(AB)USE ME: A Mixed Reality Performance Installation Exploring Use of the Body as a Mediating Object

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Abstract. Performance art has long been used as a means for challenging various social constructs, such as ethics and personhood, and sometimes in ways which from the outside can appear traumatic for the performer – perhaps the most famous example being Marina Abramović's *Rhythm 0* (1974). Moreover, the nature of such constructs and our experiences when they are challenged have become arguably more complex with the digital world and the ever increasing amount of our lives spent in virtual environments. In this paper, we present a mixed reality performance installation inspired by *Rhythm 0* in which the subjective experiences of both a human performer, used as an interface for mediating visual and aural outcomes in this space, and the participants interacting with the body of this performer, are gathered through a shared narrative interview following six separate performances. We evaluated the experiences of both the performer and participants through a qualitative analysis centered around the specific words and statements used with respect to performing objecthood from the perspective of the performer and cognitive absorption from the perspective of the participants. Our analysis is supplemented by methods used in information retrieval for assessing the amount of similarity in the respective transcripts of the performer's and participants' interviews.

Keywords: Performance art installation · Mixed reality · Body · Cognitive absorption · Qualitative analysis · Information retrieval

1 Introduction

Performance art works can provide spaces in which boundaries are pushed, social constructs are challenged, and artists are able to explore often deep, inner aspects of themselves and of the individuals who may take part in the performance. Moreover, such experiences can be powerfully positive or negative for all involved. Arguably, the most well-known example of such a performance art work is Marina Abramović's *Rhythm 0* (1974). In her performance, Abramović offered herself up to the audience as an object to be treated in any way they saw fit. On a table

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in front of her she provided a variety of tools, ranging from a feather to a gun and bullet, which participants were free to use on her body. Over the course of a six-hour long performance, Abramović reportedly endured a number of rather shocking behaviors from the participants including having her clothes cut from her body, her skin pierced, and her life threatened by a loaded gun.

Rhythm 0 utilized the notion of the human body as an object to shed light on the limits to human behavior and in doing so, challenge the social constructs of what constitute ethical actions and personhood in society. Over the years, much has been written about the significance of *Rhythm 0* and its findings [1,22]. Interviews with Abramović and others closely associated with her performance have provided further insight into her experience, however, these same insights into the experiences of the participants and how these align or not with those of the performer are lacking. In recent years, the digital world and ever increasing time we spend in virtual environments, such as those found in online gaming platforms and social media, have made these limits and constructs illuminated by *Rhythm 0* perhaps more complex and difficult to navigate. Indeed, in recent research on immersive virtual gaming environments, greater perceived immersion in such spaces has been linked to greater cognitive aggression in individuals [12] and the role of anonymity and the rapid transmission of information, for example, in cyber-bullying on social media, has been explored [18]. Fortunately, this situation has provided new mediums in the form of virtual and mixed-realities as well as opportunities to explore interesting topics and questions for researchers and performance artists alike.

In this paper, we present (AB)USE ME, a mixed reality performance installation inspired by Abramović's *Rhythm 0* wherein the performer's body acts as a mediating instrument or tool through which visual and aural stimuli are produced in response to the physical movements and touch, respectively, by participants. With this work, we are seeking to better understand the subjective experiences of a performer whose body is used as an object and the participants who are asked to physically use this performer's body as an object. In particular, we are interested in exploring this dynamic in the context of a mixed-reality space in which the participant becomes fully absorbed and how this factors into the respective experiences of the performer and participant. In Sect. 2, we discuss related work pertaining to performance art with an emphasis on *Rhythm 0*, mixed reality and its use in performance art practice, and cognitive absorption. In Sect. 3, we introduce the conceptual framework used in the design of (AB)USE ME and reflect on how this framework was used to motivate the design of the interactions and outcomes of the installation. In Sect. 4, we discuss our evaluation of the experiences of both the performer and participants in six separate performances of (AB)USE ME. In particular, we provide a qualitative analysis in which the focus is on the specific words and statements used with respect to performing objecthood from the perspective of the performer and the five dimensions of cognitive absorption from the perspective of the participants. This analysis is further supported through a method frequently employed in information retrieval known as cosine similarity, which we use to assess the

(a) (b)

Fig. 1. Yoko Ono's performance of *Cut Piece* (1964) [17] in (a) and Marina Abramović's performance of *Rhythm 0* (1974) [2] in (b).

degree of similarity in the respective transcripts of the performer and participants' interviews. In Sect. 5, we conclude the paper and discuss some possible future work.

2 Related Work

In this section, we provide an overview of performance art practice as it relates to performing objecthood, use of mixed reality in this practice and how to design for it, as well as information concerning cognitive absorption and its relevance to experiences with digital technologies and virtual environments.

2.1 Performance Art

In the 1960s and 1970s, a new type of performance art known as *endurance art* emerged. Such performances typically involved the performer having to endure some particular experience or otherwise strenuous activity, often lasting for lengthy or unspecified periods of time in a more narrowly defined type of performance known as *durational art*. Crucial to the success of both types of performance is the performer's ability to *perform objecthood* [22] wherein the artist is required to disassociate themselves from any perceived negative experiences throughout the entirety of the performance. Consequently, an important subject emerged within these types of performance art, namely, the objectification of the human body and ethical questions concerning how we act towards others in such a performance space [22, p. 18]. Two prominent examples of performance

art pieces from this time period are Yoko Ono's *Cut Piece* (1964) and Marina Abramović's *Rhythm 0* (1974) shown in Fig. 1.

