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'Who is this body?' – A qualitative user study on 'The Machine to be Another' as a virtual embodiment system†

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ABSTRACT: Like no other medium, virtual reality (VR) offers new possibilities to alter the perception of reality. These possibilities are mainly related to the feeling of presence in a virtual environment. With the VR performance 'The Machine to be Another' (TMTBA), we find an innovative embodiment system that enables a virtual body swap between two users. Hence, we conceptualise the performance as some kind of breaching experiment in order to alter self- and body perception. With the use of TMTBA and a qualitative research approach, we hope to gain a closer insight into the formation, alteration and persistence of body images. This challenges the phenomenological idea that our sense of bodily presence is essentially anchored in our physical or 'objective' body as we know it and seems to potentially expand our notion of what bodily presence can mean.

KEYWORDS: body schema, body swap, embodiment, phenomenology, qualitative study, 'The Machine to be Another', selfhood, virtual reality, zero point

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'Through my body I understand the other...'
(Merleau-Ponty, 1966, p. 220).

Introduction

Due to the steady expansion of virtual reality (VR) applications in the entertainment sector and in various fields of science, immersive experiences increasingly emerge as an empirical object of research. Virtual reality enables users to extend the natural limitations of their own body through the users' embodiment of various avatars (Petkova & Ehrsson, 2008; Slater et al., 2010; Gonzalez-Franco & Peck, 2018). These virtual experiences concern central areas of selfhood, identity and embodiment.

On the one hand, virtual reality enables new ways of perceiving one's own body, identity and (inter)connections with others. On the other hand, VR brings along a strange diffusion of fiction and reality. That is why experiences and interactions in VR paradoxically appear increasingly unmediated, although they take place in a completely mediated environment. Thus, the use of VR stirs up old, but relevant and fundamental questions of phenomenology: What is the difference between lived and virtual body? What is virtual embodiment, anyway? How do virtual experiences shape identity and the body (Gallagher, 2005) – and vice versa?

Concerning the topic of this article, we mainly focus on Merleau-Ponty's body-oriented phenomenology. From that phenomenological point of view, body and mind are inseparably intertwined (Merleau-Ponty, 1966). His works on phenomenology help to shed more light on the relationships between embodiment, interaction, language, reflection and intersubjectivity. Here, the basic idea is to perceive the self not as a closed unit, but rather as some kind of reflexivity resulting from the embodiment of different perspectives that have always referred to other people or perspectives associated with them. As Merleau-Ponty notes, the self and others are inevitably entangled in 'a four-term system: my being for me, my being for the other, the other for itself, and his being for me' (Merleau-Ponty, 1966, p. 80). With the help of VR technology, we are trying to intervene at this four-term system in order to get more insights into its dynamics as well as its limits and possibilities.

While most VR applications involve embodying an avatar in computer-generated worlds, the VR performance 'The Machine to be Another' (TMTBA) provides a live embodiment simulation. TMTBA first and foremost presents itself as an 'empathy-machine' (Milk, 2015), i.e. a technology that enhances empathy, and has been used in many studies appropriately (de Oliveira et al., 2016; Bertrand et al., 2018; Ventura et al., 2018; Cebolla et al. 2019). Based on this research, the aim of this study is to examine whether conducting a body swap using TMTBA alters the perception of oneself and the other person in regard to selfhood, embodiment and perspective-taking of others. In order to do this, we use qualitative research to analyse the experiences during the performance from a phenomenological point of view.

That leads to our main research questions: What is it like to be virtually embodied in another person's body? Which physical

sensations towards the virtual and real body show up during its use? What is it like to see your own body through the eyes of another person? In regard to phenomenological tradition and with TMTBA, we are able to put the notion of a 'secondary body' to the test, which Merleau-Ponty claims to be necessary to fully perceive one's own body.

Related work

As far as the history of embodiment as a philosophical concept goes, the matter to which it refers is far from self-evident. The concept of embodiment designates a dimension of bodily existence that is not absorbed in an objectivist or materialist understanding, but is closely connected to the category of lived experience. It is phenomenology, which clearly distinguishes between the physical, objective body (*Körper*) and the subjective, lived body (*Leib*) (Merleau-Ponty, 1966; Husserl, 1989). In the phenomenological tradition, the body is regarded as an organ of perception, as the 'zero point' (Husserl) of all orientation, as the way to fundamentally access the world. This tradition has found its clearest, paradigmatic expression in Merleau-Ponty's philosophy, and whose phenomenology of perception is a theory of bodily experiencing the world.

The German distinction of *Leib* (lived body) and *Körper* (objective body), which is mainly influenced by Husserl, implies a systematic distinction between two different perspectives on 'the same'. We *are* our (lived) body and we *have* our (objective) body (Wehrle, 2020). For Merleau-Ponty as well, the subjective body differs from the objective body in the way that we can never walk around it and, accordingly, never look at it completely.

In addition, every corporeal experience provides us with a body schema, or body image, i.e. the phenomenological understanding of our bodies extended in space and time. Merleau-Ponty (1970, p. 139; emphasis in original), stressing the experiential nature of space and time, cautions that '[w]e must avoid saying that our body is in space, or in time. It *inhabits* space and time'. He uses the term to refer to an immediate knowledge (an impression) of my body as it juts into the fabric of experiential space and time. For this reason, we cannot speak of the phenomenological body image as a stable entity, but as a way of talking about the bonds and the interface between body and world.

The body schema, as Schilder (1999) understands it, is an unstable, dynamic structure that is constantly changing in order to adapt to different situations or even to anticipate them. However, these changes are only understandable against the background of a changing environment in which the presence of other people plays a major role: 'We feel that when somebody comes near us, he is intruding in our body-image even when he is far from touching us. This emphasizes again that the body-image is a social phenomenon' (Schilder, 1999, p. 212). Interestingly, current research in neuroscience and psychology clearly emphasises the relevance of the term body schema, especially with regard to the unity of perception and motor skills, as well as the inclusion of the presence of the other in one's own postures and movements (Gallagher, 2000).

