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Research paper

The Effects of User's Role and User's Mood towards Cyber Sickness Symptoms on Desktop Computer in Virtual Reality Environment

Salyani Osman [1]*, Le Cong Hoang[2], Suzana Basaruddin[3], Rohaya Abu Hassan[4], Che Manisah Mohd Kasim[5], Ratna Zuarni Ramli [6]

[1,2,3,4,5]*Faculty of Communication, Visual Art and Computing, Universiti Selangor, Malaysia*
[2]*Faculty of Computer Science and Mathematics, UiTM, Malaysia*
** Corresponding author E-mail:salyani@unisel.edu.my*

Abstract

Virtual reality is a promising technology that shows rapid growth in recent years. In some virtual reality practicality cases, users perceive symptoms that are similar to motion sickness. This symptom occurs due to cyber sickness or simulation sickness. Apparently, there are many factors that could contribute to cyber sickness. This study will focus on user's role and user's mood factors. The objectives of this research are to examine the user's role and user's mood effects towards cyber sickness symptoms and the interaction between both factors towards cyber sickness symptoms. A set of data was collected by using simulated sickness and arousal scale questionnaire and the result shows that user's role and user's mood effect on cyber sickness, meanwhile, there is no interaction effect between user's role and user's mood towards cyber sickness. This research outcomes contributed to the awareness of the cyber sickness among computer users in accordance to develop better virtual reality system in future.

Keywords: *Cyber sickness, simulator sickness, virtual reality, desktop simulation.*

1. Introduction

Virtual Reality (VR) is a promising technology and that's growing fast within a few years. Despite a big progress in VR technology, VR user still meets some troublesome experience while getting immersed in the VR environment. The user will get symptom that are similar with motion sickness. This was called cyber sickness simulation sickness.
Cyber sickness can cause some serious problems, such as effecting user's judgment to VR system which is used for training, education and serious gaming applications [1]. It stated that the user who suffer cyber sickness, feels that the simulation system is less pleasant, more arousing and causes more distress. Cyber sickness may create health and safety concerns [2]. The symptoms are general discomfort, fatigue, headache, eye strain, difficulty in focusing, increasing in salivation, sweating, nausea, difficulty in concentrating, fullness of the head, blurred vision, dizziness with eyes open, dizziness with eyes closed, vertigo, stomach awareness, burping [3], vomiting, and postural instability [4]. [3] list down the symptom of cyber sickness (Table 1) within three groups: nausea, oculomotor discomfort, and disorientation. Some symptoms can be within more than one group.
Cyber sickness of desktop users has become an important issue due to the increasing use of serious gaming applications on the platform [5]. Nowadays, VR also being used in medical treatment (rehabilitation) [6,7,8], education research [9,10] and teaching [11]. There is a study that examined the relationship between cyber sickness and user's control [12,13,14]. User's control to cyber sickness can be affected from different factors such as field of view, display fidelity and user's role. There are also some studies that examine the relationship between cyber sickness and user's mood (anxiety, stress) [4,5,15].
This research focuses on identifying the effects of cyber sickness by experiment on VR environments in desktop system. The objectives are to identify the effect of user's role to cyber sickness symptoms, to identify the effect of user's mood to cyber sickness symptoms, and to identify the relationship of the interaction of user's role and user's mood towards cyber sickness symptoms. Before turning to this research results, this paper presents a brief discussion of the effect of user's control and user's mood to cyber sickness.

2. Related Work

2.1. The effect of user's control to cyber sickness

Lots of literature discuss about user's control to cyber sickness in VR system. [12] study the effect of field of view (FOV) of 1 screen vs. 3 screens, display fidelity (stereoscopic vs. monoscopic), and user role (driver vs. passenger) to identify the presence of cyber sickness in VR system. The result of this study shows that high FOV passenger was reported as the highest nausea rating. This study not only focus on cyber sickness and user's role, but also in the presence of two other factors: FOV and display fidelity. Therefore, the result about effect of user role in cyber sickness is quite hazy.
[14] focus on effect of user's control in cyber sickness. With motion-sickness adaptation theory in mind, this study tries to test whether user's control affects cyber sickness. The result shows that, in active scenario the participants suffer cyber sickness lesser

