (55%)	189 (60%)	311 (58%)
Living situations			
Living with a family of 2 generations (parents and children)	194 (87%)	281 (89%)	475 (89%)
Living with a family of 3 generations (grandparents, parents, and children)	27 (13%)	32 (11%)	59 (11%)
Lives alone	0 (0%)	1 (0%)	1 (0%)
Types of vehicles used			
Moped and Scooter	32 (14%)	40 (13%)	72 (13%)
Scooter	36 (16%)	65 (20%)	101 (19%)
Powered two-wheeler less than 50cc	140 (63%)	185 (59%)	325 (61%)
Powered two-wheeler over 50cc	13 (7%)	24 (8%)	37 (7%)
Driver's license status			
Possesses a powered two-wheeler driver's license	26 (12%)	41 (13%)	67 (13%)
Does not own a powered two-wheeler driver's license	195 (88%)	273 (87%)	468 (87%)
Riding experience (years)			
0–1	40 (18%)	65 (21%)	105 (20%)
2–3	70 (32%)	94 (30%)	155 (29%)
4 and over	111 (50%)	155 (49%)	266 (51%)
Daily riding distance (km)			
0–1	18 (8%)	27 (9%)	45 (8%)
2–3	42 (19%)	65 (20%)	107 (20%)
4–10	102 (46%)	151 (48%)	253 (47%)
11 and over	59 (27%)	71 (23%)	130 (25%)
Total	221 (100%)	314 (100%)	(100%)

(3) Check internal consistency (Cronbach's alpha)

Reliability analysis is used to check the internal consistency of the scale. The consistency of a scale is accepted when Cronbach's alpha coefficient is greater than 0.6 and removed if it is less than 0.6 [34].

Cronbach's alpha coefficient is calculated according to the formula below.

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2}\right)$$

In which:

α = the computed Cronbach's alpha
K = the number of items
$\sigma^2_{Y_i}$ = the variance of every item
σ^2_X = the variance of the total scale

(4) Check the appropriate factor analysis (KMO measure)

SPSS 20 is used to check the KMO coefficient (Kaiser–Meyer–Olkin), an index used to consider the appropriateness of factor analysis. The value of KMO must reach a value of 0.5 or higher ($0.5 \leq \text{KMO} \leq 1$), which is a sufficient condition for factor analysis to be appropriate. If this value is less than 0.5, factor analysis is likely inappropriate for the research data set.

(5) Extract initial factors

Meaningful initial factors are extracted when indicators include eigenvalue > 1, total variance explained $\geq$ 50%, and Sig Bartlett's test < 0.05.

(6) Rotate the component matrix with Promax

Promax rotation is applied once the roles of the model's variables have been determined.

(7) Decide whether to change the number of items and factors in the model

A decision is made as to whether adjustments need to be made (e.g., withdrawing or add item(s), including factor(s), etc.).

(8) Determine sizes and use in extensive studies

The number of variables is determined after considering adding or removing variables from the research model.

(9) Set up the path diagram by these sizes and items

The overall fit of the data is evaluated based on the model fit indexes, including Chi-square/df, CFI, TLI, GFI, and RMSEA, using AMOS Graphics 24.

(10) Check the goodness of fit of the measurement model (CFA)

Like Cronbach's alpha, composite reliability (CR) is a measure used to measure the internal consistency of indicators on a scale. While Cronbach's alpha assumes that factor loadings are the same for all items, CR considers the varying factor loadings of the items. CR values range from 0 to 1, and the confidence level is high when the CR value is close to 1. In particular, the reliability value from 0.6 to 0.7 is acceptable with exploratory research. The overall fit of the data is evaluated based on the model fit indexes, including Chi-square/df, CFI, TLI, GFI, RMSEA.

(11) Decide on the selection of factors in the CFA model

Removing factors is considered when composite reliability is less than 0.7.

(12) Check SEM model fit and report results

This study employed the two-step approach to linear structural equation modeling (SEM) developed by [35]. The first step uses confirmatory factor analysis (CFA) to specify the number of factors, construct relationships between measured variables and factors, and test the goodness of fit for the CFA model. The next step investigates the relationship between latent variables using the SEM model. To check the goodness of fit of these models, the goodness-of-fit index (GFI) and comparative fit index (CFI) should approach 1.0, the square error of approximation (RMSEA) should be less than 0.08, and Chi-square/df should be less than 5.0 [34].

3. Results

3.1. Descriptive Statistics

Cronbach's alpha coefficients and composite reliability (CR) were calculated for all scales in the study's previous analysis. Table 2 reports the number of items, means, standard deviations, composite reliability, and internal consistency (i.e., Cronbach's alpha values). All Cronbach's alpha and CR values satisfy conditions greater than the minimum 0.6 [34]. Moreover, most of the CR on all scales has a value greater than 0.7 [34], except for the scale of risk perception and attitude towards traffic safety, which is approximately 0.7.

Table 2. Number of items, mean scores, Cronbach's alpha, CR.

Measures	Number of Items	Mean (Range 1–5)	Standard Deviation	Cronbach's Alpha	CR
Personality traits					0.70
Anxiety	8	3.78	0.789	0.80	
Sensation seeking	8	3.37	0.799	0.78	
Anger	8	3.68	0.866	0.83	
Altruism	8	3.91	0.725	0.82	
Normlessness	4	2.62	0.968	0.62	
Risk perception					0.66
"Probability of being involved in a traffic accident"	2	2.68 a	1.54	0.47 b	
"Worry and concern for yourself being hurt in traffic"		2.71 a	1.60		
Attitudes toward traffic safety					0.68
Traffic flow vs. rule obedience	9	3.57	0.94	0.86	
Speeding	5	3.29	0.91	0.69	
Fun-riding	3	3.43	0.96	0.67	
Subjective norm					0.88
Influence from family members	2	3.90	1.31	0.81	
Influence from important people	2	3.87	1.33	0.86	
Influence from friends	2	3.56	1.23	0.73	
Perceived behavioral control					0.74
Riding experiences	2	2.68	1.10	0.63	
Riding skills	2	2.71	1.10	0.61	
Behavioral intention					0.84
Drinking and riding	2	2.84	1.19	0.62	
Violation of traffic rules	2	2.76	1.55	0.89	
Speeding	2	2.80	1.34	0.74	
Reckless riding behavior	9	3.72	0.888	0.88	0.88
Not-giving-way behavior	3	3.87	1.129	0.81	0.81
Lacking observation behavior	2	3.49	1.118	0.70	0.70

a: five-point Likert scale, b: the correlation coefficient between the two risk perception items.

