Perceive the Living Condition of Refugee in Virtual Reality: A Comparison of the Active and Passive Interaction Mode

Fig. 1. The prototype of active condition and passive condition .

Virtual Reality can portray immersive situations that may affect the promotion of empathy in certain situations and decrease implicit bias towards vulnerable populations. However, the assumption of different interaction modes may cause differences in perception has been proved in-game science that refers to the intrinsic behaviors and psych of play. In this paper, we compare two conditions of navigations in experiencing the refugees' real life in virtual reality and discover the different effects from the conditions. The active condition allows participants to make choices using gaze and the passive condition only allows them to watch the 360-degrees videos in a certain sequence. The participants in both conditions wear a helmet-mounted display(HMD) and watch the same 360-degree videos about refugees. Results show the active navigation mode has significant effects on one dimension of attitudes towards refugees than passive viewing.

CCS Concepts: • **Human-centered computing** → **Virtual reality**; **Usability testing**; **User studies**; **Interface design prototyping**.

Additional Key Words and Phrases: virtual reality, interaction design, refugees, empathy, 360-degree videos

1 INTRODUCTION

Virtual Reality (VR) is the use of computer-based technology to develop an inciting and propelling environment to create a simulated environment [33]. The maturity of virtual reality has added a variety of interactive methods to

applications in education, health care, entertainment, etc., and has achieved a use effect that is difficult to achieve with two-dimensional screens. 360° video allows viewers to sense the action from all angles and directions. These videos provide viewers an immersive way for viewers to watch, undoubtedly, 360° video can have the greatest impact when playing in a VR device, making people feel like they are in it[9]. Wilson et al., [34]presented the taxonomy of four navigation modes: (a) physically passive navigation (the subject visualizes the Virtual Environment(VE) without moving), (b) physically active navigation (the subject moves using a motor interactor), (c) psychologically passive navigation (the subject follows directions), and (d) psychologically active navigation (the subject freely explores the VE). In our study, we compared psychologically active navigation (i.e., the active condition) and passive viewing (i.e., the passive condition). The passive viewing condition in our study allowed users to watch the 360° videos but they were not allowed to change the sequences in a psychological navigation (a landscape indicated the spatial information), while in our active condition, users are encouraged to choose the sequences of videos and also would be guided by a panoramic landscape picture.

Recently, the Afghanistan crisis has drawn close attention, and the refugee issue has also aroused heated discussion. More and more individuals are involved in the perception of the living condition of refugees. Prior research suggested that the appropriation of VR into humanitarian contexts is grounded on the hope that it will enable empathetic connections between the immerse and the distant sufferers[14]. Clouds Over Sidra[2], a 360° film, describes a Syrian girl living in the Zaatari refugee camp, Jordan from the first perspective view, which is a typical film work in VR. However, another study argued that VR does not facilitate a direct relationship between a user and the experiencing subject in reality to achieve empathy[11]. They declared that the empathy aroused by the experienced subject depends on the VR designers and what content they presented, rather than the subjects in reality. Thus, we collected some 360° videos that reflect the living conditions of refugees fairly objectively. And our first research question is that immersive technology, VR, known as the "ultimate empathy machine"[6]has an impact on empathy towards refugees. Previous work studied how virtual experience affects the level of participants' cognitive response according to active and passive navigation. Wallet et al., [32]and Cao .,[7] also proved the active and passive navigation may cause differences in the performance of users in VR games. However, there is a lack of research on how active navigation and passive viewing play a role in affecting users' empathy toward refugees after VR experience. Thus, another goal of this study is to find out if active navigation mode in VR experiences influences participants differently from passive navigation mode, and how it affects their level of empathy towards refugees afterward.

To better understand this, we collected samples (n=36) from 2 conditions. This experiment compared and analyzed active and passive conditions based on presence, engagement[27][25], kindness, indifference, separation[20], feelings toward refugees, attitudes toward refugees[1], and System Usability Scale(SUS)[4]. Qualitative data from semi-structured interviews were also collected and analyzed to find in-depth reflection on the VR experience. The obtained results allow us to discuss the current use of VR systems for an immersive experience. Firstly, VR as the "empathy machine" does have an impact on empathy towards refugees. Secondly, it proposes active navigation in VR systems better evoke empathy reactions compared to passive viewing. The results revealed that kindness and attitudes towards refugees in active navigation mode have significant effects.

The obtained results allow us to discuss the current use of VR systems for immersive experience. Firstly, VR as the "empathy machine" does have an impact on empathy towards refugees. Secondly, it proposes active navigation in VR systems better evoke empathy reactions compared to passive viewing. The results revealed that kindness and attitudes towards refugees in active navigation mode has significant effects.

This paper presents our contribution as the understanding of the differences between "Active" and "Passive" navigation mode in VR and its impact on empathy; and also a prototype innovation in VR interaction which applied the gaze system as the main interaction in active navigation with 360-degree videos content. In particular, it can help facilitate a minor direction on how to evoke empathy using VR systems. Hence, apart from giving evidence on the impacts on the empathy of active and passive navigation towards refugees in VR, our work also paves the way for future research on designing a system for watching 360° videos with interactive navigation.

2 RELATED WORK

2.1 The Presentation of Refugee

The UN High Commissioner for Refugees(UNHCR) has declared the definition of refugee: A refugee is someone who has been forced to flee his or her country because of persecution, war , or violence[31]. In particular, Afghans make up one of the largest refugee populations worldwide. After the Afghanistan crisis, the number of people fleeing will likely continue to rise[30]. According to the UN High Commissioner for Refugee(UNHCR), more than 800,000 Rohingya refugees are hosted in refugee camps in Bangladesh. The Islamic population of the Rohingya, who were forcibly removed from Myanmar to neighboring Bangladesh ever since 2016, living in makeshift shanty towns with scant resources[29].

