Tobias Bieseke

Ndinguwe
Dealing with unfamiliar experiences in virtual worlds

Intention

The "Ndinguwe" research project of the FH-Dortmund University of Applied Sciences and Arts investigates the interaction between perception and narration in virtual space based on head-mounted displays (HMDs). The central research question thus emerges as follows: How do the participants integrate experiences with unfamiliar forms of perception into their personal space of experience? The focus is on three main points: first, the self-representation of the participants as avatars in virtual space; second, analyzing the relationship between virtual objects and their influence on perception through haptic feedback; and third, the interface between the virtual environment and the real world in so-called mixed realities (MR). In order to implement the investigation of the research subject in the context of artistic research, a research group[1] was assembled to develop an experimental setting that would generate multiple perceptual states that were unfamiliar to the recipients. The unknown that is at issue here finds its first expression in the word Ndinguwe, which means "I am you" in the Xhosa[2] language.

In the experiment, perceptual situations are created that for many participants do not correspond to their familiar world of experience and accordingly represent a first contact with unknown forms of

1 The research group comprises Harald Opel (artistic director of storyLab kiU), Tobias Bieseke (project management), Jan Schulten (programming), and Azziza El-Yabadri (art direction).

2 Xhosa is one of the official languages in South Africa, in which former President Nelson Mandela coined the philosophical term Ubuntu, which means "I am because we are." Ndinguwe with its meaning "I am you" is a schematic reduction and further development of this conception of existence. Project trailer: https://vimeo.com/915943769

perception. Such initial contacts are of particular importance because the experience is consciously perceived and thus receives a well-founded categorization. The spectrum of unknown perceptions can even affect perceptions to the extent that forms of haptic hallucinations can occur, or it can take away subjects' control over proprioception.[3] The experiment transports the self-perception to the virtual avatars, which are equipped with characteristics that are considered discriminating factors (age, gender, body composition and ethnicity). The simulated first-person perspective of these existences is experienced by the participants and reflected upon with the research team. Furthermore, there are encounters with haptic objects such as a ball or a chair, which are interactive parts of the experiment. The application does not use any visible control elements, but the interaction happens through the body actions of the participants, which are familiar to them from their lifeworld. These experiments lead to actions of unfamiliar perceptions in interaction (e.g. unfamiliar self-image, interaction with invisible persons, etc.). This is discussed in relation to various events, such as interacting with a ball or facing a virtual self-representation. These states of reality are analyzed and contextualized using the schemas of postphenomenology to elaborate the relation between human perception and technology.

Human-technology relationships

In his approach to postphenomenology, the philosopher of technology Don Ihde structures the relations between humans and technical artifacts into different *human-technology-world relations*.[4] Regarding the experiment, the scheme of *alterity relation*[5] is essential, in which the technique – following Ihde – becomes the *quasi-other*. Ihde critically remarks on this anthropomorphism that technology is extrapolated to what technology as a medium cannot achieve, namely, to be an optimized human being. Experiences with these technologies will not be experiences with artificial, more efficient humans, but experiences with the *quasi-other*. However, to appreciate how such technologies change human experience, there must be a recognizable differentiation

3 Self-awareness of body position or limbs in space.
4 Don Ihde, Technology and the lifeworld: from garden to earth, The Indiana series in the philosophy of technology (Bloomington: Indiana University Press, 1990), 72.
5 In addition to the *alterity relation*, Ihde further differentiates in the schemes *embodiment, hermeneutic or backround relation* to describe different human-technology relations.

of the relations between subject, technology, and world, Ihde[6] argues. For the *alteration relation*, he developed the following formal notation of the technologically mediated world relation:

Human —► technology-(-world).

This schema means that humans relate to (—►) technology, which either represents its own technical world (technology-) or is related to the real world (-world). This also applies to Ndinguwe, in which the participants partially or completely lose their visual relationship with the world by means of technology and are confronted with an optical, technical representation of the world. The subject is immersed and enters a computer-generated environment into which their self-representation is depicted as a human imitation (*the quasi-other*). Besides the named scheme, Ihde distinguishes between micro- and macroperception.[7] While microperception refers to the sensory perceptions of the subjects, macroperception refers to the culturally and hermeneutically mediated perception, which is thus always characterized by interpretive and design performances. For the evaluation of the experiment, it is exactly these microperceptual classifications that are of interest, which is why the method of microphenomenology was used for the evaluation. There are approximately 70 evaluations, of which, only the six doctoral students of experimental computer science at the Academy of Media Arts (KHM), including Georg Trogemann, will be focused on in this text. The experiment was created within the framework of this doctoral program and allows a precise observation in relation to the genesis of this project.

Experiment setup

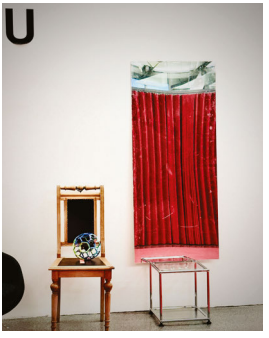
The transportable setup must be able to create a physical self-representation, track objects, and depict the real environment via cameras. Initially, the experiment is a virtual reality (VR) experience, which can be experienced via an Oculus Quest Pro HMD and within an exclusively prepared environment. The experiment was preceded by a six-month development process that explored a wide variety of technical methods towards implementing virtual self-representation,

6 Ihde, Technology and the lifeworld, 229.
7 Ibid. 29.

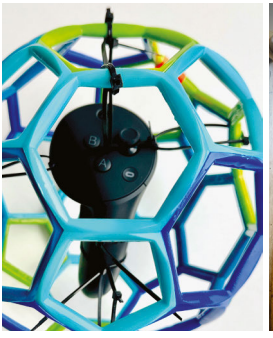
MR, and haptic feedback. In this method, the given technical possibilities of the HMD were modified for the experiment, such as controllers as tracking sensors or the use of the HMD integrated cameras (passthrough) for mixed reality parts in the experiment. Since the mobility of the project is essential for the evaluation and the experiment, we did not use a spatial constraint and used only mobile objects (mirror, prepared ball, and chair). These objects are tracked for the connection between the haptic object and its virtual representation and are given a position in real space.

During the experiment, the participants are sent on a linear narrative journey with various interactive passages. A chronological script was prepared, which corresponds to the format of a classic cinematic screenplay.[8] This script is an interactive construct with an experience path that follows the patterns of classic narratives.