than participant in passive scenario but it does not reduce cyber sickness as much as active-passive scenario. [13] assess the prevalence and severity of sickness symptoms experienced in each of four VR display conditions; head mounted display (HMD), desktop, projection screen and reality theatre, with controlled examination of two additional aspects of viewing (active vs. passive viewing and light vs. dark conditions). The result shows that user who does not have control in the Virtual Environment (VE) appear more likely to suffer cyber sickness. As outcome of analysis of those studies mentioned above, the first hypothesis in this study is:
H_1: There are significant relationship between user's role and cyber sickness.

Table 1: Cybersickness symptom

1	General discomfort (Nausea & oculomotor discomfort)	7	Sweating (Nausea)	13	Dizziness with eyes closed (disorientation)
2	Fatigue (oculomotor discomfort)	8	Nausea (Nausea & disorientation)	14	Vertigo (disorientation)
3	Headache (oculomotor discomfort)	9	Difficulty concentrating (Nausea & oculomotor discomfort)	15	Stomach awareness (Nausea)
4	Eye strain (oculomotor discomfort)	10	Fullness of the Head (disorientation)	16	Burping (Nausea)
5	Difficulty focusing (oculomotor discomfort & disorientation)	11	Blurred vision (oculomotor discomfort & disorientation)		
6	Salivation increasing (Nausea)	12	Dizziness with eyes open (disorientation)		

2.2. The effect of user's mood to cyber sickness

The effect of user's mood to cyber sickness was presented by [4]. The study highlighted that users who is in negative emotion should not use VE simulators. In this case, user's mood will be created by VR system itself (i.e. the VR system is boring make user feel sleepy) instead of creating user's mood before the exposure to VE (i.e. user feeling sleepy caused by external factor before using VR).

There are other studies of cyber sickness affecting user's mood [5,15]. [5] study was about the effect of FOV to cyber sickness, and effects of cyber sickness to user's evaluation to VR system. This experiment shows that cyber sick group feel the VE as less pleasant and more arousing, and possibly also more distressing. In other study [4] find a way to predict anxiety. The result of this experiment showed that self-reports simulator sickness score (SSQ) can predict 98% of anxiety responses. This show that there is relationship between cyber sickness and user's mood (in this case is anxiety). This study is different from other studies in a way it proposes user's mood as the factor and the cause that affect cyber sickness as the dependent variable.

Studies mentioned above has been analysed, and as an outcome, second and third hypotheses are presented:

H_2: There are significant relationship between user's mood and cyber sickness

H_3: There are significant relationship between the interaction effect of user's role with user's mood and cyber sickness.

3. Method

It is important to note that the main goal of this study is to identify the effects of different user's role and user's mood on cyber sickness. This is shown in the study design discussed as following:

1. Identifying the effect of user's role to cyber sickness symptoms

This study used a 2x2 between groups experimental design. User's role had two levels: player/user and viewer/spectator. Follow [16] study, video game competitiveness was chosen because it elevated aggressive behavior and physiological arousal, which is through video game competitiveness it will influence aggressive behavior. In this case, video game of driving environment has been tested.

SSQ were measured by letting participant fill in pre-exposure SSQ before using VR system and fill in post-exposure SSQ after using VR system. Both pre-exposure SSQ and post-exposure SSQ were derived from [3] containing 16 symptoms: general discomfort, fatigue, headache, eye strain, difficulty focusing, salivation increasing, sweating, nausea, difficulty concentrating, fullness of the head, blurred vision, dizziness with eyes open, dizziness with eyes closed, vertigo, stomach awareness and burping. In SSQ, there are four representative score that could be found: nausea-related subscore, oculomotor-related subscore, disorientation-related subscore (the scores for the symptoms of the specific aspects) and total score (the score shows how much cybersickness user gets from the exposure to VR system). An example of how to calculate each representative score is shown in Table 2. Each symptom is rated by none, slight, moderate, severe represent in turn for score 0, 1, 2, 3 and these scores will be sum up by each group for each group scale score. The total SSQ score is computed by sum up 3 group scale score and then multiply with 3.74 which base on the formula [3].