In relation to the notion of selfhood, Merleau-Ponty's concept of the body schema refers to the question of the subjectivity of physical existence. According to him, a subject belongs to the world just as it is the centre or source of its experienced world. In Merleau-Ponty's words, the body is simultaneously *in the* world and *to the* world: 'As the one who sees or touches the world, my living body is never capable of being seen or touched itself' (Merleau-Ponty, 1966, p. 117). In his book *Phenomenology of Perception*, Merleau-Ponty even argues that we would need a 'secondary body' to observe one's own body:

> I observe external objects with my body, I handle them, examine them, walk around them, but my body itself is a thing which I do not observe: in order to be able to do so, I should need the use of a secondary body which itself would be unobservable (Merleau-Ponty, 1966, p. 107).

In addition to this twofold aspect of the body (*Körper/Leib*), phenomenology stresses that our incorporative and disappearing body through which we perceive and act in the world must be ascribed a status as a fundamental 'zero point' (*Nullpunkt*) of all orientation towards the world. Husserl (1989, p. 274) notes that

> [t]he lived-body has acquired the object, that previously was there, on the right, left, near, far, in front of, and so on, in such a manner that it loses its thereness, suffers the loss of its mode of orientation, and enters into the zero point of experiencing.

First a Husserlian concept, the connection between embodiment and zero point has been present since the early days of phenomenology and designates an absolute, but perceptual 'here' to our placement in the world (Shimizu, 2011).

To VR research, these phenomenological considerations are especially intriguing. From the very beginning, VR research has been concerned with the question of what it means to feel being present in the (virtual) world (Heeter, 1992; Steuer, 1992). Besides dealing with the question of (virtual) presence, body ownership illusions (BOIs) have become a major paradigm used in VR research. BOIs are immersive experiences that produce body and perceptual illusions by presenting virtual information from a first-person perspective while users embody a virtual body (avatar). For many years now, the illusions of owning alien body parts or even feeling present in another person's body has been well researched (Riva et al., 2019). The first broadly known BOIs were the rubber hand experiments (Botvinick & Cohen, 1998), which created the illusion of owning a synthetic arm. With the help of virtual reality, this illusion has been further expanded to full-body ownership illusions (FBOIs) (Slater et al., 2009).

In summary, the special importance of FBOIs lies in the fact that they are able to manipulate the sense of having a body and thus alter the conditions of minimal phenomenal selfhood (MPS) (Blanke & Metzinger, 2009; Limakowski, 2009). Minimal phenomenal selfhood is defined as the most basic possible kind of self-consciousness or self-awareness. With regard to BOIs, the search for MPS asks, 'what are the minimally sufficient conditions for the appearance of a phenomenal self, that is, the fundamental conscious experience of being someone?' (Blanke & Metzinger, 2009, p. 7).

Here, it is assumed that identification and therefore the feeling of embodying an avatar is increased by a similarity in the visual appearance of the user and the virtual body (Murray, 1999). Recently, that could be confirmed by showing that both a higher degree of realism in the representation and the similarity of an avatar

> significantly increase virtual body ownership, virtual presence, and dominance compared to generic counterparts, even if the latter were generated by the same photogrammetry process and hence could be valued as equal in terms of the degree of realism and graphical quality (Waltemate et al., 2018, p. 1651).

From there, it quickly became clear that VR offers more than the mere addition of alternative realities: 'VR is the representation of possible worlds and possible selves, with the aim of making them appear as real as possible – ideally, by creating a subjective sense of "presence" in the user' (Madary & Metzinger, 2016, p. 18). Since then, VR research has shown that the (playful) adoption of another body can be accompanied by altered self-perception and perception of others. Many studies indicate a great potential for the use of VR in relation to embodiment research (Ahn et al., 2013; Slater & Sanchez-Vives, 2014). For example, one research group succeeded in manipulating the subjective localisation of the body of their subjects (Lenggenhager et al., 2007). With regard to intersubjectivity, studies in VR show that embodying a different avatar can result in increasing empathy and affection for the group of people depicted (Falconer et al., 2014; Heeter et al., 2020). Further studies show that embodiment of another gender (Slater et al., 2009) or different age (Banakou et al., 2013), or different skin colour (Peck et al., 2013; Maister et al., 2013) may lead to similar illusions of embodiment.

Concerning the questions in this article, we have to clarify the difference between the experience of feeling embodied in another person's body and in a fictional avatar. That question arises because VR can not only offer alternative views on relations towards oneself and the world, but also allows users to experience being someone else by 'stepping into the shoes' of the first-person perspective of another real person or avatar. Even though this is very new territory even for VR research, in this regard we are following Gerry (2017), who differentiates between these two possibilities along the question of whether or not the embodiment setup encourages an awareness of the other *as other*.

In using avatar setups, 'the user is not directed towards the avatar as another, but instead controls the avatar-other like a puppeteer exploring his or her own actions and embodiment' (Gerry, 2017, p. 40). In this way, avatar embodiment could be personally meaningful and involve strong emotions, but there is no real other to understand. This view is also shared by Klevjer (2012, p. 20), who asks: 'How can avatarial embodiment be both a kind of extension and a kind of re-location at the same time?'. Regarding video game avatars, to Klevjer embodiment in virtual worlds seems to be something different from just a physical body extension:

> unlike cars and walking sticks and pianos, video games extend our bodies across a material divide, into screen space. This material gap is a major complication, which obviously Merleau-Ponty does not address (2012, p. 24).