Previous study reported that it would enable empathetic connections between the immerse and the distant sufferers through VR under the humanitarian contexts[14]. For example, Clouds Over Sidra, a VR documentary, describes a Syrian girl living in the Zaatari refugee camp, Jordan from the first perspective view, which is a typical film work in VR. However, the storytelling followed the self-reported script which increased the empathy from the girl child's point of view. And the videos are made from a static camera, the scene watched by the audience was from the eye of the filmmaker, who was outside of the refugee group. The 360° video footage used in this study was shot in the Dhaka refugee camp in Bangladesh, which recorded the day-to-day activities of Rohingya refugee camps in Southern Bangladesh in a state of non-manipulation. Instead of investigating the hardships of refugees from a Western perspective, the photographer moved the 360° camera around, following them when they walk around and play football to be part of the story to show how the experience lives in real life. As the video shooter thought: Human empathy is what joins us together despite diverse backgrounds and expectations[28]. In this article, we control the way we interact with navigation to measure people's empathy.

2.2 Empathy in VR

Empathy is used to refer to a wide range of psychological capacities that are thought of as being central for constituting humans as social creatures allowing us to know what other people are thinking and feeling, to emotionally engage with them, to share their thoughts and feelings, and to care for their well–being, that is, the capacity to place oneself in another's position[5][26]. Past research has shown that virtual reality experiences can help inspire spectators to have a higher degree of empathy for vulnerable populations, for instance, black people[3], women[12], children[22], refugees[17] , etc. That shows VR designers establish role-plays to achieve an empathic actuality—an emotionally charged interpretation of life—which may result in compassion or sympathy. Users end up empathizing directly with a VR designer and their presented representations, not their subjects in lived reality[11].

Schutte and Stilinović[24]used the United Nations documentary 'Clouds over Sidra' to provide participants a tour of a refugee camp with Sidra. They compared individual engagement and level of empathy through the virtual reality condition of a tour of a refugee camp. They compared individual engagement and level of empathy through the virtual

reality condition wearing a VR headset and the two-dimensional format of a panoramic (non-360), and the results showed that Virtual reality experience resulted in better engagement and a higher level of empathy[24]. As Irom discovery: Virtual reality videos enable spectators to hear and see the refugees directly which allows spectators to be "present" in the situation they face without the interference of cultural filters[14]. Therefore, exploring the connection between refugees and empathy in the virtual reality environment has become the starting point of our research.

2.3 Active and Passive Navigation In VR

Prior researchers designed a study to ask participants to explore the virtual museum actively and passively. Only the participants in active exploration conditions were able to make decisions about their routes. And it showed that allowing players to navigate freely through the game has positive effects on cognitive interest and a feeling of presence[10] . And another study showed that compared to those under the passive exploration condition, the participants under the active exploration condition traveled for a longer distance during the egress task and rated this task to be more difficult[7]. It also proved the stronger feeling of presence in the active condition than the passive condition. Wallet, Grégory et al.[32] asked participants to conduct sketch-mapping tasks, they found that the detailed VE increased performances compared to the undetailed VE condition, and allowed subjects to benefit from the active navigation[32]. Sauzéon proved that active navigation increased recognition hits compared with passive navigation[23].

3 METHOD

3.1 Participants

Our test locations are in Milan, Italy, and Shenzhen, China. Researchers recruited 11 students and 25 students and company employees in two locations through campus networks and social media to conduct the test, a total of 36 people (20 female, age: 25.41±5.01 years old). All participants can speak fluent English or Chinese, and have normal vision or wear contact lens without any known mental or physical impairments, 23 of them had used VR devices before. Participants had to be adults who were informed of the study's purpose and procedures, then they signed an informed consent form before the test, that they know they have the right to withdraw and stop the test at any time without penalty.

3.2 Study Design

We adopted a between-group design. The independent variables were the active navigation and passive viewing. Active Navigation allows participants to use the build-in system to choose the watching order or even revisit as they need. Passive viewing conditions were a fixed watching experience. The contents were the same in both conditions. The dependent variables were self-reported ratings on engagement, three components(Kindness, Indifference, and Separation) of the Compassion Scales(CS), Feelings and Attitude toward Refugee(FTR, ATR), and System Usability Scale (SUS) in a post-experience survey.

We also conducted the semi-structured interview after the testing. We first learned about participants' experiences and feelings of using VR devices in the past, as well as their experienced differences from this test. In addition, we referred to the user engagement Scale (UES) [18]. Investigate the participation of participants in the two environments from aspects of Aesthetics, Affect, Focused Attention, Control, Interest, etc. We have different questions for participants of active condition and passive condition. The question for the former is:

(1) what is the order in which you watch the video, and why did you make this choice?

(2) Have you repeated or jumped out of a scene? Once you get into the interface, are you interested in exploring it further?

(3) Where do you start exploring?

Finally, participants were asked to summarize their cognition of refugees, including their previous channels of understanding and impression of refugees, and whether they had donated to vulnerable groups in the past. In this way, verify the participants' daily prosocial behaviors[19].

Herrera et al. in their research suggested a method to measure the behaviour of participants after the empathy test[13]. We followed this method in our study, we provided 10 Euro or 100 RMB vouchers as test compensation. In addition, they can also choose to accept the vouchers or donate them to the refugee camp of Dhaka, Bangladesh through the website of [16]. It was also a part of behaviour measurement, it enabled us to know how they would behave after doing the test. The study received ethics clearance according to the ethics and privacy regulations of our institution.

3.3   Procedures

After the recruitment, we collected the demographics and contacting information of the participants. Then we assigned the 2 conditions, active navigation and passive navigation randomly to the participants. We made the appointment with each participant in 2 places, one is a private meeting room in Italy. Another place is in a separate room in China. When the participants arrived at the place, they were asked to follow the process:

- Consent: Sign a consent form, and then we gave them an introduction about the purpose and background of the test.
- Device Configuration: Wear the VR device and adjust the device to a comfortable status.
- Doing the Test: participants were asked to finish watching all the videos(8.7 minutes in total) in passive condition, and we encouraged the individuals who were in active condition to choose the videos freely based on a landscape menu that contains 5 spots in total. During the test, we observed their behaviour and took notes and photos. When they finished using the VR prototype, they were supposed to directly fill a survey, see the appendix.
- Post Interview: A semi-structured interview was conducted after the survey, the interview separated into 3 parts: introduction, condition(active or passive) and summary, the interview outline can also be found in appendix.
- Compensation and Donation: when the interview was finished, the participants were told that the amount of their donation would be donated to the organization, the website is:http://phalscox.org/

3.4   Measures

A survey featuring four parts would be used to collect quantitative data after participants finish their VR experience.

