HCI Coursework Report

User Experience of VRChat on PC and VR Platform

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1. Introduction & Hypothesis

Virtual reality (VR) is a way of using technology to create environments designed for expressly human interaction. By wearing the VR headset, users are completely drawn into a whole new world which allows them to interact with their virtual environment in a way which is not possible using any other medium. VR headsets are supposed to be more interactive, engaging and pleasant way while connecting to the virtual world as compared to desktop.

Virtual reality is improving more and more as a competitive technology every day. It is revealing innovative applications in the teleconferencing that can revolutionize socializing experience and co-working and industries as well. As VR continuously growing and improving, the experiences are feeling more real.

To figure out if VR could bring better user experience, we proposed the hypothesis as: “When using virtual reality version of a teleconference application, users will communicate more efficiently as compared to the desktop version of the same application.”

To prove our hypothesis we used VRChat (a freeware application on Steam) as our target application because it has both the VR version and desktop version. By using VR headsets with VRChat software, users can work on a virtual whiteboard, collaborate in work with other users, bring other tools in, and, most importantly, get around a table together as a conference. It allows the teams to get connected and hear each other in a much more effective and engaging way as compared to other online meeting software.

2. Experiment Procedure

2.1 Participants Recruitment

Six participants was invited to the experimental study. Those participants were selected randomly from the class of the Human-Computer Interaction module of the Computer Science department in UCD.
All the participants were guided about the experimental procedure. Before we start the experiment, every participant was asked if they had 3D sickness to make sure no one has any adverse reaction during the experiment.

2.2 Experiment Environment

The experiment used Oculus VR headset powered by Lenovo Legion Y520 with Intel Core i5-7300HQ CPU and a NVIDIA GTX 1060 MaxQ GPU.

2.3 Experiment Procedure

Before starting the experiments, participants were asked to fill a pre-experiment questionnaire which was included their age, gender, their previous history of using video conference software and any virtual reality application or headsets.

The experimental procedure was divided into two steps which were performed in the same circumstances.

- In the first step, participants were provided with the VRChat Desktop version to interact with the application and chat with. As an experimental task, they were asked to pick a pen from the interaction space of the application to write numerical numbers 1, 2, 3 and drawing a triangle, a square, and a circle. The time was recorded for understanding the application and writing the numerical characters and drawing shapes separately.

- In the second step of the experiment, the same participants were provided with the Oculus VR headset connected with the virtual reality version of the VRChat application. Then they were asked to pick a virtual pen from the virtual space to write numerical numbers 1, 2, 3 and drawing a triangle, a square and a circle on their virtual whiteboard. The time duration of understanding the application, writing the numerical characters and drawing shapes were recorded separately.

All participants were prompt to fill a post-experiment survey to share about the experience they have during the experiment. It includes questions on a scale of 1-9 about interaction, control, communication, immersion, and effectiveness comparison of the Desktop and VR version of the VRChat.

3. Variables & Experimental Data

3.1 Independent Variables

The only independent variable in this experiment is the version of the teleconference application: the desktop version or the Virtual Reality version.

3.2 Dependent Variables

The experiment concerns the user experience of the different aspects, such as satisfaction rate, communication motivation rate, immersion, ease of use and learning.

The satisfaction rate is how the participant feels with the VR chatting software on the target platform. In this experiment, it is measured by giving out the questionnaire and let the participants fill their objective feelings. For instances, how do they feel about the same chatting application on different devices in general, how immersive and controllable do they feel during the experiment. In other words, gathering the satisfaction rate is one of the most direct ways to measure how good or how bad the software is in the aspect of user experience.

In an online chatting software, whether the environment of it can encourage users to communicate with each other is essential. A good chatting environment can make sure the conversation has good quality and even improve the efficiency of the meeting, reaching the final goal easier and earlier.

The immersion feeling of the user can, to some extent, reflect the satisfaction and motivation when the user experiences the software. As long as the users feel that they are immersed with the virtual environment, the quality of online meeting can be as good as the quality of raising an offline meeting. Not to mention that the online meeting has some advantages such as no region limitation, more creative way of expressing, etc., compared to the offline meeting.

Different devices have different ways to use, which means, the ease of use and learning circle of one software can be different when it is adapted to different devices. The ease of use is how handy is the software to use for the different levels of users, meanwhile, learnability is how easy is the software to learn for

the beginners. For instance, the software might be really hard to use for beginners and also hard to learn, however, as long as the user learned how to use it, the user experience can be extremely enjoyable and the functionality of it can be powerful.