Compared to avatar embodiment, embodying another person's body should imply the 'recognition of the alterity of another and sharing of bodily and agentive experiences to foster positive regard for the other' (Gerry, 2017, p. 40). To Gerry, the goal of 'virtual alterity systems', as she names them, is to make the user curious about the other, asking themselves how it would be being someone else who is different from oneself.

Surprisingly, on paper this is exactly that principle of a 'secondary body' as well as the manipulation of the 'zero point' of orientation which TMBA promises to provide. With the help of the embodiment system, users should be able to feel present in the other person's body and see their own bodies in real time from the perspective of a secondary body, i.e. another person's point of view.

Method

To fully understand how a user experiences that kind of body swap in VR and in order to identify the 'phenomenological dimensions of the technologically mediated body" (Balsamo, 1993, p. 123), we need to build up a rich phenomenology of user embodiment. For that, this study uses a qualitative approach to the perception of virtual embodiment. In particular, we used questionnaires and a semi-standardised interview as measuring instruments. The questionnaires collect demographic data as well as self-assessments on body awareness (Mehling et al., 2018) and empathy (Mehrabian, 1996). In the interviews, the participants were asked about their experience during the performance, e.g. whether and to what extent the impression of feeling present in the other person's body was achieved. This data allows us to reconstruct the individual differences in using VR (see Harth et al., 2018). The method of analysis is the documentary method (Bohnsack, 2010) and distinguishes between the intentional expressive meaning and the documentary meaning of communication. Therefore, the qualitative approach does not aim at statistical saturation, but at showing typical (as in typology) statements and propositions, which may underline, question or even challenge phenomenological tradition.

Participants

A total of 30 people (19 female, 9 male, 1 diverse, 1 unassigned) with an average age of 32 years participated in the study. Conditions for participation were a minimum age of 18 years, as well as the exclusion of serious physical diseases, implanted medical devices or mental illnesses. Participants were recruited by an online event management software (Eventbrite) and the university's website. All names of the participants were anonymised according to the usual procedures of qualitative social research.

Material

For this study, the VR performance called 'The Machine to be Another' (TMTBA) was used to enable two users to exchange their perspectives for a so-called body swap. The concept was first developed by BeAnotherLab (see http://beanotherlab.org). In order to carry out the study, the principles of TMTBA were reproduced in the 3D engine Unity. In addition to the original setup, we enhanced the technical system with 3D video feeds by using stereoscopic 3D cameras (ZED Mini).

The participants were equipped with an Oculus Rift CV1 VR headset, whose screen showed the live video feed of the 3D camera on the other participant's headset. This enabled the participants to see each other's bodies and the environment from the other's perspective (see Figure 1).

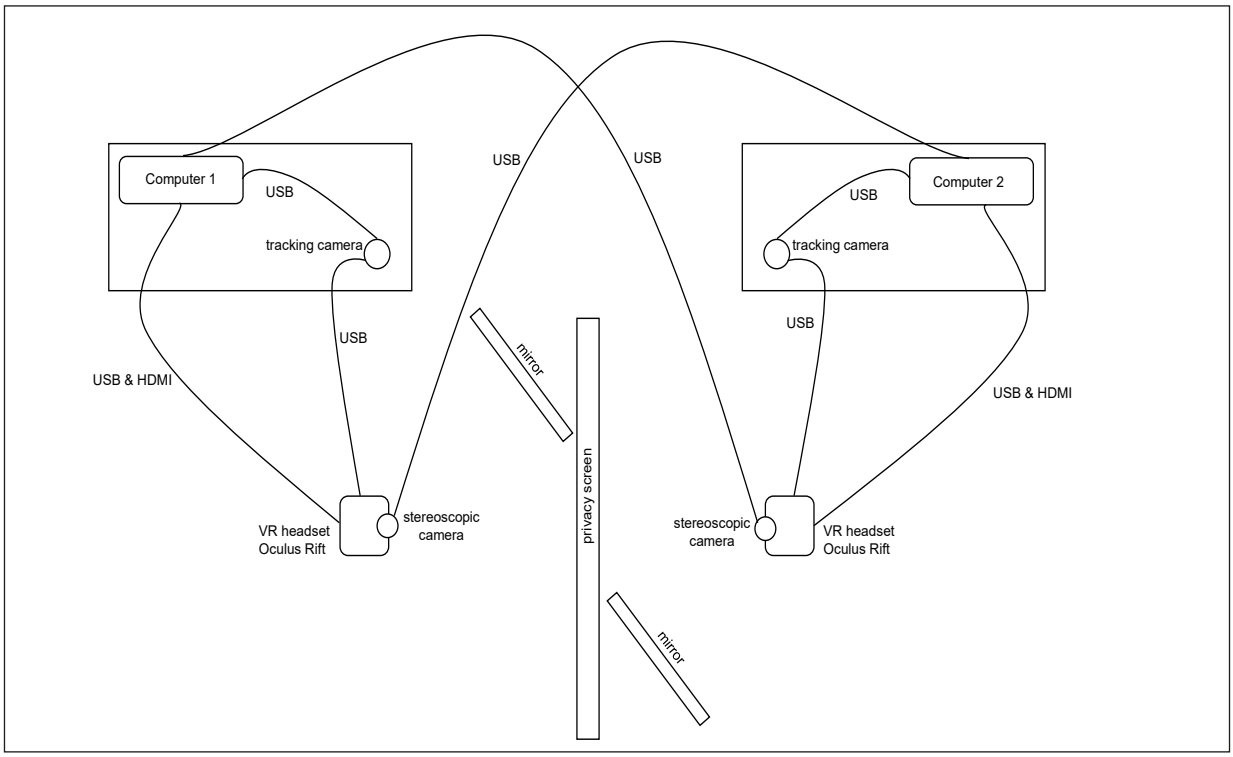

FIGURE 1: Schematic representation of the technical setup

Data collection and analysis

The demographic data as well as the self-assessments regarding empathy and body awareness served primarily to contrast the qualitative data of the interviews. However, the analysis of this data does not show any general tendencies or correlations. That is why the two quantitative constructs have been neglected in the following analysis. Rather, the semi-standardised interviews with an average duration of about 20 minutes serve as primary data for this study.