3.2. EFA and CFA

The results of the EFA showed that rotation factor loadings ≥ 0.3, KMO = 0.835 > 0.5, total variance extracted = 64.003 > 50%, eigenvalues > 1.0. The indicators show that the model is consistent with the research data. The results of the CFA showed that CFI = 0.941,

GFI = 0.918, TLI = 0.931, RMSEA = 0.039 < 0.08. Chi-square/df = 1.804 < 5. The model is consistent with the observed data [34].

3.3. SEM Model

As a first step, to examine the cause-and-effect relationship [36] between personality traits and risky riding behavior, the authors conducted a linear structural analysis (SEM) to explore the causal relationship between personality traits and risky riding behavior of research participants. The results of the analysis are shown in Figure 3. The next step was to determine what causes crash-related riding behavior. We divided the sample set into two parts: sample 1 (N = 221—related to traffic accidents) and sample 2 (N = 314—never related to traffic accidents), performing multigroup structural equation models to test separate structural models.

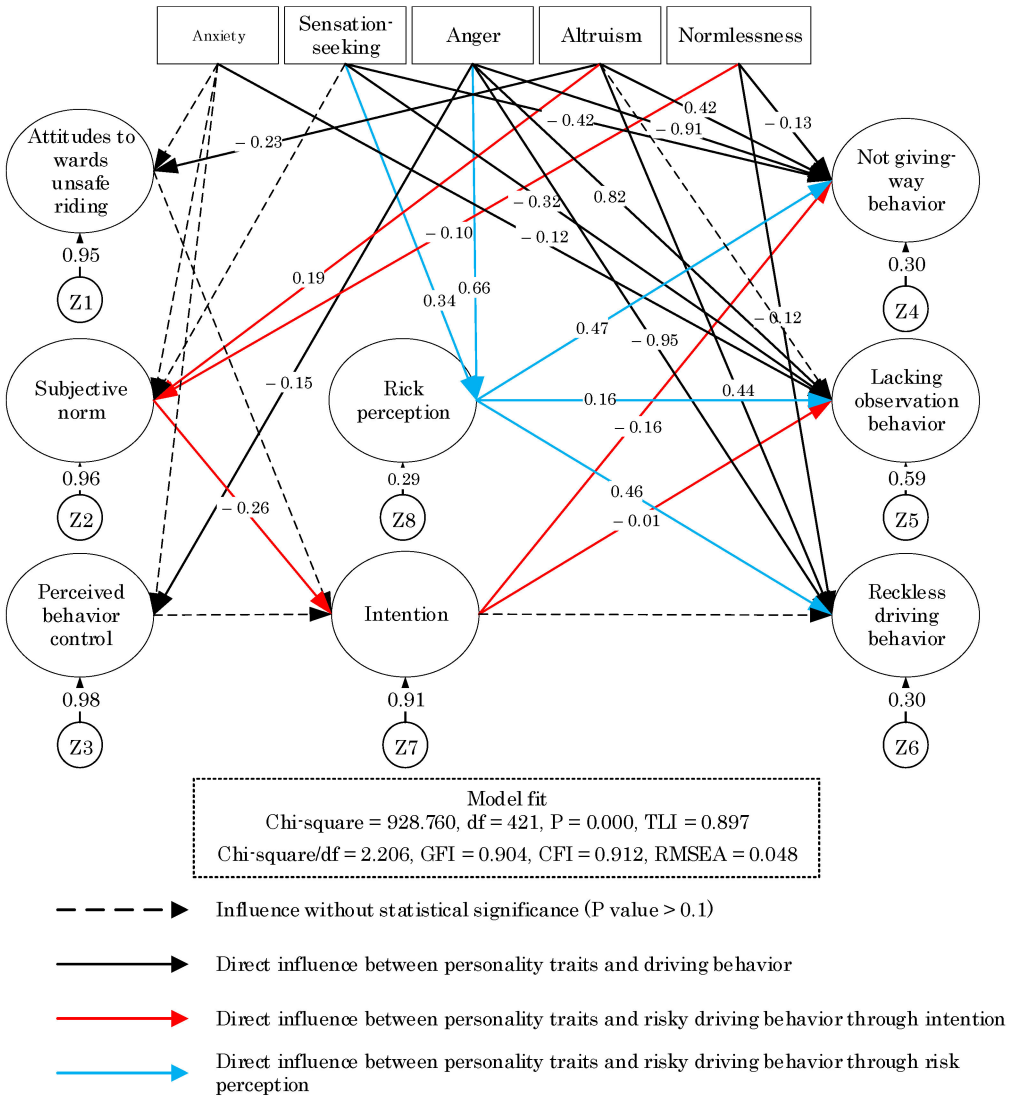

Figure 3. Structural equation model of the relationship between personality traits and riding behavior.

3.3.1. General SEM Model

According to the goodness-of-fit indices, the model predicts the actual data well. More specifically, the ratio of the chi-square value to degrees of freedom $\chi^2/df = 2.206$ is less than 3, which is considered the maximum value for linear structure [35]. Furthermore, other indicators, such as CFI = 0.904, CFI = 0.912, and GFI = 0.904, are above the recommended value of 0.9. The interaction structure of factors (arrows), factor loadings (β), and residuals (Z) in regression equations are shown in Figure 2. The standardized coefficient β shows the

degree of strong or weak influence with a significance level of $p < 0.05$. From the results of residuals, the estimated SEM model explains 70% of the total variance in not-giving-way behavior, 70% in reckless riding behavior, and 41% in lack of observation behavior.

Personality traits affect the not-giving-way behavior directly and indirectly through risk perception and behavioral intention in the TPB. Drivers with sensation seeking ($\beta = -0.42$), anger ($\beta = -0.91$), altruism ($\beta = 0.42$), and normlessness ($\beta = -0.13$) have a direct influence on the behavior. The higher coefficients indicate that sensation-seeking and angry drivers are more likely to engage in not-giving-way behavior than other drivers. Sensation seeking and anger indirectly influence not-giving-way behavior via risk perception. Individuals reported to have a high score on sensation-seeking and anger personalities had better risk perception of traffic safety than other personality traits.

The personality traits affect the lacking observation behavior directly and indirectly through latent variables such as risk perception and behavioral intention in the TPB. Lacking observation behavior is directly influenced by the personality traits of anxiety ($\beta = -0.12$), sensation seeking ($\beta = -0.32$), and anger ($\beta = 0.82$). Anger personality has the strongest direct effect, and anxiety personality has the weakest effect on lacking observation behavior. This behavior is also influenced indirectly by personality traits similar to the not-giving-way behavior.