Table 2: SSQ symptom's weight

Symptoms	Nausea	Oculomotor	Disorientation
General discomfort (x_1)	1	1	
Fatigue (x_2)		1	
Headache (x_3)		1	
Eye strain (x_4)		1	
Difficulty focusing (x_5)		1	1
Increased salivation (x_6)	1		
Sweating (x_7)	1		
Nausea (x_8)	1		1
Difficulty concentrating (x_9)	1	1	
Fullness of head (x_{10})			1
Blurred vision (x_{11})		1	1
Dizzy (eyes open) (x_{12})			1
Dizzy (eyes closed) (x_{13})			1
Vertigo (x_{14})			1
Stomach awareness (x_{15})	1		
Burping (x_{16})	1		
Total	[1]	[2]	[3]

Score:
[1] = x1 + x6 + x7 + x8 + x9 + x15 + x16
[2] = x1 + x2 + x3 + x4 + x5 + x9 + x11
[3] = x5 + x8 + x10 + x11 + x12 + x13 + x14
Nausea = [1] * 9.54
Oculomotor = [2] * 7.58
Disorientation = [3] * 13.92
Total Score = ([1] + [2] + [3]) *3.74

2. Identifying the effect of user's mood to cyber sickness symptoms

For measuring arousal score, this study let participants fill in arousing scale derived from [17]. This tool was used to rate different feelings and emotions by using 5-point Likert scale from 1

which is very slightly or not at all to 5 which is extremely. There are 9 different feelings: 3 positive and 6 negative: alert, aroused, powerful, fatigued, inactive, quiet, sleepy, slow and worn-out. After participant fill in the arousal scale, the experimenter will reverse the score of negative feeling. To calculate the score for arousal scale, add up the score of all the items (negative feeling is reverse score). The higher the score that means participant feel more arousal when lower the score means participant feel sleepier.
This study was based on research methodology flow which is consisting of three stages as shown in Figure 1. In stage 1, preliminary study was used to identify the factors of cyber sickness which need to be examined. While in stage 2, data collection was done, which consists of 3 steps to gain the complete data. The three sub-steps are instrument development, survey questionnaires (quantitative data), and data analysis. On stage 3, finding research contribution and conclusion.