Procedures

The performances took place on 25 January 2020 in the facilities of the Akademie für Theater und Digitalität in Dortmund, Germany. Each performance lasted about 20 minutes and included four sequences. The performance followed a fixed structure and was supervised by two assistants to ensure comparability.

At the beginning of the performance, both participants sat on chairs and were separated by a privacy screen. It was pointed out that they should move at the slowest possible speed so that synchrony between their own body movements and the visually perceived body movements could take place as perfectly as possible (Bertrand et al., 2014).

Exploration: In this short first sequence the participants should get used to the VR system. Here, they were able to freely explore their own and the other's movements of head, hands and body.

Touch: In the second sequence, the assistants gave the subjects external tactile feedback by touching the hands of the subjects at the same time ('high five', synchronous stroking over and tapping on the hands). Finally, both subjects were instructed to stroke their thighs up to the knee at a slow speed.

Object manipulation: In this sequence, the assistants handed the subjects a tennis ball. At this point, the participants were free to move and act at their own pace. After the tennis ball was taken away, the assistants held a large mirror (approx. 40 x 50 cm) in front of the subjects' bodies.

Face to face: In order to remove the separating screen, the VR displays were briefly darkened. By fading the image back in, the participants could now see their own body sitting in front of themselves (from the perspective of the other person, see Figure 2). In this sequence, the subjects were allowed to move their hands and arms freely.

FIGURE 2: When the screen is lifted, the participants are able to see themselves sitting in front of each other

After about five minutes, the displays were dimmed again, and the subjects were asked to take off their VR headsets and the interview was conducted.

Empirical data

The analysis of the material clearly shows that the VR experience left some strong impressions on the participants. These impressions mainly relate to two aspects: 1) alterations of the usual perception of the body; and 2) alterations of the usual perception of oneself and the other. The empirical findings with regard to these two aspects will be presented in the form of typical statements from our sample.

Alterations of body perceptions

The first question in each interview focused on the general description of what the participants experienced during the performance. A very typical reaction to the question was:

> **Mary:** *I got much higher quality than I expected first of all. That was impressive and it went pretty well for me that that immersion was there. VR is always a risk that motion sickness and especially with this overlapping depth* [sic]. *So, I think it is a product, it is well prepared, and the impact was there like we were really like: 'Who is this body? This looks like mine, but it's not, but it feels like mine.'*

In almost every interview the participants expressed their surprise about the effect of TMTBA. Almost all subjects experienced at least a strong feeling of being present in the other's body. This sensation coincides with our expectations and confirms existing research on full-body illusions.

In the case of Mary, who is a VR-experienced subject and works professionally with VR, the experience of the body swap led to the perception that she could no longer clearly distinguish between her own body and the body which she saw. As she notes, she felt as if the seen body was her own body, although she rationally knew that it could not be. As we will show, many other participants also struggled when they tried to put their experiences into words.

Already, in this first passage, we understand how difficult it is for the test participants to express their perceptions precisely. Rather, in the case of Mary, she varies between the categories of a real and virtual body as well as between the difference of visual input and proprioceptive input. Her reflection on this contradictory experience leads her to the significant (and title-giving) question 'Who is this body?'. This particular question shall guide our further exploration of the participant's experiences in embodying another body.

We can find a very similar first reaction in the interview with Carla and Bettina:

> **Bettina:** *I had the headset on, and it was completely crazy that from the beginning I thought: 'That's me'. So, I saw my hands and felt the weight in my legs and did not even realise that my trousers had a different colour. Yeah, I thought it was really crazy.*
>
> **Carla:** *In addition, I would say that some kind of contact has taken place where I simply do not know, so: Who did I actually meet there? Have I met myself, have I met another person, or what?*

Both participants were immediately confused by the fact that they could no longer easily decide which body they inhabited. Bettina took the virtual image she had seen for real. Thus, she expressed with the notion 'That's me' both her reassurance that one must not mistrust one's own perception as well as her astonishment that at the same time this perception cannot be true. Once again, rationality and feeling, reflection and perception collide. In addition to the abovementioned fluctuating categories, we may find the first indications in the differentiation between *Leib* and *Körper* – or different body images. Here, it seems that the well-known quotation 'seeing is believing' (Murray, 1999) becomes quite literal.

In the case of Carla, she seems to have felt embodied as well, but asks herself, whom did she 'actually meet' during the performance: Did she meet herself or someone else? The case of Carla stands as an indication for the initiation of a reflexive state of mind that is scrutinising its own body schema. The swap of perspectives and the feeling of being present in the other's body leads Carla to a distancing experience towards herself. This leads us to the question: what exactly happens from a phenomenological perspective when you are able to observe yourself through the virtual eyes of another person? What else could that be but a 'secondary body' which Merleau-Ponty denotes as essential for a deeper understanding and insight into one's own lived body? Fortunately, it is Merleau-Ponty who gives us the first indications on how perceptual belief (*foi perceptive*) functions as a necessity inherent in all our perceptions:

> We see things for ourselves, the world is what we see: Phrases of this kind are the expression of a belief shared by the common man and the philosopher as soon as he opens his eyes; they refer to a deep layer of mute opinions inherent in our lives (Merleau-Ponty, 1966, p. 17).

But how and to what extent could these (virtual?) sensations be taken for granted, or taken for real? For this question, it makes sense to further expand on the distinction between a 'sense of ownership' and a 'sense of agency' (Dolezal, 2009). While a sense of ownership confirms that it is you who has a certain experience, the sense of agency establishes the impression that you are also the author of the underlying action:

> However, agency and ownership of action are two phenomenologically distinct aspects of an experience. It is possible to have a sense of ownership of an action or movement without a sense of agency (Dolezal, 2009, p. 218).