Reckless riding behavior is influenced directly and indirectly through risk perception (Table 3). Reckless riding behavior is strongly influenced by anger personality ($\beta = -0.95$), moderated by people with altruism ($\beta = 0.44$), and weakly influenced by people with normlessness ($\beta = -0.12$). Only sensation seeking and anger indirectly influence reckless riding behavior via risk perception. The direct influence of sensation-seeking on not-giving-away behavior is -0.4200. The indirect effect of sensation seeking on not-giving-away behavior through risk perception is $0.34 \times 0.47 = 0.1590$. The total influence of sensation seeking on not-giving-away behavior is $(-0.4200) + 0.1590 = -0.2610$. The sign (-) indicates an inverse relationship.

3.3.2. Multigroup SEM Model

There is no consensus on testing methods. The choice of testing method depends on the research purpose. Therefore, within the scope of the article's research, the preferred T-test is performed to test the average difference of two independent samples. In this case, the assumption is stated that there is no difference in variance between the two samples and that the data of the two samples should follow a normal distribution with a 95% confidence interval. In other cases, if the variances of the two samples are different, Welch's test will be applied. More specifically, if the data do not follow a normal distribution, the nonlinear Mann–Whitney U test is used to test the difference between the two samples with the effect size (Cohen's d). This value is defined as $0 < d < 0.20$ weak effect, $0.21 < d < 0.5$ modest effect, $0.51 < d < 1$ moderate effect, and $d > 1$ strong effect.

Table 4 shows differences in the average values between the two samples (related to traffic accidents and not related to traffic accidents) of the factors of anger, influence from family members, violation of traffic rules, speeding, and lack of observation behavior. To clearly illustrate the results in Table 4, the testing procedure for testing anger personality differences was conducted as follows:

Step 1: Two-tailed t-test, in which the t-test gives two significant populations and two independent samples. The population standard deviation is unknown and follows a normal distribution.

State the hypotheses:

Null hypothesis H_0: $\mu_1 = \mu_2$

Alternative hypothesis H_1: $\mu_1 \neq \mu_2$

Step 2: Rejection region.

Choose significance level $\alpha = 0.05$

Degrees of freedom $df = N_1 + N_2 - 2 = 221 + 314 - 2 = 533$.

Critical value of 2-tailed test: $t_c = 1.964$, $\alpha = 0.05$, $df = 533$.

The rejection region for this two-tailed test is R = {t: |t| > 1.964}

Table 3. The total direct and indirect influence of personality traits, mediating factors on risky riding behaviors.

Category	Risky Riding Behaviors	Direct Effect	Indirect Effect through		The Total Effect of Risky Riding Behaviors
			Risk Perception	TPB/Behavioral Intention	
Personality traits					
Anxiety	Not-giving-way	N/E	N/E	N/E	N/E
	Lacking observation	−0.1200	N/E	N/E	−0.1200
	Reckless riding	N/E	N/E	N/E	N/E
Sensation seeking	Not-giving-way	−0.4200	0.1590	N/E	−0.2610
	Lacking observation	−0.3200	0.0540	N/E	−0.2660
	Reckless riding	N/E	0.1564	N/E	0.1564
Anger	Not-giving-way	−0.9100	0.3100	N/E	−0.6000
	Lacking observation	0.8200	0.1060	N/E	0.9260
	Reckless riding	−0.9500	0.3036	N/E	−0.6464
Altruism	Not-giving-way	0.4200	N/A	0.0080	0.4280
	Lacking observation	N/E	N/E	0.0005	0.0005
	Reckless riding	0.4400	N/E	N/E	0.4400
Normlessness	Not-giving-way	−0.1300	N/A	−0.0042	−0.1258
	Lacking observation	N/E	N/E	−0.0003	−0.0003
	Reckless riding	−0.1200	N/E	N/E	−0.1200
Mediating factors					
Rick perception	Not-giving-way	0.4700	N/E	N/E	0.4700
	Lacking observation	0.1600	N/E	N/E	0.1600
	Reckless riding	0.4600	N/E	N/E	0.4600
Attitudes toward traffic safety	Not-giving-way	N/E	N/E	N/E	N/E
	Lacking observation	N/E	N/E	N/E	N/E
	Reckless riding	N/E	N/E	N/E	N/E
Subjective norms	Not-giving-way	N/E	N/E	0.0416	0.0416
	Lacking observation	N/E	N/E	0.0026	0.0026
	Reckless riding	N/E	N/E	N/E	N/E
Perceived behavioral control	Not-giving-way	N/E	N/E	N/E	N/E
	Lacking observation	N/E	N/E	N/E	N/E
	Reckless riding	N/E	N/E	N/E	N/E

Note: N/E: no effect.

Step 3: Statistical testing.
Since the population variances are equal, the t-statistic is calculated as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(N_1-1)\,SD_1^2+(N_2-1)SD_2^2}{N_1+N_2-2}\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}} = \frac{3.78-3.60}{\sqrt{\frac{(211-1)0.7642^2+(314-1)0.926^2}{211+314-2}\left(\frac{1}{211}+\frac{1}{314}\right)}} = 2.376$$

Table 4. Differences in personality traits, mediating factors, and risky riding behaviors between riders involved and not in accidents.

Category	Riders Involved in Accidents		Riders Not Involved in Accidents		Difference (*p*-Value)
	Mean Scores	Standard Deviation	Mean Scores	Standard Deviation	
Personality traits					
Anxiety	3.77	0.730	3.79	0.829	−0.02 (0.732) ^{NS}
Sensation seeking	3.44	0.770	3.32	0.816	0.12 (0.080) ^{NS}
Anger	3.78	0.764	3.60	0.926	0.18 (0.0179) *
Altruism	3.93	0.706	3.89	0.738	0.04 (0.614) ^{NS}
Normlessness	2.49	0.878	2.71	1.019	−0.22 (0.070) ^{NS}
Mediating factors					
Risk perception					
"Probability of being involved in a traffic accident"	4.26	1.415	4.00	1.616	0.26 (0.053) ^{NS}
"Worry and concern for yourself being hurt in traffic"	5.05	1.616	4.99	1.579	0.06 (0.057) ^{NS}
Attitudes toward traffic safety					
Traffic flow vs. rule obedience	3.49	0.921	3.62	0.956	−0.13 (0.114) ^{NS}
Speeding	3.23	0.881	3.33	0.925	−0.10 (0.215) ^{NS}
Fun riding	3.48	0.944	3.39	0.977	0.09 (0.333) ^{NS}
Subjective norms					
Influence from family members	4.12	1.220	3.75	1.362	0.37 (0.001) *
Influence from important people	4.00	1.307	3.78	1.350	0.22 (0.060) ^{NS}
Influence from friends	3.68	1.180	3.48	1.271	0.20 (0.065) ^{NS}
Perceived behavioral control					
Riding experiences	2.61	1.070	2.73	2.735	−0.12 (0.196) ^{NS}
Riding skills	2.68	1.097	2.73	2.732	−0.05 (0.608) ^{NS}
Behavioral intention					
Drinking and riding	2.80	1.152	2.87	1.229	−0.07 (0.523) ^{NS}
Violation of traffic rules	2.55	1.538	2.89	1.538	−0.34 (0.011) *
Speeding	2.61	1.275	2.92	1.376	−0.31 (0.009) *
Risky riding behavior					
Reckless riding behavior	3.75	0.790	3.69	0.940	0.06 (0.455) ^{NS}
Not-giving-way behavior	3.97	1.080	3.78	1.150	0.19 (0.053) ^{NS}
Lacking observation behavior	3.33	1.080	3.59	1.130	−0.26 (0.009) *