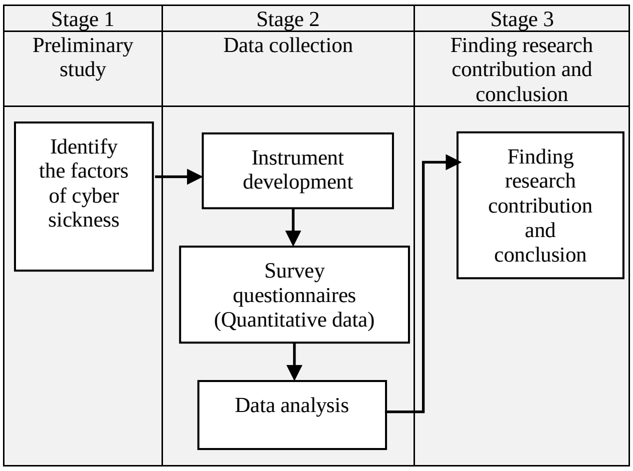

Figure 1: Research Methodology Phases

Participants of the study were 22 University Selangor (UNISEL) undergraduate students who voluntarily participated in the experiment. Out of 22 participants, two participants were unable to complete the questionnaire, and eight participants were removed due to various reasons like too experienced with VR system, the last time using VR system is too close (this will make participant adaption or habituation and effect to cyber sickness rating), and in not good condition before taking this experiment. Therefore, the total number of participants for this experiment are 12 consisting of 8 males and 4 females. Their age is range between 18 to 24 years old.
The system included a color laptop monitor with a diagonal size of 14 inches (35.56 cm) and a resolution of 1366 x 768 pixels. The frame rate was 60 Hz, with system latency less than 120 milliseconds. The participant's viewing distance was 70 cm. The field of view is 30° x 18° (H x V). The experiment started with gathering all the participants before they were briefed about the purpose of this experiment. Then, each participant filled up the questionnaire about their demographic information, VR experience and pre-exposure SSQ. Next, participants were asked to experience the VR system. In the VR system, participants must involve in driving a car or watching the car racing for 15 minutes. They were instructed to travel from starting point to the finish within the duration. During participation, the VR system of the screen have been recorded for observation purposes. After 15 minutes, participants were asked to stop and fill in arousal scale questionnaire and post-exposure SSQ.

4. Result and Discussion

All the data were analyzed using descriptive statistical approach include means, T-test, Spearman's correlation and two-way ANOVA for testing the data which leading to the conclusion of hypothesis. In this research, Spearman's correlation was used. According to [18], the most appropriate reliability coefficient for a two-item scale is the Spearman-Brown statistic. The experiment results fall into three categories: effect of user's role (hypothesis 1), effect of user's mood (hypothesis 2), and interaction effect of user's role and user's mood (hypothesis 3).

4.1. Effect of user's role to cyber sickness

Analysis were done through (i) Descriptive analysis for hypothesis 1 (ii) T – test for testing hypothesis 1.

Compare the mean of total score
Compare mean of total score between user/player and viewer/spectator are shown in the following Table 3.

Table 3: Mean of total Score base on user's role

User or Viewer	N	Mean
User	6	31.7900
Viewer	6	38.6467

Table 3 shows that user's role affect the total score of cybersickness. The mean of total score for user is 31.79 and for viewer is 38.6467. The mean of total score of viewer is higher than total score of user (21.57% higher).

Table 4: T-Test Score of Total Score base on user's role

	N	T	DF	Sig. (2-tailed)
Total Score	12	8.374	11	0.000

Table 4 shows that user's role has a significant different in mean of SSQ, with a p-value=0.000, which is less than 0.05 level of significance. This confirms that user's role significantly affect the total score of cybersickness.

Compare the mean of nausea-related subscore
Compare mean of nausea-related subscore between user/player and viewer/spectator is described in the following Table 5.
The data in Table 5 shows that user's role affect the nausea-related subscore of cybersickness. The mean of nausea-related subscore for user is 12.72 and for viewer is 28.62. Nausea-related subscore of viewer is higher than nausea-related subscore of user (125% higher).

Table 5: Nausea-related subscore base on user's role

User or Viewer	N	Mean
User	6	12.7200
Viewer	6	28.6200

Table 6 shows that user's role has a significant different in mean to nausea-related subscore, with a p-value=0.019 which is less than 0.05 level of significance, therefore, user's role significantly affect the nausea-related subscore of cybersickness.

Table 6: T-Test Score of Nausea-related subscore base on user's role

	N	T	DF	Sig. (2-tailed)
Nausea Score	12	2.755	11	.019

Compare the mean of Oculomotor-related subscore
Compare mean of Oculomotor-related subscore between user /player and viewer/spectator is described in the following Table 7. The data in Table 7 shows the mean of oculomotor-related subscore for user is 35.3733 and for viewer is 34.11. Oculomotor-related subscore of viewer is lower than user (3.57% lower).

Table 7: Oculomotor-related subscore base on user's role

User or Viewer	N	Mean
User	6	35.3733
Viewer	6	34.1100

Table 8 shows that user's role has a significant different in mean of oculomotor-related subscore, with a p-value=0.000 which is less than 0.05 level of significance. This revealed that user's role significantly affect the Oculomotor-related subscore of cyber sickness.

Table 8: T-Test Score of Oculomotor-related subscore base on user's role

Oculomotor Score	N	T	DF	Sig. (2-tailed)
	12	7.688	11	.000

Compare mean of Disorientation-related subscore

Compare mean of Disorientation-related subscore between user /player and viewer/spectator is described in the following Table 9. The data in table 9 shows the mean of disorientation-related sub-score for user is 34.8 and for viewer is 39.44. Disorientation-related subscore of viewer is little higher than disorientation-related subscore of user (13.33% higher).