Both works shown in Fig. 1 invited audience members to interact with the performers over a sustained period of time. In Ono's *Cut Piece*, she would remain seated and the audience was invited to participate in the performance by cutting away pieces of her clothing. A single performance lasted for as long as there were still clothes on her body and was performed several times over the years. Abramović's *Rhythm 0* was performed only once and in this performance, she laid out seventy-two items on a table, ranging from those that could be used in soft and caring ways, such as a feather and cake, to those intended for destruction, such as a gun and bullet. Other items included those not inherently dangerous but could be misused to cause pain, such as a rose, as well as more neutral items such as paint. "I am the object," a note on a table read, "there are 72 objects on the table that one can use on me as desired" [1]. The performance lasted for 6 h, during which she did not respond to any actions taken by any of those audience members that chose to participate.

While both performers invited their audience members to act upon them, there was no plan for how these actions should unfold. As noted in [22, pp. 44–50], the observed outcomes were the result of entirely autonomous decisions on behalf of the audience and the impulses of those individuals that arose from interacting with a "tenaciously passive female body". Importantly, however, both performances resulted in the performers having to endure sometimes shockingly aggressive responses from a number of audience members, with Abramović's life being threatened with the loaded gun [22, pp. 49–50]. Her clothes were also cut from her body, even though she did not invite the audience to do so as explicitly as Ono had done. Further still, the thorns of the rose were reportedly used to pierce her skin and one audience member cut her throat with a razor blade causing her to bleed.

In [22, p. 75], *Rhythm 0* is described as "a cautionary tale about the dangers of objectification". Abramovićs partner gave the following statement in an interview with the performance artist, Linda Montano, describing the experience of performing objecthood:

> So the whole notion of being an object became a very obvious thing in our work, in all of our performances – to make yourself an object. ... If you make a mistake and fall, at that very moment you are an object. ... The moment you fall unwittingly, without a choice, without choosing, in that moment you are left to be an object. ... You see, it's the noninvolvement of self, of consciousness, of decision, of realization [22, p. 69].

The essence of such performances it seems lies in the performer being willing and able to let go of much of what constitutes one's sense of self including awareness, reaction, autonomy, and control. However, the degree to which performers perform objecthood can differ, as Ono in her performance can be seen in Fig. 1(a) choosing to cover herself as clothes are cut away from her body while Abramović can be seen in Fig. 1(b) remaining absolutely still. According to [22], Abramović's choice to perform objecthood in the way that she did was

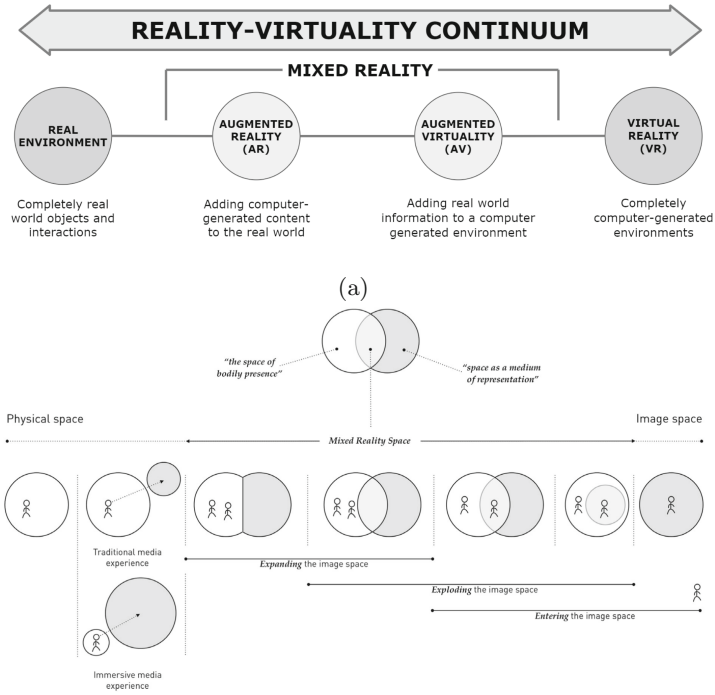


Fig. 2. The Reality-Virtuality Continuum (as described in [13]) shown in (a) and the approaches to mixing realities portrayed along this continuum (as taken from [21, p. 81]) in (b).

a significant contributing factor to the aggressive actions which ensued. Moreover, Abramović hinted at the effect these actions had on the participants at the conclusion of the performance when she stopped performing objecthood and they left without ever speaking to her [22, p. 74]. This was the pivotal moment in which the objecthood of the performer was broken for the participants and they were confronted with the realization that she was indeed a thinking, feeling person.

2.2 Mixed Reality in Performance Art

In recent years, a type of performance art known as *mixed reality performance* has emerged and involves experiences that are intended to "express both their mixing of the real and virtual as well as their combination of live performance and interactivity" [5, p. 1]. Mixed reality in this sense lies along a so-called reality-virtuality continuum, shown in Fig. 2(a), in between two, opposing spatial ends – physicality and virtuality. Mixed reality exists between these two extremes within

the realms of augmented reality, where computer-generated content is added to the physical world (e.g., projecting the current weather onto the field-of-view in a pair of glasses) and augmented virtuality, where real-world information is added to a computer-generated environment (e.g., using a person's actual body rather than an avatar as the player in a virtual game) [6, p. 2].