* $p < 0.05$ (confidence interval is 95%); ^{NS}: not significant.

Step 4: Decide on the hypothesis.

$|t| = 2.376 > t_c = 1.964$. Reject hypothesis H_0, choose hypothesis H_1;

Using the *p*-value method: $p = 0.0179 < \alpha = 0.05$. The hypothesis is not rejected.

Step 5: Conclusion.

There are substantial differences between the two samples. In other words, those who had or had not had a traffic accident significantly differed in self-reported behavior.

Step 6: Confidence interval.

The confidence interval calculator is 95%: $0.031 < \mu < 0.329$.

Step 7: Graph illustrates the relationship between P and t (Figure 4).

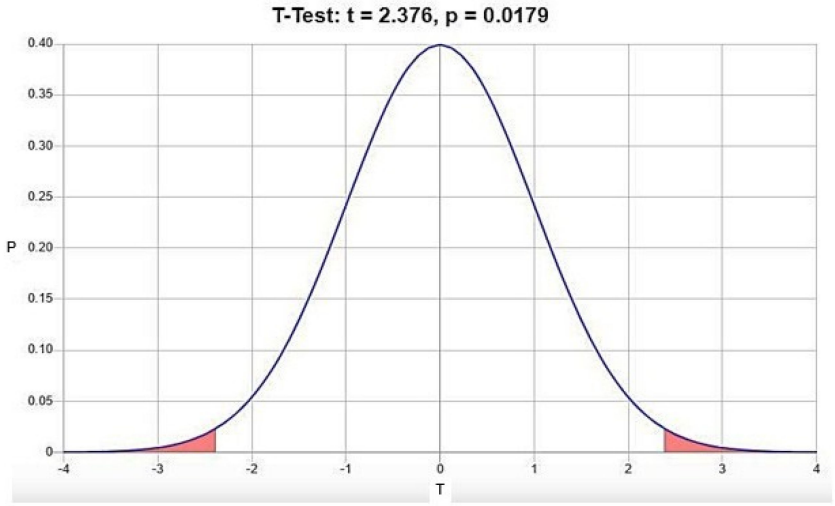

Figure 4. Relationship between P and t.

Table 4 shows the personality traits, mediating factors, and risky riding behavior of powered two-wheeler riders who have been involved in accidents and have not been in accidents in the last three years. Regarding personality, people who have been involved in accidents have stronger sensation-seeking, anger, and normlessness personalities than those who have never been involved in an accident. In terms of risk perception, people involved in accidents seem to have a better perception of accident probability than people who have never been involved. Regarding subjective norms, people involved in accidents are more willing to listen to advice from family members, surrounding close ones, and friends than those not involved in accidents. For risky riding behavior, there was no difference in the frequency of performing not-giving-way behavior and reckless riding behavior between the two groups of people. However, those involved in prior traffic accidents are less likely to engage in lacking observation behavior than people not involved in accidents. These results make sense because the people involved in an accident would have gained more experience and learned from their previous traffic accident mistakes.

Structural differences between personality traits and riding behavior with the potential for accident risk are shown in Figure 5—people not involved in traffic accidents and Figure 6—people involved in traffic accidents. Indexes such as $\chi^2/df = 1.825$, GFI = 0.874, CFI = 0.912, RMSEA = 0.051 are related to traffic accidents, and indexes $\chi^2/df = 1.827$, GFI = 0.825, CFI = 0.831, RMSEA = 0.062 are for the sample that has never been involved in a traffic accident. These indices demonstrate that the structural multigroup model fits the research data well.

Firstly, the not-giving-way behavior of those involved in the accident had a stronger direct positive impact ($\beta = 0.83$, $p < 0.05$) than those involved in the accident ($\beta = 0.26$, $p < 0.05$) from altruistic people. In addition, this behavior is also indirectly affected by weak polarity ($0.33 \times 0.63 = 0.2079$, $p < 0.05$) from sensation-seeking people, moderate positive indirect ($0.67 \times 0.63 = 0.4221$, $p < 0.05$) from anger, and weak negative personality ($-0.45 \times 0.63 = -0.2838$, $p < 0.05$) from altruistic personality through risk perception. In particular, this behavior has a weak positive indirect effect $\{0.12 \times (-0.20) \times (-0.20) = 0.0048$, $p < 0.05\}$ by people with altruism through the subjective norm and behavioral intention. However, personality traits did not indirectly affect the not-giving-way behavior of those who had never been involved in a traffic accident in the last three years.

Second, the lack of observed behavior of those involved in the accident had a weak direct negative effect ($\beta = -0.15$, $p < 0.05$) from anxious people and a moderate negative direct effect ($\beta = -0.37$, $p < 0.05$) and a strongly positive effect ($\beta = 0.73$, $p < 0.05$) from altruistic people. In addition, lacking observation behavior is also indirectly affected

by weak polarity ($0.33 \times 0.49 = 0.1617$, $p < 0.05$) from feeling-seeking people and has a moderate positive indirect ($0.67 \times 0.49 = 0.3282$, $p < 0.05$) from angry people and a weak negative indirect ($-0.45 \times 0.49 = -0.2205$, $p < 0.05$) from people with altruistic personality through risk perception. In comparison, personality traits did not influence this behavior for those who had never been involved in an accident in the last three years.

Third, reckless riding behavior directly by those involved in a traffic accident has a stronger positive direct influence ($\beta = 0.91$, $p < 0.05$) than those who have never been involved in an accident ($\beta = 0.19$, $p < 0.05$) by altruistic personality. Lack of normative personality did not affect reckless riding behavior for those who had been involved in an accident. In contrast, this personality trait had a weak direct negative effect ($\beta = -0.16$, $p < 0.05$) for those who had never been involved in an accident. Altruistic personality has a positive indirect effect $\{0.12 \times (-0.20) \times (-0.16) = 0.0038, p < 0.05\}$ through the subjective norm and behavioral intention on reckless riding behavior. Altruism did not indirectly affect reckless riding behavior among those not involved in an accident in the last three years.