3.4.1   Prescene Engagement. Three engagement Likert scale (1-7, Strongly Disagree to Strongly Agree) questions were adapted from the User Engagement Questionnaire[27][25] , to measure Engagement. As suggested in studies They measure participants on how visually involved, how controllable the experience is, and how auditory involved.

3.4.2   Subscales of Compassion Scale. Three subscales of The Compassion Scale (CS)[20]were used to measure "Kindness", "Indifference", and "Separation". Each subscale contains 4 items. The goal was to measure if participants reacted distinguishable from another group. The complete compassion scale was a more comprehensive measure. The reason this study only used these three subscales was because other sections were not as straightforward as those three. On the other hand, those three components were adapted using the first version of the CS instead of the most recent version.

3.4.3 Attitude and Feelings toward Refugees. Attitude toward Refugees consisted of a total of 24 items and feeling toward Refugees consisted of a total of 10 items. They were adapted from a study trying to create a validated scale to measure feelings and attitudes toward refugees minors of host countries[1]. For this study, words like "minors" and "children" were taken out of the original version to measure more general feelings and attitudes toward refugees.

3.4.4 System Usability Survey(SUS). SUS has proved to be a valuable evaluation tool, being robust and reliable. It correlates well with other subjectives measures of usability[4]. Ten items adapted from the SUS were used to measure and analyze the usability and learnability of the system. We declared that the "system" in the survey has a certain meaning of the representation of the virtual environment, rather than the wearable device. All the statements were on a 5 point scale from strongly disagree to strongly agree. Examples have been added to the statement that "I found the various functions in this system were well integrated." to obtain the knowledge about the coherence between the 360-degree videos and the user interface.

4 SYSTEM DESIGN AND IMPLEMENTATION

4.1 Apparatus

Participants in both active and passive navigation conditions wear a google cardboard V2 VR device, a mobile phone HUAWEI Mate 20 Pro with 1440x3120 pixels resolution, 6.39 Inches OLED screen as the display(figure 2).

Fig. 2. Participants wearing the device during the test.

4.2 Materials

The virtual environment consists of 360-degree videos about the Rohingya refugees living in a refugee campus in Dhaka, Bangladesh. Those videos are about both the positive and negative life of the refugee and framed by refugees themselves[28]. All the videos are shot by a 360 camera in first person perspective. It allows the audience to follow their activities such as climbing hills and playing football through watching the videos. Since the video materials are numerous and incoherent, In order to make the storytelling smooth and well-integrated, we picked 5 360-degree videos from all the materials, the duration of all the videos is 8.68 minutes. It consists of 5 spots, they are Family 1(Indoor scene, a big family sitting on the floor and chatting), Family 2(Indoor scene, boy child holding the camera move in

the campus), Kitchen(Indoor scene, the shared cooking space in the campus, showing the cooking utensils and food), Playground(Outdoor scene, children playing football in a rural ground) and Bridge(Outdoor scene, walking through the trail and climbing hills), and we arranged the passive condition in this order. In active condition, all the videos are the same, but the sequences are not fixed, participants could make a choice freely.

4.3 Prototypes

4.3.1 Prototype of Active Condition. The prototype of active navigation is an android application developed by unity. We designed a gaza system and a navigation menu for the experience of watching the 360-degree videos about the living conditions of refugees. At the beginning, there were instructions about how to use the gaze system. Users were supposed to move their head and turn around their head to move the ray of gaze to highlight a spot or confirm selection. A panoramic landscape picture illustrated the environment of the refugee campus,.5 pop-up spots indicators appeared and they could move around the head to make the gaze selection confirmed by staying at the indicator for a while(Figure 3), there would be a loading circle on the screen, when the loading was finished, it would directly enter the spots they selected, and a 360-degree video about that spot started to play automatically. They could skip or repeat watching the videos without time limitation. In each spot, there was an exit button, which can be highlighted and selected by the gaze pointer. After watching the videos by their own selection, there also was an indicator for going out of current position, which leads back to the main landscape and makes another spot selection by gazing, see Figure 4.

4.3.2 Prototype of Passive Condition. We created the prototype of passive viewing condition by editing the 360 degree videos with a certain sequence of the spots. The content, transition time, and animation of this video are highly consistent with the active. At the beginning of the videos, there was also a landscape indicating the position of each spot before the corresponding video starts. This different control method is set to know if the participants are free to make a choice of the content they want to watch, would they gain a stronger perception of the refugees living condition.

Fig. 3. Use gaze to select a spot in the prototype of active navigation.

4.4 Implementation

Since we decided to use the google cardboard VR device rather than other VR devices such as Oculus Quest 2 virtual reality headset. When developing the prototype in active navigation condition, we used the Google VR SDK for Unity with Android devices. It is not so convenient to design hand interaction without the touch controllers, thus we decided to design a gaze system for selecting interaction. It consists of the eye raycaster and the pointer which displays in the center of the view. Users can easily make selections by moving around their heads to make the pointer coincide
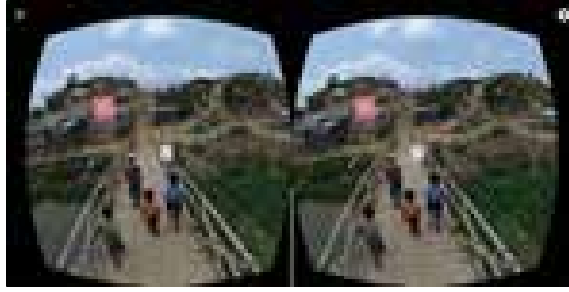
Fig. 4. Going out of one spot in the prototype of active navigation.

with the spot indicator. Once they coincide, the spots turn to the hover selection and the corresponding videos are under loading status, at this moment staying for a while when the video finishes loading the system will bring the audience to another scene, where another video starts playing automatically. The spots indicator contains 3 statuses: 1. Unselected: the default status of the spots indicator, the appearance is pure pink gradient icon; 2. Hover: When the gaze pointer coincides with the spot indicator, an icon with the meaning of "proceed" appears in the center of the indicator; 3. Selected: If the pointer stays at the indicator till the video finishes loading, the pink circle inside the indicator become larger.