The participants are understood here as "context-creating living beings"[9] who independently create a coherent experience in interaction with the system. Actions can be divided into passive and active interactions: passive interactions include interactions with the mirror, passing the curtain, or watching the world, while active interactions include playing with the ball or interacting with the chair. The various scenes are loosely related to each other in terms of content and are connected associatively to form a plot or not. The scene chronology is composed as follows: MR intro, Montepulciano walk, mirror room, MR mirror room, ball game in the park, haptics and flying, and the MR outro.



Prepared chair with controller.



Hex Ball XXL with Controller.

Mobile objects of the experiment.

8 Link to the script, accessed August 17, 2023, https://drive.google.com/file/d/1Zde7qnUmyKiMkCQ3n-LXsald6alJ5wVX/view

9 Referring to Ihde, sociologist Alexander Schmidl highlights that subjects not only see, but always see "something." And what is seen they relate to their biography, their situation, their intentions or their life narrative. Alexander Schmidl, Relationen: eine postphänomenologische Soziologie der Körper, Technologien und Wirklichkeiten, Erste Auflage (Weilerswist: Velbrück Wissenschaft, 2022), 36, 62ff.

Evaluation

The evaluation was conducted with the support of the method of microphenemonology, which has its roots in the psychology of the Würzburg School. At the center of this method is the subjective "experience" of the participants, which is simultaneously expressed in language. Ideally, a kind of flow is created in which the perceptive mechanisms, associations, moods, reflections, or observations of the participants can be expressed in words. Thus Gerhard Benetka and Thomas Slunecko write in their text: "»Erleben«, das zur Sprache kommt" ("»Experiencing« that comes to speech"/ translated by the author):

> *Microphenomenologists want to induce with their questions a kind of experiential trance, in which one does not look back on what has been experienced, but in which the experience is held in presence and spoken from the epistemic authority of this current experience. They want to go, to put it in a phenomenological turn, to the experience itself – and not to be content with the memory of what has been experienced.*[10]

Microphenomenology can be used as a method to explore the processes of microperception, which Don Ihde describes as subjective perceptual processes that have not yet found a cultural and hermeneutic classification. In this way, parts of the experience are situationally transparent and increase intersubjective comprehensibility. Of course, this method is misappropriated for the artistic research applied here. As described, it has a different structure and pursues its own production goals. The results varied accordingly. Some participants felt overwhelmed with the task of translating the experience into language. With others in turn, one could document numerous descriptions and associations in the event moments.

Experiment documentation

Using this method, approximately 70 evaluations were collected, with each run taking about 20-40 minutes. An attempt was made to record each evaluation both from the first-person perspective of the headset and from the external perspective of an external camera with image and sound. A room microphone was used to enhance the audio quality and synchronization of the inside and outside cameras.[11] Holistic documentation was created for around

10 Gerhard Benetka and Thomas Slunecko, „»Erleben«, das zur Sprache kommt", Journal für Psychologie 29, Nr. 2 (o. J.): 30, https://doi.org/DOI:10.30820/0942-2285-2021-2-17 (translated by the author)

11 The participants were informed before the recording that they would be recorded with their eyes and recognizable parts of their faces obscured by the headset.

90% of the evaluations. During each interview, a handwritten script was prepared to record the most important statements. The videos were synchronized in editing software and the respective images were arranged side by side. For the evaluation, the verbal statements were transcribed.[12] Concise actions were noted in parentheses (e.g. becomes scared, looks at hands, etc.). Relevant statements were marked and noted in time using the time code. Later in this text, the relevant statements of the six doctoral students will be quoted and analyzed.[13]

The experiment: Step by step

MR intro: At a defined starting point, the HMD with the already-launched application was placed on the head or in front of the eyes of the participants. Through the HMD, participants saw the real space with the addition of a portal in which a cube was floating. The cube contained the word "Ndinguwe." The following words resounded in continuous repetition: *"Touch the ring and follow the circle to enter the rabbit hole."* At the back of the room, a four-digit code number was visible and randomly assigned to the participants. The loading function of the first scene was triggered when participants reached the portal and moved their hand along the outer ring.

Subject enters in MR Intro Ndinguwe. On the left, the subject is seen in the room. On the right, the first-person perspective of the subject.

1. Montepulciano corridor: After the scene loading process was complete, the mixed reality application started. A virtual corridor appeared and moved towards the users, with numerous holes in the walls of the virtual corridor allowing a view of the real environment. Video portraits could be seen on the walls of the corridor, and a

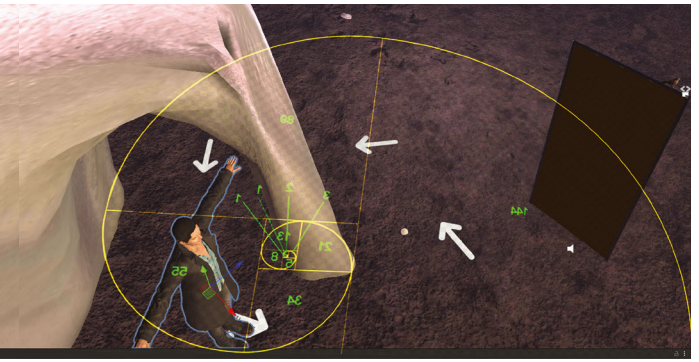
12 „Transkription Evaluation Ndinguwe KHM – Google Drive", accessed October 05, 2023, https://drive.google.com/drive/folders/1x3hwbSspnn55RvVpZBvU8ASba2zyfwyq

13 „(27) Ndinguwe Videoevaluation KHM - YouTube", accessed October 05, 2023, https://www.youtube.com/playlist?list=PLM5l1cypHpWmqoh3yA-DTWiigsiyEnGnm

voice could be heard from offstage speaking a poetic text. The corridor showed the upper corridor of Palazzo Ricci in Montepulciano, Italy and referred to the first directional experiment: "Draw a straight line and follow it."[14] Visually, the corridor surrounded the participants and slowly passed by them. The aim of this first scenario was to ascertain how the combination of VR and MR worked and how the subjective experience of proprioception behaved with two different visual experiences of motion: one that was spatial motionless (MR) and the other one with the motion of the virtual corridor. At the end of the corridor, the participants reached a room hidden behind a curtain. A ball appeared and after a short pause it flew towards the participants' heads. After that, the next scene was loaded.