The total direct and indirect influence of personality traits on riding behavior with potential accident risk on the factor of accident experience is shown in Table 5. First, the not-giving-way behavior represents a personality difference that leads to potentially dangerous riding behavior. In particular, the total influence of personality on the behavior of those involved in an accident was much lower than that of those not involved. Next, the lack of observation behavior also shows personality differences that lead to potentially dangerous riding behavior. The total influence of personality traits did not affect the lack of observed behavior of those involved in the accident. In that case, personality traits affect riding behavior with the potential for an accident. Finally, reckless riding behavior also exhibits personality differences that lead to potentially dangerous riding behavior. The total influence of personality on reckless riding behavior was higher for those involved in an accident than those not involved.

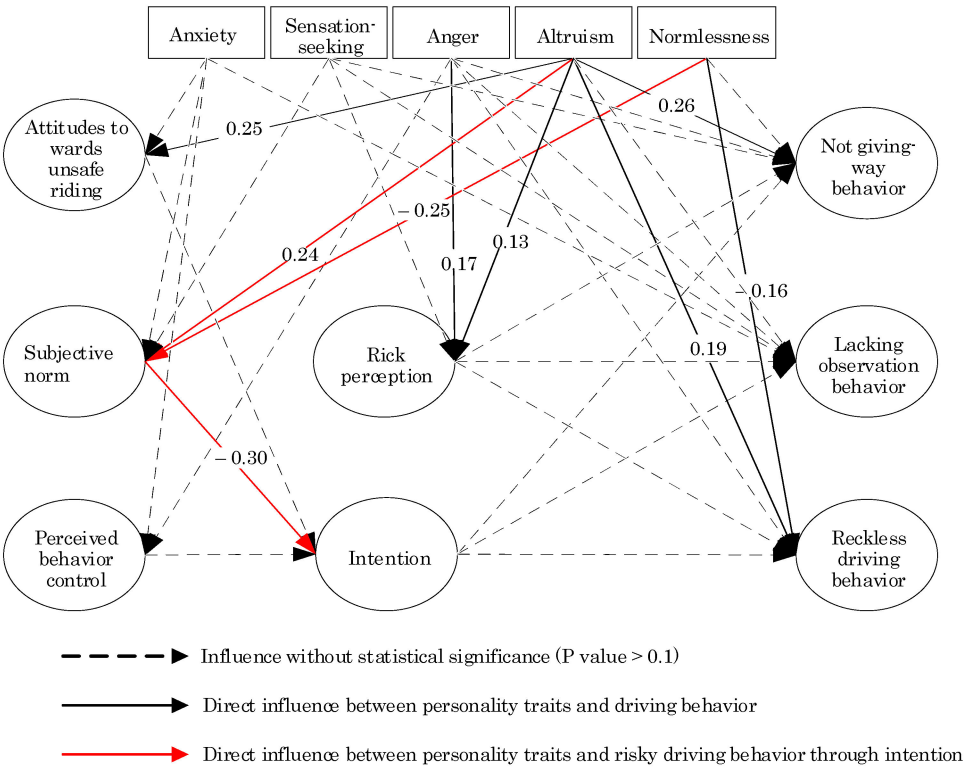

Figure 5. Multigroup SEM model—samples not related to traffic accidents.

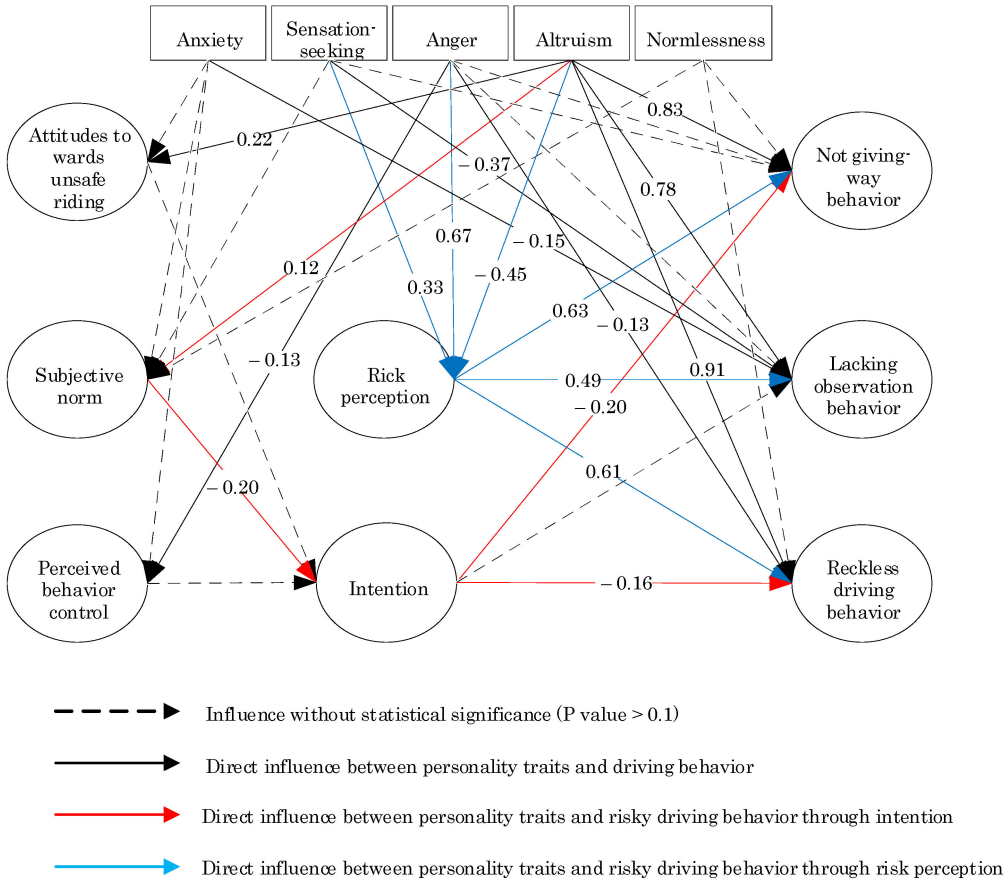

Figure 6. Multigroup SEM model—samples related traffic accidents.

Table 5. The total influence of personality traits on risky riding behavior (related to traffic accidents—not related to traffic accidents).