5 RESULTS

With the data collected from participants (n=36), there was one participant who failed to complete the task. One data point was dropped. Only the remaining sample (n=35, 19 female) would be used for data analysis, and each condition consists of a different number of samples: active conditions(N=17), passive conditions(N=18). One-way ANOVA analysis would be used when normal distributions are met. Wilcoxon signed-rank tests were performed if data did not meet the Shaprio-wilk test for ANOVA.

5.1 Attitude Toward Refugee

The Shapiro-wilk test was performed to test both conditions. The result was shown in Table 1. Since it was not considered statistically normal distributed, a Wilcoxon test was conducted to test individual questions between Active and Passive conditions. No significant results were found. However, a summary of rating results across participants in each condition could be seen in the following figure 5. There were variations between active and passive conditions as shown in the heat map but the Wilcoxon test for each question across active and passive conditions did not statistically show significance.

Table 1. The Test Result of Attitude Towards Refugee

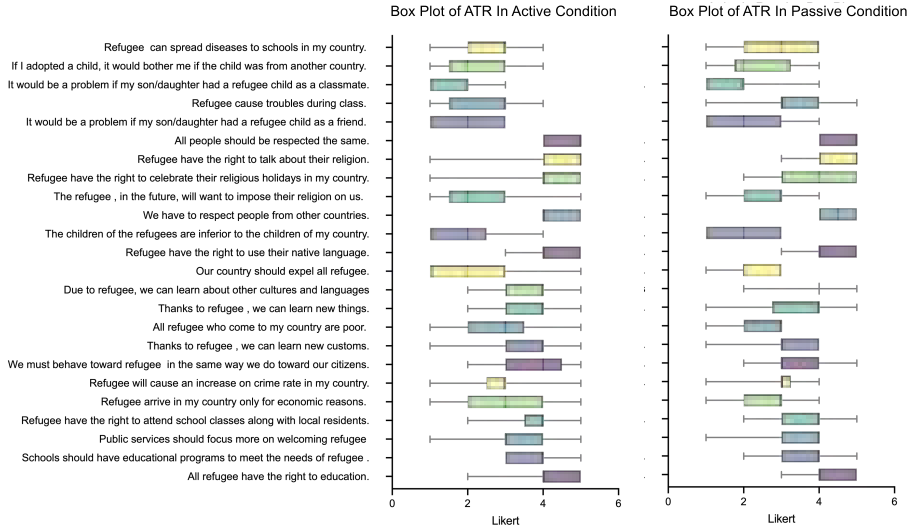| Descriptive					Shapiro-Wilk
Variables	Mean	SD	N	Sig.(p)	Result
Active	3.23	1.25	17	0.42	OK
Passive	3.22	1.17	18	0.61	OK

Fig. 5. Box Plot of Attitude Towards Refugee in both condition.

5.2 Feelings Toward Refugee

The Shapiro-wilk test was performed to test both conditions. The result was shown in Table 2. Since it was not considered statistically normal distributed, a Wilcoxon test was conducted to test individual questions between Active and Passive condition. No significant results were found. However, summary of rating results across participants in each condition, there were varies between active and passive condition as shown in the heat map but the Wilcoxon test for each questions across active and passive conditions did not statistically show significance.

Table 2. The Test Result of Feeling Towards Refugee

Descriptive					Shapiro-Wilk
Variables	Mean	SD	N	Sig.(p)	Result
Active	3.37	1.06	17	0.011	OK
Passive	3.58	0.77	18	0.025	OK

5.3 Kindness, Indifference and Separation

Kindness, Indifference, Separation were three subscales adapted from the original version of the Compassion Scale(CS). Each subscale would be averaged across four questions in each section[20] We conducted Shapiro-Wilk Normality to test that both conditions were not significantly rejected to be normally distributed(See. Table 3). Therefore, a one-way ANOVA was performed to compare both active and passive conditions of the "Kindness" subscale. The result (p-value = 0.103) suggested that participants in the active condition respond similarly to another condition. Descriptive statistics for three subscales of both conditions were shown in Figure 6.

Table 3. The Test Results For the Compassion Scale

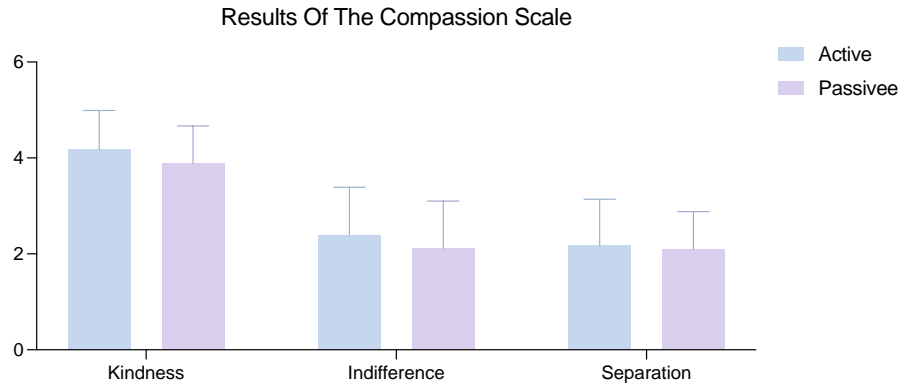|	Descriptive				Shapiro-Wilk
Variables	Mean	SD	N	Sig.(p)	Result
Kindness Active	4.18	0.81	17	0.496	OK
Kindness Passive	3.89	0.78	18	0.58	OK
Indifference Active	2.18	0.96	17	0.09	OK
Indifference Passive	2.1	0.78	18	0.057	OK
Seperation Active	2.4	0.99	17	0.61	OK
Seperation Passive	2.12	0.98	18	0.03	NO

Fig. 6. Results of the Compassion Scale.

5.4 Engagement

Each question of engagement could be categorized into "Visual Involvement", "Controllability", and "Audio Involvement". After testing with Shaprio-wilk with each question's normality, they were considered not normal so Wilcoxon tests were performed for each three questions across the two conditions. We did not find any significance on Visual and Control across two conditions. However, Auditory (p-value = 0.02305) was found to be significantly different between the two groups. We were afraid that was due to the environmental differences between media players and locations.