Concerning the embodiment system, TMTBA, we have to relate Dolezal's concept of agency to the concept of synchrony because only through synchronous movements of the real (own) and the virtual (other person's) may body agency occur.

That leads us to the case of Lisa and Vanessa, where a sense of agency, at least temporarily, has occurred. This performance was quite special because Vanessa was exceptionally adept at following Lisa's movements. Therefore, for Lisa, the performance seemed more like puppeteering an avatar than a symmetrical interaction:

> **Lisa:** *So, my first feeling that emerged was actually curiosity. So, 'Oh yes, I can!' Because I noticed this synchronicity, that we were very synchronous. I was like: 'Oh yes, I have another body, cool! I can see how it works'. As if I just have my body now, but I have a layer*

> *or a wetsuit or something over it, right? So, this is how I had the perspective for me. So, as if I have a new skin and I can see how the world is from the perspective of this other body, right?*

Due to Vanessa's extremely synchronised movements, Lisa was able to flawlessly immerse herself in the body illusion. Her saying 'Oh yes, I have another body, cool!' indicates that Lisa could at least temporarily experience a very strong feeling of presence in Vanessa's body. Vanessa's synchronous movements created a sense of agency, which is indicated by Lisa's notion of how she 'can see how the [body] works'. Here, the embodiment aspects of 'I can', as well as the aspect of 'I have', are coming together. Synchrony establishes agency, and agency establishes embodiment. In Lisa's words, both aspects of embodiment – the aspect of 'I can' as well as of 'I have' – come into play. Nevertheless, Lisa's metaphor of a 'wetsuit' suggests that she still felt the other body more like a second skin that she wears but does not own.

As a result, Lisa is stuck in experiencing a duplicated body image. Here, we have to assume that this is a general effect of VR systems because at the current state of VR technology, virtual embodiment always has to vacillate between two spheres of being present. It is exactly this, what Penny (1994, p. 242) calls the 'split body condition' or the 'double body'. But we could assume that this duplication indicates the general question of phenomenological embodiment: What does Lisa's experience of a double body means for the distinction of the subjective and the objective body?

In any case, it becomes obvious that even in the best case of synchrony and visual similarity, the participants still feel a difference between seen and lived body. Again, this could of course only have been the case because of technical restrictions (stuttering image, video resolution, restricted field of view, etc.). However, we assume that a fundamental difference between embodied perceptions (seeing versus feeling) is revealed here: To a certain extent, the experimental crisis of perception that TMTBA induced seems to stress and question the participant's body schema.

In the case of Larissa and Andreas, for example, the collision of the visual and tactile cues made it difficult to put the feeling of being present into words:

> **Larissa:** *But yeah, especially with the ball* [laughing], *I really thought it was such a middling impression. Because I am not in my body, but I am of course not in the other one either, so it was like right in between. And that is what the movement does. So, straight when you pass the ball from one hand to the other and then like: 'Huh, how? I feel that, but I definitely don't see my hand'. That was really the middle feeling.*
>
> **Andreas:** *Yes, I find that an amazing description. Because in the end I think it was exactly that feeling: not being in your own body anymore and not being completely in the other body, but more like being in an open space. Like bodiless suddenly. That is it really, I think.*

It becomes clear that Larissa and Andreas could also not feel (completely) present in the other body. Both address the feeling of 'in between' to the discrepancy of visual and tactile feedback. According to Husserl, we should attribute the differences between the visual and the tactile area to the fact that in tactile perception the body not only perceives something, but also always feels itself. Unlike a visual (or auditory) perception that I can share with others, the feeling of touch is always unmistakably mine. For Husserl (1989), touch thus becomes something like a new Cartesian ground for the fundamental constitution of an ego.

But is not it exactly this that the performance of TMTBA tries to induce? According to the experiment's procedures, the visual illusions should ideally be supported by a synchronous touch. In case of success, the visual and tactile experience should be brought together, so that the illusion of the body swap becomes temporarily perfect. In the case of non-synchronicity, the visual and tactile illusion breaks down and the ego constitution remains in one's own – perceptible, touchable – body. In reference to that unbridgeable chasm between the objectifiable (touched) body and subjective bodily sensations, Merleau-Ponty speaks of an asymptotic approach in which the bodily subject would be both perceptive and perceived at the same time, but always shifted to one side or the other. Again, we can find these kinds of oscillation in the participants' statements when they report about experiencing points of transitions, or tipping points between visual and tactile cues towards a virtually expanded body schema.

Interestingly, however, in the case of Larissa and Andreas, this uncomfortable feeling of disparity does not result in a rejection of the virtual image as a mere simulation. They rather report a third place which exists in addition to their own and the other's body. Both participants describe it as a 'middle feeling', a feeling of being 'in-between' (later, in the interview, Larissa calls it an 'experience of being in-between'). Andreas even describes it as some kind of disembodiment: 'Like bodiless suddenly'. According to him, he was feeling present neither in his own body, nor in the other body.

Again, it becomes clear how TMTBA functions as a breaching experiment in regard to perceiving similarities *and* differences between the living body and the virtual body. This can be concluded from the fact that many test subjects were searching for new words, for neologisms, to describe their new sensations and feelings. For it is clear, especially from a phenomenological perspective, that language is not just a sign of thought. Rather, thinking is in language and language is in thinking; they circularly enclose each other: 'Thus for the speaker the word is not merely the translation of already finished thoughts, but that which first truly accomplishes the thought' (Merleau-Ponty, 1966, p. 211). Maybe then, it is exactly this search for new words which aims at understanding one's own thoughts, feelings and experiences. In speaking about the experience, the participants are reassuring, reassessing and reproducing their quite new and unique experiences from just some minutes before. Where neologisms are sought, where the familiar language fails, it becomes particularly interesting because what cannot (yet) be said, cannot (yet) be thought.