Personality Traits	Not-Giving-Way Behavior		Lacking Observation Behavior		Reckless Riding Behavior	
	No	Yes	No	Yes	No	Yes
Anxiety	-	-	-	−0.1500	-	-
Sensation seeking	-	0.2079	-	−0.2083	-	-
Anger	-	0.4221	-	0.3283	-	0.2787
Altruism	0.1900	0.5513	-	0.6045	0.19	0.6393
Normlessness	-	-	-	-	−0.16	-
Total influence	0.1900	1.1813	0	0.5745	0.0300	0.9180

Not related to traffic accidents = No; Related to traffic accidents = Yes. Sign "-": no effect.

4. Discussion

4.1. Relationships between Personality Traits and Behavior

A direct relationship between personality traits and riding behavior is found in the model. While personality traits such as anxiety, sensation seeking, anger, and normlessness directly affect riding behavior negatively, altruism directly influences behavior positively, as shown in Table 3. It means that individuals with higher scores on the anxiety, sensation-seeking, anger, and normlessness personality tend to engage in unsafe riding compared to those with altruistic personality traits. More specifically, overly anxious people tend to drive without observing their surroundings. People scoring higher on sensation-seeking personality will likely ignore priority vehicles and exceed the speed limit. Individuals with higher scores on anger tend to overtake other vehicles without keeping a safe distance,

even to the extent of verbally abusing surrounding riders. Individuals with higher scores on normlessness personality are more likely to not yield to other vehicles in traffic. The obtained results are consistent with the results proposed previously [5].

An indirect relationship between personality traits and riding behavior through mediating factors was discovered in this study. Personality traits such as sensation seeking and anger indirectly and strongly influence risky riding behavior through risk perception. This indirect relationship indicates that individuals with sensation-seeking and anger personality had more awareness of accident risk, which helps to reduce risky behavior. This result has an important implication for risk-awareness education to reduce traffic accidents for these people. Altruism and normlessness personalities indirectly and weakly affect risky riding behavior through subjective norms in the TPB. It implies that relatives and friends influence people with normlessness personalities and listen to their advice on opposing dangerous riding behaviors. Thus, raising awareness about safe riding in the community is crucial in reducing traffic accidents. Other research studies also found this result [16].

Through the cause-and-effect relationship in the research model, there is substantial caution for people who are powered two-wheeler riders and have been involved in an accident in the past. This result differs from previous studies [7,10]. Altruism and normlessness indirectly influence not-giving-way behavior through the subjective norms and behavioral intention in the TPB. People with high scores on altruism are less likely to engage in not-giving-way behavior. The results of this study are consistent with the literature [6,7,10].

Changing an individual's personality can be very difficult. The results of our research model (Figures 3 and 6), however, demonstrate that personality traits not only directly affect risky driving behavior but also indirectly affect this behavior through risk perception. The results of this relationship support the development of education programs in the future.

In addition, indirect influences formed from mediating factors such as risk perception and TPB play an important role in reducing the direct influence of personality traits on risky riding behavior. As it is difficult to change personality within a short period of time, changing mediators is important to change behavior. The direct, indirect, and total influence of personality traits, risk perception, and subjective norms in the TPB on not-giving-way behavior, lacking observation behavior, and risky riding behavior are shown in Table 3. Personality traits other than anxiety have indirect influences on risky riding behavior. Indirect effects strongly reduce the direct effects of sensation-seeking and anger through risk perception. Similarly, the direct effects of altruism and normlessness are mitigated by indirect effects via subjective norms in the TPB.

The most significant difference in findings between this study and the studies of [4,7,8,11,13,17] is that personality traits indirectly affect risky riding behavior through attitudes toward traffic safety. As in previous studies, our research further found that personality traits, directly and indirectly, affect risk-riding behavior assessment through subjective norms, behavioral intentions in the TPB, and risk perception. This is considered the key point of this study compared to previous studies.

4.2. Differences between Accident-Involved and Non-Accident-Involved Powered Two-Wheeler Riders

The study examined statistical differences in influential factors between powered two-wheeler riders who have been involved in a traffic accident or have never been involved in a traffic accident in the past three years. As shown in Table 4, individuals involved in traffic accidents tend to be stronger in the personality traits of sensation seeking, anger, and normlessness than those who have never been involved. Furthermore, accident-involved riders have higher risk perceptions and a higher degree of opinions and perceptions from family members (subjective norms) than non-accident-involved riders. This is reasonable since riders will be better aware of safe riding after experiencing a traffic accident. The previous section also indicated that sensation seeking, anger, and normlessness indirectly influence risky riding behavior through risk perception and subjective norms. Therefore,

this group of people needs to be educated to raise their awareness of riding safety and to reduce their risky riding behavior.

Structural differences in the cause-and-effect relationship between those involved in a traffic accident and those not involved in a traffic accident have been found in this study. First, the not-giving-way behavior of individuals involved in an accident is directly influenced positively by the lack of standards and indirectly by the sensation-seeking, anger, and altruistic personality traits via risk perception. In addition, the not-giving-way behavior is also indirectly positively influenced by altruistic personality through subjective norms and behavioral intention in the theory of planned behavior TPB. Meanwhile, personality did not affect the not-giving-way behavior of those not involved in an accident. Next, lack of observation behavior was negatively influenced by anxiety, sensation seeking, and altruism positively for individuals involved in the accident. In addition, unobserved behavior is also indirectly positively influenced by sensation-seeking, anger, and altruism through risk perception. Meanwhile, lack of observation behavior does not directly or indirectly affect the behavior of those who have never been involved in an accident. Finally, reckless riding behavior for individuals involved in an accident is directly negatively affected by anger. In contrast, negative feedback from normlessness directly affects individuals who have never been involved in an accident.

4.3. Practical Significance of the Research Results

Based on the results of this study, risk awareness is found to be a potential factor that plays a mediating role in the cause-and-effect relationship between personality traits and risky riding behavior. Therefore, education programs focusing on improving risk perception when riding [37–41] should be developed.

The results of our study (Figure 3) indicate that young drivers are strongly influenced by personality traits such as sensation-seeking, anger, and normlessness. Personality traits directly and indirectly influence potential factors leading to risky riding behavior. Their personality traits prompted them to engage in dangerous riding behaviors such as running red lights at intersections, swerving, and even riding fast in densely populated areas. This research result is consistent with previous studies [4,6]. The results of those studies indicate that personality traits directly influence risky riding behavior and indirectly influence behavior through attitudes toward traffic safety. However, we found that personality also indirectly affects riding behavior through latent factors in the TPB. This finding suggests that we can also educate riders by promoting programs that improve risky riding perception besides educating riding skills and traffic rules to improve safe riding behavior.

