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Driver Behavioral Intention to Microsleep Episode Based on Theory of Planned Behavior

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Abstract: Road accident also one of the higher contributions to fatality rate around the world. Recently, microsleep become a popular reason that influence the increasing number of road accidents. This study is conducted to determine the possible causes of microsleep behavior among drivers as well as analyze the relationship between microsleep behavior and Theory of Planned Behavior variables. Therefore, 200 online questionnaires were distributed randomly to private vehicle drivers in all Johor district using Google Form. The results of this study show the most cause of microsleep behavior happen among driver is due to not enough rest or sleep before driving. Furthermore, the relationships between microsleep behavior and Theory of Planned Behavior are all significances.

Keywords: Road Accident, Microsleep, Theory of Planned Behavior

1. Introduction

Road accident is one of the most well-known contributions towards fatalities especially in huge populations country. High populations have relation with the increasing number of vehicles and road users in a country [1]. Malaysia is not an exception country in this popular tragedy. Major causes of road accident are divided into three factors which are human, environmental and vehicles. The age, gender, experience, physical and behavior of human that related to the decision making, reaction time and risk taking contribute significantly to the potential of road accident happen [2]. Human factor describes the behavior of potential and capacity of individual for physical and mental to respond any stimulation that happen in life. Behavior of human concept can be described based on psychology whereas include six elements that related to each other such as cognitive concept, antecedent stimuli and anticipated consequences [3].

Microsleep can be defined as sleeping in second long period because of some part of brains not functioning like usual as long as physical and mental remain unconscious up until minutes. Sleep has four stages to emphasize the condition sleep among people. However, microsleep cannot be categorized in sleep due to the uncontrollable and unconscious episode along with microsleep does not take such a long time to happen. Falling asleep when in wheel even in short time can be extremely dangerous where this behavior can lead to accident as potential injury or fatal for the road users [4]. Drowsiness while driving influence the number of road accident due to sleepiness stimulates brain for not paying fully attention and give drowsiness for someone [5].

Theory of Planned Behavior has been developed by Ajzen to identify the behavioral intention that leads to action of behavior in particular situation. Theory of Planned Behavior able to understand and predict individual attitude along with emphasize the individual attention and behavior [6]. Driver behavior can be monitor and analyze using theoretical models which is Theory of Planned Behavior. TPB is the most suitable and well-known theory in traffic to discuss about the driver intentions. This theory model has been used widely especially in traffic study [7].

This study focuses on driver behavioral intention towards microsleep episode using Theory of Planned Behavior. This study also analyzed the relationship between microsleep behavior and Theory of Planned Behavior (TPB) variables. At the end of this study, the data can be used as a guide for authority to raise awareness about microsleep episode among drivers.

2. Materials and Methods

This study focuses on driver behavioral intentions towards microsleep episode. Questionnaire is a tool that able to collect respond and information from. The questionnaire divided into three parts which are Section A, B and C. Section A focused on demographic questions such as gender, age, race and hometown area while Section B focused on respondent's experience in binary scale design. Design question for Section C based on Theory of Planned Behavior variables in Likert Scale with 5 level (strongly disagree, disagree, neutral, agree, strongly agree). The chosen location for this research is at all districts in Johor since Johor reported 2.7% of road accident caused by drowsiness behavior among road user and this number increased from 2018 [8]. For the sample size. 200 sample size number is adequate for any model of research and structure after assuming there have no problem regarding the missing data and distribution [9]. Hence, 200 sample sizes used in this research.

Three types of analysis used in this study. First, descriptive analysis to describe frequency and percentage of respondent's demographic and respondent's experience while emphasized mean and standard deviation of TPB variables based on respondent's perceptions. Second, correlation analysis lies between -1 until +1 and 0 means the correlation is absence [10]. Three models are conducted for correlation analysis which first is attitude, subjective norms and perceived behavioral control as independent variables and Intention as dependent variables. Next, second model is behavioral as dependent and intention as independent while third model is perceived behavioral control as independent and behavior as dependent variables. This correlation analysis applied on section C for these three models regarding the respondent's perception using TPB variables. Lastly, regression analysis is an approach to examine the model of data according to the elements in Theory of Planned Behavior in questionnaire survey. Regression analysis used to analyze questions on Section C of questionnaire. The equation based on basic multiple regression formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$$

Where;

Y = Dependent variable (Intention and Behaviour)
$X_1, X_2 \ldots X_n$ = Independent variable (Attitude, Subjective Norm,

Perceived Behavioural Control)

$\beta_0, \beta_1, \beta_2...\beta_n$ = coefficients or regression of independent variables in the study

Alpha Cronbach Analysis used to check the acceptability and validity of questionnaire only can be applied in Likert Scale type questions to check reliability and internal consistency [11]. The acceptable value for Alpha Cronbach is above than 0.7 [11]. Therefore, Alpha Cronbach for this study is 0.746 and it considered as acceptable internal consistency.