When designing in particular for installation/media art spaces in which a mixing of realities occurs, we can look at a somewhat more nuanced view of the reality-virtuality continuum shown in Fig. 2(b). According to [21, p. 58], when designing for such a mixed reality space, one must consider the relationship between three main elements: the physical space (indicated by a clear circle), the so-called 'image' or virtual space (indicated by a shaded circle), and the viewer (indicated by one figure within the circles), where the role of the viewer can be one of an 'active user', 'participant' or 'immersant' [21, p. 58]. In a performative space, there would be an additional element of the performer to consider (indicated by a second figure within the circles). One will note in Fig. 2(b), for example, that the first diagram illustrates the space encountered by a viewer experiencing only the physical world such as when walking outdoors, while the final diagram illustrates this same viewer entirely within an image space such as when experiencing virtual reality. As one moves from a physical space to the image space (from left to right), the image space gradually becomes more prominent in the experience of the viewer – first expanding, then exploding, and finally entering [21, p. 75]. For example, the second diagram in Fig. 2(b) at top illustrates the space encountered by a viewer when consuming traditional media such as when watching television, where the viewer is situated within the dominant physical space with a wholly separate image space that is comparatively smaller in size. However, the relative importance of the image space to the experience of the viewer depends not only on how it is mixed with the physical space but how immersive this image space is for that individual. For example, the second diagram Fig. 2(b) at bottom illustrates a highly immersive image space through its relatively larger size when compared to the physical space. Of particular importance to the mixed reality space we present in this paper is the distinction between the fourth and fifth spaces illustrated in Fig. 2(b). In the fourth diagram, when one moves from an image space that is expanding to one that is exploding, the viewer and performer both exist within the physical space but with some prominent mixing of the image space as part of their experience, such as the visual presence of a hologram, However, neither individual is able to affect this projection in any way. In contrast, the fifth diagram illustrates a more exploded image space wherein the performer (or viewer) is situated within a space which is both physical and virtual and where he or she is able to affect the virtual space.

2.3 Cognitive Absorption

Exploring people's interactions with virtual environments and how to make such experiences more enriching is a wide ranging interest shared by researchers in

Table 1. The five dimensions of cognitive absorption (CA) when interacting with software and their explanations as characterized in [3].

	CA dimension	Explanation
1	Temporal dissociation	"...the inability to register the passage of time while engaged in interaction" [3, p. 673]
2	Focused immersion	"...the experience of total engagement where other attentional demands are, in essence, ignored" and "...results in amplification of perceived ease of use" [3, p. 673]
3	Heightened enjoyment	How pleasurable an experience is "contributes to perceived ease of use in that enjoyable activities are viewed as being less taxing" [3, p. 673]
4	Sense of control	A sense of being in charge and exercising control over interactions with software should reduce the perceived difficulty of interaction [3, p. 673]
5	Amplified curiosity	The extent to which an experience arouses "sensory and cognitive curiosity" and the interaction "invokes excitement about available possibilities" [3, pp. 666–673]

HCI and digital artists alike. Such endeavours necessarily require an understanding of human psychology and behavior with many terms such as immersion, cognitive flow, and enjoyment, among others, serving as relevant objects of study [3,10,15]. A multidimensional construct known as cognitive absorption (CA) is one such term encompassing many of these others that we have elected to focus on in the design and evaluation of our installation.

Cognitive absorption has been defined as "a state of deep involvement with a software" and is based largely on previous research in engagement and flow [3, p. 1]. As characterized in [3], cognitive absorption consists of the five dimensions shown in Table 1 of temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. When designing for digital technologies and interactive spaces in performance art, it is clear how artists might be concerned with many of these dimensions of cognitive absorption – from cultivating a sense of heightened enjoyment and curiosity for their participants to establishing a highly immersive setting wherein the interactions afforded by this space offer high degrees of control. As [14] notes, immersion in a skillfully designed participatory and performative digital space should encourage participants to explore the possibilities of this environment and bring joy along the way. However, highly immersive digital spaces, for example, are not without their drawbacks. As noted by [12,19], high levels of immersion and presence in such virtual environments can lead to aggressive feelings and behaviors. In particular, both perceived realism and perceived controller naturalness have been shown to have a positive effect on perceived immersion which in turn has a positive affect on cognitive aggression [12, pp. 74–75]. Designing spaces so as to avoid possibly negative outcomes from participants such as aggression may not necessarily be a great concern, however, it might be something of interest for artists to explore this

boundary and balance between such immersive experiences, the participants' interactions within such a space, and the outcomes they produce.

Measuring whether or not a person is cognitively absorbed in a particular technology can be challenging due the subjective nature of such an experience and the complexity in obtaining accurate assessments of mental states [10]. However, several methods for measuring cognitive absorption as well as its related constructs of immersion, presence, and flow have been suggested, with questionnaires largely being preferred [3,10,15]. In contrast, interviews can serve as an important resource for collecting rich, qualitative data regarding not only how much a person claims to have experienced, for example, temporal dissociation or an amplified sense of curiosity, but also what words and expressions they use to describe the subjective nature of that experience. It is this latter approach that we have chosen to adopt in this paper.

3 Design of (AB)USE ME: A Mixed Reality Performance Installation

In this section, we introduce the conceptual framework for our mixed reality performance installation, (AB)USE ME, by describing our considerations when designing its physical and digital spaces. Next, we discuss our motivations for the interactions and visual and aural outcomes within this space. We conclude with an overview of its implementation details.

3.1 Conceptual Framework

(AB)USE ME is a mixed reality performance installation situated within the fifth diagram of mixing realities shown in Fig. 2(b) along the reality-virtuality continuum – containing both physical elements, in the form of a human performer, and virtual elements, in the form of a digital avatar in the likeness of the performer projected onto a screen facing the performer and participant. A participant's interactions in this mixed reality space occur through physical manipulation of the performer's body, which acts as an interface with the digital avatar, where her movements and the felt intensity of the participant's touch are presented to the participant in the form of visual and auditory feedback, respectively. The overall conceptual framework of (AB)USE ME is illustrated in Fig. 3.