Figures 3 and 6 indicate that personality traits indirectly influence risky riding behavior through perceived risk; this relationship implies that the factor of risk perception plays an important role in explaining this relationship. Furthermore, we already know that it is difficult to change a driver's personality in a short period of time. Therefore, instead of focusing on changing drivers' personalities, we should guide them to improve their awareness of risky situations when they participate in traffic.

Multigroup modeling results (Figures 5 and 6) indicate that people involved in traffic accidents are strongly influenced by normlessness, anger, and sensation-seeking personalities. These personalities encourage people to ride faster, speed up, and not yield to other road users. These behaviors are the leading cause of traffic accidents, which implies that we should change the driver training and licensing process with current regulations. Teaching riders to be aware of dangerous situations also reduces traffic accidents in the future. Furthermore, to improve dangerous riding behavior and reduce traffic accidents, we need to identify those at risk of accidents who have reckless riding, do not give way, and lack observation behavior, and train them differently from others.

4.4. Limitations of the Study

This study has pinpointed personality traits that affect powered two-wheeler riders, causing traffic accidents. However, the framework of our paper still has limitations. Firstly,

the analysis of intermediate effects to determine the independent and dependent variables has not yet been conducted. This study is based on the research undertaken by [4,7,31–33]. The proposed model of these studies still considers personality traits as an independent variable and risky riding behavior as a dependent variable. The intermediate effects analysis has not yet been performed to determine the variable's role. Future studies can use genetic algorithms (GA) to analyze intermediate effects to assess the role of research variables in the model. Secondly, this study focuses on the causes of riding behavior causing traffic accidents. The improvement of risky riding behavior for riders needs detailed guidance. Future studies should consider this issue to improve riding behavior for young powered two-wheeler riders. Thirdly, adding other variables to the model, such as traffic environment variables, road conditions, and weather, could provide greater insight. Finally, this study's sample was made up of mostly self-reported riders about personalities, attitudes, and behavior. Research on different types of vehicles should also be examined in the future.

In this study, self-reported riding behavior was conducted through a questionnaire survey. Future studies should consider observing riding behavior through video-captured methods to increase the robustness of the proposed models. Additionally, in this study in Phu Yen, Vietnam, motorized two-wheelers, including mopeds, scooters, and small motorcycles, are the most common vehicles. Studies in other cities should consider the most commonly used vehicle types in their locales.

5. Conclusions

The direct and indirect influence of personality on risky riding behavior through attitude has been studied by [4,6]. Accordingly, the results of these studies indicate that personality traits such as sensation seeking, normlessness, and anger strongly influence driver behavior. Meanwhile, people with anxiety and altruism personalities were less likely to engage in risky riding behaviors than those with the abovementioned traits. Furthermore, the results of these studies have not yet determined whether personality traits such as sensation-seeking, normlessness, and anger are associated with riding behavior that causes traffic accidents. According to the argument of these studies, risky riding behavior can lead to risky riding behavior. Therefore, to answer this question, our study was conducted to determine the personality factors affecting the riding behavior causing traffic accidents of young powered two-wheeler riders. The results of the multigroup model with a linear structure between personality characteristics and riding behavior causing traffic accidents indicate that the riding behavior causing traffic accidents of those who have experienced traffic accidents is influenced by sensation-seeking, normlessness, and anger personalities. In other words, people prone to personality traits such as sensation seeking, normlessness, and anger were more likely to push them to commit the act of causing an accident at least once in the last three years. Meanwhile, those who were more altruistic and anxious reported never having a traffic accident. This study's findings can be used by transportation agencies and the department of public safety to develop education and outreach programs to mitigate traffic accidents in Vietnam and other countries where motorized two-wheelers are the dominant mode of transportation.