Table 9: Disorientation-related subscore base on user's role

User or Viewer	N	Mean
User	6	34.8000
Viewer	6	39.4400

Table 10 shows that user's role has a significant different in mean of disorientation-related subscore for user with a p-value=0.001, which is less than 0.05 level of significance. This revealed that user's role affect significantly on the disorientation-related sub-score of cybersickness.

Table 10: T-Test Score of Disorientation-related subscore base on user's role

Disorientation Score	N	T	DF	Sig. (2-tailed)
	12	4.222	11	.001

As summary, Figure 2 depicts that user's role affect the cyber sickness. User's role not only affect the total score but also affect the sub-score. The most heavily influenced by user's role is the nausea sub-score with the mean from viewer is 150% higher from user. With this, the first hypothesis was proved to be true. This result was examined by T-test with result value of p for each total score, nausea sub-score, oculomotor sub-score, disorientation sub-score are: 0.000, 0.019, 0.000, and 0.001 (all p-value < 0.05 level of significance).

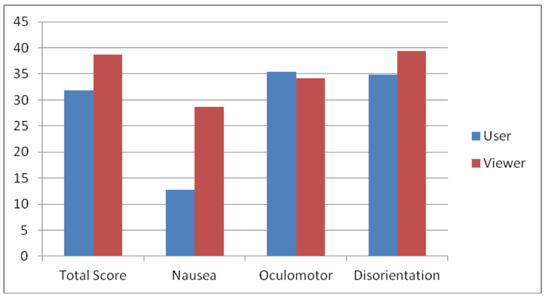

Figure 2: Effect of user's role to cyber sickness

4.2. Effect of user's mood to cyber sickness

Analysis were done through (i) Scatter plot chart analysis for hypothesis 2 (ii) Spearman's correlation for testing hypothesis 2.

Correlation between arousal score and total score

From Figure 3, it shows that there is a negative correlation between arousal score and total score. This mean that with a low arousal score, the SSQ total score will be high and vice versa. Therefore, when users feel sleepy or bored about VR system, this will also increase the cybersickness. But if the users feel active and interested in the VR system, this will decrease the cybersickness

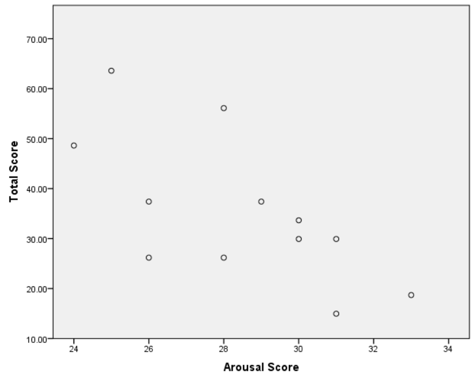

Figure 3: Scatter plot show negative correlation between arousal score and total score

Table 11 shows that arousal score and total score have a statistically significant linear relationship with p = 0.019 (p < 0.05). The direction of the relationship is negative, meaning that when arousal scores increase, total scores tend to decrease and vice versa. The magnitude, or strength, of the association is strong with r = 0.660 (0.5 < r < 1).

Table 11: Spearman's Correlation between arousal score and total score

			Arousal Score	Total Score
Spearman's rho	Arousal Score	Correlation Coefficient	1.000	-.660*
		Sig. (2-tailed)	.	.019
		N	12	12
	Total Score	Correlation Coefficient	-.660*	1.000
		Sig. (2-tailed)	.019	.
		N	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation between arousal score and nausea sub-score

From Figure 4, it shows that there is a negative correlation between arousal score and nausea sub-score. This means that with a low arousal score, the nausea sub-score might be high and vice versa. Therefore, when users feel sleepy or bored about VR system, this may increase the nausea. But if the users feel active and interested in the VR system, this may decrease the nausea.