5.5 System Usability Scale

Bangor et al.[4] provided the information about the distribution of System Usability Scale(SUS) scores in their data. We followed this study to analyse our statistics. Table 4 shows basic statistical information about the distribution with the data collected from test of active condition and Table 5 depicts the passive condition. Figure 7 shows a graph of the distribution of the Overall SUS scores from our collected data set.

The central tendencies of the active condition and passive condition were not identical, with a mean difference of 2.8. The mean of the SUS score in active condition was 68.4, and the mean of passive condition was 65.6. There also were similar differences for the Median of SUS Score in those two conditions. The score in both conditions was acceptably good while the central tendencies of the SUS score indicated a significant effect in the active condition. As expected, the

Table 4. The SUS distributions of Active Condition

statistic	SUS Score	Usability	Learnability
N	17	17	17
Mean	68.4	66.2	77.2
SD	7.8	6.2	17.8

Table 5. The SUS distributions of Passive Condition

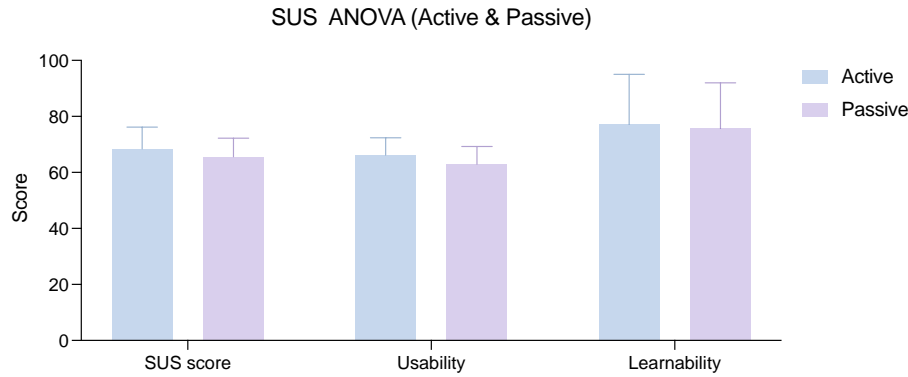| statistic	SUS Score	Usability	Learnability
N	18	18	18
Mean	65.6	63.0	75.7
SD	6.6	6.3	16.3

Fig. 7. SUS Results of Active Vs. Passive.

statistics and distributions of the SUS score and usability from active conditions had higher values than the passive condition. In contrast, the distributions of the Learnability were distinct, it had a lower value compared to the passive condition. The reason could be that the prototype of active condition applied the gaze system as the main interaction which currently was not so familiar to participants, and they may need to pay more effort to comprehend the usage.

5.6 The Semi-Structured Interview Results

Neutral perspective 360-degree video. In the interview, we found that the 360-degree video footages we used are considered to show the daily life of refugees without themes or stories, but only some pictures, P04 and P28 told us that:*Compared with the ups and downs of the film Capharnaüm, it is not as easy to affect the participants. Movies are artistic, and the content I watch today is closer to life.* His words reflect that the video we use is completely neutral that exclude the director's perspective and scripts, about this issue Robinson's investigation of audiovisual depictions of the refugee concluded that they are not predisposed to create a strong impression of either individual agency or character, both of which are important factors in capturing and holding audience attention[21]. P28 said: *The news only says that the local situation is very miserable, usually shows a whole group of people without showing the specific life of refugees.*P27, a holder of different views, said: *In the news, the entire refugee camp may be overlooked from the perspective of a drone,*

*and the whole refugee camp can be seen, and this part of the environment can be seen from a human height.*Therefore, we found that different participants have inconsistent judgments and requirements for the acquisition of visual information richness, while compared with personal life experience, P33 believes that: *This place is like our life in the 1960s, and the road is as steep as the mountain road back to my hometown.*

The most profound impression scene. As many as 9 participants had the most profound impression on the playground scene. As Ray notes in his study: Following a protagonist with a 360 camera during play while he chases after the ball, as if the audience is also chasing the ball[28]. One participant who loves playing soccer said: *The ball itself has a sense of movement, so it is more attractive.[P27]* About this scene, three participants in passive condition said: *Playing football is a happy picture, I think the children are very happy.[P23] Where there is exercise, no matter how hard the objective conditions are, the mentality won't be worse.[P27] Children playing football still have their entertainment life and happy memories.[P29]* It shows that they can empathize with the emotions of refugee children, however, none of the active condition participants mentioned this. Another participants noticed that: *They do not have a dedicated football field, but only this empty space, which reflects the problem of uneven distribution of educational resources.[P19]* Such thinking means that participants begin to show concern for the wellbeing of the refugee children and go beyond emotional empathy to the stage of cognitive empathy in psychological sciences[8].

Selection of playback order in active condition. In the active condition, most participants choose outdoor playgrounds and bridges to start their journey. When asked the reason they consider that a more complete look of the refugee camp can be seen in the outdoor scene so they can observe the construction of their house, or we can call it just sheds or rough huts. These scenes are more shocking to them compared to static scenes indoors: The movements of refugees haven't changed much which are relatively repetitive and boring, so they have the behavior of skipping out of indoor videos. A participant at the beginning think that she can play with them, similarly, another female participant in bridge fragments found:

A boy always looked at me and talked to me, as if to guide me, thinking I'm not familiar with this environment.[P8]

There is not much feedback like this while we cannot rule out the fact that they have used VR devices before. To a certain extent, their past experience may make them mistakenly believe that there will be more interactions in the virtual reality environment. In stark contrast, there have not been such voices in passive condition. From this, we can assume that the sense of interactivity of navigation can be carried over to the rest of the video. In Cao's exploration of actively or passively in the virtual museum, their participants under the passive exploration condition due to following predetermined routes, needed much less knowledge to complete the task[7]. We can judge from this that active navigation naturally provides people with a controllable and explorable impression, even in an emergency, it will make them spend more time and energy as they experience more in-tensive acquisition and processing of information

6 DISCUSSION

The goal of our study was to examine the influence of Active navigation in VR has on participants' empathy, feelings, and attitudes toward refugees. SUS systems were analyzed to compare Active and Passive conditions. We investigated if significant differences exist between groups.

