Learning About Catcalling: An Interactive Virtual Gallery Concept Raising Awareness for Street Harassment

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***Abstract*—In this paper, we describe a virtual reality (VR) application that educates and sensitizes visitors for street harassment, a globally prevalent form of violence predominantly targeted against women. The phenomenon, also known as Catcalling, recently gained renewed attention in public discussions initiated by social media activists. Combining VR with interactive instruction settings known from museums might be a promising way to effectively reach victims, bystanders, and aggressors alike and obtain a lasting attitude and behavior change. We present a virtual gallery where visitors can explore a variety of curated interactive multimedia material intended to inform, raise awareness, inspire empathy, perspective-taking, and behavioral change. With interactions such as a self-assessment test, as well as opportunities for visitors to leave feedback and thoughts in the gallery, this virtual world can be used as a sensitization tool. Based on a first evaluation with experts (N = 16), the original proof-of-concept prototype was extended and evaluated by a larger group including students (N = 50).**

***Index Terms*—virtual reality, street harassment, self-assessment, sexism, sensitization, awareness.**

I. Introduction

Street harassment is a public and daily problem for women and men around the globe [1], which can start supposedly harmlessly, e.g. a whistle or verbal chanting, but might also progress to sexual assaults and physical attacks [2]. The prevalence of this form of harassment is alarmingly high. According to a study by the Stop Street Harassment Organization [3], 99% of surveyed women indicated to have already been victims of sexual harassment by strangers in the public. Since there is a wide range of what harassment includes and each person has their own understanding of accepted behavior, there is a lack of understanding for victims of such harassment. According to Walton et al. [4], flirting and expression of sexual interest are frequently reported motivations to engage in Catcalling behavior. The reaction that is desired by actors is typically friendliness.

There are already many campaigns that want to raise awareness of this problem. The Catcalls movement for example, which was founded in New York in 2018 [5], has set itself the task of chalking up the harassment on the streets in the places where the incidents happened. In this way, the activists not only want to draw attention to the problem locally but also to reach an even wider mass of people by distributing the chalk drawings via social media, such as Instagram, to create a basis for discussion. Such campaigns are an important way to get the topic out to the public, but they probably mainly reach those people, who are already interested, became victims, or are sensitized towards the phenomenon, while they might fail in actually reaching aggressors and changing their mindset and behavior. Also, while the impact in terms of outreach might be identifiable via likes, shares, comments, the effect of specific posts (videos, comments, etc.) on viewers is hardly measurable. Therefore, appropriate (measurable) methods to sensitize people still need to be developed and tested.

With our approach of a virtual reality gallery, we want to provide information about the subject of sexism and raise awareness among visitors. Visitors of the gallery are presented a freely accessible gallery with interactive sensitization material, based on real stories of harassment staged and processed in art works, paintings, audio, video, and quiz activities. A self-assessment test at the beginning of the gallery helps visitors check and reflect on the level of their sexist attitude. Visitors can leave a trace by providing feedback and revisit feedback of earlier users.

II. Background and Related Work

Catcalling describes an unwanted and harassing, often sexually related attack of strangers in public. These attacks are mostly carried out by men with the aim of defaming their counterpart (usually a woman), showing sexual interest, and flirting where most of them would expect a friendly answer from the victim [4]. Only a small minority of aggressors do Catcalling because of misogyny [4]. But Catcalling is not only unacceptable because of what the aggressors say or shout, but also due to the (most) invisible consequences for the victims. These attacks silence victims, put them in an unpleasant situation, and harm them psychologically [6]. These facts, together with the misbelief that such (verbal) attacks are regarded as, e.g., harmless flirting, sets a stage for intervention and sensitization.