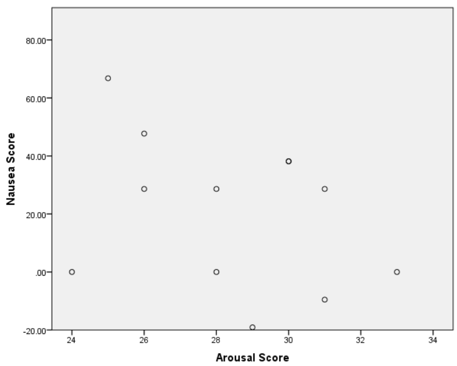

Figure 4: Scatter plot show negative correlation between arousal score and nausea sub-score

Table 12 shows that arousal score and nausea sub-score don't have a statistically significant linear relationship with p = 0.313 (p > 0.05). The direction of the relationship is negative, meaning that when arousal scores increase, nausea sub-score tend to decrease and vice versa. The magnitude, or strength, of the association is moderate with r = 0.318 (0.3 < r < 0.5).

Table 12: Spearman's Correlation between arousal score and nausea sub-score

			Arousal Score	Nausea Score
Spearman's rho	Arousal Score	Correlation Coefficient	1.000	-.318
		Sig. (2-tailed)	.	.313
		N	12	12
	Nausea Score	Correlation Coefficient	-.318	1.000
		Sig. (2-tailed)	.313	.
		N	12	12

Correlation between arousal score and oculomotor sub-score

From Figure 5, it shows that the point is scattered everywhere. This means that there is no real correlation between arousal score and oculomotor sub-score. Therefore, the arousal score doesn't affect oculomotor sub-score.

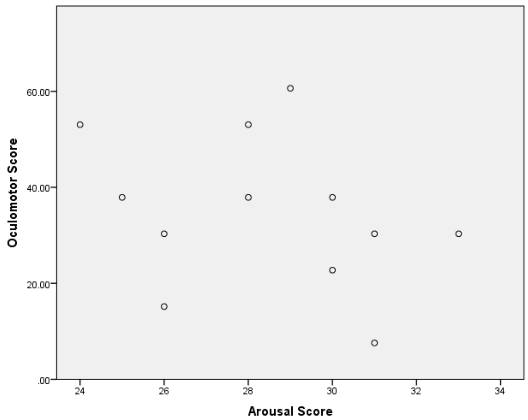

Figure 5: Scatter plot show no correlation between arousal score and oculomotor sub-score

Table 13 shows that arousal score and oculomotor sub-score don't have a statistically significant linear relationship with p = 0.217 (p > 0.05). The direction of the relationship is negative, meaning that when arousal scores increase, oculomotor sub-score tend to decrease and vice versa. The magnitude, or strength, of the association is moderate with r = 0.385 (0.3 < r < 0.5).

Table 13: Spearman's Correlation between arousal score and oculomotor sub-score

			Arousal Score	Oculo-motor Score
Spearman's rho	Arousal Score	Correlation Coefficient	1.000	-.385
		Sig. (2-tailed)	.	.217
		N	12	12
	Oculomo-tor Score	Correlation Coefficient	-.385	1.000
		Sig. (2-tailed)	.217	.
		N	12	12

Correlation between arousal score and disorientation sub-score

From Figure 6, it shows that there is a little negative correlation between arousal score and disorientation sub-score. This means that with a low arousal score, the disorientation sub-score might be high and vice versa. So, when users feel sleepy or boring about VR system, this may increase the disorientation. But if the users feel active or interested in the VR system, this may decrease the disorientation.