Alterations of self- and other perceptions

The unique feature of the VR performance 'The Machine to be Another' is that it not only provides the opportunity for full-body illusions, but also a new perspective on your own body. As noted in the procedures, in the second half of the performance we removed the privacy screen between the two subjects. From

then on, the participants could each see their own (real) bodies sitting in front of them – from the other's body perspective. Correspondingly, the participants' reactions to this were full of amazement and surprise:

> **Lisa:** *Yes, so the first impulse to see myself was like this: 'Oh, oh. Okay. What is that?' or 'Who is that?'*
>
> **Vanessa:** *Well, I found it a lot more unpleasant to see myself than to be in your body* [laughing]. *So, for me that was a total switch. I felt really good before and thought it was really cool and when I saw myself, I thought* [laughing] *I thought it was really awful.*
>
> **Lisa:** *I was like, 'Oh, my God.' It's like when you recognise yourself in a photo and you're like, 'Huh?' And then I found it really interesting, because I know that from photos or when you see yourself in a video and you see yourself talking like this and you think like: 'Oh God'. But then I saw myself in the movements I was doing and then I thought: 'Oh, ah yes', so my – really my thought was like this: 'Oh, actually you are a really nice person* [laughing]. *How you are sitting there right now'* [laughing].

The surprise expressed in Lisa's impulse 'Who is that?' obviously arises from the unfamiliar experience of seeing herself from outside of her body in real time. Similar to the third-person view of oneself and one's actions on a video recording, a feeling of distance to one's own self-perception is established. Again, we can find reflections on the participants' view on their body images. Quite different from observing oneself in a mirror, the VR experience provides a new degree of objectification of one's own body. Seeing your own body in front of you strongly implies a different location in time and space – a different (secondary) body.

While the alternative self-perception takes place from the first-person perspective of the other participant, we have to assume that Lisa's zero point of orientation becomes confused as well when being viewed or acting from a second-person perspective. This shift in Lisa's orientation results in a degradation of her self-evaluation ('*Oh my God'; 'really awful*'). Nevertheless, she quickly gets used to this new perspective and becomes more kind towards herself ('*Oh, actually you are a really nice person*, [like, how you are sitting there]'). However, the laughing at the end of the sentence seems to still indicate a distanced view of herself.

A similar experience of new self-perceptions happened to Leopold who performed together with his wife, Maike. For Leopold, the whole experience proved to be a 'crucial experience', as he says, of seeing the big physical differences between his wife and himself. This even goes so far that he develops a new perspective of his relationship. While Leopold usually identifies himself with what he calls a 'warrior' (he is rather tall and very muscular), the altered perspective from the eyes of his smaller wife leads to a strong change in self-perception. The change of perspective and swap of bodies enables Leopold to better understand his wife's needs as well as her view of herself:

> **Leopold:** *I often get the accusation that a certain emotionality is exceeded where I should be a bit more careful. And I think that has helped me a little bit right now...Yes. Here I am again at the point where I saw myself. I think sitting in front of me and having the feeling that I'm having a conversation with myself, or when I'm having a discussion with myself, and then listening from the background: 'Yes, you're terribly solution-oriented' and 'I only need to be emotional for five minutes' and 'Just leave me alone', I think that's the crux of the matter, where I think: Okay, wow you're literally talking to a wall then. In these discussions, I am neither physically vulnerable nor emotional...*
>
> **Maike:** *And because you now somewhat felt into me, so to speak, it helped you to understand?*
>
> **Leopold:** *Because I have for once confronted myself, so to speak, yeah. By seeing myself. Then I say: Yes, I have moved out of the position to empathise with you, and now I have just noticed how it is, being confronted by me.*

It is worthwhile to take a closer look at this 'crucial experience' which Leopold talks about. Leopold usually sees himself as an assertive, solution-oriented and physically unassailable man. For example, as he reports, he does not mind taking the dog for a walk in the woods at night. At the same time, his self-attributed traits are in stark contrast to the characteristics of his wife, who is rather small and slim and appears to be rather emotional.

Through the virtual swap into his wife's body and the inevitable taking of her perspective of himself, Leopold became aware of his effect on others – and especially his wife. He imagined, for example, how situations of dispute would be perceived from his wife's perspective: '*Okay, wow you're literally talking to a wall then.*' This new experience of an alternative view of his body leads to his crucial reflection on his effect on others.

This experience is consistent with the considerations of Moll and Meltzoff (2011), who define the taking of different perspectives as also the understanding that others may see things in a different way. Perspectives often originate from subjective persons, so perspective taking is not just about what is visible from a certain viewpoint, but also the thoughts and feelings *behind* that viewpoint. This is exactly what Leopold was able to experience during the experiment and TMTBA has made him take this alternative perspective on himself ('*and now I have just noticed how it is, being confronted by me*').

In Leopold's case, the use of TMTBA has thus enabled him to think about himself in a new way. However, it is clear that Leopold is not able to truly incorporate his wife's feelings. In the interview, he notes that he '*moved out of the position' and 'empathised*' with his wife. But this only happens as a simulation, as an imaginary idea of how his wife would *probably* feel – and not how she *actually* feels. Even the supposedly different view of oneself, as in the case of Leopold, always remains a view of one's own perspective. Leopold can indeed look at himself from his wife's point of view and imagine how she might perceive him, but he cannot determine how she perceives him precisely. With VR, we can see from another head's point of view, but we cannot see inside another's head.

