

## ***How People Social in VR: A Behavior Mapping Study in Virtual Environments***

Maozhu Mao, Chiba University, Japan

The Asian Conference on Psychology & the Behavioral Science 2021  
Official Conference Proceedings

### **Abstract**

Social VR is emerging with commercialized VR equipment in recent years. In 2020, the COVID-19 global pandemic dramatically changed people's life. Governments recommend people stay at home, and the number of people in social VR also increased. This study focused on VRChat, one of the most popular and free-to-play social VR games. A systematic observation and behavior mapping had been conducted for a week (five weekdays and two weekends) in three maps (Worlds). Based on the VRChat user number and time relationship, each map's observation was conducted every 2 hours, starting from 8:00 to 22:00 (JST), and over 1000 users have been observed. And the map selection is based on language use and cultural elements in the map, including Japan, China, and English-speaking countries. People's positions on the map, behaviors, topics of conversation, and language use have been collected. The mapping results present on maps and other data such as the number of people, people's behaviors, and distance between people are statistically analyzed. The results of this study are 1. People would like to socialize in front of mirrors with a variety of avatars. 2. Only a few people take seats in virtual environments since most users are sitting in the real world when they are in VR. 3. Most people's distances between each other are from 1 to 2 meters, and the distance is statically different compared to people in front of mirrors and other areas.

Keywords: Virtual Environment, Social VR, Behavior Mapping

**iafor**

The International Academic Forum  
[www.iafor.org](http://www.iafor.org)

## **Introduction**

With teleology development, virtual reality (VR) games have become more affordable and easy to access, allowing geographically separated people to interact with avatars (Perry, 2016). People could use VR as a communication tool (Riva, 1999) and increase collaboration utility (Blascovich, 2002). Many factors could affect the experience of VR. One of them is the virtual reality environment (VRE) itself (Churchill & Snowden, 1998), and the virtual world design could change people's social interactions (Bowers, Pycock, & O'Brien, 1996). The embodiment or avatar of the users could alter the VR society (Bredikhina, Kameoka, Shimbo, & Shirai, 2020), influencing people's behavior in VRE (Benford, Bowers, Fahlén, Greenhalgh, & Snowden, 1995). Transcultural communication could be commonly found in multiplayer online games (Thorne, 2008), and second language use and learning also occur (Peterson, 2010). One of the games been researched before is Second Life. Human-agent interactions were analyzed (Pallay, Rehm, & Kurdyukova, 2009), and people's spatial social behavior was also investigated. There are also some limitations to VR. VRE's sense of being affected by VR models (Schubert, Friedmann, & Regenbrecht, 1999), harassment behavior has also been observed in VRE (Shriram & Schwartz, 2017). Other limitations such as technical problems, price, security also been mentioned (Wang, 2020). This research focused on people in a virtual environment, finding out how VRE influences people's social behavior and how people interact with others in a VRE. Popular social VR games could be an ideal platform to conduct research to fulfill this research object.

## **Methodology**

There are many researches focused on the virtual environment before. VRE could become a basic research tool in psychology (Loomis, Blascovich, & Beall, 1999) and suitable for conducting social psychology research (Blascovich, 2001). Ethnography in virtual worlds (Boellstroff, Nardi, Pearce, & Taylor, 2012) and Playing Ethnography (Pearce, 2011) also provided the methodology foundation. William H. Whyte's observation method, based on the real world, has also been considered for this research (Project for Public Spaces, 2010).

## **Game Selection**

The game selection could be necessary to research social VR games, and there are several social VR games on the market. Altspace VR and Oasis VR have few active users, and Facebook Horizon is under invite-only beat, making VRChat an appropriate platform. In 2020, the COVID-19 pandemic hugely changed people's daily life. Data from World Health Organization (WHO) and Steam which is the largest digital distribution platform for PC gaming suggest that COVID-19 confirmed case and active user in VRChat may have connections (data of COVID-19 confirmed cases weekly change from Jan-2020 to Mar-2020 is so high that cannot fit into Figure 2). The pandemic limited people's social life, and the need to socialize may encourage the video game industry and increase the number of active users in VRChat (Fig 1).

## **Data Collection**

In VRChat, people have several ways to experience the VRE. The game supports full-body tracking, but only a few people have a complete set of VR equipment, which hasn't been observed in this research. People could also use VR headsets and controllers to explore the

VR world, which has only been observed in few cases. Most players use a traditional keyboard and mouse in this game, and the data collection for this research was also conducted in this way.

During the data collection, the researcher conducted systematical observations with video recording in the game as a non-interactive player. The observation was completed in 2020, five weekdays and two weekends, are Sep.24 (Thu.), Sep.25 (Fri.), Sep.26 (Sat.), Sep.27 (Sun.), Sep.28 (Mon.), Sep.30 (Wed.) and Oct.6 (Tue.). The data were collected every two hours from 8:00 to 22:00 (JST), record people's position on the map, and write down the topic of the chat, type of interaction, and the language they are using.



Figure 1: VRChat Active Player Change (Percentage)-Data from Steam.

