Utilizing the Proteus effect to Improve Interactions Using Full-Body Avatars in Virtual Reality

Martin Kocur
University of Regensburg
Regensburg, Germany
martin.kocur@ur.de

Niels Henze
University of Regensburg
Regensburg, Germany
niels.henze@ur.de

Valentin Schwind
University of Regensburg
Regensburg, Germany
valentin.schwind@ur.de

ABSTRACT

Virtual Reality (VR) allows us to perceive the world through any possible embodiment – *the avatar*. Behavioral changes due to the strong bond between the user and the virtual avatar is known as *Proteus effect*. Previous work found that the Proteus effect occurs when characteristics of the appearance are associated with knowledge and experiences gained by anticipated entities or stereotypes. Based on the findings that the Proteus effect can trigger behavioral changes, we hypothesize that the appearance of an avatar in VR can be manipulated in a way that users will perform tasks better than they would perform them using their real or any casual embodiment. As one of the most important human behavioral characteristics is exerting force, we are planning to conduct a study investigating if muscular or slim avatars are able to change physical forces of the physical self. Our hypothesis is that people will apply more force when they interact in a more powerful-looking appearance. An effect would have far-reaching consequences and implications for the interactions with avatars in HCI and VR.

KEYWORDS

Proteus effect, body ownership illusion, virtual embodiment, motion capturing, virtual avatar

1 INTRODUCTION AND BACKGROUND

Inducing the Proteus effect by transforming the self-representation is shown in previous work [8]. Yee et al. investigated in a one-on-one talk scenario in VR if the attractiveness of the embodied avatar affects our behavior in terms of interpersonal distance and self-disclosure [9]. Results indicate that we behave more self-confidently in the body of a more attractive avatar.

They show similar results in a second experiment where they manipulate the height of avatars as height is associated with self-esteem and competence. In a VR bargaining task, taller participants behave more confidently and perform better in negotiation. Consequently, the visual appearance of our embodiment affects our behavior.

There is further evidence in recent experiments where implicit racial bias against a particular group of people is decreased by embodying a member of this group [3, 4]. Furthermore, being virtually represented by *Albert Einstein* as a stereotype for superior intelligence improves cognitive task performance [1]. Not explicitly related to the Proteus effect but highly relevant in context of our research are findings how shape, size, and pose of avatars not only have consequences for self-perception but also social implications [2, 5, 7].

Results of previous work indicate that virtual body ownership illusion not only evokes perceptual but also behavioural and attitudinal changes. Despite previous studies, the underlying mechanism causing the Proteus effect has hardly been explored. Therefore, it is our research goal to gain a better understanding of the Proteus effect and its implications for HCI. As the effect can trigger behavioral changes, we focus on the general question if the effect can be utilized to improve task and input performance of users in VR.

One main characteristic of behavioral changes is exerting forces through the proprioceptive system. As first step in our research, we investigate the question if inducing the Proteus effect using avatars with different muscular appearance can affect a user's applied physical force.

2 PLANNED EXPERIMENT

We want to take advantage of the possibilities in VR through manipulations of the user's virtual body to investigate if behavioral changes caused by the Proteus effect can be altered in a way that users with their virtual avatar will put more effort into physical tasks when their virtual appearance indicates to be stronger. We are planning to conduct an experiment using implicit and explicit force measures using

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a within-subject design with the single factor Body with the two levels *muscular* and *slim* (see figure 1).

We induce body ownership illusion by substituting the person's real body through a muscular or slim virtual body in VR using a head-mounted display. The participants see their virtual body and the environment from first-person perspective. Furthermore, we enhance the feeling of body agency by visuomotor synchrony. Participants' real movements are captured with Optitrack motion capturing[1] and transferred to the virtual body. When a participant moves a body part the equivalent virtual body part is moving synchronously. We include a virtual mirror into the virtual environment so that the participant constantly perceives the virtual body as its own. Hence, we will measure explicit grip strength through the maximum isometric strength of the hand and the forearm through a force measuring device called dynamometer to quantify the participant's real physical power.

In addition, we implicitly identify the *Just Noticeable Difference* (JND) in a two-alternative forced choice task (2AFC) for weight perception to investigate the sensitivity to weight. We will use constant stimuli in which the participants will estimate weight pairs where one always has a constant weight. Participants must decide which of the two weights appears to be heavier. As the JND stands for the amount of a change in a stimuli to be detectable and noticeable, we assume that JND while embodying a muscular person differs from JND while embodying a slim person. This idea is based on previous work [6], which investigated the effect of virtual limb-ownership in a visual-haptic integration task and found an effect of a hand embodiment on JND. However, we assume to trigger a stronger body ownership illusion by not only focusing on hands but also integrating the entire body.