Discussion

The breaching experiments conducted in this study attempted, so to speak, to outwit the distinction between virtual and actual body. The study itself focused on the (dis)ability of participants to differentiate between image and reality, between actual being and mere appearance. For this, we used the performance 'The Machine to be Another' which provides an immersive body swap that is supposed to enable new perceptions of the world and oneself. The use of TMTBA made it possible to simulate accessing the world through a virtual medium in a dual sense. While being immersed in the medium of VR, the participants inhabited the point of view of another person present in the same environment. But the adjective 'virtual' indicates the fact that these experiences of alterity stayed only temporary, only playful, only as an *as if*. In this way, it categorically differs from one's own corporeality, one's own lived body, which is our own inevitable medium through which we are in the world. One does not simply get out of one's own (material) body.

At the same time, this is exactly what we made possible in our study. At least in principle – by being able to take the perspective of another person's view, a new view of oneself is created. That is why we have to come back to the article's title and question of our participants: Who the hell is this body anyway, that I'm seeing the world from, if it's not my body? In exactly this encounter of contradictions, we can observe the participants when they come across the practical difference between living and objective body. In a certain sense, our crisis experiment questions the phenomenology itself as to whether it is adequately elaborated for today's technical conditions. The questions of 'Who is this body?' (Mary) and 'What is that?' (Lisa) both refer to the same goal of anchoring: Who or what is this body that I am supposed to inhabit here as a living body? Who or what should this body be that I see sitting there objectified in front of me? And from which fundamental perspective/embodiment/modality can I even ask this question right now?

Nevertheless, despite these virtual extensions of the body schema, nobody is able to overcome the physical body, yet. So, the view of oneself – through the eyes of the other – is still a view with one's own eyes, one's own perceptual apparatus and one's own embodied knowledge. Only then, can we establish the virtual embodiment of the other person's body as an extension of the accustomed embodiment – and not a 'real' swap of bodies.

Only with Leopold, so it seems, does a temporary shift of the usual zero point of orientation seem to occur. He is able to see the world in a different light through the virtual eyes of his wife – and this includes himself, his own body. The virtual embodiment in his wife's body creates a change in the modality of his orientation towards the world. Through the new point of view, he gains a new way of objectifying himself, his body schema and his presence in the world. Through TMTBA, Leopold gains a new way of accessing the world, which – from the other person's point of view – includes himself/his body.

However, concerning previous research on FBOIs we can confirm that in most cases the participants had – for at least a few moments – the feeling of being present in the body of the other person. Even though expected, this already is an important result and confirms Merleau-Ponty's insight 'that we are able to understand something that goes beyond what we thought of ourselves' (Merleau-Ponty, 1966, p. 212). The empirical data of our study so far gives phenomenologically rich answers to the question on how virtual embodiment experiences in another person's body are perceived. All together, we were able to reconstruct three types of embodiment experiences: 1) temporary full-body illusion; 2) collapsing of the embodiment illusion; and 3) the experience of an intermediate embodiment, feeling present neither in their own nor in the other's body.

Most of the participants succeeded easily in aligning the virtual body of the other person with their own body. Consequently, they experienced what is called full-body illusion (Slater et al., 2010). In general, this feeling of presence was accompanied by the feeling of disembodiment from one's own body. However, the full-body illusions did not last long because of desynchronisation between visual and actual body or because the participant used reflective distancing. This collapse of illusion, this shift back to the actual body was described as a memorable experience itself. Here, we may be able to see at work the Cartesian ground that Husserl pointed out: even if 'seeing is believing', in case of doubt, touch wins over visuals.

The third variant mentioned by our participants is of particular interest: the experience of a 'disembodied' state, or a feeling of being present 'in between'. Due to the switches of embodying both the visual and the physical body, some of the subjects had the feeling of being completely disembodied. This feeling, which was described in the interviews as 'neither being the other body, nor one's own', but as an 'in-between experience', is – according to our knowledge – not yet found in research on out-of-body experiences (Blanke & Metzinger, 2009).

In all three variants (full-body illusion, breaking of illusion and disembodiment) we can identify shifts and transformations of the body schemata, maybe even the zero point of orientation. The virtual expansion of the body schema is a testimony to the elasticity of the body. From a phenomenologist's perspective, this is somewhat expected, because embodied subjectivity does not stop at the boundaries of the skin, but is extended as 'being toward the world' (Merleau-Ponty, 1970). Here it becomes obvious that the MTBA is not about only *one* user owning the body of another. Rather, it is about working together as a team in an emergent process of mutual understanding, convergence and connection. TMTBA is a performance that aims at shared agency, shared transpositions of perspectives and shared knowledge about being embodied in the person's body. The experience of 'unison' that appears during the performance is then proof of the social element in the relational system of embodiment.

In the aspects of phenomenology, this break of immersion can be traced back to the lack of feedback, which is based in the well-known example of 'double touch' (Husserl, 1952). If one's right hand touches the left, the latter appears as a palpable object offering resistance to the right hand's touch (i.e. as *Körper*); however, through a change of attention, it can also become a feeling hand, that is a part of the bodily subject (*Leib*). Applied to the virtual performance, we immediately see that the feeling hand never changes – even though it might look different in the virtual image. In the virtual double touches during TMTBA, there was no embodied difference. Even when the hand looked significantly older or younger, the sense of touch would stay unaltered.

Therefore, the change of perspective is an imagining, while being in their own bodies at the same time. From the perspective of relational phenomenology (Vogd & Harth, 2019), it is clear why this cannot succeed: The circularity of mind and body is

not interrupted but only mixed up by the perception of the virtual embodiment. Or, as Zahavi stresses, we have to conclude that the subjective body (*Leib*) always precedes the objective body (*Körper*). That is why the virtual body as a spatial object is 'dependent upon and made possible by the prereflective functioning body-awareness' (Zahavi 1999, p. 104). It is Husserl's constitutional concept of tactile feedback that fundamentally grounds every perception of *Körper*. Even for Merleau-Ponty, the body is fundamentally defined by its motor activity, which means not only that the body is capable of movement, but also that the movements of the body itself in turn structure and shift space and time.