3. Results and Discussion

3.1 Descriptive Analysis

Based on the data obtained in Table 1, male contributes 46% while total female respondent 54 percent. Respondents in 20-29 years old recorded as the highest percentage (82%) while the least range age of number respondents is 19 years old and below (1%). The highest nationality of respondent is Malay with frequency 158 (79%) followed by Indian (9.5%). Meanwhile, Chinese recorded 9% and the least contribution of percentage is others with 2.5% only. Johor Bahru contributes the highest of percentage district while least percentage for this survey is Ledang with contribution only 3%. The highest percentage of occupation is student with 36% and the least is unemployed with 8%. For government, private and self-employed are recorded as 13%, 32.5% and 10.5% respectively. Most of respondent have B/D license with 90.5% compared to the other licenses. 70% respondent has private vehicle and 30% do not have private vehicles. The highest percentage among respondents are 5 years and below (48%) while the least percentage is 16-20 years of driving experience (2.5%). The percentage of yes with 51.5% while no is 48.5%. The highest respondents experience in accidents is one times (52.4%) followed by 2 and 3 times in 27.2% and 12.6% respectively. No respondents experience 5 times accidents but 3.9% experience in 4 times and more than 5 times in whole life. The result shows female respondents is slightly higher than male and most of respondents in range 20-29 years old. Driver characteristics such as gender and age contribute to risk of accidents as youngest and older contributes to the higher fatal in road accidents. In addition, gender differentiation of driver between female and male lead to strong evidence that male driver has high risk in accidents [12].

Table 1: Respondent's Demographic

Item	Frequency (n)	Percentage (%)
Gender		
Male	92	46
Female	108	54
Age		
19 years old and below	2	1
20-29 years old	164	82
30-39 years old	13	6.5
40-49 years old	6	3
50 years old and above	15	7.5
Nationality		
Malay	158	79
Chinese	18	9
Indian	19	9.5
Others	5	2.5
District		

Johor Bahru	41	20.5
Ledang	6	3
Kota tinggi	38	19
Kulaijaya	20	10
Mersing	37	18.5
Batu Pahat	14	7
Muar	10	5
Kluang	15	7.5
Pontian	5	2.5
Segamat	14	7
Occupation		
Student	72	36
Government	26	13
Private	65	32.5
Self-Employed	21	10.5
Unemployed	16	8
License Type		
B/D	181	90.5
P	10	5
L	2	1
No license	7	3.5
Private Vehicle Ownership		
Yes	140	70
No	60	30
Driving Experience		
5 years and below	96	48
6-10 years	63	31.5
11-15 years	18	9
16 years and above	23	3.5
Accident Experience		
Yes	103	51.5
No	97	48.5
Total Accident Experience		
1 – 2 times	82	79.6
3 – 4 times	17	16.5
More than 4 times	13	3.9

Table 2 shows 57.5% of yes respondents experience unwell situation while driving and another 42.5% is no. Along with 57.5% of yes, 29.6% take medicine that can cause drowsiness while driving while 70.4% is not taking drowsiness medicine while driving. Furthermore, 82% of respondents have drowsiness experience while 18% is no. The highest percentage of times of respondent experience this situation is more than 5 times. Meanwhile, 1,2,3,4 and 5 times are 12.2%, 21.3%,24.4%, 3.7% and 4.3% respectively. Besides, 45.4% of yes responds while 54.5% is not experience microsleep while driving and the highest percentage of times is 2 times with 25.4% while the least percentage is 4 times in whole life with 6.6%. From the respondent's experience data, the causes of microsleep behavior among drivers are unwell situations while driving and not enough rest or sleep before driving. The most microsleep

cause is not enough rest or sleep due to highest percentage between the other experiences. The contribution of works gives high risk of experiencing drowsiness during driving due to sleep deprived and tiredness [13].