6.1 General Finding

We found a significant effect of Active condition on one item within the ATR. Participants rated higher in Active condition versus Passive condition. For the item in ATR, which was "Refugees cause trouble in class", participants in

passive condition agreed more in contrast to Active group. There was no significant difference between active condition and passive condition with regard to the rest of ATR and FTR.

Taken as a whole, we observed it lacks an obvious bias between the active condition and the passive condition according to the results of the survey scale. But the subscales confirm our assumption that the active navigation mode tends to have a better impact on the perception. Specifically, we found a significant effect of Active condition on one item within the ATR.

While the participants also claimed that both the active and passive condition has a more immersive experience than the 2D model. Moreover, the novel prototype applied gaze system in the active navigation mode has a higher SUS score than the normal 360-degree videos in the passive condition.

6.2   Time spent in both Conditions

We also observed that the impact on their kindness and attitude towards refugees are almost irrelevant with the test duration. Participants finish the VR experience in active condition in 8.1 minutes(SD= 2.7). And participants assigned to the condition of passive navigation with a longer duration of 8.6 minutes(SD= 0.5). It was contradicted with the study of Cao[7], they reported the results that participants in active exploration condition spend longer time than the passive exploration condition. but the difference is that the tasks they performed in their study were about wayfinding, it involved more spatial knowledge, on the contrary, the tasks we designed in our active navigation condition only needed participants to move around their heads to explore the environment. Thus, it did not require much time to explore repeatedly since it did not depend on long-distance body movement.

6.3   The Effect of VR

Even though none of the Compassion Scale was found to be significantly different across two conditions. A study in the past had shown results of higher empathy and engagement by comparing VR and 2D videos [24]. In other words, VR is a reasonable tool being used to create immersive experiences for the general public. This work, setting both conditions in the immersive VR environment, demonstrated that putting more degrees of active engagement to provoke empathy components such as "Kindness" could be considered an advantage compared to passive viewing.

6.4   Behavioural Expression

Not only did we wonder how 360-degree video in VR would affect people's empathy, but we also tried to figure out how they would behave after the test. We obtained an interesting finding from the behavior measures that the results of their empathy transformation are unexpected, which means that the participants in active condition with a stronger kindness and better attitudes towards refugees, on the contrary, donated less than those in passive condition, with the average donation amount percentages of 65.2% and 75.2% respectively. This finding may relate to their income level and occupation, or other potential factors such as their trustworthiness in the organization that collected the donations. It needs more evidence to draw a meaningful conclusion about their behaviors after the test. We found that it is not the longer they experienced in the test, the stronger their kindness and attitudes were impacted by the 360-degree videos in VR. Moreover, we found that the different watching sequences of the videos was the most important control, which enabled participants in the active condition to skip and repeat watching freely. From our observation and the interview results, we found that 4 participants in active condition repeatedly watched the videos. Two of them repeatedly watched the video of the kitchen. They talked about their motivations as they wanted to know more detail about what they are cooking and how they cook since the culture of refugees is different from theirs. Another two participants chose

to watch the video of the bridge twice. They told us that since the shabby house around the bridge impressed them the most, and they have strong feelings for it, one of the participants lived in a similar environment in her early age. Hence, the control of selecting the watching sequences freely allows them to experience the content according to their preferences and mood at that time. Even the experience duration in some cases was less than those in passive condition, since some of the participants skipped some parts, however, the content they chose, actually is the decision after their empathetic thinking.

6.5 limitations And Future Work

Our tests were performed in different locations, and although the VR equipment and the researchers were confirmed for consistency, there were unavoidable differences in details, mainly including tests that are not conducted in the same laboratory or even in the same country. European people are closer to refugees, especially recently. Reception (refugees and security) [15], the Italian participants in this test have real personal experience of refugees, while the Chinese participants have almost never had contact with refugees in their life. When they receive questionnaires and interviews, They can only imagine what they understand about a refugee coming to their own country and how he or she sees their relationship.

On the other hand, we find that now the videos are a bit blurry for participants and only one side of the phone's speaker has sound effects, this kind of immersion experience does not give participants the feeling of being deeply involved in it. It does not make them feel that they are standing in this 3D world. In addition, we only collected self-reported data of participants, which was insufficient for us to form a conclusion. When immersion is done well, empathy will naturally increase, but in this experience, it is not enough. One of our participants said only if the whole system works well enough will she want more interaction that also provides enlightenment for the production of VR videos.

We can be in the next step of research from the selection of sample and experiment design was improved: Firstly, recruit participants of the same race and nationality who have lived here for more than three years at the test site, this guarantee for the local culture,the policy they have a common cognitive basis, to reflect the reality of the local people for refugee community through the research. This is also conducive to subsequent post-test of the same group of participants who completed the pre-test, using implicit association test(IAT) to test the extent to which the virtual reality environment we created can reduce their implicit bias towards refugees[19]. Secondly, we should use a better quality VR HMD to avoid objective factors such as the picture, sound effects, and headset weight that appeared in this study, so that participants can get a better experience during the experience to avoid virtual reality sickness. In order to make the test data have broad reliability, we should also consider further hardware and setup time necessary to implement physiological tracking that measures arousal through skin conductance, heart rate, and reflex response times[8].

7 CONCLUSION

We designed and developed a novel active navigation prototype that applied the gaze system and presented 360-degree videos about the life of refugee camps in VR. And we designed a study to research how active navigation mode in VR experiences influences participants differently from passive mode, and how it affects their perception of refugees. The participants were randomly assigned to these 2 conditions and wore a VR device to experience the living condition of refugees. The results suggest that the kindness and attitude towards refugees in the active condition are at a higher

level than in the passive condition. Future work involves trying better VR devices and improving prototype design to gain better engagement in the active navigation mode.

ACKNOWLEDGMENTS

REFERENCES

[1] Georgia Angelidou, Eva Aguaded-Ramírez, and Clemente Rodríguez-Sabiote. 2019. Design and Validation of a Scale Measuring Attitudes toward Refugee Children. *Sustainability* 11 (2019), 2797.