As shown in Fig. 3, (AB)USE ME was designed with considerations for both the physical and digital spaces which comprise the mixed reality space of the installation. The digital space (shown on the left side) was designed with conditions supporting cognitive absorption with a particular emphasis placed on the dimension of focused immersion (shown in Table 1). These conditions were a perceived realism to the avatar and a perceived naturalness to its movements with those of the performer's body. With these conditions in mind, we might consider whether or not participants will become sufficiently immersed within this space that they ignore the nature of the interactions they are having – that is, lose sight of the awareness of and consideration for the fact they are using a

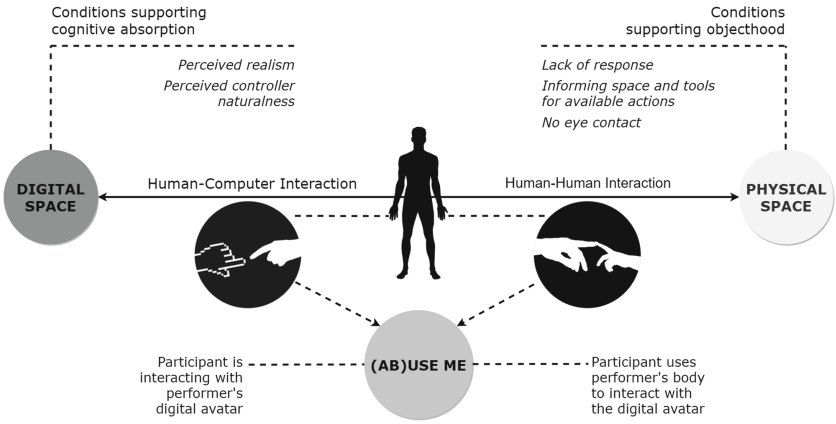


Fig. 3. Conceptual framework of the proposed mixed reality performance installation, (AB)USE ME.

living, feeling person and not merely an object. The physical space (shown on the right side), was designed with conditions inspired by those found in *Rhythm 0* that we suspect will support the ability of the performer to perform objecthood and the recognition of the performer as an object by the participants. These conditions were a complete lack response from the performer to the actions of the participants and an 'informing space' which consisted of (1) a statement, spoken aloud at the start of each performance of (AB)USE ME, clarifying that the performer is free to be interacted with, and (2) interactions of touch and movement, similar to the tools provided in *Rhythm 0*, for informing the participant of possible actions within this space. Additionally, we have designed the possible interactions with the performer to be carried out while the participant is standing directly behind the performer and behind a line on the floor that they should not cross. This ensured that both the performer and participant would remain facing the projection and that no eye contact was not possible with the performer.

3.2 Interactions and Outcomes

An important feature of the mixed reality space in (AB)USE ME is the feedback participants receive from their interactions of movement and touch with the performer's body in the form of visual and auditory stimuli, respectively. This visual stimuli consist of (1) an avatar in the likeness of the performer designed to be both realistic and exhibit movements which align naturally with those of the performer's body, and (2) a set of three different effects projected onto the avatar corresponding to three intensity levels of physical movement and touch. Figure 4 shows the six stages in designing the avatar in (a) and the final avatar with the set of three visual effects projected onto it in (b).

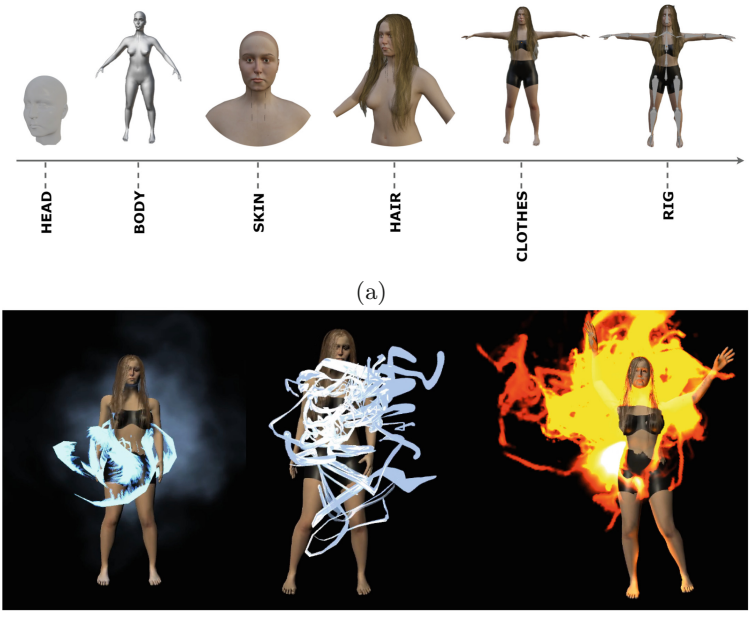
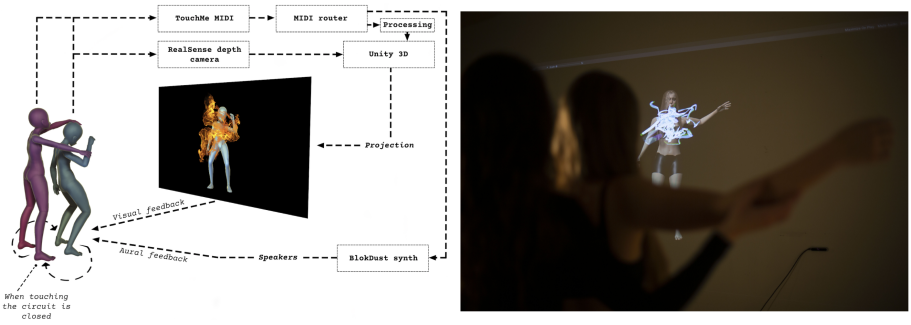


Fig. 4. The digital visual components of (AB)USE ME with the design stages of the performer's avatar in (a) and the visual outcomes corresponding to light, medium, and rough interactions with the performer's body shown projected onto the avatar (from left to right) in (b).