3.3 Data Visualisation

3.3.1 Total score on each platform

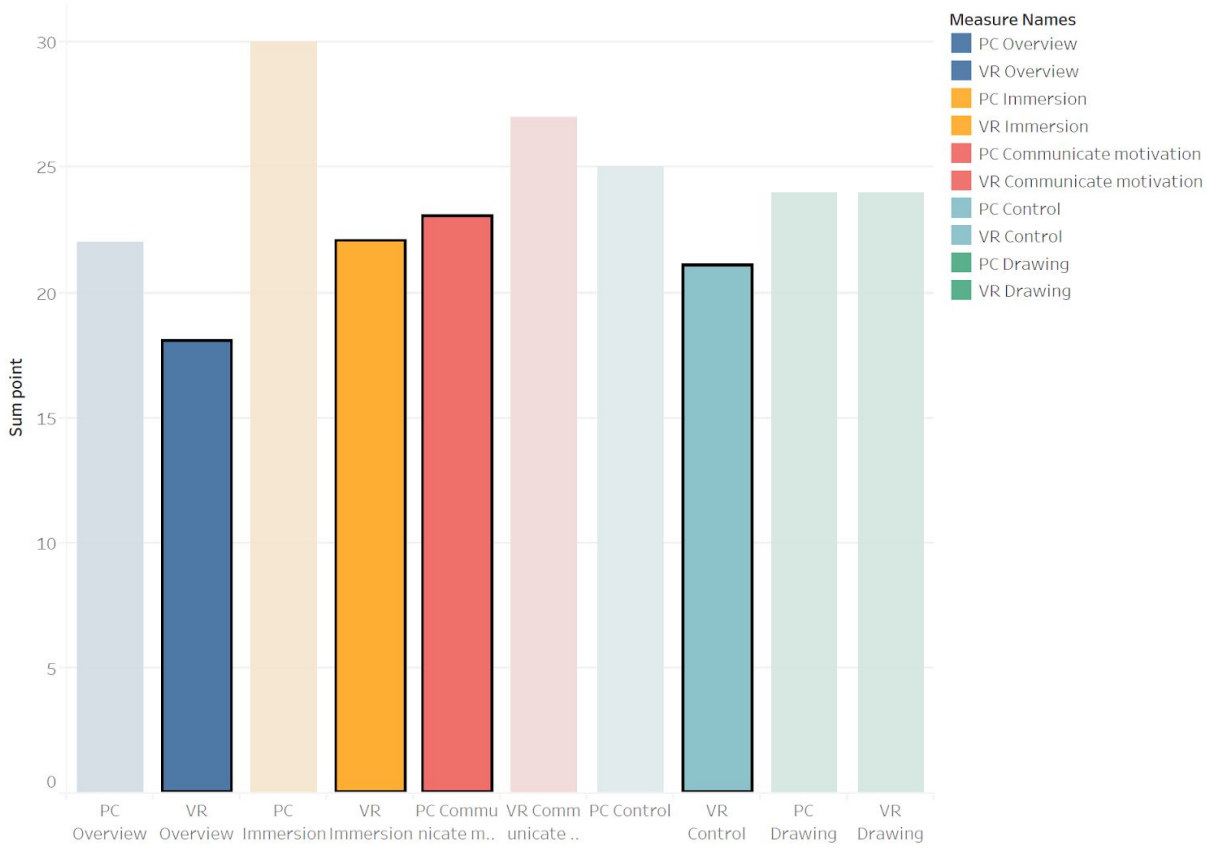

Figure 1 : Overview, Immersion, Communicate motivation, Control, Drawing feeling are summarised in this chart. The lower the better.

The chart above (*Figure 1*) illustrates the total score for each category. The lower the score is, the better it performs in the experiment. The bars of the platform that has a lower score (better performance) have been highlighted in the chart. As we can see that VR platform has a better overall feeling of the participants, a more immersive environment and a more controllable feeling, which means that the chatting software on VR platform would provide a better user experience generally.

The ease of drawing for each device is the same in the overview. The specific analysis of this will be presented in the following chapter as well.

When it comes to the communication motivation rate, the PC platform has better a figure. The reason why this happened will be analyzed in the following sub-chapters.