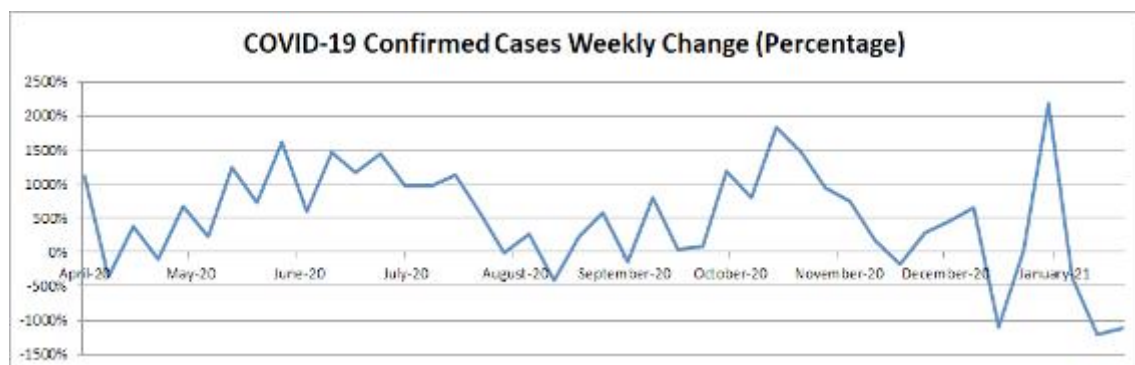


Figure 2: COVID-19 Confirmed Cases Weekly Change (Percentage)-Data from WHO.

<b>Black Cat</b>	<b>Mon.</b>	<b>Tue.</b>	<b>Wed.</b>	<b>Thu.</b>	<b>Fri.</b>	<b>Sat.</b>	<b>Sun.</b>	<b>Total</b>
Public	3063	2742	2680	2621	2866	3497	3347	20816
Private	295	397	283	284	347	581	398	2585
Total	3358	3139	2963	2905	3213	4078	3745	23401
P-Public	91.22%	87.35%	90.45%	90.22%	89.20%	85.75%	89.37%	88.95%
P-Private	8.78%	12.65%	9.55%	9.78%	10.80%	14.25%	10.63%	11.05%
<b>Chinese Bar</b>	<b>Mon.</b>	<b>Tue.</b>	<b>Wed.</b>	<b>Thu.</b>	<b>Fri.</b>	<b>Sat.</b>	<b>Sun.</b>	<b>Total</b>
Public	319	494	344	333	442	409	486	2827
Private	18	33	27	21	49	29	80	257
Total	337	527	371	354	491	438	566	3084
P-Public	94.66%	93.74%	92.72%	94.07%	90.02%	93.38%	85.87%	91.67%
P-Private	5.34%	6.26%	7.28%	5.93%	9.98%	6.62%	14.13%	8.33%
<b>Japan Shrine</b>	<b>Mon.</b>	<b>Tue.</b>	<b>Wed.</b>	<b>Thu.</b>	<b>Fri.</b>	<b>Sat.</b>	<b>Sun.</b>	<b>Total</b>
Public	644	776	577	1491	1518	1777	882	7665
Private	29	24	31	150	55	130	67	486
Total	673	800	608	1641	1573	1907	949	8151
P-Public	95.69%	97.00%	94.90%	90.86%	96.50%	93.18%	92.94%	94.04%
P-Private	4.31%	3.00%	5.10%	9.14%	3.50%	6.82%	7.06%	5.96%

Table 1: Number of Player and Percentage of Public Map.



Figure 3: Black Cat (In VRChat)

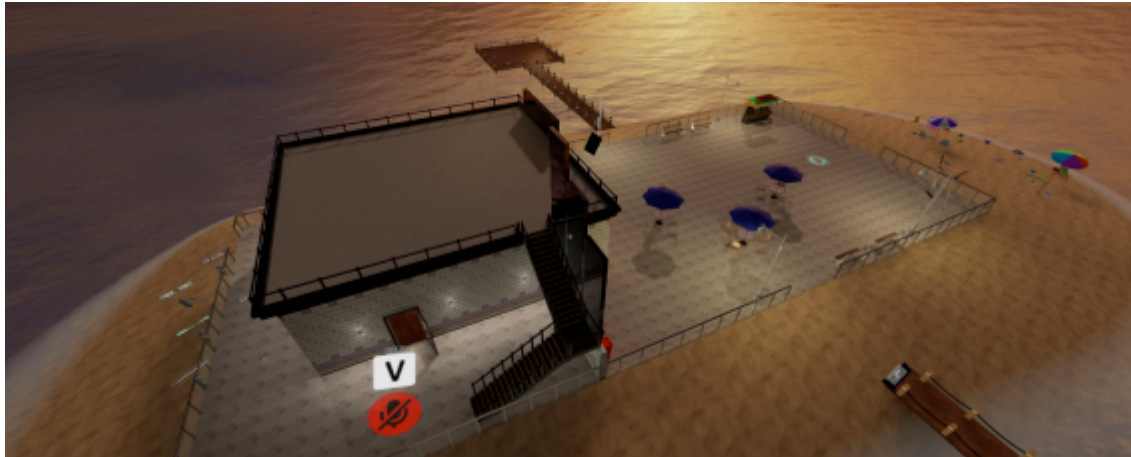


Figure 4: Chinese Bar (In VRChat)