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VR-technology is very popular today and could soon be a comparatively inexpensive alternative to awareness-raising environments like large-scale, personal group training or advertising campaigns. In contrast to these, VR can help to engage better and focus on a particular topic by minimizing external distraction. VR gives users the freedom to explore the virtual worlds of their interest and, since the virtual world is built up as a gallery here, visitors can choose which exhibits to watch and for how long. As a result, immersive worlds, as well as curiosity about the medium of virtual reality, have helped users to better engage in the training methods. Sensitization training in VR already exist and have also been evaluated. For example, the VR-game presented in "Through Pink and Blue Glasses" [7] is intended to generate empathy as well as to inform and sensitize regarding sexism and gender stereotypes. Players experience different sexist situations in different roles to provide them the widest possible range of opinions and views. The results show that changing roles and situations have a positive effect on participants' behavior in real sexist situations that are otherwise ignored. Herrera et al. [8] also investigated the impact and efficiency of VR perspective-taking tasks compared to traditional empathy-generating strategies (e.g., paper or desktop) in a homeless scenario. They found that participants using the VR-condition felt just as empathetic as in the traditional narrative-based perspective-taking task. However, participants of the VR-condition have shown a significantly higher willingness to help the homeless. Virtual worlds can thus be designed creatively in their sensitization effect, whereas this is not the case with real and static training. The virtual environment at hand is structured as a gallery or museum. An ever-growing amount of research reveals the important role that museums and galleries play in encouraging visitors to participate in a dialogue on current social issues. These institutions "shape us in the way we see and perceive others and the world around us" [9]. This is due not only to the material exhibited in the museums and galleries but also to the environment itself, which provides an intellectual atmosphere. The aim is to transfer the potential of real museums and galleries to create a "sustainable, just and fair world" [9] to the virtual environment and help visitors to question their views on sexism. Of course, a gallery also invites you to explore it independently and at your own pace. Visitors can, as in a real museum or gallery, voluntarily visit the exhibits reducing the likeliness of reactance, a psychological effect of resistance caused by a feeling of reduced freedom. Kubota et al. [10] have investigated this exploration factor in more detail in a science museum and found that it correlated positively with the congenital learning of the subjects. So it is likely that a freely explorable environment provides a better basis for learning and knowledge building than a forced approach. In addition, using a gallery metaphor for the VR approach allows visitors to explore a familiar concept. This should allow a focuses on the content and reduce orientation time for visitors.

Fig. 1. Catcalls picture on the gallery wall, adopted from [12], which says *"Oh, you're French, I'll get an Eiffel Tower in my pants."*

III. Implementation

The material collection is presented as a virtual exhibition, where visitors can explore several themed areas. The VR-application itself was developed in Unity 3D, displayed by an Oculus-based VR-device, and builds upon assets and functionality created in a related project [11] that focuses on diversity sensitization.

A. Interaction and Material Selection

This section covers the interactive material used in the gallery. Besides pictures and floor animations of Catcalls, videos and quiz elements are implemented as well as instructive information boards and artworks related to street harassment and its prevalence and roots in patriarchy. Also, feedback walls and a garden with interactive tree decorations are part of the gallery.

1) Self-assessment test: The self-assessment test is a feature in the gallery, which is intended to provide an individualized experience. On entering the room, visitors are given the chance to take a test that is based on the *Modern Sexism Scale* [13]. This scale measures Old-Fashioned and Modern Sexism and is comprised of 13 statements (e.g. "Women are generally not as smart as men" or "Discrimination against women is no longer a problem") that visitors can rate on a 5-point Likert scale (1 = do not agree at all, 5 = absolutely agree).

Visitors who complete the test are provided feedback on how they score. Based on the total score, participants can be divided into different groups (e.g., 65-50 points: Rather no sexist attitudes, etc.). Test scores are displayed to raise awareness of one's attitude and initiate reflexion.

2) Sensitization Material: In order to generate the Catcalls' content as close as possible to the real Catcalls from regional German Catcalls initiatives on Instagram, like "catcallsofaugsburg" [14] and "catcalls.hamburg" [15], we implemented the chalk drawings in two versions. The first version was modeled after art exhibitions in galleries. As shown in Figure 1, these Catcalls have been attached to the gallery walls with a wooden frame in order to give the visitor a noble feeling, as it is the case in modern museums. Any picture could be displayed here.

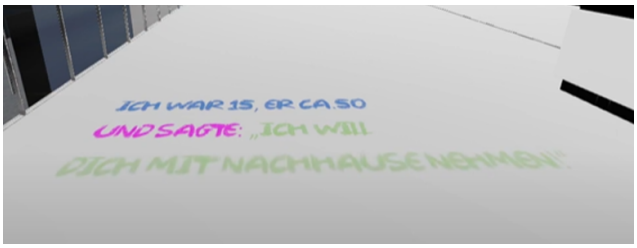

Fig. 2. Animated Catcall on the floor which reads *"I was 15, he was 50. He said that he wanted to take me with him"*.

Fig. 3. Users can leave notes via a whiteboard leaving a trace in the gallery and encountering reactions from other users.