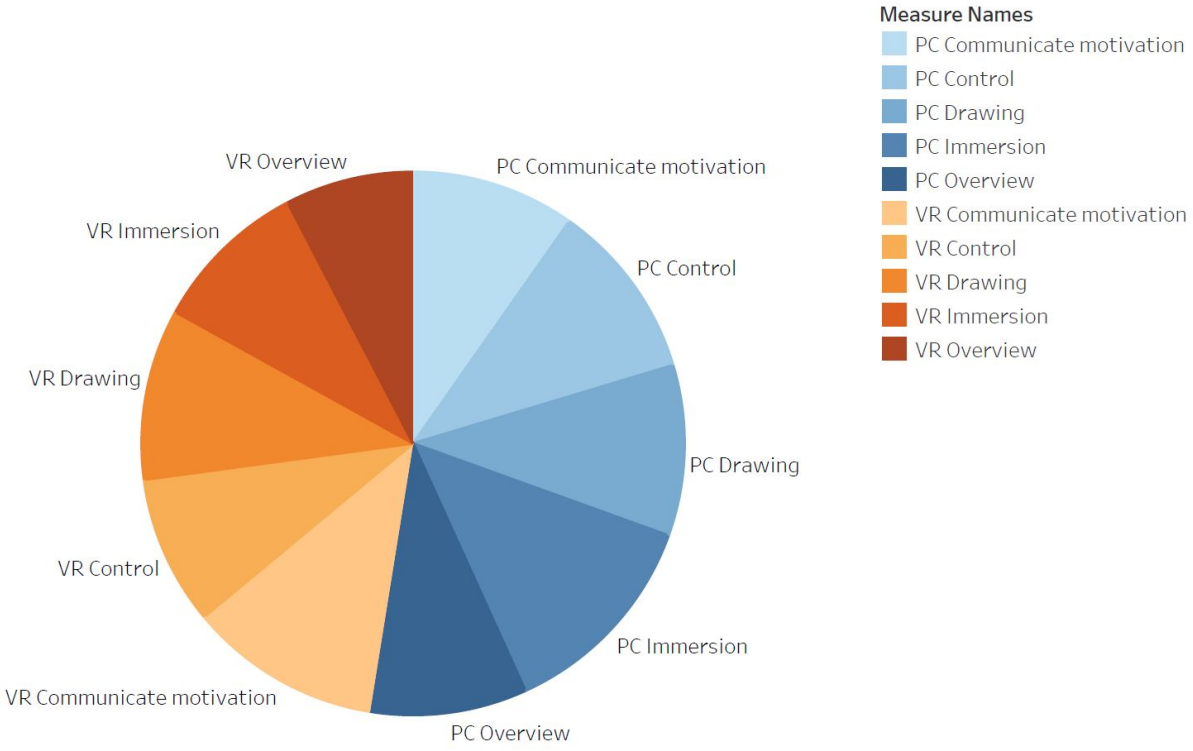

Figure 2 : Overview, Immersion, Communicate motivation, Control, Drawing feeling are summarised in this pie chart. The lower the better.

The pie chart divides the data into two main parts: the brown part VR platform and the blue part PC platform. As we can see from the chart, the total performances of the two platforms do not have too much different. In this case, online chatting software in VR is just slightly better than in PC.

From both figure 1 and figure 2, it is hard to say that the VR platform is much better than the PC platform equipped with the same software. The VR platform has better performances in some specific areas, including the immersive feeling, which is a word “defined” by Virtual Reality but still does not have too many advantages in this competition.

3.3.2 Ease of drawing score with objective feeling

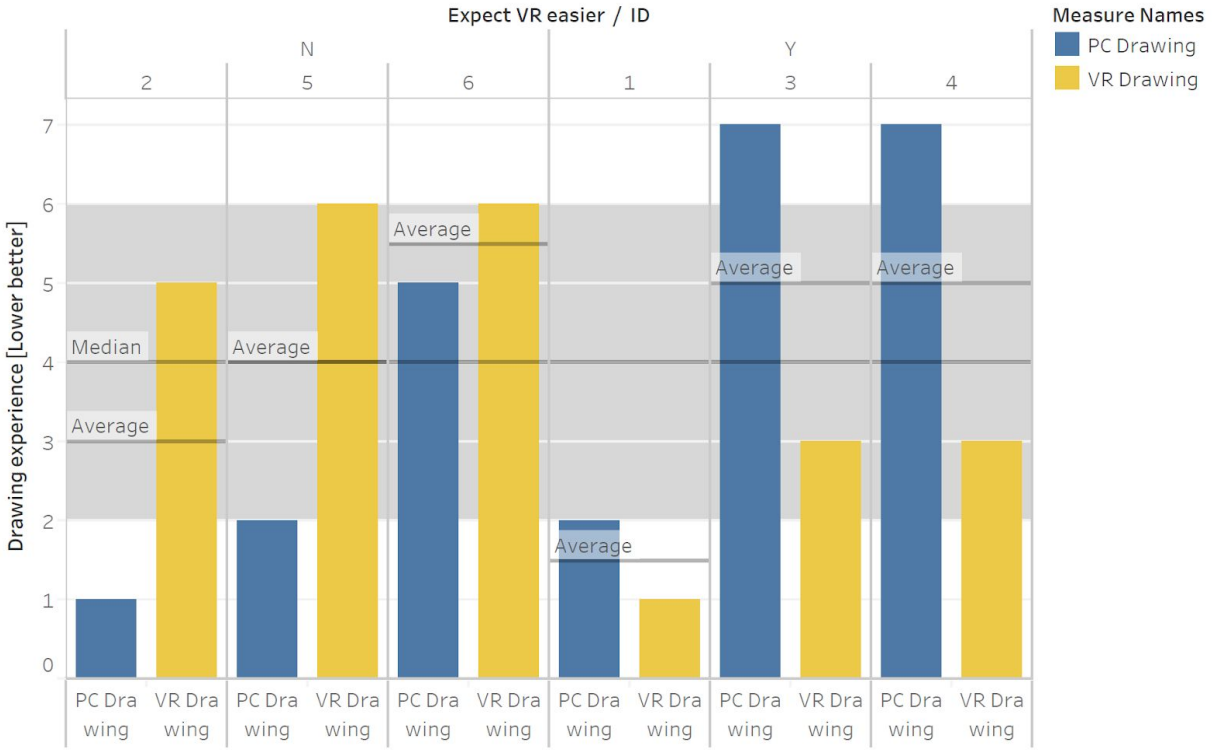

Figure 3: PC and VR drawing feeling for each ID broken down by participants' feeling. The lower the better.