2. Mirror room: The mirror room was architecturally modelled on a spiral shell and based on the proportions of the Fibonacci sequence. In this space, the participants started at an archway and circled a central column, encountering a mirror that showed them their virtual representation, namely their avatar (the *quasi-other*). Near the mirror, an inner monologue of the respective avatar could be heard, which referred to the avatar's personal fate.[15]
The participants could then try out their interaction in front of the mirror while listening to the narration of the character. Their visual representation was limited to gestures, their upper body, their position, and the movement of the fingers. Facial expressions were not displayed, and the position of the legs was calculated below the position of the upper body via an algorithm. As a result, the legs followed the movement of the upper body with a somewhat delayed, sometimes grotesque appearance. When the participants crossed the starting line, their respective avatar transformed in the following sequence: a) homosexual man, b) Ukrainian woman without a hand, c) old man with dementia or d) African refugee. The choice of characters was based on characteristics that favored discrimination (age, gender, physical condition, and ethnicity). There was a transformation process from passive to active interaction because, depending on how much

14 This is a study trip of the doctoral students to Montepulciano in the summer of 2022, during which they worked together experimentally on their respective doctoral topics. Tobias Bieseke u. a., Montepulciano Journal - The poetics of Making (Verlag der Kunsthochschule für Medien, 2022), 59, https://e-publications.khm.de/frontdoor/index/index/docId/238?fbclid=IwAR1laFz57K_BeEo9BY_RBV_dh6L60-j4s3_jmncLdKfuVsJpiZSHRgNYreo
15 Fatma Aydemir und Hengameh Yaghoobifarah, Eure Heimat ist unser Albtraum: Mit Beiträgen von Sasha Marianna Salzmann, Sharon Dodua Otoo, Max Czollek, Mithu Sanyal, Olga Grjasnowa, Margarete ... Paukenschlag zur aktuellen Rassismus-Debatte, 10. Aufl. (Berlin: Ullstein fünf, 2019).



Shell walk with Fibonacci sequence

time the actor spent with a character in front of the mirror, the character changed the following scenes. After the participants followed the arrows around the center column four times, the next room was loaded.

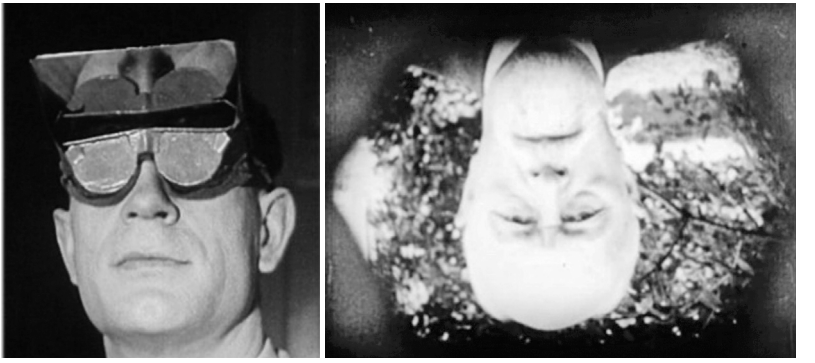
3. MR mirror room: In this space, the participants returned to mixed reality and saw a virtual and a real mirror. In the virtual mirror, they were shown the avatar with which they had spent the most time. In the real mirror, they saw their physical reflection (with HMDs). When the participants look down at themselves, they saw their virtual body optically superimposed on their physical bodies. The visual experience of being overlaid by a virtual avatar offered an altered view of the self and its virtual representation. After a period of 1.5 minutes, the next room was loaded.

Actor touches the mirror with virtual hand

4. Ball game in park: The fourth room was a city park scenario made from a three-dimensional reproduction (Google Earth) of Dortmund's Stadtgarten and Friedensplatz. The participants heared a voiceover providing hints about what to expect. An abstract structure appeared, reminiscent of a tree, from which balls were shot at the participants with a percussive sound. Participants could either block the balls with their hands or avoid them. The ball firing was interrupted twice with a short pause, during which the voiceover spoke again. With each break, the frequency of shots increased, and the balls came from additional directions.

If the ball collided with the participant's head area, their vision in the headset turned orange and became blurred. The challenge of this situation could not be completely fulfilled, given that not all of the balls could be deflected, nor could all of them be dodged. This provoked a stressful situation in which unexpected actions may occur (e.g. falling or taking off the HMD). After this phase, a double (the *quasi-other*) – in the form of an avatar – appeared in front of the participants and imitated their tracked hand and head motion but could not walk. This was different from the mirror image. When the participants raised their left arm, the double also raised its left arm (from the participant's perspective), meaning that the avatar was therefore not mirrored. A ball appeared in front of the participant, and a voiceover instructed the participant to hit the ball back and forth between themselves and their avatar. This was intended to be difficult and was informed by experiments made by experimental psychologists Theodor Erismann and Ivo Kohler with the inversion glasses in the 1930s. The researcher observed that it takes an average of three days until the brain has adjusted to such inversion movements.[16]

Left: Ivo Kohler with the inverted glasses. Right: Theodor Erismann as seen through the glasses.



5. Haptic feedback and flying: The previous environment darkened, and the participant's avatars were invisible again. The researcher communicated with the participant to take the controllers from their hands and introduce a chair to the participant's physical space.

16 This experiment involves a pair of glasses equipped with prisms that interchange up with down and right with left. This experiment is not the same as Ndinguwe, but it requires a similar cognitive performance. See also: „Theodor Erismann - Zentrum für Geschichte der Psychologie", accessed October 05, 2023, https://www.uni-wuerzburg.de/zgp/archiv/film-fotoarchiv/theodor-erismann/

The controllers were affixed to a "Hex Ball XXL" by a protective cover with rubber bands and cable ties. The participant was told that they had to catch a ball again. The Hex Ball XXL was thrown to them physically and was tracked and represented in the virtual environment in real time. Soon a 3D representation of a chair appeared in the virtual environment in the place matching its position in the participant's physical space. Two chairs appeared, one a green transparent scheme of the chair and one a physical wooden chair. The wooden chair was also equipped with a controller to track and display its position accurately in VR. When the participant placed the wooden chair in the place of transparent green chair, a countdown started. Participants were then asked to take a seat in the chair. After sitting they had sat down, a flight through virtual Dortmund began. It was accompanied by a poetic text of the voiceover, while the chair flew upwards through a decaying landscape. The virtual environment disappeared in a bright light, and the participants' view returned to MR.

Steffen looks down on the virtual city while flying.