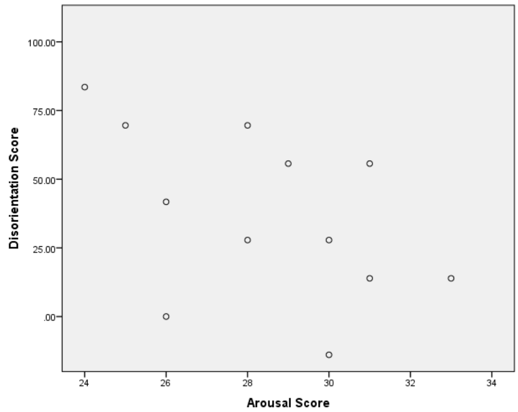

Figure 6: Scatter plot show negative correlation between arousal score and disorientation sub-score

Table 14 shows that arousal score and disorientation sub-score don't have a statistically significant linear relationship with p = 0.091 (p > 0.05). The direction of the relationship is negative, meaning that when arousal scores increase, disorientation sub-score tend to decrease and vice versa. The magnitude, or strength, of the association is moderate strong with r = 0.509 (0.5 < r < 0.1).

Table 14: Spearman's Correlation between arousal score and disorientation sub-score

			Arousal Score	Disorien-tation Score
Spearman's rho	Arousal Score	Correlation Coefficient	1.000	-.509
		Sig. (2-tailed)	.	.091
		N	12	12
	Disorien-tation Score	Correlation Coefficient	-.509	1.000
		Sig. (2-tailed)	.091	.
		N	12	12

As summary, Table 15 shows the result that support the second hypothesis and therefore the hypothesis is accepted.

Table 15: Summary of effect of user's mood to cybersickness

Spearman's rho		Total Score	Nausea Score	Oculo-motor Score	Disorien-tation Score
Arousal Score	Correlation Coef-ficient	-.660	-.318	-.385	-.509
	Sig. (2-tailed)	.019	.313	.217	.091
	N	12	12	12	12

From Table 15, the data shows that user's mood affect the cybersickness. User's mood has significant affect with the total score (p = 0.019< 0.05) even though it is not significant to others sub-score (p > 0.05). User's mood has a negative correlation with cybersickness with the strength is strong (0.5 < r = 0.660< 1).

4.3. Effect of user's role and user's mood to cyber sick-ness

Analysis were done through (i)Two-way ANOVA for hypothesis three

Interaction Effect of user's role and user's mood to total score

In Table 16, the independent variables interaction (the "User's role * User's mood " row) do not have a statistically significant effect on the dependent variable, "Total Score". From the "Sig." column, there is no statistically significant interaction at the p = .517 level (p > 0.05). That means the interaction of user's role and user's mood are not affecting cybersickness total score.

Table 16: Interaction of user's role and user's mood to total score

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)
Corrected Model	2271.819[a]	10	227.182	3.609	.390
Intercept	15364.027	1	15364.027	244.090	.041
User 's role	393.984	1	393.984	6.259	.242
User's mood	1958.264	7	279.752	4.444	.350
User 's role * User's mood	172.514	2	86.257	1.370	.517
Error	62.944	1	62.944		
Total	17218.736	12			
Corrected Total	2334.764	11			

a. R Squared = .973 (Adjusted R Squared = .703)

Interaction effect of user's role and user's mood to nausea sub-score

In Table 17, the independent variables interaction (the "User's role * User's mood " row) do not have a statistically significant effect on the dependent variable, "Nausea Score". From the "Sig." column there is no statistically significant interaction at the p = .562 level (p > 0.05). That means the interaction of user's role and user's mood are not affecting cybersickness nausea sub-score.

Table 17: Interaction of user's role and user's mood to nausea sub-score

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)
Corrected Model	7250.591[a]	10	725.059	3.983	.373
Intercept	4293.092	1	4293.092	23.585	.129
User 's role	743.261	1	743.261	4.083	.293
User's mood	6097.777	7	871.111	4.786	.339
User 's role * User's mood	394.384	2	197.192	1.083	.562
Error	182.023	1	182.023		
Total	12559.601	12			
Corrected Total	7432.614	11			

a. R Squared = .976 (Adjusted R Squared = .731)

Interaction effect of user's role and user's mood to oculomotor sub-score

In Table 18, the independent variables interaction (the "User's role * User's mood " row) do not have a statistically significant effect on the dependent variable, "Oculomotor Score". From the "Sig." column, there is no statistically significant interaction at the p = .471 level (p > 0.05). That means the interaction of user's role and user's mood are not affecting cybersickness oculomotor sub-score.