Table 2: Respondent's Experience

Item	Frequency (n)	Percentage (%)
Having Unwell Experience Lead to Drowsiness while Driving		
Yes	115	57.5
No	85	42.5
If yes, Do You Take Any Medicine Causes Drowsiness Before Driving		
Yes	34	29.6
No	81	70.4
Having Drowsiness Because Lack of Rest or Sleep while Driving		
Yes	164	82
No	36	18
Total Drowsiness Experience		
1 – 2 times	55	33.5
3 – 4 times	46	28.1
5 times and more	63	38.4
Having Microsleep while Driving		
Yes	91	45.5
No	109	54.5
Total Microsleep Experience While Driving		
1 – 2 times	39	42.9
3 – 4 times	22	24.2
5 times and more	30	32.9

3.2 Correlation Analysis

There have three models conducted for correlation analysis which first is attitude, subjective norms and perceived behavioral control as independent variables and intention as dependent variables. Next, second model is behavioral as dependent and intention as independent while third model is perceived behavioral control as independent and behavior as dependent variables.

Table 3: Correlation Analysis for TPB Variables

	BEH	PBC	SN	ATT	INT
BEH	1	.200**	-.068	.096	.069**
PBC	.200**	1	.135	.209**	.268**
SN	-.068	.135	1	.398**	.324**
ATT	.096	.209**	.398**	1	.488**
INT	.069**	.268**	.324**	.488**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Based on Table 3, the first model, attitude and intention show r = 0.488 as weakly positive correlation and significant between this relationship while subjective norms and intention shows r = 0.324 where it is also weakly positive correlation and significant. Perceived behavioral control as independent and intention as dependent shows r = 0.268 where this relationship is weakly positive correlation and significant. Second model is between behavior as dependent and intention as independent variables. These two variables show r = 0.069 where there is weak relationship and significant. Next, third model shows r = 0.200 where this relationship is weakly position correlation and significance. The correlation analysis for three models in this study shows significance but weak relationship. Perceived behavioral control gives important contribution to behavior because of the experience itself [14]. Meanwhile, perceived behavioral control and intention are contributed to driver behavior [15].

3.3 Regression Analysis

3.3.1 Regression Analysis for First Model of TPB Components

Tables 4 shows model summary and value of R^2 is 0.284 which means 28.4% of the data fit this model. The changes in intention variable depends on three independent variables combined and took place (attitude, perceives behavioral control and subjective norm). Table 5 shows Analysis of Variance (ANOVA) of multiple regression for first model. The F test value is 25.965 by dividing mean square (7.394/0.285). There has a significant relationship between independent variables (attitude, perceived behavioral control and subjective norm) and dependent variable (intention). Table 6 shows coefficients of attitude $\beta 1 = 0.396$, t =5.926, p < 0.05 which means there has a significance relationship while perceived behavioral control shows $\beta 1 = 0.166$, t =2.682, p < 0.05 also has a significance relationship. Lastly, the data for subjective norms is $\beta 1 = 0.144$, t =2.178, p < 0.05 and has a significance relationship. Attitude shows maximum strong predictor while subjective norms as minimum predictor. Attitude is the most significant predictor followed by Perceived Behavioral Control and lastly Subjective Norms [16]. Low R squared values in study field of social science research is accepted due to human behavior cannot be predict precisely [15].

Table 4: Model Summary for First Model

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.533ª	.284	.273	.53365	.284

Table 5: ANOVA for First Model

ANOVAª						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.183	3	7.394	25.965	.000ᵇ
	Residual	55.817	196	.285		
	Total	78.000	199			

a. Dependent Variable: INT
b. Predictors: (Constant), SN, PBC, ATT

Table 6: Coefficient for First Model

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.676	.346		4.840	.000
	ATT	.422	.071	.396	5.926	.000
	PBC	.111	.041	.166	2.682	.008
	SN	.121	.056	.144	2.178	.031

a. Dependent Variable: INT

3.3.2 Regression Analysis for Second Model of TPB Components

Table 7 shows model summary and R^2 is 0.004 which means 0.4% of the data fit this model. Low R squared values in study field of social science research is accepted due to human behavior cannot be predict precisely [15]. The change in behavioral variable depends on the changes in intention. Table 8 shows Analysis of Variance (ANOVA) of linear regression for second model. The F test value is 0.690 which means there has significant relationship in this model due to $p < 0.05$. Table 9 shows the coefficient to predict second model on independent variables to dependent variable. For intention variable, the data shows $\beta = 0.63$, t =0.831, $p < 0.05$ which means there has significance coefficient relationship between intention and behavior. The second model for this study, Intention has significant predictor to behavior. Driver's intention while driving has significant relationship towards driver behavior [17].