In order to give the stories behind the pictures an even more realistic touch, audio tracks reading out loud the text as soon as the visitors are in front of the specific exhibit. The second implementation is based on the actual chalking on the streets. When exploring the gallery, visitors will repeatedly come across chalk drawings on the floor, which will fade in when the visitor comes closer, as visualized in Figure 2 which says: "I was 15, he was 50. He said that he wanted to take me with him". The Catcalls on the floor should immediately catch the visitor's eye and show vulgar statements or incidents of unwanted sexualized attention women are regularly exposed to. In addition to the Catcalls exhibits on the wall and on the hallway, two videos from YouTube [16] [17] were included. The first video is from the "CatCalls of Mainz Initiative" [18] and explains the beginnings of the movement in Germany. The second video shows a social experiment in which a woman performs typical vulgar harassment against strangers on the street and presents their reactions. Most of the passersby demonstrated that they consider this type of harassment inappropriate and uncomfortable. As an interactive element within the virtual environment, a quiz corner has been implemented, where one of four different buzzers can be pressed to answer the displayed question (e.g. "Which percentage of 811 interviewed women said, that they have already experienced some form of harassment on the street?" [3]). In the survey, 99% of the interviewed women stated that they already have experienced some kind of harassment on the street. Choosing one of the buzzers, one of four predefined answers can be given, namely 99%, 22%, 32% and 68% - the question will be resolved and the different types of harassment on the street are shown in a slide show with pre-recorded female voices, e.g. unwanted sexual contact, whistling, and blocking the way. Additionally, due to the inclusion of pictures and captions from the initiatives from Instagram as works of art, the gallery is offering an aesthetic approach of dealing with Catcalling. To explain the origins and results of patriarchic structures in society, information boards about the patriarchate are included in the gallery, not only as art exhibits but also with the intention to inform. The board provides general information about the social system and raises awareness for the social role of women. With an excursus on patriarchy in public and private spaces, as well as firmly anchored global social systems, the visitor will be made aware of this mostly unconscious problem.

All audio-visual media presented aim to inform, allow perspective taking and raise empathy regarding roots and circumstances of sexual harassment.

3) Visitor Feedback: The gallery intends to raise empathy, provoke thought and stimulate the exchange of views among visitors. Feedback, therefore, is an essential element and feature. Visitors are encouraged to share their thoughts and impressions. For that, we implemented two different feedback collection approaches: a) sticky notes that can be attached to a feedback wall b) a whiteboard that can be drawn on. By using a laser pointer starting from the VR-controller, visitors can interact with the feedback boards.

In the sticky-notes feedback version, which can be seen in Figure 3, visitors can create new notes for their responses and thoughts with the keyboard below the whiteboard. Different colors are available for the notes. To stimulate a vital discussion in the virtual space and learn about previous visitors' reflections, previous feedback notes can be explored and an impression of other visitors' feedback is given. This way, visitors can encounter a variety of views stimulating their critical thinking on the topic.

The second feedback option uses a whiteboard for drawing seen in Figure 4. Visitors can leave sketches and paintings as a creative reaction to the gallery expressing their thoughts and feelings with the VR-controller. In doing so, they can choose between four different colors and a color palette and adjust the thickness of the drawn line. By pressing the button "undo" or "clear" visitors can revert their last changes or start completely new. The feedback left by the users, both on sticky-notes and the drawing board, is then stored and displayed in the feedback garden, described in the following section.

4) Garden of Reflexion: Since not all the feedback can be displayed on the walls inside the gallery, but might be valuable and thought-provoking, user feedback is presented in the treetops in the garden, as illustrated in Figure 5. Paintings, sketches, and sticky-notes provided by earlier visitors are represented as 3D-cubes to show the feedback on a flat surface. By hovering over a cube with the laser pointer of the VR-controller the visitors can pull the 3D-cubes towards themselves. With the possibility of pointing at objects with the laser beam from a distance and pull them towards you, visitors

Fig. 4. The gallery allows creative reactions via the the drawingboard as one of two feedback features.

Fig. 5. In the garden all the visitor feedback is exhibited and can be revisited.

are provided a fun and playful examination of the feedback from previous gallery users.

The garden, which is the end of the gallery, is intended to provide visitors with an exciting interaction with the medium of VR and to provide the opinions and thoughts of previous visitors in order to create even greater awareness on the sexual harassment topic.