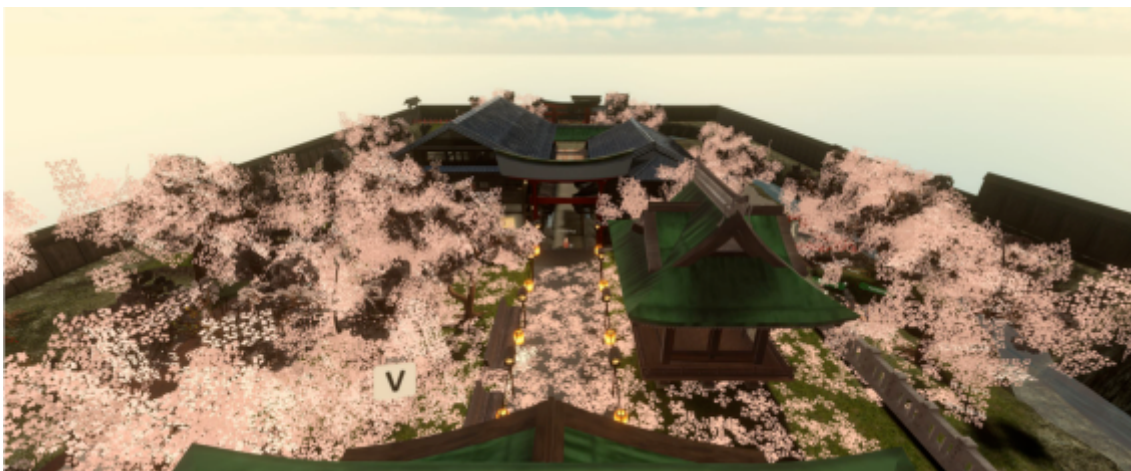


Figure 5: Japan Shrine (In VRChat)

### Map (World) Selection

In VRChat, players have to choose and get into a map (world) then interact with other players. Hundreds of maps exist in the game, many of them are created by individual players, and a group makes some players in the game community. Each map allows a certain number of players to join, and it could be public that allows everyone to join or create a private world with a password. Three popular maps that are usually created as public worlds have been selected (Table 1). Black Cat (Fig 3) is an indoor bar with that most players speak English. Chinese Bar (Fig 4) is on a beach with a structure with two floors, and this place has more Chinese speakers. Japan Shrine (Fig 5) has ample outdoor space with several facilities to find players from Japan.

### Results

#### People's Positions in VRE

Three selected maps were measured by step off in the game, so the scale is not perfectly accurate. The layout plan also shows elements such as tables, benches, chairs, trees. The following maps (Fig 7, Fig 8, and Fig 9) show the distribution of active players who interact and talk to others represented as red crosses and inactive players who stand there represented as blue circles. Since this research focuses on people's social behavior and their interactions, players that move around were not considered.

From three maps with people's distribution, an apparent phenomenon is that many people would like to stay in front of mirrors and interact with other people. Based on the observation, about half of the people in these three maps were observed in front of mirrors.

	Mirror	Other	Total	Mirror (Percent )	Other (Percent)
Black Cat	66	43	109	60.55%	39.45%
Chinese Bar	228	293	521	43.76%	56.24%
Japan Shrine	348	255	603	57.71%	42.29%

Table 2: Number of Players been Observed

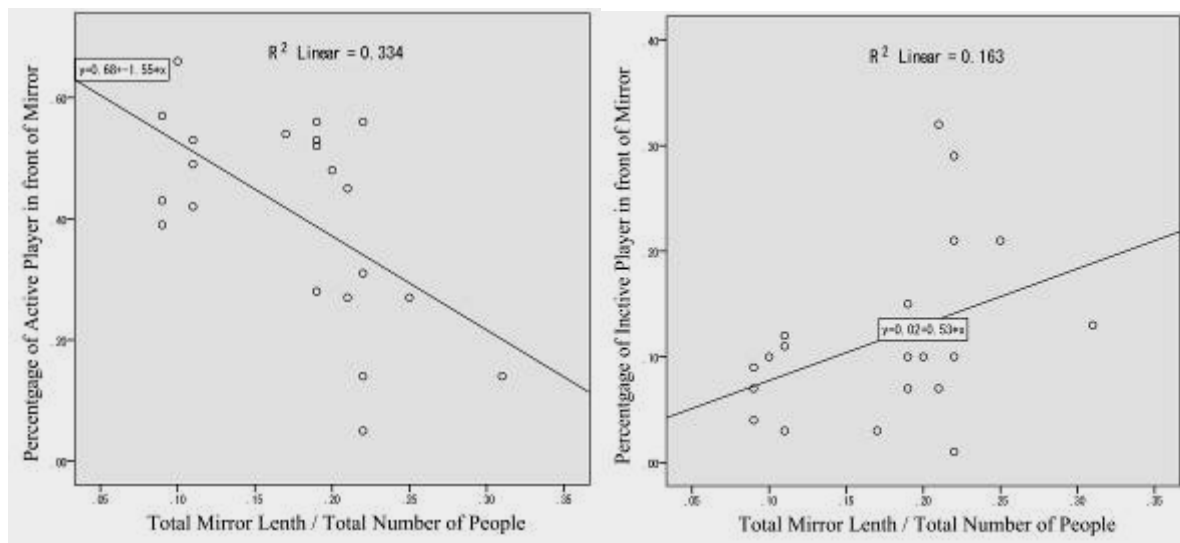


Figure 6: Regression Analysis of Active and Inactive Player in front of Mirrors

The regression analysis also indicates some results. The percentage of active players in front of the mirror will decrease with the increase of mirror length per person, with  $R=0.583$  and Sig. of 0.006. On the other hand, the inactive player in front of the mirror will increase, with  $R=0.403$  and Sig. of 0.07.