The bar chart above combined the two data sets from the questionnaire. One is whether the participants think the online meeting is easier in VR and the other is the rate of drawing feeling in two platforms.

As we can see from the chart (figure 3), the rate of drawing feeling is related to the objective feeling for each participant: the participant who carries the negative feeling about this question rates PC with a better score (lower better) and vice versa, which means all the samples are valid in this chart.

The participant who thinks the meeting is easier in VR (especially ID 3 and 4) rates the PC with a worse score (lower better) that is above the median area in this experiment. However, the participant carrying opposite opinion rates VR with a score within the median area. From this point of view, we could say that the participants who said no in this question do not have a strong preference for drawing in PC or in VR.

3.3.3 Counterbalancing & Learnability

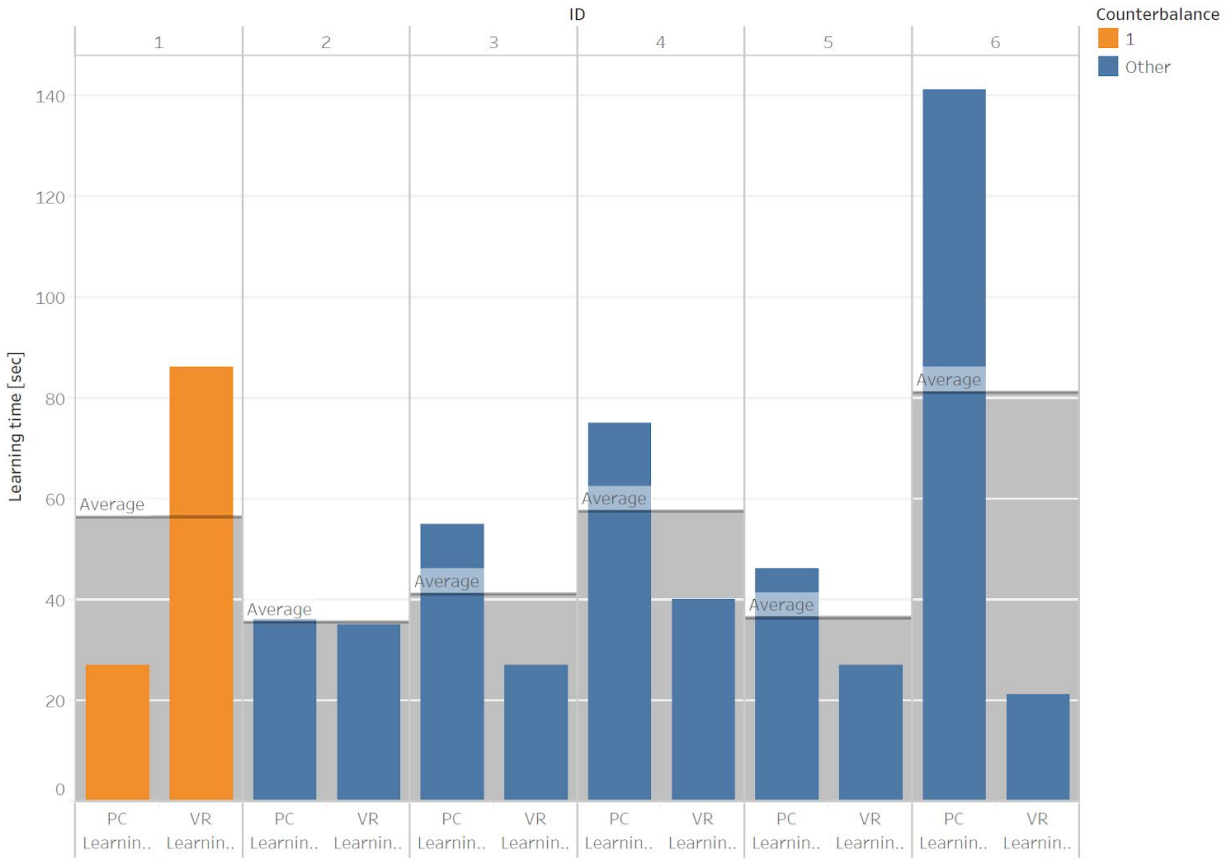

Figure 4: PC and VR Learning Time for each participant. Colour shows details about the counterbalancing.