B. Museum Room Arrangement

After the material and interaction elements of the gallery have been described in the previous section, this section describes the spatial arrangement of material in the gallery. The VR-gallery consists of three different rooms and a garden. The first room, which can be seen in Figure 6, contains several room dividers to make sure that visitors will see the material in the room in a specific order. The material in the entrance area intends to raise interest and encourage the visitor to start exploring the gallery. When visitors take their first steps in the gallery environment, the previously mentioned Catcall statement is fading in on the ground. After this, the visitor will see the first video at the end of the hallway to evoke curiosity and to inform about the general topic and goal of the gallery. While watching the video, visitors will see two Catcall paintings hanging to the left of the projection of the video. These paintings, combined with the video, should let the visitors immerse themselves in the world of Catcalls and should have a sensitizing effect. Another Catcall on the ground is fading in, when entering the next hallway. At the end of the hallway, a large picture with a story behind the Catcall is shown. The first room contains, apart from two other Catcalls on the floor, the quiz at the end. So far, visitors of the gallery have learned and discovered that the problem of street harassment is ubiquitous and apparently widespread. With the quiz question, they are supposed to deliberate how many women struggle with this problem and estimate percentages.

The second room, which differs in appearance and presentation and is based on modern art exhibitions, is reachable by stairs. The first impression a visitor has of the room is shown in Figure 7. Unlike in the first room, visitors are not directed along specific hallways and are invited to explore the room in random order. On the right side of the room are a few artworks (including caricatures) and the logo of the Catcall movement as pictures. What the respective image is supposed to represent is explained to the visitor with a caption. On the left side of the room are exhibits about patriarchy.

In the middle of the room are again four Catcall paintings displayed, ready for the visitor to explore. At the end of the room, the second video is shown near the exit. After those two rooms full of material to sensitize the visitor, two more areas are implemented to be explored. The first one is the feedback room including the sticky-notes whiteboard and the whiteboard for paintings visually separated by a semitransparent wall. From here, visitors can enter the ”Garden of Reflexion”.

C. Technical Implementations

This section describes the technical implementations of the various materials and mechanics used within the VR-application. The self-assessment test is integrated as a web page and can be natively inserted into the virtual environment by using *Web View Forms* from Vuplex [19]. In order to display the web page in the gallery, a *Canvas Object* has been integrated as a basic component, which serves as a User Interface (UI) element, enabling visitors to interact with the contents of the *Canvas Object*. Using a *Prefab* of Vuplex, which receives the URL to display, the web page can be made visible at runtime. In order for players to interact with the elements of the website, the virtual controllers, which depict the hands, have been equipped with a laser pointer.

To make the experience more immersive audio tracks were used in two distinct ways. The first variant is triggered by the press of virtual buzzers that are distributed throughout the scene. Once a collision between the hand of the avatar and the buzzer mesh is detected, the allocated audio file for the respective buzzer is played. The second variant uses designated zones within the scene, where the audio file is triggered as soon as the visitor is entering the boundary, i.e. in front of an exhibition. The same approach is applied for Catcalls on the ground and for the two embedded videos in the sensitization rooms. Video playback is implemented through the usage of a custom shader updating video frames at runtime. As a means to trigger audio sources, buzzers are also used for the quiz mechanics. Questions presented through embedded videos can be answered by pressing the respective buzzer, resulting in a video that presented the solution. As with the self-assessment test, the feedback options both use *Web View Forms* from Vuplex [19] to integrate the web pages natively into the VR-