The results show that VRE mirrors could attract both active and inactive players, but the effect is different. The reason why people would like to stay in front of mirrors may be able to be explained in the following paragraphs.



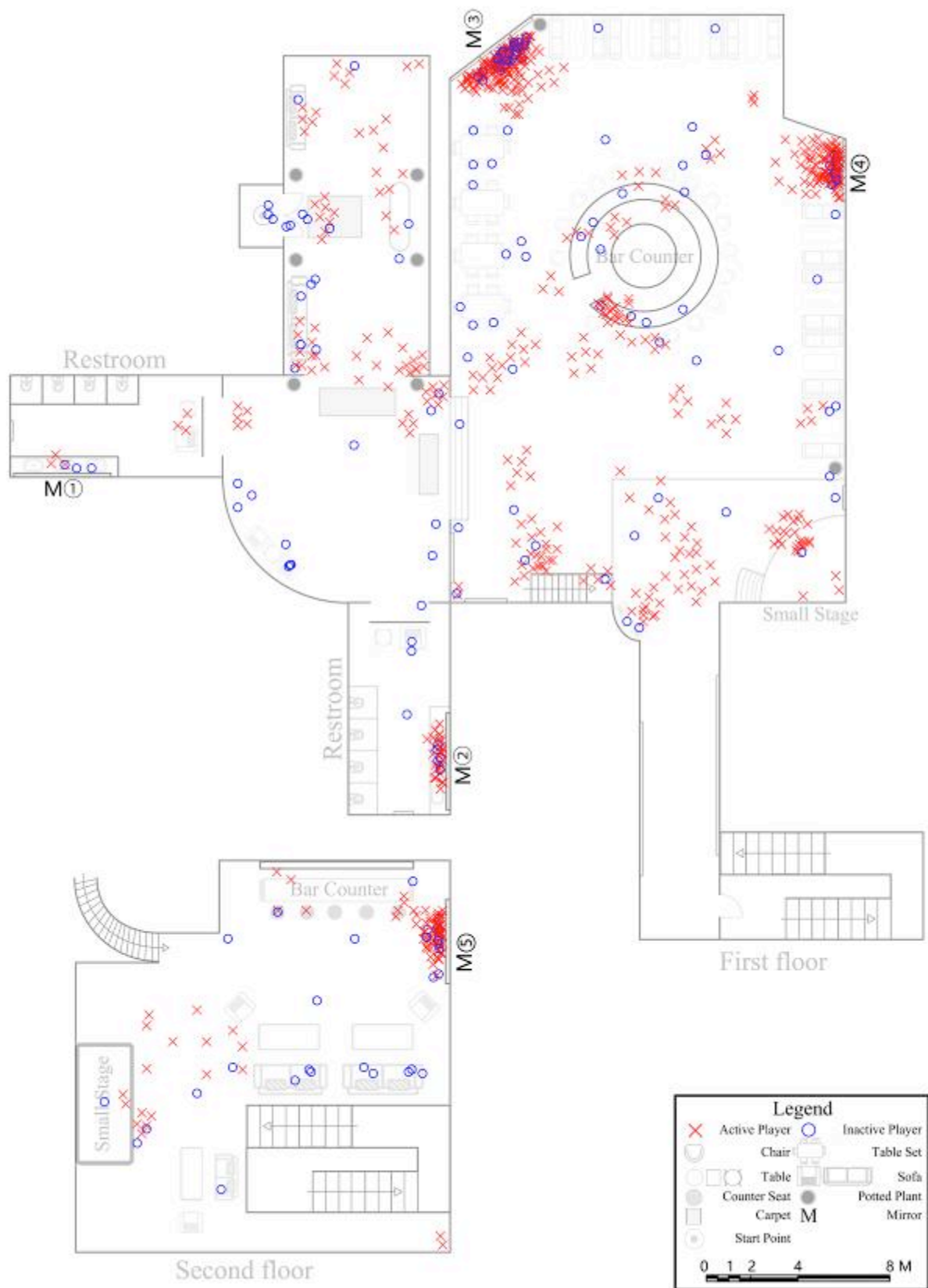


Figure 7: People's Distribution in Black Cat

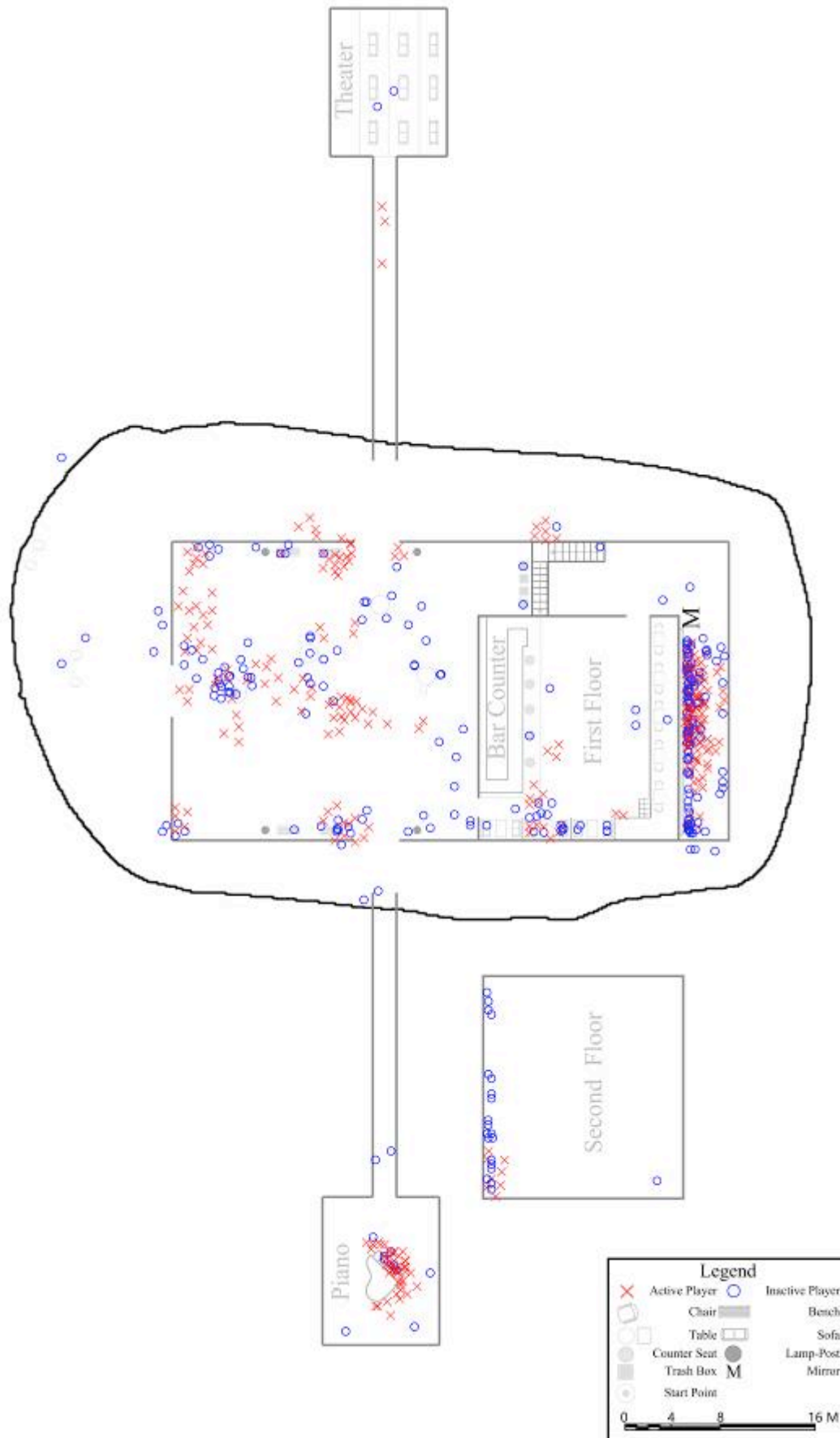


Figure 8: People's Distribution in Japan Shrine



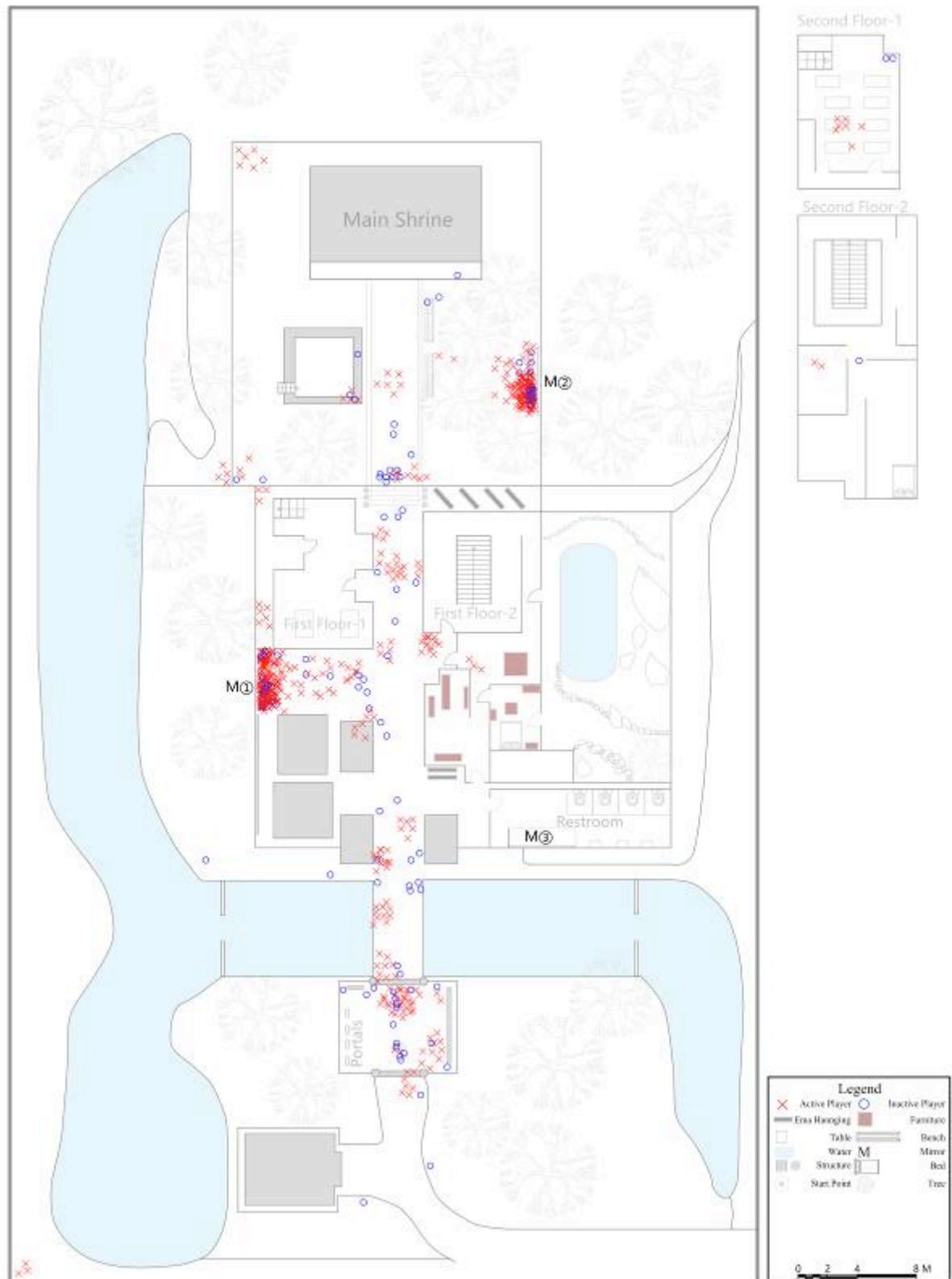


Figure 9: People's Distribution in Japan Shrine

## Interactions in VRE

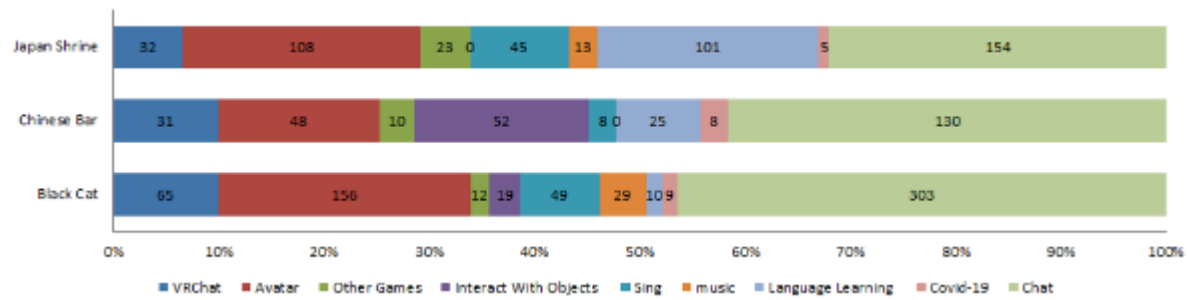


Figure 10: Interactions and Topics by Percentage

There are many kinds of interactions been observed in VRE during the data collection (Fig 10). A considerable part of them just chatting about daily life, and many people talk and interact with avatars. People also talk about games, especially about this game VRChat, and some people would like to start a free concert inside the game.



Figure 11: Avatars in VRChat