As this experiment is a within-group design, the counterbalancing should be considered. The origin plan for this experiment is having half a group of participants attend VR version first and the other half attend PC version first. However, in the real experiment, the counterbalance was forgotten as the time prepared for the experiment was quite short and the VR version side took too much time to complete, which was out of our expectations. So in the end, we only got 1 participant who was attending the VR version first (highlighted in orange in the chart, figure 4).

From the chart (figure 4), it can be seen that the counterbalancing affects a lot in the with-in group design. If the ID 6 data were excluded due to the exception of the data, the rest shows that the average learning time of the VR version is longer. One of the participants also concluded that “The learning curve is long”

and “The interface is hard to adapt for 1st time user” and another participant also said, “You have to potentially try harder exert yourself more using VR than regular video chat”.

3.3.4 Communicate Motivation

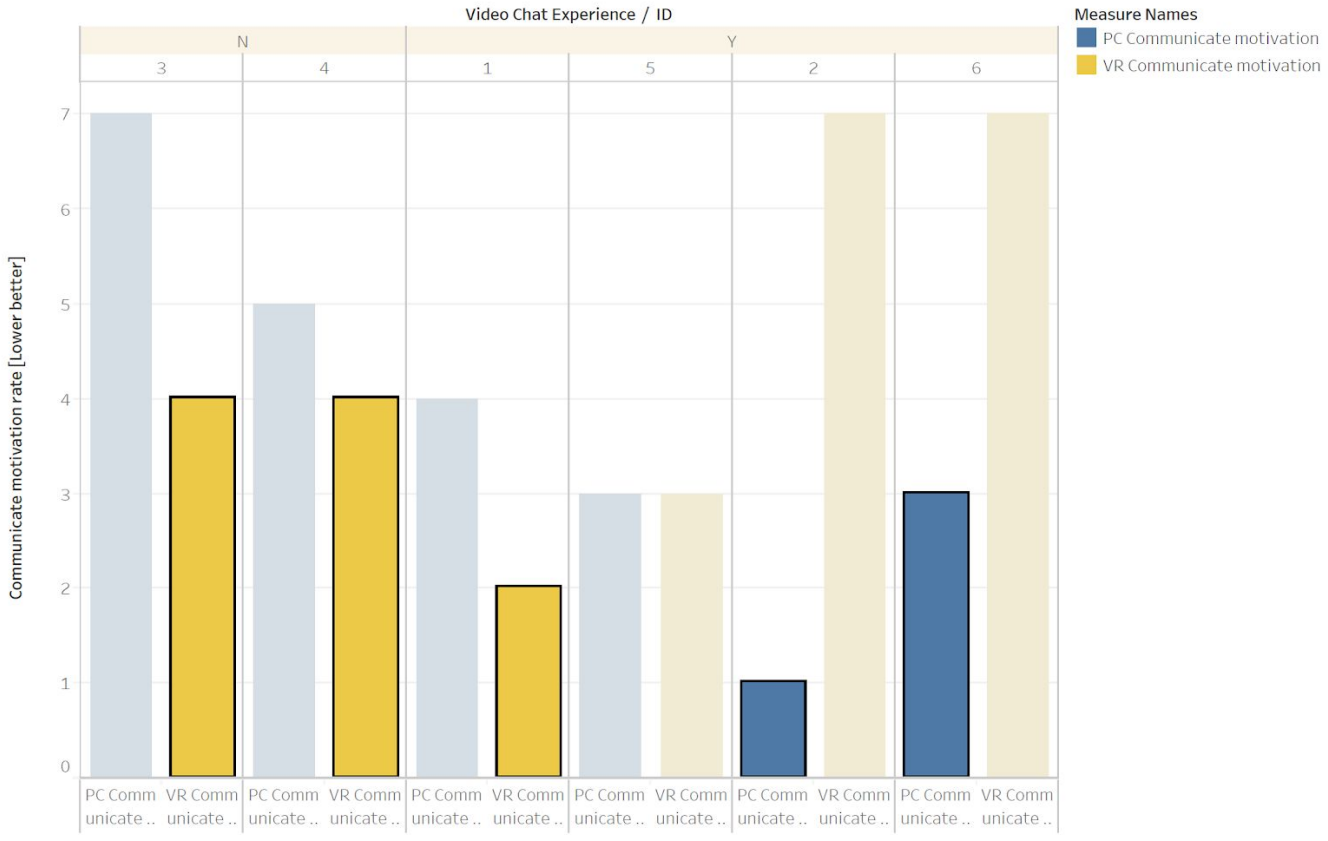

Figure 5: PC and VR Communicate motivation for each ID broken down by Video Chat Experience. The lower score means better communicate motivation.

After the experiment, the background research of the participants is also finished along with the questionnaire. When it comes to the previous experience of video chat, 4 out of 6 participants gives positive answers.

For those who have not use video chat application before, the VR version of video chat software can encourage them to communicate with each other. The situation is more complex when it comes to experienced participants. One participant thinks VR is more motivated than PC, one participant thinks they are exactly the same, while the majority (in this category) think the traditional desktop version is still a good way to have a online video chat. To sum up, for users who never use other video chat before, VR might encourage them to talk.