environment. The laser pointer of the VR-controller is also used for the interaction. The first feedback option of the Post-it Wall provides the functionality to create post-its and place them on the provided whiteboard. The application uses the JavaScript library *jQuery* to dynamically add post-its, which can manipulate the *HTML DOM* if necessary. A button on the board which can be seen in the upper left corner of the Figure 3 allows new post-its with the *addNewNote()* method to generate. This method receives as parameters the name of a class for the randomly generated color of the paper, the title, and the content. In this method, the information that visitors can specify individually on the notepad is then appended to the *HTML DOM* to make the note visible. This happens with * Tags*. In order to allow users to fill the notes with content, the *addNoteEvent()* method is used, which takes the pre-created note as an argument. When entering the title or content text, the respective elements in the * Tags* will be overwritten and made visible. In order to make the post-its interface more lively, the methods *saveNotes()* and *loadNotes()* have been implemented. Both use *localStorage* for saving and loading the previously generated post-its. The second feedback option, drawing pictures, has also been implemented as a website which can be seen in Figure 4. The *Canvas Web API* [20] uses, which is intended for graphical drawings *JavaScript* and *HTML*, which allows drawing natively with an input device. To this end, a *<Canvas> Tag* was created with a fixed static width of 2220 pixels and a height of 1100 pixels. This setting improves the operability in VR, as the interaction elements such as the buttons or the drawing itself are scaled more comfortably for the display of a VR-glasses. The garden contains the feedback cubes, which visitors can view in detail by pulling the cubes with the laser pointer of the VR-controller, which are provided with the *Distance Grab* functions by the Oculus Integration for Unity Package [21]. An example of these cubes can be seen in Figure 5. By aiming at the cube objects with the virtual controller and press the trigger key the objects will be pulled toward the player. To make the tangible elements more visible, it has been equipped with UI-elements, which serve as an indicator for the grasp of the objects. The cube has a blue indicator, which is activated when the outgoing laser of the VR-controller points to the selected cube. This blue UI-element signals the visitor that the cube can be pulled at the touch of a button. All interaction cubes have a specific area, the garden, where the *Distance Grab* functions are allowed to avoid unwanted interactions such as pulling cubes through walls. If the visitor hold down the trigger key, the cube will fly into the virtual hands. Here the cube can be viewed from all sides. When releasing the trigger button of the VR-controller, the cube flies back to its place in the tree crown. To make this possible, the 3D-cube was connected with a *Sphere Object* to the *Hinge Joint* component. Both the cube and the *Sphere Objects* are equipped with a *Rigidbody Component*, which equip the objects with the conditions of physics, e.g. mass and gravity. In addition, the position of *Sphere Objects* in the virtual world is statically set to keep them from moving. Accordingly, the position of the 3D-cubes is dynamically adjusted, because they must be movable. Also, the *Mesh Renderer* of the *Sphere Objects* is not active to hide them. With these settings, visitors can only see the 3D-cubes inside the gallery and interact with them.

Fig. 6. The first sensitization room with both Catcalls implementations, a video and the quiz.

Fig. 7. The second sensitization room with caricatures, exhibits about patriarchy and the second video.

IV. Evaluation of the Proof-of-Concept Prototype

The gallery was developed considering interdisciplinary views from experts from the fields of Gender Studies, Psychology, Human-Computer Interaction, and Computer Science in design and material selection, in order to ensure a solid concept on the technical and the content level. The gallery prototype was evaluated using an online questionnaire set up in soscisurvey due to contact restrictions cause by the SARS-CoV-2 pandemic, and circulated among members of the equal opportunities office and people with know-how in Psychology and Human-Computer Interaction. The survey asked about prior experience with VR and Catcalling, as well as demographic questions (gender, age, background etc.) and presented a video recording, walking visitors through the gallery. It concluded with a list of statements covering technical and conceptual aspects of the gallery to be rated for (dis)agreement on a Likert scale. Furthermore, participants were given the chance to leave recommendations and comments on strengths and weaknesses in text boxes. Data from 16 participants (3 male, 11 female, 2 diverse) showed that the visual design of the gallery and its general attractiveness, the feedback features and learning opportunities provided in the application, as well as its potential to raise awareness for Catcalling and empathy with victims were seen positively (for details refer to [22]).

While there were a lot of positive comments about the gallery design itself, all the sensitization material and the feedback options, ideas for extensions and changes were also mentioned. Especially the qualitative data provided via the open feedback sections and discussions about further features lead to a redesign of some visual elements such as the low resolution of images, the color choice of the explanatory text for the feedback options was too glaring and the font of the captions of the cartoons was not particularly legible. The participants explicitly wanted a trigger warning, which is now displayed at the beginning of the gallery in the new revision, and an individualized environment to reach and sensitize as many user groups as possible, especially aggressors (self-assessment test).

V. Evaluation of the Revised VR-Gallery Application

A. Measures and Procedure

The online survey was mainly circulated among students in Computer Science programs and staff working in the e-learning team or the university didactics team. Students were addressed via an announcement in the learning platform Moodle and received course credits for their participation. The e-learning and didactics teams were directly contacted via email. After following the link, the landing page would introduce participants to the overall goal of the project, inform them about the procedure and major elements of the questionnaire; the duration was announced to be 15 minutes. Besides age and gender, prior usage of VR was assessed as well as prior experience in the area of teaching, gender studies and/or technical background allowing multiple answers. Familiarity with Catcalling campaigns and prior confrontation with Catcalling (either as an aggressor or as a victim) were assessed.