MR outro: In the last scene, the participants returned to MR. Suddenly, a crow appeared and flew towards the players in a similar way to the balls before. This was to test if the haptic feedback had changed their perception of the virtual objects. The participant's changed perspective was inferred from differences in their behavior towards virtual objects flying towards them. The outro was used to provide a retrospective reflection of the experience for the participant. The headset was removed and the experiment ended.

Methodology of the implementations

During the experiment, the experimenter conducted the survey with the participants directly while experiencing the different scenarios. Initially, each actor read aloud the randomized virtual code number he/she

was assigned at the beginning of the experiment. This gave each evaluation a unique chronological index number and an individual code number. A questionnaire was used to ask the participants about their experiences with the application. Here are some of the questions used:

How is your body feeling? How do you experience the mixture of reality and VR (MR)? How do you experience the contacts with the virtual objects? How do you experience the virtual body (missing arm, age, skin color)? How do you understand the text? How do you describe your relationship to the avatars (empathy, defense, identification)? How do you experience your environment? How do you experience the game with your virtual double? How do you experience the haptic feedback? Please describe how you experience the flight.
At the end, the *participants* were asked a few retrospective questions: *How did you experience the journey? How would you describe your relationship to the avatars? Could you identify a narrative? Is there anything that will stay with you?*

The same questions were not always used; rather, the specific situations of the various participants were addressed individually. Over time, the interviews were reduced to simply asking them to report on their experiences, while the investigator occasionally offered suggestions. This method developed during the process and retrospectively proved to be less disruptive and more fruitful in terms of the individual quality of the statements. Unfortunately, there was a camera failure during the exterior shot of Natalie and damage during the first-person perspectives of Zahra and Christian H. due to discharged batteries. The damaged recordings were able to be restored with image errors (glitches) and used for appraisal (see video link).

Christian H. with image errors in the MR display, but he did not see them during the experience.

Behavioral studies

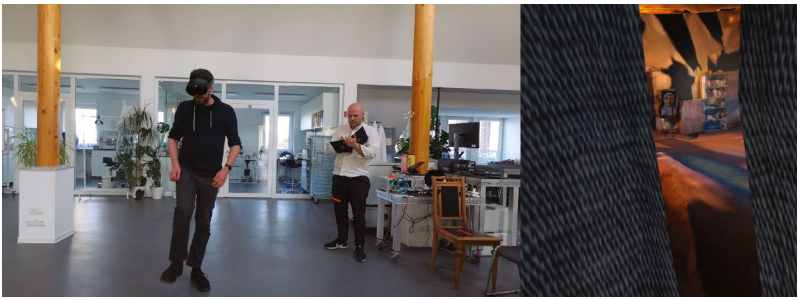
The participants described the touching of the portal in the MR intro occasionally as a feeling of electric *"tingle"* in the fingertips. However, such statements tended to be the exception. Furthermore, this effect occurred more frequently in participants who had infrequent to no prior VR experience. The doctoral students could not describe such an effect and described instead as a gesture they performed in empty space. When the gait of Montepulciano approached the participants, this was positively received and not perceived as problematic, although proprioception and visual flow were opposites. Often it was even described as pleasant, because the participants did not have to move themselves but still progressed, *"similar to a moving walkway at the airport or a train ride."* However, the comparison to moving walkways or trains is deceptive, especially from a perspective point of view: On a train ride, the static subject moves with the carriage while the surroundings pass by. In this experiment, the subject stands statically in the environment while the virtual object passes by the participants. The effect may be similar, but the relationship of the object to the background changes, resulting in different parallactic effects; a visual difference we do not find in the real environment. The holes in the virtual environment, which reveal the view of the environment, were partly perceived as errors, but also often used as a reference for one's own body sensation. So, Georg and Somi said hello as they drove by and Somi said, *"Here is a hole, so I can see you."* Individual participants described entering the virtual tunnel as a layer that interposed itself between and overlaid their perception of the environment and their own cognitive notion of the environment. Most of the participants experienced this with expectant excitement and their attention was almost continuously focused on the virtual image layer, although it was not physically real. The narrative text level mostly disappeared in the perception in the background noise of the interactive experience.

Somi looks through a hole in the MR.

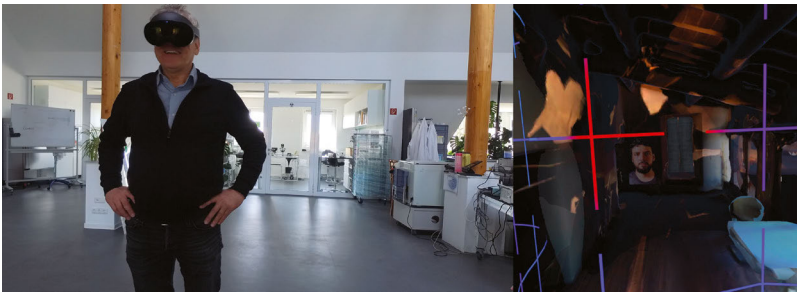
The straight line of Montepulciano

The particularity of the evaluation with the doctoral students was their knowledge of the corridor of Montepulciano, which was completely unknown to the other participants. It was often described as a café or, due to the moving movement, as a treadmill. However, for the PhD students this place in Montepulciano was a space filled with memories, where we discussed, experimented, thought, and acted. This space was considered the starting point of this experiment, which was why it was taken up intermedial. The doctoral students gladly accepted this offer of perception and identified the photogrammetric scan as the known location. It was observed that memories of the previous experiment were awakened. Somi said: *"And now I see the environment of Montepulciano. It comes over me."* She looked to the ground, perhaps searching for the line that provided guidance to the doctoral students in the Montepulciano experiment. Therefore, Steffen took a slightly stooped protective posture to avoid hitting his head on the ceiling struts again, as he had previously done. On the other hand, Zahra faced difficulties reconciling the overlap of the two spaces: *"It is so weird I am in Montepulciano and at the same time I am in Cologne. [...] it is like a time travelling."* Natalie described the feeling as follows: *"The room drives into my shins. It's a bit like in 'Stranger Things' because I know the room for real."* The physical experiences were again very present with Steffen:

> *It is strange for me because I know it, it is a strange experience of familiarity. (Makes a movement as if he is going up the step when passing through the curtain)." Ultimately, Christian H. remarked on the experience: "Sure things have come up again, so memories of Montepulciano, but especially of the events where I had the glasses on there. Otherwise, no other memories; so only of the walk. It was the same as in your experiment, just a bit extended.*



Steffen climbs the remembered step.



