先端科学技術研究科　修士論文要旨

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要旨

In this thesis, I explore how avatar embodiment in Augmented Reality (AR) impacts the Proteus effect. This is done through three studies with different experiment conditions. In the first study, I compare different perspectives (first person perspective (1PP) and third person perspectives (3PP)), different avatar age (young and elderly) and the impact on the Proteus effect in AR. In the second study, I investigate how two virtual avatars with different body shapes (regular and muscular) affect users' physical performance. In the third study, I examine the impact of virtual avatar transitions from a regular avatar to a muscular avatar. AR embodiment has little been explored, compared to Virtual Reality (VR), due to some technical challenges. Unlike VR environments, a user own body is visible in the real environment. In addition, tracking error and latency might deteriorate embodiment experience especially when the avatar body has different shape from the user real body. This is especially the case with 1PP AR embodiment, where the user can see their own real body with an AR avatar overlay from egocentric view. To deal with these technical challenges, I implemented a 3PP AR embodiment system which allow a user to observe the avatar from behind. In the presented system, a user real body was blurred (study 1) or completely erased (study 2 and 3). Furthermore, I employed several methods to examine the Proteus effect. In study 1, I measured the smoothness of walking and the time to walk in a certain distance to confirm the Proteus effect of an elder avatar. In study 2, I counted the number of lifting a dumbbell and hand-grip strength to measure the user's physical performance. In study 3, to evaluate the impact of the Proteus effect of a muscular-shaped avatar, I assessed the surface electromyography (sEMG) magnitude. As a result, I confirmed that the 3PP decreases the smoothness of walking during embodiment in study 1. In study 2, I discovered the muscular-shaped avatar appearance supports the immediate and prolonged Proteus effect. Finally, through study 3, I found that changing an avatar's appearance with visual feedback has a positive impact on retaining the sense of agency. In addition, the results showed that the impact of the immediate Proteus effect was boosted by an active transition with visual feedback. To conclude, the presented system is a promising tool to enable users to feel embodiment in the real environment and receive the strong Proteus effect, especially using a muscular avatar. The demonstrated phenomena might be used in AR training for sports employing a muscular-shaped avatar. Further, the impact of the Proteus effect for a muscular-shaped avatar could be applied to other areas which need physical tasks such as construction and logistics. In the future, I'll study an avatar's appearance change using an avatar with a different appearance such as a taller avatar. Furthermore, it will be important that future research investigate the impact of changing an avatar's appearance using other types of physiological sensors than sEMG sensors, such as electroencephalogram (EEG) and electrodermal activity (EDA).