A 5-minute video with the updated version of the application was presented. After the video, participants indicated their level of agreement for 23 self-constructed statements about different aspects of the gallery (e.g. looks, material, effectiveness, feedback options - partly reused from the earlier evaluation or newly constructed) using a 5-point Likert scale (1 = do not agree at all, 5 = fully agree). Moreover, participants could provide feedback on strength and weaknesses of the application via open text fields and had the chance to note down things they noticed or ideas they had.

B. Sample

After excluding people from the data set who did not watch a substantial part of the video (all participants below 230 seconds on the video page) and a person with implausible age information, 50 participants (11 female, 39 male) of the original 77 remained in the final data set. Age ranged between 18 and 49 (M = 23.56, SD = 2.21). With n = 45, the majority of participants were students from either Human-Computer Interaction, Applied Computer Science or Applied Informatics or Business Informatics, while 2 participants were experts in the field of VR-applications, and 3 participants were experts in the field of gender and diversity. Only 2 participants indicated to know about the Catcalling campaign in Social Media, while the majority indicated to have heard about it the first time (n = 39) in the context of the study or have heard it but not engaged further with it (n = 9). A large number of participants (n = 31) has used VR at least once; while 2 people reported not knowing what VR is.

C. Quantitative Results

Items have been subsumed in groups or remained single items. Means, standard deviations and reliabilities are documented in Table I. To check tendencies, a ttest against the test value of 3 (as the scale mean) showed that the values deviate significantly towards the positive pole, meaning, e.g. participants tend to see the gallery and its features positively.

D. Qualitative Results

Qualitative data collected via open feedback sections were subsumed and divided into thematic categories. The feedback complements the quantitative results and provides even more detailed insights into how participants perceived the gallery.

1) Impact: Participants outlined that the gallery can have an impact because the presentation in virtual reality can be very immersive and you can therefore focus more on the content compared to real physical content.

"The representation in VR may prove to be more effective than the physical design of the gallery, since the step of putting on a VR-headset and then diving into a "other world" can encourage the desire to discover and thus also the willingness to stand apart with the contents."

"I like to use VR technology to draw people's attention to the issue. As a result, the users are not distracted by other influences from the environment and the focus should be almost entirely on the content."

2) Design of the Virtual World: Participants perceived the design and the layout of the rooms appealing and meaningful. The statements suggest that the simple design of the gallery is appropriate to focus more on the content and is close to reality. Furthermore, the multimedia material was considered suitable to create a potentially sensitizing effect.

"The virtual environment is beautiful but simple and does not distract from the actual topic. I like the use of multimedia material such as pictures, videos and texts. The texts and videos used seem to be of appropriate lengths to keep visitors interested. A lot of information is provided."

"I was particularly touched emotionally by the voices of the victims as well as the concrete examples of what happened. This awakened memories and made the situations very lively. The strength lies in the fact that it is possible to put oneself in the position of the victims. This in turn can bring a change of perspective in "offenders". Leaving through the open foyer and the garden is very successful: This makes breathing easier again and I got out of the "movie" well."

3) Requested Features: The participants requested mainly two features for the future. On the one hand they thought that the use of perspective-taking could be significant, so that one can, for example, relive situations of victims or as

TABLE I
QUANTITATIVE RESULTS: SUBSUMED ITEMS AND SINGLE ITEMS

Items [1 = do not agree at all; 5 = fully agree]	***M***	***SD***
Attractiveness and Usage Intention; α = .69	3.75	.97
I think the gallery visually appealing.		
I think the gallery has interesting elements.		
The gallery seems to be very well thought out.		
I would like to visit the gallery with a virtual reality headset.		
I could imagine recommending the gallery to others.		
Impact; α = .85	3.82	.73
Through the gallery I learned new things about Catcalling.		
I think the gallery is a great way to raise awareness of Catcalls.		
I think the gallery is able to promote empathy with the victims of Catcalls.		
Through the thoughts and feedback of other visitors, you gain new perspectives.		
I think the gallery could get people to rethink their attitude towards Catcalling.		
I think the gallery could get people to take action against Catcalling.		
Feedback Feature; α = .72	4.21	.82
I like the opportunity to leave feedback in the gallery.		
I like the opportunity to see/read the feedback of other people.		
If I would visit the gallery, I would leave feedback.		
Self-assessment-Test; α = .77	4.00	1.01
I like the opportunity to test myself in the self-assessment room.		
If I could go to the gallery with a VR-headset, I would take the self-assessment test.		
I think I could learn to navigate the gallery with the controllers.	4.50	.74
I would prefer to leave my feedback as a post-it.	3.56	1.13
I would rather draw something than use the post-its for my feedback.	2.14	1.14
I am afraid I will feel sick using a VR-headset.	2.08	1.24
I think it is reasonable that the gallery can display other content based on the level of sexism.	3.92	.93
I think the Catcalls on the floor are appealing.	3.48	1.07
The gallery provides information about Catcalling with a raised finger.	3.58	.99

the aggressor. On the other hand, a multiplayer extension to explore the gallery together was mentioned.