Table 7: Model Summary for Second Model

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate	R Square Change
1	.063ᵃ	.004	.002	.399	.004

Table 8: ANOVA for Second Model

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.110	1	.110	.690	.007ᵇ
	Residual	27.208	171	.159		
	Total	27.318	172			

a. Dependent Variable: BEH
b. Predictors: (Constant), INT

Table 9: Coefficients for Second Model

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.

1	(Constant)	1.696	.266		6.376	.000
	INT	.040	.048	.063	.831	.007

a. Dependent Variable: BEH

3.3.3 Regression Analysis for Third Model of TPB Components

Table 10 shows model summary and R^2 is 0.04 which means 4% of the data fit this model. Low R squared values in study field of social science research is accepted due to human behavior cannot be predict precisely [15]. The change in behavioral variable depends on the changes in perceived behavior control. Table 11 shows Analysis of Variance (ANOVA) of linear regression for third model. The F test value this third model is 8.265 which means there has significant relationship in this model due to ($p < 0.05$). Table 12 shows perceived behavioral control for $\beta = 0.200$, t =2.875, $p < 0.05$ which means there has significance relationship between intention and behavior. Third model for this study shows significant relationship between Perceived Behavior Control and Behavior of microsleep while driving. Perceived behavioral control has strong significant effect on behavior [18].

Table 10: Model Summary for Third Model

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.200[a]	.040	.035	.487	.040

Table 11: ANOVA for Third Model

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.958	1	1.958	8.265	.004[b]
	Residual	46.917	198	.237		
	Total	48.875	199			

a. Dependent Variable: BEH

Table 12: Coefficients for Third Model

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.846	.151		12.263	.000
	PBC	.106	.037	.200	2.875	.004
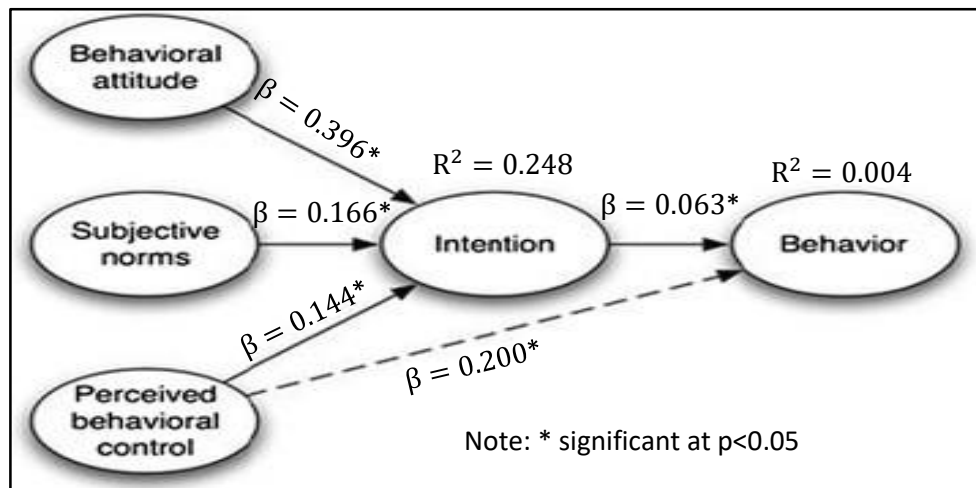
Figure 1: Summary of Regression Analysis on Three Models of TPB

4. Conclusion

Microsleep is one of driver's reason affecting road accident especially for those who has sleep disorder due to lack of concentration while driving as well as and stimulation become lower [5]. Based on this study, the possible causes of microsleep behavior among drivers are unwell condition while driving, take any medicine cause drowsiness that verified by health expert before driving and not enough rest or sleep before driving. The most microsleep cause happen while driving is due to not enough rest or sleep before driving. Theory of Planned Behavior variables have significant relationship between microsleep behavior in regression analysis. In regression analysis for first model, attitude shows maximum strong predictor compared to perceived behavioral control as well as subjective norms as minimum predictor. Furthermore, second and third model also shows significant relationships. Correlation analysis for three models in this study shows significance but in weak relationship. The findings from this study may be used for further research to improve the deficiencies identified regarding the microsleep episode in this study.

