

APPENDIX A
EXPLORATORY STUDY PART 1

A. Stimuli Order

There were 8 possible stimuli combinations between the 2 NMV directions (Left, Right) and 4 NMV durations (0.5 s, 1.0 s, 1.5 s, 2.0 s). Table I refers each combinations as: 1 (Left, 0.5 s), 2 (Left, 1.0 s), 3 (Left, 1.5 s), 4 (Left, 2.0 s), 5 (Right, 0.5 s), 6 (Right, 1.0 s), 7 (Right, 1.5 s), and 8 (Right, 2.0 s).

TABLE I
STIMULI ORDER FOR EXPLORATORY STUDY PART 1.

User	Block	Order
1	1	8, 7, 5, 2, 3, 4, 6, 1
	2	7, 6, 4, 2, 8, 5, 3, 1
	3	2, 7, 1, 8, 4, 3, 5, 6
2	1	6, 4, 3, 2, 7, 1, 8, 5
	2	2, 6, 7, 8, 3, 5, 4, 1
	3	8, 3, 1, 7, 5, 4, 6, 2
3	1	5, 7, 2, 8, 4, 1, 6, 3
	2	6, 4, 8, 3, 2, 1, 5, 7
	3	4, 2, 5, 8, 1, 7, 3, 6
4	1	4, 8, 2, 1, 6, 5, 3, 7
	2	8, 5, 4, 2, 7, 6, 3, 1
	3	7, 2, 5, 3, 1, 4, 6, 8
5	1	3, 5, 7, 6, 4, 2, 8, 1
	2	6, 5, 3, 4, 8, 1, 2, 7
	3	3, 4, 1, 7, 5, 8, 2, 6
6	1	7, 1, 4, 5, 8, 3, 2, 6
	2	5, 8, 7, 1, 2, 4, 6, 3
	3	3, 2, 6, 8, 5, 4, 1, 7
7	1	5, 6, 7, 3, 1, 4, 2, 8
	2	8, 6, 2, 3, 1, 4, 7, 5
	3	1, 5, 2, 4, 3, 8, 7, 6
8	1	4, 7, 1, 8, 6, 3, 5, 2
	2	6, 7, 5, 4, 8, 1, 3, 2
	3	6, 1, 3, 5, 4, 2, 7, 8
9	1	3, 2, 4, 8, 6, 1, 7, 5
	2	1, 7, 2, 8, 3, 4, 5, 6
	3	7, 6, 1, 2, 5, 8, 3, 4

B. Full Results

From the results of exploratory study part 1, which obtained participants' perceived angles after applying NMV, we compared the effect of individual angle perception (Table II) and NMV duration (Table III) using the Kruskal-Wallis test.

TABLE II
RESULT OF A KRUSKAL-WALLIS TEST COMPARING PARTICIPANT RESPONSES FOR LEFT AND RIGHT ROTATIONS.

NMV Direction	P-Value
Left	1.485e-9
Right	6.262e-11

TABLE III
RESULT OF A KRUSKAL-WALLIS TEST COMPARING NMV DURATION FOR LEFT AND RIGHT ROTATIONS.

NMV Direction	P-Value
Left	0.234
Right	0.275

APPENDIX B
EXPLORATORY STUDY PART 2

A. Stimuli Order

There were 6 possible stimuli combinations between the 3 NMV directions (None, Left, Right) and 2 neck rotation directions (Left, Right). Table IV refers each combinations as: 1 (None, Left), 2 (None, Right), 3 (Left, Left), 4 (Left, Right), 5 (Right, Left), and 6 (Right, Right).

TABLE IV
STIMULI ORDER FOR EXPLORATORY STUDY PART 2.

User	Block	Order
1	1	2, 5, 3, 6, 1, 4
	2	5, 1, 2, 6, 3, 4
	3	1, 3, 5, 2, 4, 6
2	1	3, 6, 5, 4, 2, 1
	2	5, 3, 1, 6, 2, 4
	3	3, 5, 6, 1, 4, 2
3	1	5, 1, 2, 4, 3, 6
	2	3, 2, 4, 1, 6, 5
	3	3, 2, 1, 6, 4, 5
4	1	3, 5, 6, 4, 2, 1
	2	1, 5, 6, 3, 4, 2
	3	2, 3, 5, 4, 1, 6
5	1	6, 5, 2, 1, 3, 4
	2	6, 5, 4, 2, 1, 3
	3	5, 3, 4, 2, 1, 6
6	1	4, 5, 6, 2, 1, 3
	2	1, 3, 2, 4, 5, 6
	3	2, 6, 4, 5, 3, 1
7	1	4, 3, 6, 2, 1, 5
	2	5, 4, 3, 6, 2, 1
	3	5, 2, 4, 1, 3, 6
8	1	3, 1, 6, 2, 4, 5
	2	4, 1, 3, 2, 6, 5
	3	4, 1, 2, 6, 3, 5
9	1	3, 6, 5, 4, 1, 2
	2	2, 4, 6, 3, 5, 1
	3	6, 3, 2, 4, 1, 5

B. Full Results

For the results of exploratory study part 2, which obtained participants' perceived angle after applying NMV during neck rotation, we obtained the effect of NMV direction on left and right physical neck rotations using the Kruskal-Wallis test (Table V).