As shown in Fig. 4(a), the avatar situated in the virtual space was designed in six, detailed stages so as to capture as many of the characteristics of the performer as possible and in doing so, enhance the overall realism needed to facilitate immersion (as discussed in Sect. 2.3). These characteristics include accurate head and facial dimensions, approximate body proportions, realistic skin tone and texture, accurate hair length and color, clothes which match those worn by the performer, and a skeletal rig which allowed for movements mirroring those of the performer's body in line with the controller naturalness needed to further facilitate immersion (as discussed in Sect. 2.3).

As shown in Fig. 4(b), interactions with the body of the performer are illustrated visually on the avatar in one of three ways, depending on the degree of physicality. Light physical interactions with the body of the performer, such as gently caressing her arm, correspond to light, gently moving 'feathers'. Slightly more intense physical touches, such as those needed to re-position a part of her body, correspond to more harsh, faster moving lines while extremely physical touches, such as those needed to move her entire body or cause pain, correspond to fire. Such visuals were inspired by the array of pleasurable and dangerous objects Abramović provided in *Rhythm 0* and are in line with a so-called expressive strategy of designing for interaction noted in [5] where illustrating or even



(a) (b)

Fig. 5. Conceptual overview of the mixed-reality installation space and systems used in (AB)USE ME in (a) and an image from an actual performance showing a participant standing behind the performer in (b).

amplifying the visual effect of these physical movements is one of four suggested design strategies. In addition to these visual effects, there is further feedback in the form of sound (discussed in Sect. 3.3) corresponding to the intensity of physical touch with the skin of the performer that changes in a similar fashion to the visuals – becoming more intense as the intensity of touch similarly increases.

3.3 Implementation Overview

The conceptual overview of the mixed-reality installation space and systems used in (AB)USE ME as well as an image from an actual performance are shown in Fig. 5. The 3D modelling of the avatar was created using Blender [7] and an add-on called Facebuilder [9]. We modelled the performer's head using 6 photographs taken to form a 360 degree view. A 3D model of a body was obtained from MakeHuman [11] upon which we attached the model of our performer's head. The skin of our avatar was created by importing the model's UV map from Blender to Adobe Photoshop and applying skin texture maps from MakeHuman. The avatar's hair was created with bent planes designed to resemble hair strands through the texturing node system in Blender and an additional add-on called HairTool. The clothes were created by selecting parts of the body mesh that we wanted covered and applying black material on a new, duplicated mesh at this position. The hair, clothes, and body meshes were then linked so that when the performer moved her body, the avatar's body, clothes, and hair followed suit. Lastly, rigging bones were applied to the avatar's model in Blender using armature with an automatic weights function. In order to animate the avatar, we used the Nuitrack [16] plugin for Unity which allows for skeleton tracking of up to 19 joints through a depth camera. The completed avatar was projected onto a wall approximately 2 m from the performer and participant at approximately 60% the scale of the performer's body. Visuals were produced with Unity's Mesh Effects. A TouchMe MIDI controller [23], which operates through

skin conductance, is used to produce the pitch content of the sounds produced by physical contact between the participant and performer. These MIDI values are processed and received in Processing [20] and the sounds were generated through an online synth called BlokDust [8]. Three different soundscapes, corresponding to the three visual outcomes shown in Fig. 4(b), were designed so as to aurally align with intensities portrayed by their respective visual outcomes.

4 Evaluation

In this section, we explain how the procedure for performances of (AB)USE ME and the shared narrative interviews with the performer and participants which followed were carried out. We conclude with the results and discussion of our qualitative analysis of the interviews supplemented with methods from information retrieval for assessing the degree of similarity found in transcripts of these interviews. During these discussions, we compare the experiences of the performer and participants across performances as well as within individual performances with a particular emphasis on the words and statements expressed by the performer with respect to performing objecthood and by the participants with respect to the five dimensions of cognitive absorption.

4.1 Participants and Performer

We collected data from 6 volunteer participants (4 male and 2 female) with an average age of 28.2 ± 5.9 years. Five of the participants stated having extensive experience with interactive art while the remaining participant claimed to have only little experience with the same. Furthermore, four of the participants stated having extensive experience with performance and participatory art involving touch with the remaining two participants claiming little to no such experience. The performer was a female artist and co-creator of the (AB)USE ME performance installation with academic training in and several years of experience with interactive, participatory, and performance art. All participants were informed of the interactions that would be afforded to them as well as how their data would be used. Consent was obtained in accordance with the participating university's ethical guidelines for conducting experiments with human participants.