Acknowledgement

References

[1]   W. Wang et al., "Analyzing risk factors for fatality in urban traffic crashes: A case study of Wuhan, China", Sustainability, vol. 9, no. 6, pp. 897. 2017.

[2]   Musa, M. F., Hassan, S. A. and Mashros. "The impact of roadway conditions towards accident severity on federal roads in Malaysia". PLoS one, vol. 15, no. 7, pp. 149-159. 2020.

[3]   Zinebi, Kawtar, Nissrine Souissi, and Kawtar Tikito. "Capture of general human behavior features from a multi-viewpoints analysis." The eighth Edition of the international Collo-quium on Scientific and Technological Strategic Intelligence, VSST, 2016.

[4]   Kendra, "The Four Stages of Sleep". Very Well Health. February 2020 [Online]. Available: https://www.verywellhealth.com/the-four-stages-of-sleep-2795920. [Accessed Dec. 21, 2020].

[5]   Megan, "Understanding Microsleep when Minds are Asleep and Awake". Microsleep. September 2019 [Online]. Available: https://www.healthline.com/health/microsleep. [Accessed Dec. 21, 2020].

[6]   Ajzen, I., "The theory of planned behaviour: reactions and reflections". Psychology and Health, vol. 26, no. 9, pp. 1113 -1127, 2011.

[7]   Meesmann, Uta, Katrien Torfs, and Mario Cools. "Socio-cognitive factors in road safety monitoring–Cross-national comparison of driving under the influence of alcohol, drugs or medication." IATSS research. vol. 44 no. 3, pp. 180-187, 2020.

[8]   United Nations, "World Population Prospects". World Population, January 2018 [Online]. Availble: https://www.macrotrends.net/cities/21804/johor-bahru/population. [Accessed Dec.18, 2020].

[9]   Moons, Ingrid, and Patrick De Pelsmacker. "An extended decomposed theory of planned behaviour to predict the usage intention of the electric car: A multi-group comparison." Sustainability. vol. 7, no. 5, pp. 6212-6245, 2015.

[10]   Gagne and Francois, Biochemical ecotoxicology: principles and methods. 2014.

[11]   Adetayo, Adeola E., Powel M. Worimegbe, and Benneth U. Eze. "Marketing ethics and competitiveness: a study of deposit money bank in Nigeria," Skyline Business Journal, vol. 16, no.1, pp. 1-13 ,2020.

[12]   Ma, Lu, and Xuedong Yan. "Examining the nonparametric effect of drivers' age in rear-end accidents through an additive logistic regression model." Accident Analysis & Prevention, vol. 67, pp. 129-136, 2014.

[13]   Elmansouri, Omar, Abdulmojeb Almhroog, and Ibrahim Badi. "Urban transportation in Libya: An overview." Transportation research interdisciplinary perspectives, vol. 8, pp. 100-114, 2020.

[14]   Moons, Ingrid, and Patrick De Pelsmacker. "An extended decomposed theory of planned behaviour to predict the usage intention of the electric car: A multi-group comparison." Sustainability, vol. 7, no. 5, pp. 6212-6245, 2015.

[15]   Javid, Muhammad Ashraf, and Amani Rashid Al-Hashimi. "Significance of attitudes, passion and cultural factors in driver's speeding behavior in Oman: application of theory of planned behavior." International journal of injury control and safety promotion, vol. 27, no. 2, pp. 172-180, 2020.

[16]   Johnson and David P. "How Attitude Toward the Behavior, Subjective Norm, and Perceived Behavioral Control Affects Information Security Behavior Intention". Diss. Walden University, 2017.

[17]   Cheolho, Y., and K. Hyungon. "Understanding computer security behavioral intention in the workplace." Information Technology & People, vol. 26, no. 4, pp. 401-410, 2013.

[18]   Greaves, Martin, Lara D. Zibarras, and Chris Stride. "Using the theory of planned behavior to explore environmental behavioral intentions in the workplace." Journal of Environmental Psychology, vol. 34, pp. 109-120, 2013.