Table 18: Interaction of user's role and user's mood to oculomotor sub-score

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)
Corrected Model	2580.750[a]	10	258.075	2.246	.480
Intercept	15421.989	1	15421.989	134.206	.055
User 's role	86.185	1	86.185	.750	.546
User's mood	2173.767	7	310.538	2.702	.438
User 's role * User's mood	402.195	2	201.097	1.750	.471
Error	114.913	1	114.913		
Total	17179.464	12			
Corrected Total	2695.663	11			

a. R Squared = .957 (Adjusted R Squared = .531)

Interaction effect of user's role and user's mood to disorientation sub-score

In Table 19, the independent variables interaction (the "User's role * User's mood " row) does not have a statistically significant effect on the dependent variable, "Disorientation Score". From the "Sig." column that there is no statistically significant interaction at the p = .522 level (p > 0.05). That means the interaction of user's role and user's mood are not affecting cybersickness disorientation sub-score.

Table 19: Interaction of user's role and user's mood to disorientation sub-score

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)
Corrected Model	9333.082[a]	10	933.308	1.070	.643
Intercept	18955.697	1	18955.697	21.739	.135
User 's role	290.650	1	290.650	.333	.667
User's mood	6943.296	7	991.899	1.138	.620
User 's role * User's mood	2325.197	2	1162.598	1.333	.522
Error	871.949	1	871.949		
Total	26739.763	12			
Corrected Total	10205.030	11			

a. R Squared = .915 (Adjusted R Squared = .060)

As summary based on Table 20, "Sig." column in the table shows that there are no statistically significant interaction between user's role and user's mood affect to cybersickness Total score (p = 0.517 > 0.05), cybersickness Nausea Sub-Score score (p = 0.562> 0.05), cybersickness Oculomotor Sub-Score (p = 0.471> 0.05), or cybersickness Disorientation Sub-Score (p = 0.522> 0.05). This prove that the third hypothesis is not true. There is no interaction effect between user's role and user's mood to cybersickness.

Table 20: Summary about interaction effect of user's role and user's mood to cybersickness

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)
User 's role * User's mood to Total Score	172.514	2	86.257	1.370	.517
User 's role * User's mood to Nausea Sub-Score	394.384	2	197.192	1.083	.562
User 's role * User's mood to Oculomotor Sub-Score	402.195	2	201.097	1.750	.471
User 's role * User's mood to Disorientation Sub-Score	2325.197	2	1162.598	1.333	.522

5. Conclusion

Based on descriptive statistical approach of this experiment on the effect of user's role and user's mood to cyber sickness, it shows that each user's role and user's mood do have effect to cyber sickness but they do not have interaction effect to cyber sickness. The result of user's role affect cyber sickness is aligned with research by [14] and [13]. However, there are difference light setting for this experiment. In [13], the study is in dark condition while in this experiment the settling is in bright condition. In [13], user's role affects cyber sickness total score and oculomotor stronger than others while in this experiment user's role affect cyber sickness total score and nausea stronger than others. In dark condition, the eyes are easier to tire because of lack of light and this lead to oculomotor score in SSQ higher.

Using Spearman-Brown statistic, the result shows that user's mood affects to cyber sickness total score but does not affect nausea, oculomotor and disorientation. This experiment also proves that there is no interaction effect between user's role and user's mood to cyber sickness, therefore the hypothesis is rejected. Based on study [14] the reason may differ due to users who have control will expect what will happen next (i.e. when the person's head turns, he or she expect the visual field to change later). If users have no control, they did not expect when there's moving and the sickness symptoms will be easily raised. This research is limited to the study of cybersickness in small FOV (laptop screen). The researchers suggest examining in large FOV like using big screen, projector or using HUD. Another limited of this research is that the real useful experiments data are smaller compared to the total number of experiments (12 over 22). The researchers also suggest to increase the useful experiment data with a well plan and organizational testing and experiment study.

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