4. Statistical Tests & Results

We can not give the experimental result by simply read the graph in the previous part. The statistical test is a piece of more persuasive evidence.
At first, As it is mentioned in Part 3.1, there are 2 categorical values (the desktop version and VR version of one same teleconference application) of the only independent variable in this experiment, so that the experiment results should come from 2 paired groups. Second, to minimize the influence of individual difference, the within-group test is applied. Finally, we assume the population of the sample data follows the normal distribution. Therefore, the paired t-test is adopted in this experiment.

4.1 Rewrite Statistical Hypothesis

Our research hypothesis assumes that the VR version has a better user experience than the desktop version. In the experiment, the user experience is measure based on the score of satisfaction rate, communication motivation rate, immersion rate, ease of use and learning. To simplify the comparison process, these metrics are given equal weight and normalized to a number between 1 and 9 (***the lower score represents better experience***). Overall, our statistical hypothesis "VR version has better user experience than desktop version" could also be written as "VR version has a ***lower*** overall score of satisfaction rate, communication motivation rate, immersion rate, ease of use and learning than the desktop version".

4.2 Statistical Test & Results

According to appendix d: Origin Data of the Experiment, all of the scores have already been normalized except for the "ease of learning". As it is known, the longer time it takes on learning, the less ease of learning the application brings. So we made a table below to help us invert the time of learning into the metric we need.

	More than 3min	2min to 3min	100s to 2min	80s to 100s	60s to 80s	40s to 60s	20s to 40s	10s to 20s	less than 10s
Score	9	8	7	6	5	4	3	2	1

Table 1: Learning Time-Ease of Learning Score Mapping table

By adding all the relevant score together we can calculate the overall score of each sample data. Then we calculate the difference between PC and VR scores. Since we assume that PC version has a higher score, the PC version is regarded as the minuend in the subtraction. Results are shown in table 2.

	S1	S2	S3	S4	S5	S6
PC Score	21	10	36	36	19	29
VR Score	16	26	17	19	25	30
Difference	5	-16	19	17	-6	-1

Table 2: Overall Score of Each Sample

Next, we can calculate the means, standard deviations, standard errors and T value as below (n=6):

$$Mean_{difference} = 3 \qquad SD_{difference} = 13.5$$
$$SE_{difference} = 5.51 \qquad T_{alpha/2}(6) = 0.544$$

After checking the one tail t-test table and find that the alpha is less than 50%. The statistical hypothesis is rejected.

5. Conclusion

The statistical results do not support the statistical hypothesis. We cannot ensure that the score of the VR version is higher than the desktop version. Therefore, our hypothesis, “VR version has better user experience than a desktop version for the same teleconference application” is a rejected. As a result, no evidence proves that VR brings better user experience.

However, the sample volume of the experiment is too shabby to give a scientific conclusion, not to mention that the gender and the background of the participants are not controlled in this case. The counterbalancing also affects a lot in this experiment. The problem like some participants did not fill the questionnaire properly affects as well. Because of these, the result of the experiment may not have too much value for reference.

For future work, we could increase the number of participants and prepare a more complete background control. Pay more attention to the counterbalance and condense the content of the questionnaire.

Appendix

Appendix a: Pre-expirenment Questionnaire

Please fill in some basic demographic info and if possible please answer some questions about your experience.

- Please indicate your gender ▢Male▢Female
- Roughly how old are you ▢18-25 ▢26-35 ▢36-45 ▢46+
- Have you used Virtual Reality before? ▢Yes ▢No
    - If yes, what equipment have you used and how many times?

      .....

      .....
- Have you used video chat before? ▢Yes ▢No
    - If yes, what software have you used and how often do you use it?

      .....

      .....
- Did you feel the online meeting was better in VR? ▢Yes ▢No
    - If so why do you think that it was?

      .....

      .....
- Do you think it is easier to have a meeting in VR? ▢Yes ▢No
    - Why?

      .....
- Any other comments on the experience (eg. any difficulties)?