Another popular topic is avatars. People could choose avatars provided by VRChat, and there are so many avatars made by players and free for everyone to access. Based on the observation, many people choose avatars not in human shape, such as a robot, cat man, characters from anime and game, even a banana with sunglasses. As the number of the avatar in VRChart increases, the avatar becomes an interesting topic to talk about and interact.

Map	Language								Total
	English	Chinese	Japanese	E/C	E/J	C/J	E/C/J	Others	
Black Cat	635	0	0	10	5	0	0	0	650
Chinese Bar	31	148	3	73	0	20	0	4	279
Japan Shrine	307	3	12	5	81	16	20	68	512

Table 3: Language Use in Maps

Language exchanging and learning phenomenon also been observed in three maps. English, Chinese, and Japanese are the three major languages in these maps. Other languages such as

Korea, Russia, Thai, and Indonesian have also been heard. Sometimes, a group of people will communicate in more than two languages.

### People Don't Take Seats

There are many benches and chairs that people could take a seat in Black Cat and Chinese Bar, but people don't like to take a seat in VRE (Table 4), and people who are sitting are more tend to stay inactive. The mao of Japan shrine also has benches, but people cannot sit on them. Based on the researcher's memory, people could sit on benches in the Japan shrine early in 2020, the map creator of the Japan shrine may also be noticed that people don't take seats, so this function in the map has been disabled.

Black Cat	Sitting		Standing		Chinese Bar	Sitting		Standing	
	Active	Inactive	Active	Inactive		Active	Inactive	Active	Inactive
Mon.	0	2	98	14	Mon.	0	4	47	35
Tue.	0	8	94	14	Tue.	0	7	40	35
Wed.	0	8	94	14	Wed.	0	5	50	22
Thu.	1	2	93	28	Thu.	0	4	25	37
Fri.	0	2	91	21	Fri.	0	7	31	37
Sat.	2	6	98	16	Sat.	1	2	70	24
Sun.	0	5	93	17	Sun.	2	5	49	30
Total	3	33	661	124	Total	3	34	312	220

Table 4: Numbers of People Take Seat in VRE

This result may explain that most of the players are using keyboard when they playing this game. They probably were sitting when they played the game, making little sense for people to take seats in a VRE.