"The "aggressor's perspective" would also be interesting. What motivates perpetrators to engage in Catcalling?"

"Perhaps a compartment in which the visitor himself will be the "victim" of staged Catcalling would make sense, especially to give people, who have never been in contact with Catcalling, a sense of how victims might feel in such situations."

"There should be an opportunity to visit the gallery with others. In the video shown I had the feeling of being isolated because no one else was there. Especially with the subject of Catcalling and harassment I can imagine that affected people would prefer to go with friends or acquaintances."

4) Additional Feedback: Participants stated that the text in the gallery was too much and sometimes hard to read. Since the gallery for the evaluation was shown via a video, a compromised view of the exhibits may well happen.

"There was a lot of text to read. This is hard for the user, and may result in losing focus."

To sum up, the statements suggest that users do see an impact in the application, and see a special strength in using VR. Furthermore, they liked the design and the general room arrangement of the gallery and found the simple design fitting. Requested features focused on the use of perspective-taking scenarios and a multiplayer to counteract self-isolation in the gallery. The use of too much text and poor legibility were criticized. Consequently, future iterations should consider other media or avoid long texts.

VI. DISCUSSION AND OUTLOOK

This paper presents the detailed concept, engagement opportunities, and interactive material selection of a VR gallery intended to sensitize against street harassment as well as data from a user study mainly consisting of a student sample. There were limitations especially regarding the evaluation, as personal experiments could not be conducted due to the SARS-CoV-2 pandemic. Since the presented application depends on the immersion in a virtual world, an in-depth, self-regulated examination of the gallery can only be carried out with VR-devices. Thus, our results do not allow conclusions about how the gallery affects the visitors inside the gallery and how the perceived benefits of the feedback channels are. However, both presented evaluations allowed us to get feedback from experts and possible users by watching videos about the virtual gallery. As soon as the pandemic situation permits, a regular and formal evaluation of the VR application is envisaged.

The questionnaire data provide useful feedback, but the generalizability of the data obtained needs to be demonstrated with larger samples because it does not represent the total population and the test persons have been mainly students. Both methods of data collection are based on self-evaluation and are therefore not free of biases. They include very personal assessments, but do not measure the actual use or sensitization character of the application. In addition, the study participants were mostly men, on the one hand, future studies should be balanced among the sexes and on the other hand, most of the sexual assaults are also committed by men, so it is a good sign that the gallery itself was well received.

In the next step, controlled studies should investigate the actual sensitization effect of the gallery and the materials themselves. One way to do this would be to use eye-tracking to investigate how long the different sensitization materials was watched to allow an assessment of the actual effect of the gallery. It is also necessary to investigate the effects on the visitors in a pre- and post-test. This is important for the overall usefulness and impact of the gallery on visitors. This comparative basis could also be used to draw a critical assessment of the effect of the VR-gallery compared to conventional training methods in the real world.

So that the potential of the VR as a medium can be fully exploited, expansion ideas, such as perspective-takeover scenarios, are planned. Visitors are supposed to put themselves in the shoes of different people and experience different discriminatory acts. For example, men might experience typical harassment situations of women, which would probably be difficult to mediate without VR. The awareness-raising effect could thus be strengthened because empathy could be stimulated by experiencing different points of view and would be a necessary step towards the exploitation of virtual reality.

All the different areas of the virtual gallery can be expanded and improved. For example, the self-assessment test can cover a wide range of different views on sexism to visit a dynamically individualized gallery according to the reached score in the test. The possibility of showing suitable material to people with different sexist behaviors makes it possible to offer, e.g. aggressors a deviating experience or visitors who have already been victims or have less sexist attitudes a softer, more informative experience. If, for example, a person is classified into a sexist group during the test, the gallery can be generated with more sensitizing content. Victims and their physical and psychological wounds could be shown and explicit reference could be made to the fact that any harassment, even whistling, is harmful to the victims. For gallery visitors who have little or no sexist opinion, the gallery may seem more informative.