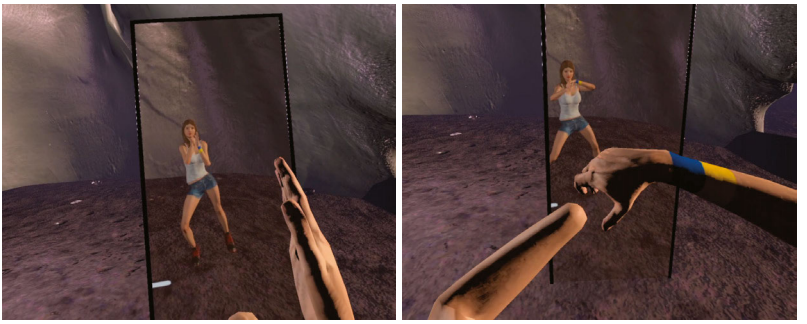
Georg drives around the room.

Identification with the avatars

The body experience with the avatars was considered exciting and curiously explored by most of the participants. The passive interaction in front of the mirror led to an intensive process of self-perception. With the setting of the mirror room, the potentials of identification, empathy, or rejection with the avatars *(the quasi-other)* were tested primarily. The reactions show a highly different relations to the virtual embodiments. The word "identification" comes from the Latin roots *identitas* "entity" and *facere* "to make" and is essentially used in psychology to describe the empathy of a subject with another person. According to this, identification, phenomenologically seen, is an observation of the foreign or the unfamiliar, which is brought into a comparison with the own self. Willingness to empathize is often synonymous with accepting the stranger into one's own self. When empathizing, stories are experienced from the first-person perspective, but that does not mean that one's persona is in danger of being displaced. In any case, this fear was not confirmed in the survey of the doctoral students, but defensive reactions nevertheless occurred in some cases.

Georg answered the question of identification with a half-state of identity as follows: *"With the avatars, one built up something like a half-identity. You've already noticed that it has something to do with you. Something irritating, something in between. You weren't just someone else, you could look at the hands. I didn't have a defensive reaction, but an irritation. I could not establish an identification. So, the stories that were told had nothing to do with me, they were the stories of these avatars, but not mine."* Christian R. described the condition similarly: *"It's not like looking at yourself in the mirror but standing by a person and looking at them in the mirror. I do feel identification, otherwise I wouldn't look at why I'm missing a shoe or why I'm missing a hand. So, there is an identification, but cognitively you know that this is not my reflection."* When we interpret Christian's R., it should be noted that he used identification in the sense of identity, meaning "to spatialize localize." Participants' own hand movements were identified in the foreign mirror image. Here the participants placed themselves in an accompanying relationship with the avatars. The content of the auditory narration was not reflected, but the attention goes to the visual perception, which was partly attributed by the participants themselves to the rare use of this medium. On the contrary, Somi became very empathically involved with the avatars and spoke about them in the third person as well as the first person: *"It is strange, when I look at myself. My clothes are changing, and I don't have any hand. Oh God, my gosh, I am handicapped. It is a really strange feeling, Tobias. The guy had a very strange style, but this woman, she is extreme, she had no hand. (She follows the arrows for one more round.) I see that my clothes are changing."* It is interesting that Somi spoke of her own clothes when she looked at herself and of *"the people"* when she looked in the mirror. Somi was able to establish the most intense relationship with the story of the woman without a hand because the idea of this impairment touched her, but at the same time she connected with the narrative. By contrast, Zahra felt a heightened impulse of defensiveness, even if it related more to visual self-perception than to narrative: *"This is the first time I see myself without a hand. Oh my God! I can't believe this, that I don't have a hand. I don't know why. I can see it, but I can't believe it."* However, Natalie dealt with the perceptual offer in a playful way: *"The strangest thing to me is*

this step and not having a hand. (Claps hands). [...] I automatically make a fist without a hand." By "step," Natalie referred to the size difference of the avatar, but probably also a technical faulty detection of the ground by the sensors. A similar detection and display error also occurred with Somi. In relation to the avatar, they were represented smaller in their height, which otherwise occurs only in children. Nevertheless, Natalie was not deterred and playfully tried out the possibilities and contradictions of the artificial restriction. Christian H. describes these grotesque motion sequences of the *quasi-other* as follows: *"Quite funny is that the leg movements behave like aliens, as you know them from science fiction movies."*



A playful way for Natalie to deal with the handicap with clapping and groping.

In the end, Christian H. very honestly described his reaction to the avatars as well as the setting as a whole as follows: *"There is an absolute defensiveness there because something is happening to you that you don't know and that you don't have any idea about. Because you have a complete relinquishment of control. And sure, then comes such a defensiveness. Somehow accepting that something like that exists, that something like that is possible. Which would probably be over by the next time or the time after that. The first time, there is already a lot of skepticism. I don't know if I really want that."* However, contrary to defenses, there were also more random factors (side effects) that further enhanced the experience. This was the case with Steffen when he wore the old man's avatar and grabbed his wrist. In doing so, his hand came to a stop at his watch, and he described touching the old man's hospital bracelet as follows: *"It's a very strange feeling right now because this band is right where my watch is. So, I'm almost like a little bit scared right now when I touched it."* Such moments are very immersive and can create the

illusion for fractions of a second that the visual deception is real, even if Steffen did not claim that for himself. Natalie, on the other hand, empathically engaged with the characters and listened intently to their stories. Throughout the evaluations, occasional imaginaries could be observed, which sometimes becoming physical. For example, Natalie described a strange perception during the story of the police murder of Mouhamed Dramé in *Dortmund*,[17] Germany: *"(Runs through the arch, the figure changes) This moment is totally crass, when you go through it. Then the body becomes so different. [Pause] Oh, I'm bleeding, I think, here. (She looks for a wound on her fingers) The text is already crass."* The fact that Natalie is looking for blood on her hand is indicative of her sensation of intense immersion.

The avatar of Christians is changing.

Natalie is searching for a wound on the hand.