### Player distance

There is some research about personal distance in VR, but they use a human-shaped model and are conducted in a controlled laboratory environment (Iachini et al., 2016). In this research, many players' avatars were observed were not in human shape, and the closest distance between players was categorized.

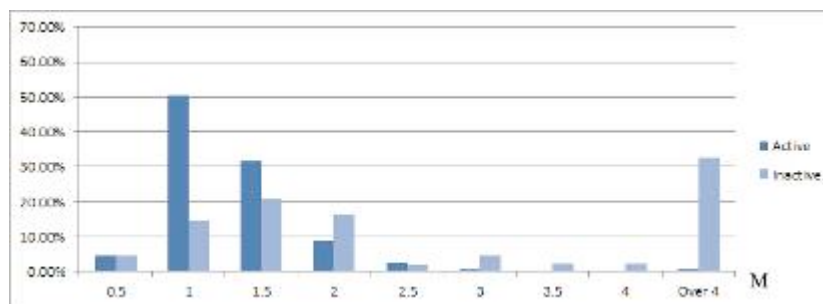


Figure 12: Personal Distance in front of Mirror

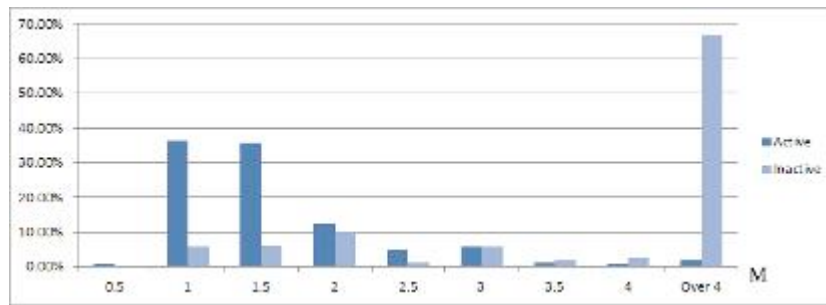


Figure 13: Personal Distance in Other Area

Player's distance is categorized in to 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, and over 4 meters. Fig. 12 and 13 shows that many people's distance is from 1m to 2m, and for players that are not in front of the mirror, more inactive player's distances are more than 4m. Since the data of player's distance is nonparametric, Mann-Whitney U Test has been conducted for active and inactive players.

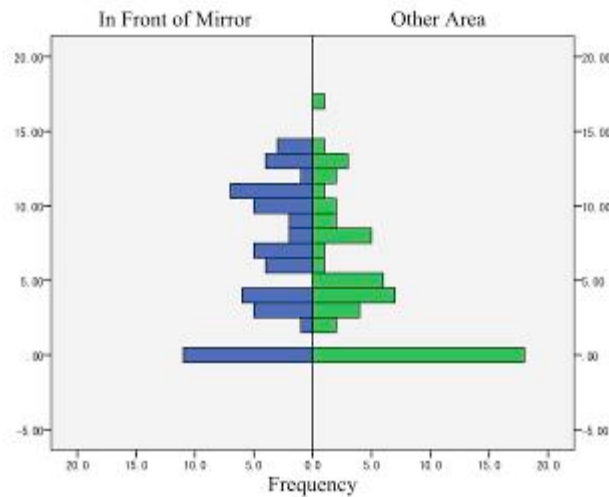


Figure 14: Frequency of Active Player's Distance

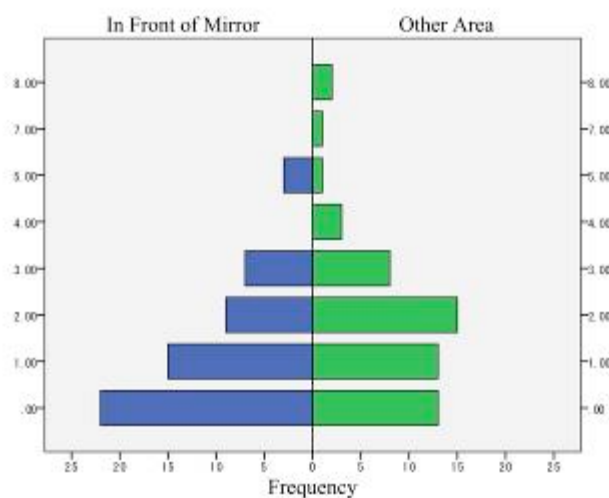


Figure 15: Frequency of Inactive Player's Distance

A Mann-Whitney U test was run to determine if there were differences in the number of active people between the mirror area and other areas. Distributions of active people's

numbers were not similar, as assessed by visual inspection. The number of active people in the mirror area (mean rank = 62.54) and in other areas (mean rank = 50.46) were statistically significantly different,  $U = 1229.5$ ,  $z = -1.991$ ,  $p = 0.047$ , using an exact sampling distribution for  $U$ . For inactive players, the distributions of inactive people's number were similar, as assessed by visual inspection. The median number for inactive people in the mirror area (1.00) and in other areas (2.00) were statistically significantly different,  $U = 1209.5$ ,  $z = -2.150$ ,  $p = 0.032$ , using an exact sampling distribution for  $U$ . The result of the  $U$  test shows that for both active and inactive players' distance in front of mirrors and other area has statistically different.