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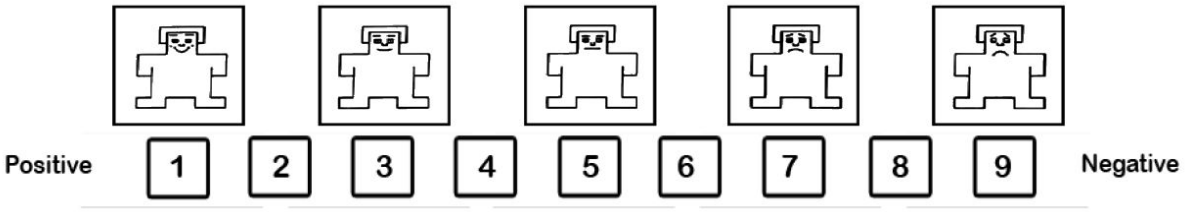
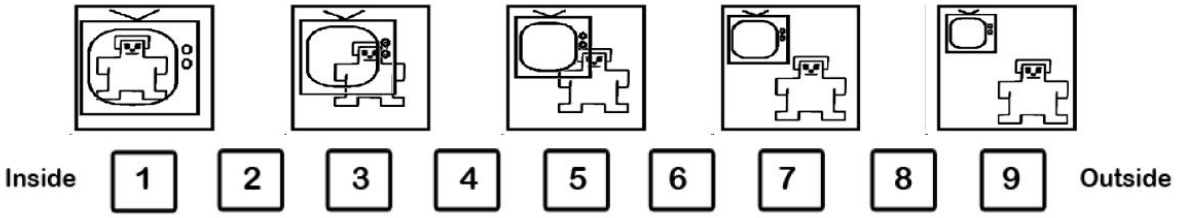
Appendix b: VR Version Experience Questionnaire

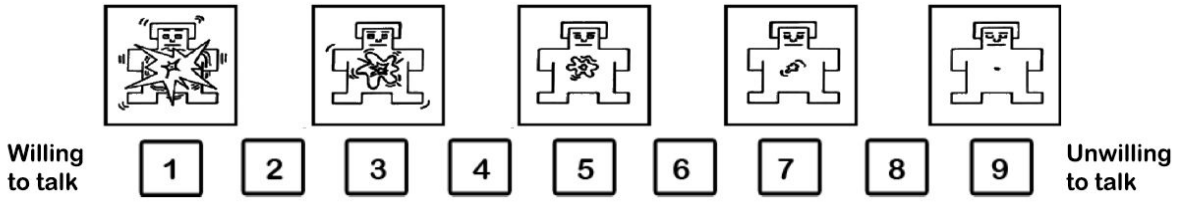
- Please rate on a scale of (1) very positive to (9) very negative of the Virtual Reality Meeting



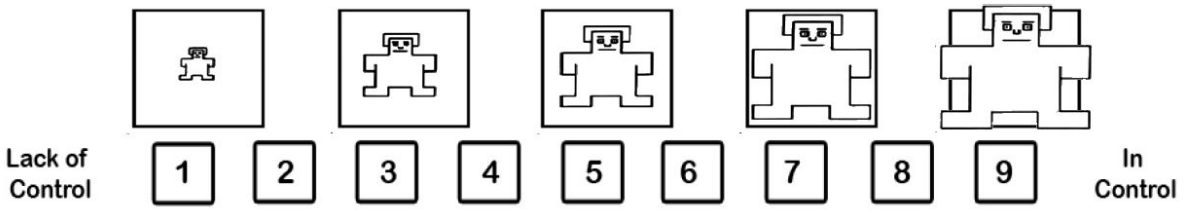
- In terms of immersion, rate on a scale of your feelings of being (1) inside to (9) outside the VR



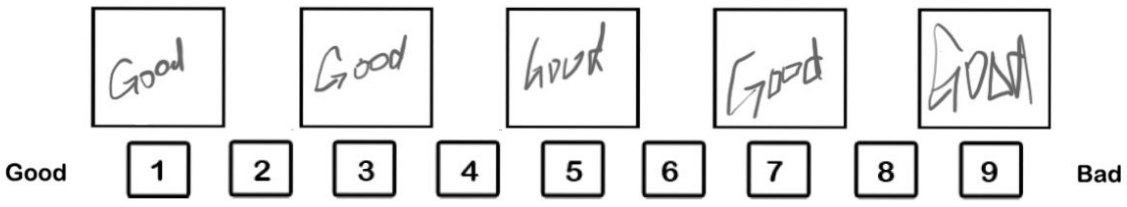
- Please rate on a scale of (1) willing to communicate to (9) unwilling to communicate in VR



- Please rate on a scale of (1) no control to (9) in control of the VR Meeting

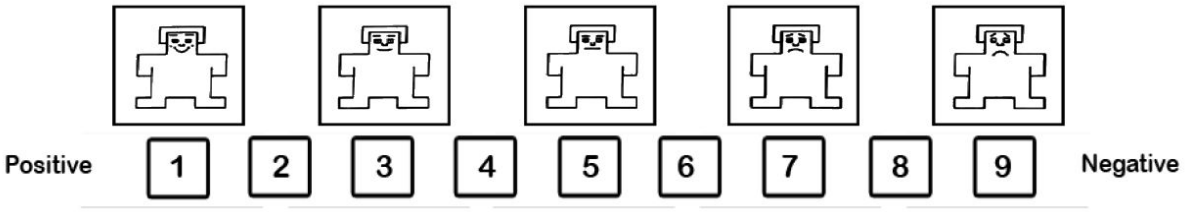


- How handy it is to draw on white broad on a scale of (1) Good to (9) Bad in VR Meeting