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References

1. Phu Yen Department of Police. *Phu Yen Road Accident Report*; Phu Yen Department of Police: Tuy Hoa, Vietnam, 2018.
2. Fiske, D.W. Consistency of the factorial structures of personality ratings from different sources. *J. Abnorm. Soc. Psychol.* **1949**, *44*, 329–344. [CrossRef]
3. Goldberg, L.R. A broad-bandwidth, public-domain, personality inventory measuring the lower-level facets of several five-factor models. In *Personality Psychology in Europe, 7*; Mervielde, I., Deary, I., Fruyt, F.D., Ostendorf, F., Eds.; Tilburg University Press: Tilburg, The Netherlands, 1999; pp. 7–28.
4. Wong, J.-T.; Chung, Y.-S.; Huang, S.-H. Determinants behind young motorcyclists' risky riding behavior. *Accid. Anal. Prev.* **2010**, *42*, 275–281. [CrossRef] [PubMed]
5. Chen, C.-F. Personality, safety attitudes and risky driving behaviors—Evidence from young Taiwanese motorcyclists. *Accid. Anal. Prev.* **2009**, *41*, 963–968. [CrossRef]
6. Nordfjærn, T.; Jørgensen, S.H.; Rundmo, T. An investigation of driver attitudes and behaviour in rural and urban areas in Norway. *Saf. Sci.* **2010**, *48*, 348–356. [CrossRef]
7. Ulleberg, P.; Rundmo, T. Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Saf. Sci.* **2003**, *41*, 427–443. [CrossRef]
8. Chung, Y.-S.; Wong, J.-T. Beyond general behavioral theories: Structural discrepancy in young motorcyclist's risky driving behavior and its policy implications. *Accid. Anal. Prev.* **2012**, *49*, 165–176. [CrossRef] [PubMed]
9. Jonah, B.A.; Thiessen, R.; Au-Yeung, E. Sensation seeking, risky driving and behavioral adaptation. *Accid. Anal. Prev.* **2001**, *33*, 679–684. [CrossRef]
10. Rundmo, T.; Iversen, H. Risk perception and driving behaviour among adolescents in two Norwegian counties before and after a traffic safety campaign. *Saf. Sci.* **2004**, *4*, 1–21. [CrossRef]
11. Machin, M.A.; Sankey, K.S. Relationships between young drivers' personality characteristics, risk perceptions, and driving behaviour. *Accid. Anal. Prev.* **2008**, *40*, 541–547. [CrossRef]
12. Iversen, H.; Rundmo, T. Personality, risky driving and accident involvement among Norwegian drivers. *Pers. Individ. Differ.* **2003**, *33*, 1251–1263. [CrossRef]
13. Dahlen, E.R.; Martin, R.C.; Ragan, K.; Kuhlman, M.M. Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. *Accid. Anal. Prev.* **2005**, *37*, 341–348. [CrossRef] [PubMed]
14. Lucidi, F.; Mallia, L.; Lazuras, L.; Violani, C. Personality and attitudes as predictors of risky driving among older drivers. *Accid. Anal. Prev.* **2014**, *72*, 318–324. [CrossRef] [PubMed]
15. Mallia, L.; Lazuras, L.; Violani, C.; Lucidi, F. Crash risk and aberrant driving behaviors among bus drivers: The role of personality and attitudes towards traffic safety. *Accid. Anal. Prev.* **2015**, *79*, 145–151. [CrossRef]
16. Tillmann, W.A.; Hobbs, G.E. The accident-prone automobile driver: A study of the psychiatric and social background. *Am. J. Psychiatry* **1949**, *106*, 321–331. [CrossRef] [PubMed]
17. Jonah, B.A. Sensation seeking and risky driving: A review and synthesis of the literature. *Accid. Anal. Prev.* **1997**, *29*, 651–665. [CrossRef] [PubMed]
18. Lajunen, T.; Parker, D. Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. *Accid. Anal. Prev.* **2001**, *33*, 243–255. [CrossRef]
19. Shinar, D. Aggressive driving: The contribution of the drivers and the situation. *Transp. Res. Part F Traffic Psychol. Behav.* **1998**, *1*, 137–160. [CrossRef]
20. Ajzen, I. The Theory of Planned Behavior. In *Organizational Behavior and Human Decision Processes*; Department of Psychology, University of Massachusetts: Amherst, MA, USA, 1991; Volume 50, pp. 179–211.
21. Chan, D.C.N.; Wu, A.M.S.; Hung, E.P.W. Invulnerability and the intention to drink and drive: An application of the theory of planned behavior. *Accid. Anal. Prev.* **2010**, *42*, 1549–1555. [CrossRef]
22. Tunnicliff, D.J.; Watson, B.C.; White, K.M.; Hyde, M.K.; Schonfeld, C.C.; Wishart, D.E. Understanding the factors influencing safe and unsafe motorcycle rider intentions. *Accid. Anal. Prev.* **2012**, *49*, 133–141. [CrossRef]
23. Satiennam, W.; Satiennam, T.; Triyabutra, T.; Rujopakarn, W. Red light running by young motorcyclists: Factors and beliefs influencing intentions and behavior. *Transp. Res. Part F Traffic Psychol. Behav.* **2018**, *55*, 234–245. [CrossRef]
24. Oltedal, S.; Rundmo, T. The effects of personality and gender on risky driving behaviour and accident involvement. *Saf. Sci.* **2006**, *44*, 621–628. [CrossRef]
25. Kohn, M.; Schooler, C. *Work and Personality: An Inquiry into Impact of Social Stratification*; Ablex: Norwood, NY, USA, 1983. Available online: https://lib.ugent.be/en/catalog/rug01:000205911 (accessed on 10 May 2021).
26. Elliott, M.A.; Thomson, J.A. The social cognitive determinants of offending drivers' speeding behaviour. *Accid. Anal. Prev.* **2010**, *42*, 1595–1605. [CrossRef]

27. Horvath, C.; Lewis, I.; Watson, B. Peer passenger identity and passenger pressure on young drivers' speeding intentions. *Transp. Res. Part F Traffic Psychol. Behav.* **2012**, *15*, 52–64. [CrossRef]
28. Chorlton, K.; Conner, M.; Jamson, S. Identifying the psychological determinants of risky riding: An application of an extended Theory of Planned Behaviour. *Accid. Anal. Prev.* **2012**, *49*, 142–153. [CrossRef] [PubMed]
29. Elliott, M.A.; Thomson, J.A.; Robertson, K.; Stephenson, C.; Wicks, J. Evidence that changes in social cognitions predict changes in self-reported driver behavior: Causal analyses of two-wave panel data. *Accid. Anal. Prev.* **2013**, *50*, 905–916. [CrossRef] [PubMed]
30. Jovanović, D.; Šraml, M.; Matović, B.; Mićić, S. An examination of the construct and predictive validity of the self-reported speeding behavior model. *Accid. Anal. Prev.* **2017**, *99*, 66–76. [CrossRef] [PubMed]
31. Reason, J.T.; Manstead, A.S.R.; Stradling, S.G.; Baxter, J.S.; Campbell, K. Errors and violations on the road: A real distinction? *Ergonomics* **1990**, *33*, 1315–1332. [CrossRef]
32. Özkan, T.; Lajunen, T.; Summala, H. Driver Behaviour Questionnaire: A follow-up study. *Accid. Anal. Prev.* **2006**, *38*, 386–395. [CrossRef]
33. Steg, L.; van Brussel, A. Accidents, aberrant behaviours, and speeding of young moped riders. *Transp. Res. Part F Traffic Psychol. Behav.* **2009**, *12*, 503–511. [CrossRef]
34. Hair, J.F.; Anderson, R.E.; Tatham, R.L.; Black, W.C. *Multivariate Data Analysis*; Prentice-Hall: Upper Saddle River, NJ, USA, 1998.
35. Anderson, J.C.; Gerbing, D.W. Structural equation modeling in practice: A review and recommended two-step approach. *Psychol. Bull.* **1988**, *103*, 411–423. [CrossRef]
36. Mousavi, S.R.; Sarmadian, F.; Angelini, M.E.; Bogaert, P.; Omid, M. Cause-effect relationships using structural equation modeling for soil properties in arid and semi-arid regions. *Catena* **2023**, *232*, 107392. [CrossRef]
37. Bates, L.; Hawkins, A.; Rodwell, D.; Anderson, L.; Watson, B.; Filtness, A.J.; Larue, G.S. The effect of psychosocial factors on perceptions of driver education using the goals for driver education framework. *Transp. Res. Part F Traffic Psychol. Behav.* **2019**, *66*, 151–161. [CrossRef]
38. Lonero, L.; Mayhew, D. *Teen Driver Safety: Large-Scale Evaluation of Driver Education Review of The Literature on Driver Education Evaluation 2010 Update*; AAA Foundation for Traffic Safety: Washington DC, USA, 2010.
39. Mayhew, D.R. Driver education and graduated licensing in North America: Past, present, and future. *J. Saf. Res.* **2007**, *38*, 229–235. [CrossRef] [PubMed]
40. Rodwell, D.; Alexander, M.; Bates, L.; Larue, G.S.; Watson, B. Parents' perceptions of driver education: A theoretically guided qualitative investigation. *Transp. Res. Part F Traffic Psychol. Behav.* **2021**, *77*, 293–311. [CrossRef]
41. Tronsmoen, T. Associations between driver training, determinants of risky driving behaviour and crash involvement. *Saf. Sci.* **2010**, *48*, 35–45. [CrossRef]

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