## **Conclusion**

This research focused on people's social behavior in a virtual reality environment. The observation provided empirical data and suggested several residuals. 2020 is a year people live with COVID-19, limiting people's behavior in the real world. The number of players in VRChat increased, making the game become a plant form to research people's social behavior in VRE.

Mirror in VRE attracts both active and inactive players. People would like to socialize in front of mirrors, and the variety of avatars also encouraged people to interact. Only a few people take seats in virtual environments since most users are sitting in the real world when they are in VR. The data of player distance also shows that most people prefer to have 1 or 2 meters to another player. The statistical analysis supports that people's distance is different when they are in front of mirrors and other areas.

This research may help developers and researchers who work with VRE, make people's VRE experience more comfortableuuuuu, and create a more attractive virtual environment. Limitations also exist. This research was only conducted in one social VR game, and most people used the keyboard due to the cost of the VR headset. In the future, when VR equipment becomes easier to be assessed and more popular VRE open to the public, people's experience in VRE could change, and the way people socialize in VR also varies with VR equipment development.

## References

- Benford, S., Bowers, J., Fahlén, L. E., Greenhalgh, C., & Snowdon, D. (1995). User embodiment in collaborative virtual environments. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '95*. doi:10.1145/223904.223935
- Blascovich, J. (2001). Immersive virtual Environment technology as a tool in Psychological Science. *PsycEXTRA Dataset*. doi:10.1037/e324232004-012
- Blascovich, J. (2002). A theoretical model of social influence for increasing the utility of collaborative virtual environments. *Proceedings of the 4th International Conference on Collaborative Virtual Environments - CVE '02*. doi:10.1145/571878.571883
- Boellstroff, T., Nardi, B. A., Pearce, C., & Taylor, T. L. (2012). *Ethnography and virtual worlds: A handbook of method*. Princeton, New Jersey: Princeton University Press.
- Bowers, J., Pycok, J., & O'Brien, J. (1996). Talk and embodiment in collaborative virtual environments. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Common Ground - CHI '96*. doi:10.1145/238386.238404
- Bredikhina, L., Kameoka, T., Shimbo, S., & Shirai, A. (2020). Avatar driven VR Society trends in Japan. *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*. doi:10.1109/vrw50115.2020.00103
- Churchill, E. F., & Snowdon, D. (1998). Collaborative virtual environments: An introductory review of issues and systems. *Virtual Reality*, 3(1), 3-15. doi:10.1007/bf01409793
- Iachini, T., Coello, Y., Frassinetti, F., Senese, V. P., Galante, F., & Ruggiero, G. (2016). Peripersonal and interpersonal space in virtual and real environments: Effects of gender and age. *Journal of Environmental Psychology*, 45, 154-164. doi:10.1016/j.jenvp.2016.01.004
- Loomis, J. M., Blascovich, J. J., & Beall, A. C. (1999). Immersive virtual environment technology as a basic research tool in psychology. *Behavior Research Methods, Instruments, & Computers*, 31(4), 557-564. doi:10.3758/bf03200735
- Pallay, C., Rehm, M., & Kurdyukova, E. (2009). Getting acquainted in Second Life. *Proceedings of the International Conference on Advances in Computer Entertainment Technology - ACE '09*. doi:10.1145/1690388.1690395
- Pearce, C. (2011). *Communities of play: Emergent cultures in multiplayer games and virtual worlds*. Cambridge, MA: MIT Press.
- Perry, T. S. (2016). Virtual reality goes social. *IEEE Spectrum*, 53(1), 56-57. doi:10.1109/mspec.2016.7367470
- Peterson, M. (2010). Massively multiplayer online role-playing games as arenas for second language learning. *Computer Assisted Language Learning*, 23(5), 429-439. doi:10.1080/09588221.2010.520673

- Project for Public Spaces. (2010). *How to turn a place around: A handbook for creating successful public spaces*. New York, NY: Project for Public Spaces.
- Riva, G. (1999). Virtual reality as communication tool: A sociocognitive analysis. *Presence: Teleoperators and Virtual Environments*, 8(4), 462-468.  
doi:10.1162/105474699566341
- Schubert, T., Friedmann, F., & Regenbrecht, H. (1999). Embodied presence in virtual environments. *Visual Representations and Interpretations*, 269-278. doi:10.1007/978-1-4471-0563-3\_30
- Shriram, K., & Schwartz, R. (2017). All are Welcome: Using VR ethnography to explore harassment behavior in immersive Social virtual reality. *2017 IEEE Virtual Reality (VR)*. doi:10.1109/vr.2017.7892258
- STEAMCHARTS. (n.d.). Vrchat. Retrieved February 15, 2021, from <https://steamcharts.com/app/438100>
- Thorne, S. L. (2008). Transcultural communication in open internet environments and massively multiplayer online games. *AILA Applied Linguistics Series*, 305-327.  
doi:10.1075/aals.3.17tho
- Wang, M. (2020). Social VR : A new form of social communication in the future or a Beautiful Illusion? *Journal of Physics: Conference Series*, 1518, 012032.  
doi:10.1088/1742-6596/1518/1/012032
- World Health Organization. (n.d.). Who coronavirus disease (covid-19) dashboard. Retrieved February 15, 2021, from <https://covid19.who.int/>

**Contact email:** maomaofreedom@gmail.com