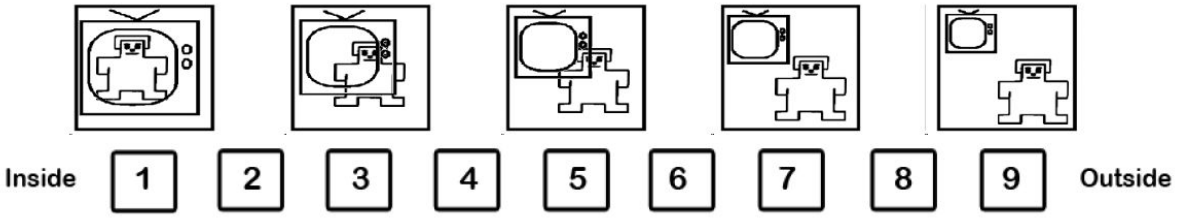


Appendix c: Desktop Version Experience Questionnaire

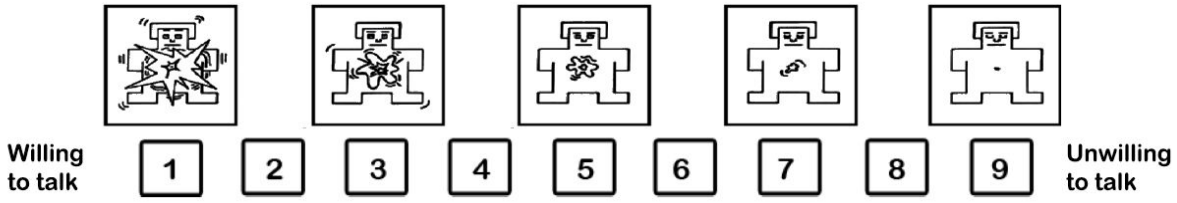
- Please rate on a scale of (1) very positive to (9) very negative of the PC Meeting Room



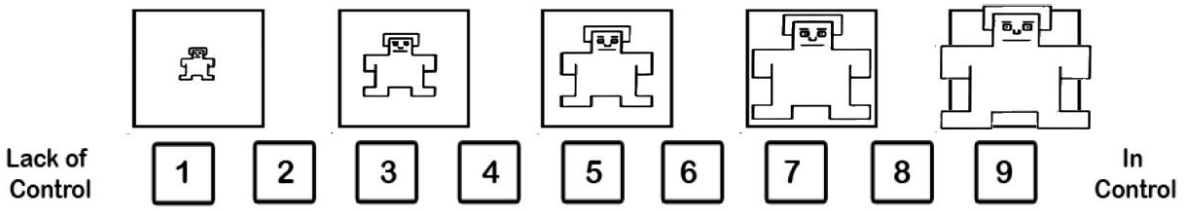
- In terms of immersion, rate a scale of your feelings of being (1) inside to (9) outside the world



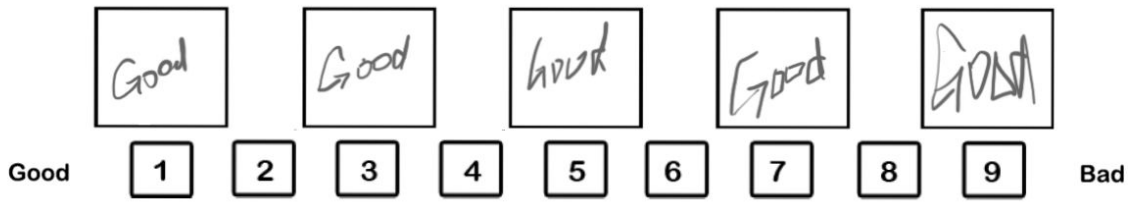
- Please rate on a scale of (1) willing to communicate to (9) unwilling to communicate in PC



- Please rate on a scale of (1) no control to (9) in control of the PC Meeting Room



- How handy it is to draw on white broad on a scale of (1) Good to (9) Bad in PC Meeting Room



Appendix d: Origin Data of the Experiment

Gender	Age	VR Experience	Video Chat Experience	Expect VR Better	Expect VR easier	PC Drawing Time	PC Learning Time	PC Overview	PC Immersion
Male	1	N	Y	Y	Y	23s	27s	3	5
Male	0	N	Y	N	N	26s	36s	1	3
Male	0	Y	N	Y	Y	27s	55s	7	7
Male	0	N	N	N	Y	18s	1m15s	6	7
Male	0	N	Y	N	N	20s	46s	1	2
Female	1	Y	Y	N	N	16s	2m21s	4	6

PC Communicate motivation	PC Control	PC Drawing	VR Drawing Time	VR Learning Time	VR Overview	VR Immersion	VR Communicate motivation	VR Control	VR Drawing
4	6	2	8s	1m26s	1	3	2	7	1
1	9	1	16s	35s	2	5	7	6	5
7	6	7	15s	27s	3	2	4	8	3
5	4	7	25s	40s	4	3	4	8	3
3	3	2	23s	27s	3	6	3	6	6
3	7	5	18s	21s	5	3	7	4	6