TABLE V
RESULT OF A KRUSKAL-WALLIS TEST COMPARING NMV DIRECTION FOR LEFT AND RIGHT ROTATIONS.

Rotation Direction	P-Value
Left	0.634
Right	0.899

APPENDIX C
VR SICKNESS & PRESENCE EVALUATION

A. Stimuli Order

There were 9 possible stimuli combinations between the 3 vibration conditions (*Baseline*, *Fixed*, *Adaptive*) and 3 camera control methods (*Video*, *Controller*, and *Neck*). Table VI refers each combinations as: 1 (*Baseline*, *Video*), 2 (*Baseline*,

Controller), 3 (Baseline, Neck), 4 (Fixed, Video), 5 (Fixed, Controller), 6 (Fixed, Neck), 7 (Adaptive, Video), 8 (Adaptive, Controller), and 9 (Adaptive, Neck).

TABLE VI
STIMULI ORDER FOR VR SICKNESS AND PRESENCE EVALUATION.

User	Order
1	7, 8, 4, 1, 2, 5, 3, 6, 9
2	3, 9, 4, 8, 1, 5, 2, 6, 7
3	1, 5, 3, 8, 4, 6, 7, 2, 9
4	8, 1, 5, 6, 3, 7, 4, 2, 9
5	4, 7, 1, 5, 3, 9, 6, 8, 2
6	3, 4, 6, 5, 8, 9, 1, 7, 2
7	5, 9, 8, 4, 7, 3, 2, 6, 1
8	4, 6, 7, 2, 5, 3, 8, 9, 1
9	9, 5, 8, 3, 7, 4, 2, 1, 6
10	1, 9, 8, 7, 3, 5, 6, 2, 4
11	6, 2, 1, 9, 8, 5, 7, 3, 4
12	1, 2, 9, 8, 7, 3, 6, 5, 4
13	4, 7, 2, 3, 1, 8, 9, 6, 5
14	3, 7, 5, 2, 1, 6, 8, 9, 4
15	6, 4, 3, 8, 7, 1, 9, 2, 5
16	5, 3, 8, 9, 2, 4, 1, 7, 6
17	4, 9, 3, 7, 8, 1, 5, 2, 6
18	4, 9, 6, 2, 5, 1, 3, 8, 7
19	3, 7, 2, 1, 8, 9, 5, 4, 6
20	8, 5, 4, 3, 2, 9, 6, 1, 7

B. Full Results

To compare SSQ scores between vibration conditions, we employ Wilcoxon signed-rank test for nausea, oculomotor, disorientation, and total score of SSQ. We repeat this for each control method: *Video* (Table VII), *Controller* (Table VIII), and *Neck* (Table IX).

We also compared presence scores between vibration conditions for each control method using the Wilcoxon signed-rank test (Table X).

TABLE VII
RESULTS OF WILCOXON SIGNED-RANK TEST OF SSQ SCORES FOR *Video* METHOD. SIGNIFICANT DIFFERENCES ARE BOLDED.

Vibration Conditions	Nausea	Oculomotor	Disorientation	Total Score
<i>Baseline vs Fixed</i>	0.0618	0.024	0.0119	0.0394
<i>Baseline vs Adaptive</i>	0.0157	0.0068	0.0063	0.0111
<i>Fixed vs Adaptive</i>	0.1348	0.5198	0.5103	0.3223

TABLE VIII
RESULTS OF WILCOXON SIGNED-RANK TEST OF SSQ SCORES FOR *Controller* METHOD. SIGNIFICANT DIFFERENCES ARE BOLDED.

Vibration Conditions	Nausea	Oculomotor	Disorientation	Total Score
<i>Baseline vs Fixed</i>	0.0784	0.1035	0.0879	0.0518
<i>Baseline vs Adaptive</i>	0.0347	0.0869	0.0920	0.0465
<i>Fixed vs Adaptive</i>	0.0828	0.6460	0.5566	0.1329

TABLE IX
RESULTS OF WILCOXON SIGNED-RANK TEST OF SSQ SCORES FOR *Neck* METHOD. SIGNIFICANT DIFFERENCES ARE BOLDED.