4.2 Procedure

Participants were asked to enter an empty room where the performer was standing motionless and facing away from the participant towards the wall where a projection of the performer's avatar was facing her and the participant. The experimenter then asked the participant to stand behind the performer as a conductive bracelet (already attached to the performer) for use with the TouchMe MIDI controller was fastened to the participant's ankle. The experimenter then stated aloud "The performer is an instrument. There are no boundaries, no right and wrong. The only boundary is the line marked on the floor which you cannot

cross. Please feel free to explore. You can start now". With this statement, we not only wanted to pay homage to *Rhythm 0*, but we wanted the participants to understand also that the performer has given consent. As instructed, the participants were then free to begin interacting with the performer. No time limit for the performances was enforced, but participants ended their time spent with the performer after an average of 8 ± 6.1 min. After the conclusion of each performance, participants were given a five-minute break in order to facilitate reflections on their experience. Following this break, participants were asked to take part in a shared narrative interview with the performer in which an open ended question asking the interviewees to describe their experience was first posed. We believed that a shared interview of this type would allow for deeper reflections on one person's experiences by allowing for the exchange of thoughts and feeling from the other, similar to a focus group setting. More narrowly focused questions addressed to the participants pertaining to the five dimensions of cognitive absorption – such as the movements of the performer's body and those of the avatar, the alignment of the sound and visual feedback, and feelings regarding use of the performer's body as an object – comprised the semi-structured narrative follow-up. Questions pertaining to feelings of objecthood and mistreatment as well as any confrontational moments with the participants, were asked of the performer. Finally, more structured questions served to collect personal data (e.g., age and related experience) from the participants and concluded the entirety of their time with (AB)USE ME.

4.3 Results and Discussion

As a first step in our analysis, we constructed a text corpus of 12 documents corresponding to the 12 transcripts of the six shared narrative interviews conducted with the performer and participants following six performances of (AB)USE ME. Each document in this corpus contained text belonging to only the performer or participant for a given performance and was preprocessed to eliminate punctuation, make all characters lower case, remove common English stop words (e.g., 'the') as well as stem the entirety of the text (e.g., converting 'interesting' and 'interested' to their common root form of 'interest'). We will assume in our following analyses that words with similar roots express similar meanings and that use of these words (and not others) by both the performer and participant indicates at least some degree of commonality between their respective experiences. Naturally, reducing rich qualitative data to such a format will invariably lose the context and ignore semantic meaning, so further qualitative analysis is also provided.

Figure 6 shows word clouds generated from our text corpus for the performer and participants illustrating the 200 most frequent words expressed across all six performances of (AB)USE ME. Words that were expressed most frequently by the performer and participants appear towards the center of their respective word clouds and with a large font while words that were expressed less frequently appear at the edges of these clouds and with a smaller font. Additionally, words that were expressed with equal frequency are shown in the same color. One will

(a) Performer. (b) Participants.

Fig. 6. Word clouds illustrating the 200 most frequent words expressed by the performer in (a) and the participants in (b) when reflecting on their respective experiences during a shared narrative interview following six performances of (AB)USE ME.

note when comparing the respective word clouds that the performer's experience is more varied, containing a greater variety of more frequently occurring words, when compared to the participants' experiences, which contain a comparatively less variety of more frequently occurring words. Some of these more frequently occurring words from the performer include (in descending order of frequency), for example, 'pain' and 'careful', 'strong' and 'uncomfortable', and 'object' and 'body'. Some of these same words from the participants include 'body' and 'move', 'sound' and 'different', and 'hand' and 'visual'. It is noticeable that words framed in the negative (e.g., 'pain' and 'uncomfortable') are used more frequently by the performer. However, both the performer and participants note the importance of the body in their experience. Perhaps not surprisingly, the participants noted the importance to their experience of the various stimuli produced by their interactions e.g., 'sound', 'visual', and 'fire'. Interestingly, the most frequently used words by both the performer and participants correspond to physical contact, however, they differ in that the performer elected to largely use the word, 'put', while the participants mostly used the word, 'touch'. This finding highlights the importance of the role physical contact played in helping to shape their respective experiences, however, the difference in how it was described suggests possibly that the nature of the participants' actions were perceived by the performer quite differently from how the participants perceived their own actions towards the performer.

These aforementioned differences between the experiences expressed by the performer and participants within each of the six performances can be explored quantitatively using a similarity measure known as *cosine similarity*. Cosine similarity is commonly employed in information retrieval to assess the extent to

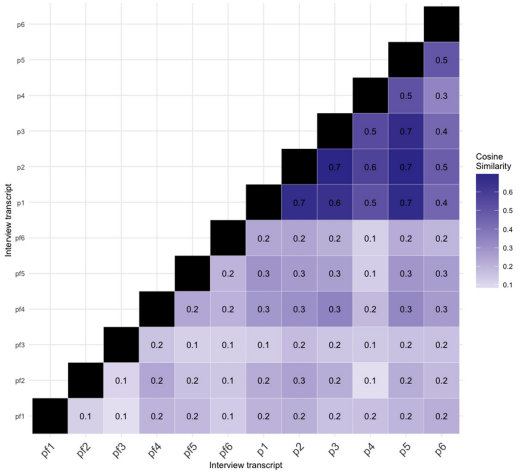


Fig. 7. Pairwise cosine similarities, c_s, for the transcripts of the shared narrative interviews conducted with the performer and participants following six performances of (AB)USE ME. Note that 'pf' denotes the performer and 'p' denotes a particular participant for a given performance number.

which two given text documents match in terms of word-for-word content [4]. Figure 7 shows the pairwise cosine similarities, c_s, between our corpus of 12 transcripts of the shared narrative interviews conducted with the performer and participants following six performances of (AB)USE ME.