Behavior in front of the real mirror

The MR sequence in front of the real and the virtual mirrors was also perceived as intense. The participants saw their own bodies overlaid by the avatar, which gave them the opportunity to compare their virtual reflection with their physical reflection. However, the participants were not informed that the time they spent with the respective figures in the mirror room influenced the assignment of their avatar. Thus, speculation arose as to the respective allocation. At the same time, Somi, who passed through the mirror room during her last run, was convinced that she was wearing the African avatar because she had passed through the self-image with him. She made the following comments: *"Because I have passed the mirror? The only time I go through the mirror is when I see this guy, so I think I represent him through that. Several times I was a different persona, then I went through one to explore the mirror world and then I was*

17 David Peters, „Tödliche Schüsse auf Mouhamed Dramé: Anklage gegen fünf Polizeikräfte", accessed February, 2023, https://www1.wdr.de/nachrichten/ruhrgebiet/anklagen-fall-mouhamed-100.html

here, now everything is black." Zahra, on the other hand, consequent held to her self-image and said: *"The thing is, I know who I am, to my reaction I see somebody else in the mirror. Very weird. Who are you (she asks her mirror reflection)?"* Zahra connected with the *quasi-other* in this way, intending to make her false mirror image a separate entity by addressing it. Christian H. also continued to lean towards his defensive posture and tried to separate a physical difference: *"You kind of try to build up a defensiveness, also I do. You hold on to what you know. I do not completely succeed, however. The play with the different mirror images is beautiful. It is a mixture of fascination and ambivalent feelings."* Georg, Natalie and Christian R. were primarily engaged in observation of their virtual bodies. By contrast, Steffen explored the room more and discovered a poem on the back behind the mirror: *"Good mirrors are not cheap."*[18] At the end, Christian H., Zahra and Steffen embodied the young man with tailcoat, Somi the African refugee, Natalie the old man and Georg and Christian R. the young woman without one hand.

Georg observes the superimposition of his own body with the avatar and sees the physical difference of the missing hand.

Ball interaction

The interaction of the doctoral students depended on the character they virtually embodied. Natalie jokingly said, "But I'm an old man. I can't do this." She also perceived the increase in the frequency of ball shots almost physically and expressed herself with expressions of pain such as, *"Aua! This is worse than dodgeball."* Natalie was visibly stressed and frustrated, which may have been a result of the high frequency of shots. Nevertheless, the constitution of the virtual body was of relevance for the ball interaction of the participants. It

18 Eve, "Poetic Medicine: Good Mirrors Are Not Cheap," Poetic Medicine (blog), 19. März 2010, https://poetrypill.blogspot.com/2010/03/good-mirrors-are-not-cheap.html

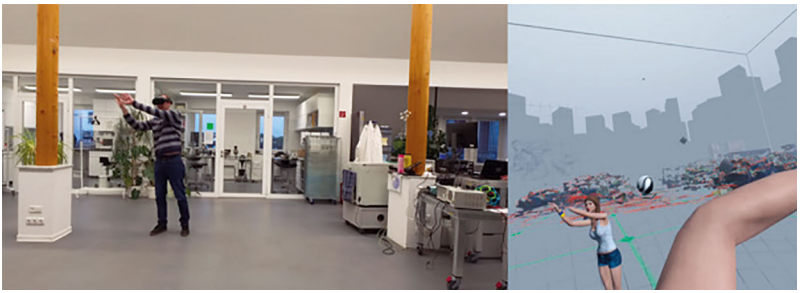
was remarkable that Georg as well as Christian R., who were both embodied by the woman without the left hand, predominantly use their right hand to block the balls. However, as the frequency of the ball's increased, their use of their left hand increased. Georg reacted to the greater ball frequency by dodging instead of defending. The self-embodiment of the participants seemed to have an impact on the interaction strategies with the environment. Most participants were right-handed and therefore mainly used their right arm. Nevertheless, many tend to strike a volleyball postured in such situations. In addition, evaluations with left-handers have also shown that they use the right hand (you can read about this in the following article). Not every actor will necessarily use the right hand, but the optical self-perception prefigures the strategy of action. In general, the contact with the ball was not perceived as haptic but as interactive.

Somi struggles with a high ball striking rate.

Behavior with the double

At the beginning of this scene, the participants were asked by an off-screen voice: *"Can you pass a few balls with your double?"* To which Somi responded in German: *"Ja, ich kann (Yes I can). I see the guy visible, it's me."* This reaction showed that Somi had now accepted her avatar as a virtual self-representation (the *quasi-other*). By contrast, Zahra continued to deny this: *"You know, I accept the places where I am in, but I don't accept that I see myself as somebody else. I don't know why."* The experience with the double triggered general confusion at first. Steffen described his experience as follows: *"(hits the ball with right to the double, but then lifts the wrong arm for the double). I can't really tell; I can see what I'm doing wrong."* Christian R. remarked in this regard, *"That's difficult. It doesn't move like my reflection."* Christian H. remarked: *"He doesn't do what I want.*

It's hard with the right/left." Georg, on the other hand, quickly found a strategic way of dealing with the situation to maximize his chances of success. He came close to the figure, bringing both hands into a static, equal posture, thereby canceling the aspect ratio right and left and mechanically moved his upper body. Nevertheless, none of the participants managed to pass the ball back and forth once. It remains to be noted that when we experience a self-embodiment in the environment, our brain is conditioned to perceive it as a mirror image.



Christian R. interprets the pages the other way around.

Haptic feedback and flying through the virtual city

In the next scene, the virtual ball became the physical representation of a "Hex Ball XXL" that could be played with. Georg said in this context: *"The haptic feedback absolutely increases the immersion. Absolutely enhances reality."* (Throws the ball to his remote-controlled self) Somi felt similarly about this state of affairs and described it as follows: *"Aha, yes, it's, nice it's completely imaginable - that's my ball, because it is in the dimension completely comparable with the thing that I see here."* For Christian R., this direct comparability was only limited: *"There's the conflict again now. The ball that you see has a round surface. The ball you feel, of course not, because the ball has the holes, this structure."* Steffen also perceived this discrepancy: *"It's a very weird feeling for me; it seems so massive, but I can reach through. I like the synchronous spinning of the ball."* Natalie remained focused on haptics: *"That's really crazy. It wobbles a little bit like the jellys I often work with. Yes. (Rolls the ball across the floor) That worked totally well."* Christian H. remained skeptical about the handling of the virtual environment even after haptic feedback: *"Too bad I saw the ball already, before that. (The ball is thrown and caught the second time.) The haptic contact with the real world doesn't really*

work for me." Nevertheless, just like the others, he managed to throw some balls to himself with the invisible playing partner. This made it clear that the participants had no problem catching the ball despite the invisibility of their own bodies. In this case, proprioceptive self-awareness was independent of visual perception.

An invisible person gives Somi a ball.