Vibration Conditions	Nausea	Oculomotor	Disorientation	Total Score
<i>Baseline vs Fixed</i>	0.0162	0.0676	0.0784	0.0255
<i>Baseline vs Adaptive</i>	0.2292	0.3634	0.4663	0.2968
<i>Fixed vs Adaptive</i>	0.3186	0.3394	0.2113	0.3240

TABLE X
RESULTS OF WILCOXON SIGNED-RANK TEST OF PRESENCE. SIGNIFICANT DIFFERENCES ARE BOLDED.

Control Method	Baseline vs Fixed	Baseline vs Adaptive	Fixed vs Adaptive
Video	0.0370	0.0105	0.3381
Controller	0.1328	0.0416	0.1541
Neck	0.0436	0.1682	0.5895

APPENDIX D NMV DURING NECK ROTATION REVISITED

A. Stimuli Order

There were 8 total possible stimuli combinations between the 2 NMV direction (Left, Right) and 4 NMV durations (0 s, 0.5 s, 1.0 s, 1.5 s). Each combinations are referred as: 1 (Left, 0 s), 2 (Left, 0.5 s), 3 (Left, 1.0 s), 4 (Left, 1.5 s), 5 (Right, 0 s), 6 (Right, 0.5 s), 7 (Right, 1.0 s), and 8 (Right, 1.5 s).

TABLE XI
STIMULI ORDER FOR NMV DURING NECK ROTATION.

User	Block	Order
1	1	2, 3, 5, 8, 7, 6, 1, 4
	2	5, 1, 2, 7, 4, 6, 8, 3
	3	5, 8, 3, 1, 6, 7, 4, 2
	4	1, 8, 7, 4, 3, 2, 6, 5
	5	7, 4, 3, 1, 5, 2, 8, 6
2	1	5, 2, 3, 8, 4, 6, 7, 1
	2	8, 3, 1, 2, 6, 5, 7, 4
	3	4, 5, 2, 3, 7, 1, 8, 6
	4	2, 6, 7, 1, 8, 5, 4, 3
	5	2, 3, 5, 7, 6, 1, 8, 4
3	1	6, 1, 7, 8, 3, 4, 2, 5
	2	2, 6, 1, 3, 7, 8, 4, 5
	3	3, 7, 6, 5, 1, 4, 8, 2
	4	3, 2, 6, 4, 1, 8, 5, 7
	5	6, 3, 1, 7, 4, 2, 8, 5
4	1	2, 8, 5, 6, 3, 1, 7, 4
	2	3, 8, 7, 2, 6, 4, 1, 5
	3	1, 6, 7, 5, 2, 8, 3, 4
	4	6, 2, 5, 7, 1, 4, 3, 8
	5	1, 4, 6, 7, 8, 2, 5, 3
5	1	2, 1, 4, 5, 3, 6, 8, 7
	2	5, 1, 8, 6, 7, 2, 3, 4
	3	5, 4, 3, 2, 8, 7, 1, 6
	4	4, 6, 7, 1, 5, 3, 2, 8
	5	1, 2, 6, 8, 5, 3, 4, 7

B. Full Results

Our one-way ANOVA on NMV duration for both left and right rotation resulted in a significant p-value. As such, we conducted a Tukey's test to compare each NMV durations for left (Table XII) and right (Table XIII) neck rotations.

TABLE XII

RESULT OF TUKEY'S TEST WITH 95% CONFIDENCE INTERVAL FOR LEFT ROTATION. SIGNIFICANT DIFFERENCES ARE BOLDED.

NMV Duration	95% Confidence Interval	P-Value
0.5 s, 0 s	(0.08, 8.81)	0.044
1.0 s, 0 s	(-3.42, 5.30)	0.943
1.5 s, 0 s	(-4.28, 4.44)	1.000
1.0 s, 5 s	(-7.87, 0.86)	0.159
1.5 s, 5 s	(-8.73, -0.00)	0.050
1.5 s, 1.0 s	(-5.22, 3.50)	0.955

TABLE XIII

RESULT OF TUKEY'S TEST WITH 95% CONFIDENCE INTERVAL FOR RIGHT ROTATION. SIGNIFICANT DIFFERENCES ARE BOLDED.

NMV Duration	95% Confidence Interval	P-Value
0.5 s, 0 s	(-9.06, -1.28)	0.004
1.0 s, 0 s	(-5.51, 2.27)	0.695
1.5 s, 0 s	(-4.91, 2.87)	0.901
1.0 s, 5 s	(-0.34, 7.44)	0.087
1.5 s, 5 s	(0.26, 8.04)	0.032
1.5 s, 1.0 s	(-3.29, 4.49)	0.978