As shown in Fig. 7, there is naturally a perfect similarity along the main, positive diagonal between the same documents (e.g., 'pf1' and 'pf1'). One will note, however, that there is a considerable amount of similarity between the individual documents of the participants (as indicated by darker shades of purple at the top right, $c_s = [0.3, 0.7]$) and much less similarity between the individual documents of the performer (as indicated with lighter purple at the lower left, $c_s = [0.1, 0.2]$). This observation is perhaps not so unexpected as the performer experienced interactions with six different participants while the participants experienced the same installation with the same performer acting in the same manner. Nonetheless, it does highlight that despite the apparent large number of common words participants used to describe their respective experiences, their interactions with the performer were perceived by her as being different. Within the participants' documents we can further see that participants 4 and 6 had the least similarity ($c_s = 0.3$) while several documents had the most similarity ($c_s = 0.7$). When looking at the text in their respective documents, participant 4 emphasized the visual and aural feedback as being important to his experience and participant 6 largely noted the importance of physical contact to his own.

To the extent that similarity between documents measured by cosine similarity indicates some shared or common experience, we can look at the documents of the performer and participant within a single performance (e.g., 'pf1' and 'p1').

Table 2. Select coded statements of performing objecthood from the performer during a shared narrative interview with participants following six performances of (AB)USE ME.

Perf. Obj.	Perf.	Performer experience
Objecthood	1	"It was not hard to get into the'object mode'. Although, the technical talk moments from him were encouraging my thoughts, but later on he calmed down and investigated more through physical manipulation, which brought me back into this 'object mode' once again."
	2	"I noticed the more I was asked to be the object and the more I was asked to do whatever the participant wanted to do, the less of me as a person there was."
	3	"I tried to remain as objectified as I could. Mentally it was a little hard to let go of me."
	4	"There was so much of careful consideration, I never really got fully to that state [objecthood]."
	5	"He really showed his dominance over me and full control. I absolutely lost myself in all possible ways...he made me bend on my knees and he put me in a very painful position."
	6	"I felt the need to give him a 'hint' at one point that there is a movement correlation. This moment was the biggest breaking in the objecthood I employed. For that moment I was not performing."
Perceived confrontation	1	"When I turned around and just looked at him, he had an intense reaction as if 'What? What have I done?'. He seemed a bit more uncomfortable all of a sudden."
	2	–
	3	"The participant was confident. That confidence stayed even when after interaction I looked at her."
	4	"Maybe he seemed a little uncomfortable, but that's about it."
	5	"I turned around and looked at him. At first, he said 'Hi', but then right after he asked agitated 'What? Why are you looking at me like this?"'
	6	–
Perceived mistreatment	1	"He squeezed my wrists so strong I felt the blood circulation was cut off in my hands."
	2	"I felt like a toy bunny thrown around, but it seemed more unintentional and child-like...innocent and accidental mistreatment."
	3	–
	4	–
	5	"Not much mistreated by physical force, but rather by lack of consideration. I, as a person, was not in his focus."
	6	–

Table 3. Select coded statements of cognitive absorption from participants during a shared narrative interview with the performer following six performances of (AB)USE ME.

CA Dim.	Perf.	Participant experience
Temporal dissociation	1	"I wasn't thinking about it [time] at all."
	2	"I wasn't thinking about time at all."
	3	–
	4	–
	5	"I wasn't really thinking about it [time] that much."
	6	–
Focused immersion	1	"I was focusing on, like, trigger the fire! trigger the fire!"
	2	–
	3	"Of course it's engaging [outcomes of interactions] and ... I think when you feel a bit like you have triggered what can be triggered then you're, like, 'I think I'm done'."
	4	–
	5	"It [touch] brings a very personal aspect to it. So I feel very present in it in that way."
	6	"Until the moment I stopped, I was not thinking so much."
Heightened enjoyment	1	"You get a new toy and then all of the sudden, you know you enjoyed the time. I'm sorry, you were the toy in this case."
	2	"It was interesting to see what outcomes came out from using you, but I didn't want to make it uncomfortable for you. So I felt I was put in a situation that was uncomfortable in a way. And that's also why it got exciting."
	3	"So I thought the visuals were cool."
	4	"I think it was interesting... I didn't feel that comfortable."
	5	"But I think actually the sounds were kind of more attracting to play with. Because probably in a way that felt more in control."
	6	"It was this spiritual healing process. That got me very fast and I enjoyed being there."
Sense of control	1	"When I moved up, it moved up. It was responsive in a way, it was fluent. But it wasn't...You saw it, it wasn't handling the positions very well sometimes."
	2	"I could definitely hear that when touching you in certain ways different stuff happened."
	3	"I felt a little limited in the way that I could interact with her because of the line that I was told not to cross ... Most of the time I could feel like I am in control."
	4	"The immediate feedback that I could see so that the model would move exactly like how I moved your arms and that I could hear sound instantly when I touched you."
	5	"It [avatar movements] seemed quite well tuned. Like, fine tuned...fast reacting."
	6	–
Amplified curiosity	1	"I was primarily curious to find out how you managed to make that work [responsive sound and visuals], I wanted to trigger different ones."
	2	"I also felt that when shaking you ... I was a bit curious also to see what would happen if I just slapped you, but I didn't do it because I don't want to hurt you."
	3	"It made me curious immediately, the set up, it's interesting."
	4	"There was this explorative aspect and I liked that you didn't really tell me what to do. I feel like I was exploring as much as I could."
	5	"It made me curious, like, 'what can I do?' To also see what is the relationship between your body and projection of what I interpret is your body. So then I started exploring that."
	6	"I was also testing if the strength [touch] had to do with the visuals and the sound. I see [it] more as a challenge. And making me explore this body in another way."