3 UTILIZING THE PROTEUS EFFECT

Based on the findings from this study, we plan to conduct further experiments. Utilizing the Proteus effect would have wide implications on the design of optimized full-body avatars for improved interactions in VR. We aim to conduct studies to investigate an additional component influencing the Proteus effect: the external perception of others in collaborative VR. Inspired by Banakou et al., we plan to investigate the individual effects of a body swap on cognitive performance and general behavior [1]. As virtually being Einstein improves cognitive processing in a solo task, we want to analyze the effect on a cooperative task in a teamwork scenario and a competitive task with a second person represented by a casual avatar.

Basically, our main goal is to identify and understand the underlying mechanism triggering the Proteus effect. We assume that repurposed illusions through implicit manipulations using full-body avatars can deliberately be used to cause behavioral changes and, thus, be utilized to improve interactions through immersive and collaborative applications.

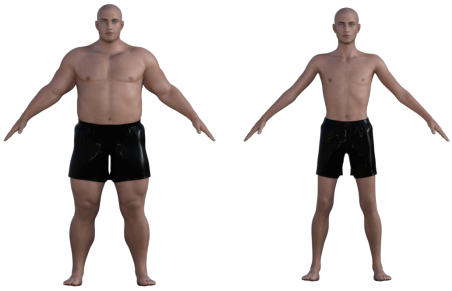

Figure 1: Muscular (left) and slim (right) avatar men created for our experiment.

[1] https://optitrack.com/

REFERENCES

[1] Domna Banakou, Sameer Kishore, and Mel Slater. 2018. Virtually being Einstein results in an improvement in cognitive task performance and a decrease in age bias. *Frontiers in Psychology* 9, JUN (2018). https://doi.org/10.3389/fpsyg.2018.00917

[2] Sally A Linkenauger, Betty J Mohler, and Dennis R Proffitt. 2011. Body-Based Perceptual Rescaling Revealed through the Size âĂŤ Weight Illusion. *Perception* 40, 10 (2011), 1251–1253. https://doi.org/10.1068/p7049 arXiv:https://doi.org/10.1068/p7049

[3] Lara Maister, Natalie Sebanz, Guenther Knoblich, and Manos Tsakiris. 2013. Experiencing ownership over a dark-skinned body reduces implicit racial bias. *Cognition* 128, 2 (2013), 170 – 178. https://doi.org/10.1016/j.cognition.2013.04.002

[4] Tabitha C Peck, Sofia Seinfeld, Salvatore M Aglioti, and Mel Slater. 2013. Putting yourself in the skin of a black avatar reduces implicit racial bias consciousness and cognition. *Consciousness and Cognition* (2013), 779–787. https://doi.org/10.1016/j.concog.2013.04.016

[5] Ivelina V. Piryankova, Hong Yu Wong, Sally A. Linkenauger, Catherine Stinson, Matthew R. Longo, Heinrich H. BÃijlthoff, and Betty J. Mohler. 2014. Owning an Overweight or Underweight Body: Distinguishing the Physical, Experienced and Virtual Body. *PLOS ONE* 9, 8 (08 2014), 1–13. https://doi.org/10.1371/journal.pone.0103428

[6] Valentin Schwind, Lorraine Lin, Massimiliano Di Luca, Sophie Jörg, and James Hillis. 2018. Touch with Foreign Hands: The Effect of Virtual Hand Appearance on Visual-Haptic Integration. *Proceedings of the 15th ACM Symposium on Applied Perception - SAP '18* (2018), 1–8. https://doi.org/10.1145/3225153.3225158

[7] Anna C. Wellerdiek, Martin Breidt, Michael N. Geuss, Stephan Streuber, Uwe Kloos, Michael J. Black, and Betty J. Mohler. 2015. Perception of Strength and Power of Realistic Male Characters. In *Proceedings of the ACM SIGGRAPH Symposium on Applied Perception (SAP '15)*. ACM, New York, NY, USA, 7–14. https://doi.org/10.1145/2804408.2804413

[8] Nick Yee. 2007. The Proteus Effect: Behavioral Modification via Transformations of Digital Self-Representation. *Journal of Experimental Psychology: General* 136, 1 (2007), 23–42.

[9] Nick Yee and Jeremy Bailenson. 2007. The proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research* 33, 3 (2007), 271–290.