[2] Barry Arora, Gabo; Pousman. 2006. Clouds Over Sidra. Retrieved 2015-01-22 from https://www.imdb.com/title/tt4396650/

[3] Domna Banakou, Parasuram D. Hanumanthu, and Mel Slater. 2016. Virtual Embodiment of White People in a Black Virtual Body Leads to a Sustained Reduction in Their Implicit Racial Bias. *Frontiers in Human Neuroscience* 10 (2016). https://doi.org/10.3389/fnhum.2016.00601 Publisher: Frontiers.

[4] Aaron Bangor, Philip T. Kortum, and James T. Miller. 2008. An Empirical Evaluation of the System Usability Scale. *International Journal of Human–Computer Interaction* 24 (2008), 574 – 594.

[5] P. Bellet and M. Maloney. 1991. The importance of empathy as an interviewing skill in medicine. *JAMA* 266 13 (1991), 1831–2.

[6] C. Bevan, D. Green, H. Farmer, M. Rose, K. Cater, D. S. Fraser, and Helen Brown. 2019. Behind the Curtain of the "Ultimate Empathy Machine": On the Composition of Virtual Reality Nonfiction Experiences. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (2019).

[7] Lijun Cao, Jing Lin, and Nan Li. 2019. A virtual reality based study of indoor fire evacuation after active or passive spatial exploration. *Computers in Human Behavior* 90 (Jan. 2019), 37–45. https://doi.org/10.1016/j.chb.2018.08.041

[8] K. Carey, Emily Saltz, Jacob Rosenbloom, Mark Micheli, Judeth Oden Choi, and Jessica Hammer. 2017. Toward Measuring Empathy in Virtual Reality. *Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play* (2017).

[9] Nonny de la Peña, P. Weil, J. Llobera, Elias Giannopoulos, Ausiàs Pomés, B. Spanlang, D. Friedman, Maria V. Sanchez-Vives, and M. Slater. 2010. Immersive Journalism: Immersive Virtual Reality for the First-Person Experience of News. *PRESENCE: Teleoperators and Virtual Environments* 19 (2010), 291–301.

[10] Chris Ferguson, Egon L. van den Broek, and Herre van Oostendorp. 2020. On the role of interaction mode and story structure in virtual reality serious games. *Computers & Education* 143 (Jan. 2020), 103671. https://doi.org/10.1016/j.compedu.2019.103671

[11] Joshua A. Fisher. 2017. Empathic Actualities: Toward a Taxonomy of Empathy in Virtual Reality. In *ICIDS*.

[12] Cristina Gonzalez-Liencres, L. E. Zapata, G. Iruretagoyena, S. Seinfeld, L. Perez-Mendez, J. Arroyo-Palacios, D. Borland, M. Slater, and Maria V. Sanchez-Vives. 2020. Being the Victim of Intimate Partner Violence in Virtual Reality: First- Versus Third-Person Perspective. *Frontiers in Psychology* 11 (2020).

[13] Fernanda Herrera, J. Bailenson, Erika Weisz, E. Ogle, and J. Zaki. 2018. Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking. *PLoS ONE* 13 (2018).

[14] Bimbisar Irom. 2018. Virtual Reality and the Syrian Refugee Camps: Humanitarian Communication and the Politics of Empathy. *International Journal of Communication* 12 (2018), 23.

[15] N-A. 2006. No time to lose. Retrieved 18 August 2021 from https://www.thelocal.it/20210818/no-time-to-lose-how-is-italy-responding-to-the-afghan-refugee-crisis/

[16] N-A. 2021. Phals Coxsbazar – PHALS (PROGRAMME FOR HELPLESS AND LAGGED SOCIETIES). Retrieved 13 August 2021 from http://phalscox.org/

[17] Marcel Neuenhaus and Maha Aly. 2017. Empathy Up. *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (2017).

[18] H. O'Brien and E. Toms. 2010. The development and evaluation of a survey to measure user engagement. *J. Assoc. Inf. Sci. Technol.* 61 (2010), 50–69.

[19] Daniel Pimentel, Sriram Kalyanaraman, Yu-Hao Lee, and Shivashankar Halan. 2021. Voices of the unsung: The role of social presence and interactivity in building empathy in 360 video. *New Media & Society* 23 (2021), 2230 – 2254.

[20] Elizabeth Pommier, K. Neff, and István Tóth-Király. 2019. The Development and Validation of the Compassion Scale. *Assessment* 27 (2019), 21 – 39.

[21] P. Robinson. 2019. Refugees on film: Assessing the political strengths and weaknesses of the documentary style.

[22] Pamela Saleme, Timo Dietrich, Bo Pang, and Joy Parkinson. 2020. A gamified approach to promoting empathy in children. *Journal of Social Marketing* 10 (2020), 321–337.

[23] Hélène Sauzéon, Bernard N'Kaoua, Prashant Arvind Pala, Mathieu Taillade, and Pascal Guitton. 2016. Age and active navigation effects on episodic memory: A virtual reality study. *British Journal of Psychology* 107, 1 (Feb. 2016), 72–94. https://doi.org/10.1111/bjop.12123

[24] N. Schutte and Emma J. Stilinović. 2017. Facilitating empathy through virtual reality. *Motivation and Emotion* 41 (2017), 708–712.

[25] Dong-Hee Shin. 2013. Defining sociability and social presence in Social TV. *Computers in Human Behavior* 29, 3 (May 2013), 939–947. https://doi.org/10.1016/j.chb.2012.07.006

[26] K. Stueber. 2019. Davidson, Reasons, and Causes: A Plea for a Little Bit More Empathy.

[27] Katy Tcha-Tokey, E. Loup-Escande, O. Christmann, and S. Richir. 2016. A questionnaire to measure the user experience in immersive virtual environments. *Proceedings of the 2016 Virtual Reality International Conference* (2016).

[28] Anika Ullah. 2019. A Case for Play: Immersive Storytelling of Rohingya Refugee Experience.