One will note that these documents (along a positive diagonal in the lower right quadrant) have a rather low similarity ($c_s = [0.2, 0.3]$) with performances 2 and 5 showing the highest degree of similarity between the documents of the performer and participant. In performance 2, the participant expressed of her experience that she was "careful of not ... making anything too uncomfortable", however, the performer perceived this participants' interactions differently, noting that she was "less careful than other people. ... She seemed very energetic and was challenging me in my postures and my movement". It is not immediately clear how we might interpret the similarity (or not) between a performer's experience with one participant and the experience of a different participant (e.g., 'pf4' and 'p1'), however, it might indicate some general themes common to the experience in general, irrespective of which participant took part.

In our qualitative analysis, we elected to apply a top-down approach in which the five dimensions of cognitive absorption (i.e., temporal disassociation, focused immersion, heightened enjoyment, sense of control, and amplified curiosity) served as the selective codes to which we coded the responses from the participants. We applied the same approach to the performer's responses using objecthood, perceived confrontation, and perceived mistreatment as the selective codes for performing objecthood. It was less important in this analysis the degree to which these categories factored into the experiences (as would have been measured using e.g., a rating scale) and more that we were able to capture the variety of words and statements used to communicate the subjective feelings related to these categories. Tables 2 and 3 show select coded statements expressed by the performer and participants, respectively, when reflecting on their experiences during a shared narrative interview following six performances of (AB)USE ME.

As shown in Table 2, it is clear that the performer had much to comment on with respect to her experiences with objecthood and somewhat less with how she perceived the actions of participants. If we look to the coded statements with respect to objecthood, her experiences varied with some interactions from participants greatly helping her to remain focused on her performance while others causing her to lose this focus. As the performer noted of the participant in performance 5, "He really showed his dominance over me and full control. I absolutely lost myself in all possible ways ... he made me bend on my knees and he put me in a very painful position" while of the participant in performance 6 the performer noted that she "felt the need to give him a 'hint' at one point that there is a movement correlation" and that "this was the biggest breaking in the objecthood I employed. For that moment I was not performing". Looking further to the coded statements pertaining to perceived confrontation, we can see that for a majority of the participants, the performer felt that there was indeed a moment of confrontation following the conclusion of the performance not unlike that noted by Abramović, with perceived discomfort and agitation from the participants being most common. For example, the participant in performance 1 asked in a surprised way "What? What have I done?" as if he had acted improperly after the performer looked at him while the participant in performance 5

asked in a more negative way "What? Why are you looking at me like that?". For the coded statements of perceived mistreatment we find that the performer felt her experience in this regard significant enough to comment on only half of the participants with some rather harshly perceived mistreatment from the participant in performance 1 and more innocently perceived mistreatment from the participants in performances 2 and 5.

One will note in Table 3 that the statements made by participants when reflecting on their experiences much more closely aligned with the dimensions of cognitive absorption concerning heightened enjoyment, sense of control, and amplified curiosity rather than to what could be coded as pertaining to temporal dissociation and focused immersion. With respect to heightened enjoyment, the participants' experiences varied from feeling as if they were playing with a new toy (performance 1) to being fixated on the visual and aural outcomes of their interactions (performance 5). Interestingly, two participants expressed both interest and discomfort in their respective experiences (performances 2 and 4), with one stating that this interest was actually due in part to this discomfort (performance 2). If we look to the statements pertaining to a sense of control, most of the participants felt that they had some control over the visual and aural outcomes and that the movements of the avatar in response to their movements of the performer's body were largely responsive and natural. However, the participant in performance 1 noted some issues involving the tracking of positions of the performer's body and the movements of the avatar, and the participant in performance 3 expressed a limited sense of control due to the line that she was told not to cross when interacting with the performer. With respect to amplified curiosity, a number of participants explicitly mentioned curiosity when describing their experience (performances 1, 2, 3, and 5) while the remaining participants mentioned exploratory aspects as being important (performances 4 and 6). The participants' curiosity was with respect to how the system worked (performances 1 and 3) and what the outcomes of their actions towards the performer's body would be (performances 2 and 5) with one participant going so far as to express being curious as to what would be the effect of her slapping the performer (performances 2). The exploratory aspects that participants found important involved having to figure out what could be done with the performer's body with out being told e.g., the participant in performance 4 expressed that "I liked that you didn't really tell me what to do. I feel like I was exploring as much as I could".

5 Conclusion and Future Work

In this paper, we presented a mixed-reality performance installation inspired by Abramović's *Rhythm 0* as a basis for exploring the subjective experiences of the performer and the participants in this space, where the performer acts as a mediating object through which visuals and sound are manipulated by physical interactions the participant has with this performer's body. Through a top-down qualitative analysis in conjunction with methods from information retrieval for measuring document similarity, we provided some interesting insight

into these experiences with respect to the specific words and statements used regarding cognitive absorption and performing objecthood which appear to align some with Abramović's experience. The performer noted, for example, having strong feelings of being treated as an object, and with several participants, she reported confrontations when the performances ended. However, this experience did not appear congruent with how many of the participants reflected on their actions towards her – a perceptual discrepancy possibly driven by the heightened enjoyment received from their curiosity and desire to explore how the performer's body affected the space. In future work, it would be interesting to pursue a more ecologically valid approach in which an audience is present to see if the behaviors of participants or their experiences remain unchanged, consider an entirely virtual recreation, or look further into the dimensions of cognitive absorption which proved difficult to assess through our chosen qualitative method. We hope our work serves as an interesting point of departure for performance artists and researchers alike wishing to explore mixed reality spaces in artistic practice and the nature of experiences with performing objecthood in such a space.

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