The resulting data from the questionnaire can also be processed with artificial intelligence in order to be able to respond more precisely to the preferences and wishes of the visitors, e.g. by different story-driven scenarios. These narratives could then be combined with the data collected from the self-assessment test to generate specific narratives for the visitors. These actions in VR could be supported by non-player characters (NPCs) which can visualize different scenarios in the world (such as public harassment scenarios). All in all, the gallery concept provides a first collection of ideas and materials that will be extended and refined in future iterations to allow an engaging and sensitizing experience.

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REFERENCES

[1] B. Fileborn, *Conceptual understandings and prevalence of sexual harassment and street harassment*, ser. ACSSA resource sheet. Melbourne, Vic.: Australian Institute of Family Studies, 2013.

[2] H. Sullivan, T. Lord, and M. McHugh, "Creeps and casanovas: Experiences, explanations and effects of street harassment," *Victims of sexual assault and abuse: Resources and responses for individuals and families*, vol. 1, pp. 237–258, 2010.

[3] "Stop street harassment - statistics," 2008. [Online]. Available: https://stopstreetharassment.org/resources/statistics/sshstudies/

[4] K. A. Walton and C. L. Pedersen, "Motivations behind catcalling: exploring men's engagement in street harassment behaviour," *Psychology & Sexuality*, pp. 1–15, 2021.

[5] "Catcalls of new york organization," 2016. [Online]. Available: https://www.catcallsofnyc.com/

[6] L. McDonald, "Cat–calls, compliments and coercion," *Pacific Philosophical Quarterly*, 2021.

[7] D. A. Muller, C. R. van Kessel, and S. Janssen, "Through pink and blue glasses," in *Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play*, B. Schouten, P. Markopoulos, Z. Toups, P. Cairns, and T. Bekker, Eds. New York, NY, USA: ACM, 2017, pp. 599–605.

[8] F. Herrera, J. Bailenson, E. Weisz, E. Ogle, and J. Zaki, "Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking," *PloS one*, vol. 13, no. 10, p. e0204494, 2018.

[9] R. R. Janes and R. Sandell, *Museum Activism*. Abingdon, Oxon and New York, NY : Routledge, 2019. — Series: Museum meanings: Routledge, 2019.

[10] C. A. Kubota and R. G. Olstad, "Effects of novelty-reducing preparation on exploratory behavior and cognitive learning in a science museum setting," *Journal of Research in Science Teaching*, vol. 28, no. 3, pp. 225–234, 1991.

[11] V. Dümpel, S. Eimler, G. Brandenberg, C. Straßmann, A. Arntz, D. Kessler, and S. Zielinski, "Comparing the effects of virtual reality vs. tablet-based diversity interventions," in *Poster presented at the 11th Conference of the Media Psychlogy Division, Chemnitz, Germany*, 2019.

[12] "Catcalls of munich organization," 2020. [Online]. Available: https://www.instagram.com/catcallsofmuc/

[13] H. Swim, Aikin and Hunter, "'sexism andracism: Old-fashioned and modern prejudices," *Journal of Personality andSocial Psychology*, vol. 68, pp. 199–214, 1995.

[14] "Catcalls of augsburg organization," 2020. [Online]. Available: https://www.instagram.com/catcallsofaugsburg/

[15] "Catcalls of hamburg organization," 2020. [Online]. Available: https://www.instagram.com/catcalls.hamburg/

[16] "Catcalls of mainz – sexuelle belästigung ankreiden," 2020. [Online]. Available: https://www.youtube.com/watch?v=YsUKLQyRB6A&t=3s

[17] "Catcalling: Rollentausch," 2020. [Online]. Available: https://www.youtube.com/watch?v=LEuleSnaFSE

[18] "Catcalls of mainz organization," 2016. [Online]. Available: https://www.instagram.com/catcallsofmainz/

[19] "3d webview - vuplex." [Online]. Available: https://developer.vuplex.com/webview/overview

[20] "Canvas web api documentation," 2021. [Online]. Available: https://developer.mozilla.org/en-US/docs/Web/API/Canvas_API

[21] "Oculus unity integration." [Online]. Available: https://developer.oculus.com/downloads/package/unity-integration/

[22] A. Helgert, S. C. Eimler, and A. Arntz, "Stop catcalling - a virtual environment educating against street harassment," in *2021 International Conference on Advanced Learning Technologies (ICALT)*. IEEE, 72021, pp. 419–421.