[29] UNHCR. 2021. Rohingya Refugee Crisis Explained. Retrieved 13 August 2021 from https://www.unrefugees.org/news/rohingya-refugee-crisis-explained/

[30] UNHCR. 2021. UNHCR - Afghanistan. Retrieved 13 August 2021 from https://www.unhcr.org/afghanistan.html

[31] UNHCR. 2021. What is a Refugee? Definition and Meaning | USA for UNHCR. Retrieved 13 August 2021 from https://www.unrefugees.org/refugee-facts/what-is-a-refugee/

[32] Grégory Wallet, Hélène Sauzéon, Prashant Arvind Pala, Florian Larrue, Xia Zheng, and Bernard N'Kaoua. 2011. Virtual/Real Transfer of Spatial Knowledge: Benefit from Visual Fidelity Provided in a Virtual Environment and Impact of Active Navigation. *Cyberpsychology, Behavior, and Social Networking* 14, 7-8 (July 2011), 417–423. https://doi.org/10.1089/cyber.2009.0187

[33] B. Wiederhold, Ian T. Miller, and M. Wiederhold. 2018. Augmenting Behavioral Healthcare: Mobilizing Services with Virtual Reality and Augmented Reality.

[34] P. Wilson, N. Foreman, R. Gillett, and D. Stanton. 1997. Active Versus Passive Processing of Spatial Information in a Computer-Simulated Environment.

A RESEARCH MATERIALS

A.1 Quetionnaire

Welcome to the research test, hosted by HCIX Club, which took about half an hour to experience virtual reality, ten minutes to fill out the questionnaire, and ten minutes to conduct an interview. Because the picture is 360-degrees, you are free to change angles and postures throughout the process, so now please put on the device on the table to concentrate on the experience.

Part 1:

- How much did the visual aspects of the environment involve you?
- How well could you move or manipulate objects in the virtual environment?
- How much did the auditory aspects of the environment involve you?

Part 2:

- If I see someone going through a difficult time, I try to be caring toward that person.
- I like to be there for others in times of difficulty.
- My heart goes out to people who are unhappy.
- When others feel sadness, I try to comfort them.
- Sometimes when people talk about their problems, I feel like I don't care.
- I Sometimes I am cold to others when they are down and out.*
- I I don't concern myself with other people's problems.
- When others are feeling troubled, I usually let someone else attend to them.
- I don't feel emotionally connected to people in pain.
- I feel detached from others when they tell me their tales of woe.
- When I see someone feeling down, I feel like I can't relate to them.
- I can't really connect with other people when they're suffering.

Part 3:

- Refugee can spread diseases to schools in my country.
- If I adopted a child, it would bother me if the child was from another country.
- It would be a problem if my son/daughter had a refugee child as a classmate.
- Refugee cause troubles during class.
- It would be a problem if my son/daughter had a refugee child as a friend.

- All people should be respected the same.
- Refugee have the right to talk about their religion.
- Refugee have the right to celebrate their religious holidays in my country.
- The refugee , in the future, will want to impose their religion on us.
- We have to respect people from other countries.
- The children of the refugees are inferior to the children of my country.
- Refugee have the right to use their native language.
- Our country should expel all refugee.
- Due to refugee, we can learn about other cultures and languages.
- Thanks to refugee , we can learn new things.
- All refugee who come to my country are poor.
- Thanks to refugee , we can learn new customs.
- We must behave toward refugee in the same way we do toward our citizens.
- Refugee will cause an increase on crime rate in my country.
- Refugee arrive in my country only for economic reasons.
- Refugee have the right to attend school classes along with local residents.
- Public services should focus more on welcoming refugee
- Schools should have educational programs to meet the needs of refugee .
- All refugee have the right to education.

Part 4:

- I feel admiration toward refugee.
- I feel hate toward refugee.
- I feel compassion toward refugee.
- I feel sorry toward refugee.
- I fear refugee.
- I feel solidarity with refugee.
- I feel indifferent toward refugee.
- I am curious about refugee.
- I feel concern toward refugee.
- I dislike refugee.

Part 5:

- I think that I would like to use this system frequently.
- I found the system unnecessarily complex.
- I thought the system was easy to use.
- I think that I would need the support of a technical person to be able to use this system.
- I found the various functions in this system were well integrated.
- I thought there was too much inconsistency in this system.
- I thought there was too much inconsistency in this system.
- I found the system very cumbersome to use.
- I felt very confident using the system.

- I needed to learn a lot of things before I could get going with this system.

Part 6:

For participating in this study, you will be compensated with a 10 euro Amazon gift card. However, you have the opportunity to donate a portion of that compensation to a homeless shelter. For example, if you chose to donate 2 euro you would receive an 8 euro gift card. If you chose to donate 4 euro you would receive a 6 euro gift card.

A.2 Semi-structured interview outline

Thank you for your answer, and we'd like to talk to you a little bit about your past experience and how you feel about this quiz.

Intro Questions:

- Is this the first time you've ever used VR glasses?If so, describe your overall feelings; If not, what have you used before? What's the biggest difference this time around?
- Is the system clear enough and colorful enough to satisfy your visual preferences? Or do you think it's unsightly/rough/fuzzy, mainly in what areas?
- Since this test may not be the same as watching a movie, watching the news, or playing a game, we want you to describe to us again what the test is similar to for you. It can be adjectives or figurative sentences.

For active condition:

- During the experience, can you focus on the screen switching operation? If not, what's distracting you?
- Can you manipulate the system with Gaze smoothly and effortlessly? The hard part?
- I noticed that you just re-gaze a certain clip/button. What's the reason?
- Does watching their lives in this way make you feel included and their friend?If you can, do you want to interact more with the people in the video, or do you just want to keep your distance from them?
-

For passive condition:

- Are you able to focus and finish watching during the experience? If not, what's distracting you?
- Does watching their lives in this way make you feel included and their friend? If you can, do you want to interact more with the people in the video, or do you just want to keep your distance from them?

Summary Questions:

- Have you ever seen a 360-degree movie before? What is it about? Do you remember anything about that?
- Have you ever seen a film about refugees before? How do you think what you saw today is different from the previous videos?
- Once you've entered the interface, are you interested in exploring it further? What sparked your interest?
- What was the scene/thing that impressed you most in this experience? Why is that?