After the ball game, a physically represented chair appears that can be moved around the room. If the participants placed the movable chair in an immovable green silhouette of the chair, a countdown started. Christian R. described this situation as follows: *"I see the chair. I'll put it here with the green chair. (He sits down on the chair) Now that's stranger than walking, where the room moved. Yes, this is already a feeling of flying, as I imagine it."* By contrast, Steffen initially accepted the situation less intuitively: *"Intense is a nice word for what I feel. I feel the need to touch the legs of the chair from below. I notice that I feel less dizziness than I would have thought before it started. But this fixed point (chair), even if I don't look at it anymore, but I still feel it, is a stabilizing help."* According to this, haptic feedback changed the relationship with the virtual environment on several levels. The proprioception – in combination with the visual perception – could be influenced by the haptics, and the illusion of half-flying was created. It was observed that the perception of the narration from off-screen in the sitting position received more attention. Thus, Somi commented on the situation as follows: *"(Talks with the voiceover) Access to what? Ah ok an exit. Access or exit? Where we wanna go? I am dead now, because it is completely white."* The observation that the sitting position favored listening was also made with some other participants outside of the observation with the doctoral students.

Somi holds the ball as it flies, which dissolves into glistening light.

Return to MR

In the last part, primarily retrospective questions were asked about the experience, with the primary aim of checking which events might solidify as memories. During the questioning, after some time, a bird appeared and flew towards the head of the actor. This was to test whether haptic feedback changes the physical presence of other virtual objects. Typically, participants dodged the bird if it was noticed. However, according to the participants this could not be attributed to a feared collision with the bird but rather the natural reaction of wanting to avoid an imminent collision. Somi noticed the bird with the following words: *"Wow that is strange (The bird appears) there is coming something and fly on my head. You know there is a crow."* Steffen mentioned during the interview that the experience of confusing the arm band with his watch will have a lasting effect on him. Zahra ultimately wanted to clarify: *"Nothing about myself was true,"* which clearly shows the difference between the two worlds. For Georg, on the other hand, the voiceover was significant: *"Very important in this, is the voice that grounds you and makes you feel lifted up. (Dodges the bird.)"* He noted that if he were to do another run-through, he would pay even more attention to narration than perception. By contrast, Christian H. saw the possible risks that such a technique entails: *"I grew up with people who were out and about in the city during the day and suddenly saw a crosshair in front of them because they were just gambling. [...] But you need completely new strategies to prepare the little people (children), who can't even cope with reality, for that."* The experience was one of ups and downs for Natalie: *"The feeling of stress will stay in my memory, but also the success of being able to physically catch the ball afterwards. That built me up again. I'm not just at the mercy, I'm able to take action."*

The bird flies towards Somi in the MR outro.

Discussion

The research question posed at the beginning, how the participants aligned their personal space of experience with the experiences in the virtual world, can be answered to the effect that the integration takes place in different stages depending on the user: there is 1) no coherence, 2) a partial coherence, or 3) an approximate coherence with known experiences.[19] If there is no coherence, the experiences are mostly perceived as irritation or error because they cannot be integrated into structures guided by the imagination (e.g. the virtual ball flies through the participants). In the case of partial coherence, ambiguous interactions occur, which partially produce effects in which the brain tries to compensate for the experience difference and thus causes hallucinations (disembodied contacts are felt; illusion of seeing blood). In the case of approximate coherence, irritations are accepted, and differentiation is subjectively difficult. A form of multimodal perception emerges (net structure of the ball is accepted despite the optic difference; haptics increases confidence in the virtual environment). Unknown experiences are therefore integrated into known ones by reference to them. The evaluation with the doctoral students showed that the place is recognized as Montepulciano. Memories of a specific experience are reactivated, and physical handling patterns (ducking the head, readiness to catch the ball) are also recalled. This memory layer can activate different memories than a photograph could due to the spatial topology

19 Mel Slater and colleagues has developed a definition (coherence is defined as the set of reasonable circumstances that can be demonstrated by the scenario without introducing unreasonable circumstances, where a reasonable circumstance is a state of affairs in a virtual scenario that is self-evident given prior knowledge) of coherence and three factors to contribute plausibility: 1) the reactivity of the environment to participant actions, 2) contingent references by elements of the environment to the participant, and 3) credibility of expectatio, i.e. the environment is constructed based on evidence of what is supposed to happen in real life where this is relevant, so that the application is supposed to be a simulation of events that occur in reality. Cf. Mel Slater u. a., "A Separate Reality: An Update on Place Illusion and Plausibility in Virtual Reality," Frontiers in Virtual Reality 3 (27. Juni 2022): 10, https://doi.org/10.3389/frvir.2022.914392

of the photogrammetric scan. Acting in these memory spaces does not correspond to acting but to acting in one's own virtual world of experience.[20] This fact has been successfully used for some time in trauma therapy[21] – for example – to treat traumatic experiences through virtual recapitulation. This effect can also be used narratologically, but these virtual places are exclusive. To use the feeling of a personal memory, either public places must be chosen or exclusive individual productions have to be created, which would make this attractive only for a smaller circle of participants.

The interaction with the avatars shows that the half-identity allows for a confrontation with the alien self, whereby the participants can react either insituatively or extituatively, i.e. either they playfully let themselves in or they reject it. Both reactions create an expanded sense of self-awareness. The technically simulated self-perception can be described with Ihde's words of the *quasi-other*. This shows that the acceptance of the mirror image as an unknown technical self-portrait is lower than when the participants only see their virtual hands. In this regard, the philosopher Tom Poljanšek, following the phenomenologists Johann Friedrich Herbart and Edmund Husserl, speaks of apperception.[22] By this, he means the process of *Hinzu-wahrnehmens* (*adding-perceiving*/translated by the author), i.e. the addition of perceptions. This is what happened to the participants when they suddenly wore an avatar. The inner monologues of the avatars, on the other hand, are less relevant and are only perceived with attention when they are of interest. As soon as the participants were no longer spectators but participants, they wanted to act and only take on the attitude of the listener to a limited extent. Identification can therefore only be generated in the sense of "locating" the self-representation and not in the sense of transferring a persona. The degree of empathy depends on the ability to get involved. The example with Steffen's watch clearly shows that

20 Cf. The philosopher Alva Noë describes the subjective world of experience as virtual, into which only those things enter that our consciousness has grasped. Their cognitive representation is thereby linked to a content (something recognized) and becomes a virtual object of the world of experience through interaction. Alva Noë, Action in Perception, Illustrated Edition (Cambridge, Mass.: Bradford Books, 2006), 215–16.