Following Merleau-Ponty (1986), we can confirm that movement 'reveals' being. For it is not being or consciousness that creates movement, but rather being (or consciousness) is revealed through and in movement. It is movement that provides the body with its unity of being a body that perceives the world and having a body that is in the world:

> The movement experience of our body is not a special case of cognition; it opens up a way of access to the world and to objects, a 'praktognosis' that can be recognized as independent, perhaps even as primordial (Merleau-Ponty, 1966, p. 168).

Through the unity of movement and the body schema, we get a glimpse of the structure of our being in the world, but only a glimpse, because both stay invisible and inaccessible to the subject (Merleau-Ponty, 1986). Here, the negativity (non-visibility) of the body schema (as a medial interface towards the world) becomes the blind spot of the sensual world par excellence. The visible body has an invisible condition, the perceived body an unperceived condition: 'The same Body which serves me as means for all my perception obstructs me in the perception of itself and is a remarkably imperfectly construed thing' (Husserl, 1989, 167).

Limitations and further research

With this study, we can confirm that visual perception alone is able to create convincing body illusions and thus enable a temporary illusion of being present in another's body: 'In sum, there is compelling evidence that BOIs interfere with the representation of one's body' (Limanowski, 2014, p. 1). However, the illusion of embodiment only works when it comes to immovable or synchronous moments, because only then does the visual information correspond to the tactile or proprioceptive information (Fuchs, 2014). In comparison with the bulk of VR studies using fictional avatar embodiment, the big difference is that the avatar movements react latency-free according to the user movements. The latency-free simulation is the main criterion for the successful immersion in a virtual environment, i.e. a strong feeling of being there (place illusion), being with (social presence) or being as (body ownership). In our data, we can find similar results: the illusion of being spatiotemporally transposed leads to an alteration of minimal phenomenal selfhood, but immediately breaks when the other's body moves without synchrony (and the illusion of agency falters or disappears accordingly). The other way around, minimal phenomenal selfhood increases even more when ownership and agency come along. Therefore, even though the performance successfully initiated the sense of ownership, it lacked an elaborate solution for producing a sense of agency. This would require either a much more sophisticated tactile feedback system or a more reliable system for achieving synchrony.

As mentioned before, FBOIs are usually thought to be triggered by two types of factors: 1) synchronous visual, motor, and tactile sensory inputs; and 2) similarity of form and appearance. While the first aspects are mainly achieved through technical advancements and solutions, the latter are thought to be related to the conceptual interpretation of the observed virtual body parts (Waltemate et al., 2018). Slater and Usoh (1994), too, argue that a high correspondence between proprioception of the physical body and other (visual) sensory data of the virtual body make it more likely that a VR user will identify with the virtual body and experience a greater sense of presence in the virtual environment.

Nevertheless, this intervention in perception can lead to the practice of multiperspectivity and to new ideas about oneself and others (Zahavi, 2008). In our sample, Leopold's case demonstrates this most impressively. He succeeds in alternatively perceiving being perceived, which leads to a difference in his thinking and feeling. At the same time, it is evident that this change in his own ideals stays only temporary and imaginative. Neither Leopold nor any other subject was able to reach the actual 'thinking and feeling behind that viewpoint' (Lindgren, 2012). In the end, we have to conclude that nobody can see his or her own body *as others do*, and it seems relatively clear that – even with advanced VR – we still need the other to attain awareness of ourselves as a body subject.

For further research, the clear differentiation between imaginary selfhood, virtual selfhood and real selfhood appears imperative. What difference does each type of selfhood make to the underlying body image and how could we elaborate on the quality of these differences? Here, we see the first indications in the possible conceptualisation of the virtual body as a virtual medium, an alternative bodily modality that leads us – through its difference – to more insights on how we perceive the world and the world's significance towards us.

This would make it much easier to clarify that there are more possibilities within the body than culture provides. VR technology reveals to us that there is some kind of surplus in our bodies that has not yet been completely realised. Especially in view of technological progress, the need to answer these questions seems increasingly urgent, while at the same time becoming increasingly difficult to answer. That is because of the cyborg's dilemma, which Biocca (1997) has foreseen: 'Choose technological embodiment to amplify the body, but beware that your body schema and identity may adapt to this cyborg form'. Experiences like TMTBA challenge the phenomenological idea that our sense of bodily presence is essentially anchored in our physical or objective body as we know it, and seem to potentially expand our notion of what bodily presence can mean.

Even in the early days of VR development, Jaron Lanier commented on the fuzzy distinction between the body and the world in VR:

> How are you connected to the world? What if your eyes were on your fingers? What if you took all the measurements and the movements of your physical body and somehow put them through a mathematical function that allowed you to control six arms at once with practice (Lanier & Biocca, 1992, p. 158).

With these not yet fully achieved possibilities in mind, it becomes even more obvious that the participants' amazement about the possibilities of TMTBA are nothing less than the enjoyable sabotage of ordinary presence. We are certain that VR still offers more untapped treasures in respect to recognising the richness of ourselves, our body and the world around us.

Alas, the promise of VR to not only swap bodies with another person, but also to better understand the others' way of thinking still has to be put into practice. Therefore, we can conclude that VR is useful in order to represent others' perspectives and even offers promising tools to mitigate stereotypes or prejudices (Cebolla et al., 2019; Ventura et al., 2020). Unfortunately, today's VR setups lack a focus for a deeper understanding of walking in another's *mental* shoes. These kinds of experiments would have to make elaborate use of another's experiencing, thinking and feeling. However, how could this be made accessible?

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Ethics statement

The study is based on the 'Code of Conduct for the Ethical Use of VR' (Madary & Metzinger, 2016) and was approved by the Ethics Committee of Witten/Herdecke University (Approval Number: 227/2019).

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