21 Cf. Jeremy Bailenson, Experience on demand: what virtual reality is, how it works, and what it can do, First edition (New York: W. W. Norton & Company, Inc, 2018).

22 Cf. Tom Poljanšek, „Nie ganz bei den Sachen", in Technik-Ästhetik: zur Theorie techno-ästhetischer Realität, hg. von Oliver Ruf und Lars Christian Grabbe, Medien- und Gestaltungsästhetik 12 (Bielefeld: transcript, 2022), 183. In this paper, the terminologies insituative or exsituative, as well as apperception are detailed in relation to immersion.

the effects of reality hybridizations cannot be artificially produced so far since they only arise through unexpected sensual analogies. The unknown is necessary for this. Such an effect can only occur if no classification of the experience takes place through the experience. The ball game showed that provoking a stressful situation results in discomfort but not cancellation. Nevertheless, physical reactions such as cries of pain or evasive reactions resulted, although it would have been sufficient to close the eyes to escape the optical bombardment. The haptic feedback, on the other hand, meant a clear increase in immersion. It turns what is seen into something material, even if it does not meet the expectations of haptics. The flight on the chair becomes more real because it has a physical basis. Here, the participants reverted from the state of the actor to the attitude of the spectator. The flight on the chair became more real because it had a physical basis. Accordingly, more of the narrative was perceived in this last phase. Overall, it remains to be noted that narration takes a backseat to interaction. For the narration to be received, according to the current state of knowledge, either the willingness of the participants must exist, or it must be stimulated (e.g. by reducing the possibilities for interaction). It is important to activate the inner attitude as a spectator or listener. This can succeed as soon as the personal lifeworld is stimulated on different levels. An attempt to category these levels follows.

Postphenomenological classification

The descriptions of the participants clearly show that each of them is sensitized to his or her own pattern of perceptions due to the *lifeworld* from which he or she lives and that the personal *lifeworld* influences the experience. For this reason, a costume designer from the theater reads the virtual skin of the avatars as a kind of costume in whose structure traces of a story can be read. Athletes recognize in the ball game with the invisible the potential for a new training method in which one must read from the behavior of the ball and not the ball player. The entire virtual experience functions as a mirror of one's own life world, which can show one how one's own thinking is structured.

The results make it clear that even before microperception, certain expectations of the environment exist that are derived from

the respective world of experience. It is expected that you can grab the ball, that you bump your head on a frame, that the ball should fall if you drop it. If these expectations are disturbed, not confirmed, or even break with known experiences, besides disbelief and irritation, contact with the unknown arises resulting in a moment of doubt and the idea of another reality behind the visually apparent. The initially named scheme of technologically mediated world relations of *alterity relation* by Don Ihde does not quite live up to its own claim of clear differentiation in the case of an HMD-based VR installation. It only captures the difference between the technological world and the real world in an inadequate way. The *quasi-other* describes the phenomenological difference, but it does not include the level of adding-perceiving. For this reason, the technology philosophers Robert Rosenberger and Peter-Paul Verbeek developed the *immersive relation,* which clearly shows the difference between the HMD-based and subjectively experienced worlds:

(I - Technology) ⟶ World MR
↘ (Technology – World) VR

In this scheme, the brackets are seen as a unit in which the "I" is connected to the technology (indicated by the hyphen). At the top, this unity connects the subject with the technology, where the world can be seen embedded in a MR, for example. With the downward arrow, a technically represented world is seen that visually overlays the environment. Rosenberger and Verbeek justify this as follows:

> *When using Google Glass, people both have an embodiment relation with the Glass itself, and a hermeneutic relation with its screen that offers a representation of the world. Therefore, it offers not one, but two parallel relations with the world. The intentionality involved in such "augmentation relations" can be indicated as "bifurcated": there is a split in people's directedness at the world, because two parallel fields of attention emerge.*[23]

This could also be what Zahra means when she said she is in Montepulciano and in Cologne at the same time, or what Georg meant when he talked about half-identities. This means that the downward arrow refers to the extension or overlay of the actual reality.

23 Robert Rosenberger and Peter-Paul Verbeek, Hrsg., Postphenomenological investigations: essays on human-technology relations, Postphenomenology and the philosophy of technology (Lanham: Lexington Books, 2015), 22.

However, this split leads at the same time to a divided attention, since both worlds are thought in parallel (which similarly describes Tom Poljanšek's thesis of apperception). The special thing about the *immersion relation* is that it can partially simulate the other relations. Thus, an immersion relation may well represent the *embodiment, hermeneutic, alterity or background relation* on the level (technology-world). Due to the content of Ndinguwe, a computer-generated self-image and a computer-generated world emerge, which corresponds to Ihde's indicators of an *alterity relation*. However, the HMD itself can also be understood as an *embodiment relation,* since the glasses disappear from the conscious perception. The potential offered by the *immersion relation* is that both worlds in cognition eventually become an imaginary world again and thus also serve only a virtual world of experience.[24] This virtual world of experience can thus be expanded to include experiences that sensitize us, allows us to focus, create awareness, or enable experiences that would otherwise have remained inaccessible to perception. The potentials of these experiences are currently unknown to a strong extent and accordingly stimulate the imagination of possible applications.

Further outlook

This is a first partial evaluation of Ndinguwe's results. However, as this is only a fraction of the assessments collected, further evaluation will take place. There is an increased focus on physical reactions, but also on the potentials of narration. The spectrum of evaluated participants includes different groups of people. The experiment was conducted with children, directors, professors, athletes, teachers, designers, sociologists, students, VR professionals (Places), museum curators, and transvestites. This broad field of lifeworlds shows a wide variety of ways of looking at Ndinguwe and thus makes diverse ways of reading visible. There were many different reactions. These reactions offer hints for further experimental investigations in which 1) the relation of interaction and narration, 2) the movement behavior of the participants in the virtual space, 3) connections between real and virtual scenes, 4) habituation effects, 5) identifications, 6) interactions and 7) technical precision can be examined. This evidence will be explored in further detail in

24 Noe, Action in Perception.

a further evaluation. A follow-up experiment would bring the relationship between multi-linear narration and interaction into greater focus. Finally, referring to the experiment in Montepulciano, it remains to be noted that the shadow play in Plato's cave always takes place as soon as we assume the position of a viewer. The moment we start to act, the narratives disappear in the background, and decision-making becomes essential.