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Visual Presentation For Sports Skill Lerning in VR

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Abstract

This paper describes the viewpoint suitable for sports training in virtual reality (VR). We compared first-person and third-person view in the accuracy of cognitive simulation and reproduction of the body part trajectory. From the third-person view, the participants were able to understand 66% of the whole body's movement, and from the first-person view, they were able to understand 52%. However, when observing complex movement such as position grasp of a forearm, the third-person view enabled memorization of the position significantly better than the first-person view. It was suggested that the viewpoint needs to be changed depending on the features of the sports.

CCS Concepts

• ***Human-centered computing*** → Human computer interaction (HCI) → Interaction paradigms → Virtual reality;

1. Introduction

It is easy to understand the intent of other person's sports movement, but it is difficult to imitate the movement of an expert precisely. VR has attracted significant attention as a way to transfer sports skills, because VR techniques can provide the expert's first-person perspective using a head mounted display (HMD) [HIM*05] [OK12]. The JackIn [KR14] framework which can switch viewpoint has shown that it is effective to daily activity.

However, there seems to be no established theory to explain the view point for sports skill transfer in VR. In this paper, we investigate the view suitable for the characteristics of the sports.

2. Viewpoint Comparison System

2.1 Devices

We implemented a viewpoint comparison system. An experts recorded the body movement using an optical motion capture system, OptiTrack. An avatar was installed, and it reflected the body movement using 3D rendering software Unity. The avatar model was created by measuring participants in 3D, and 3DCG software (MakeHuman). The participant observed the views through an HMD.

2.2 Views

As views for sports skill transfer, we compared the following three types: Coach's view, First-Person view, and Third-Person view. In each view, participants observed images recorded by a virtual camera. Coach's view is that the position and rotation of the virtual camera is consistent with the avatar's head. First-Person view is that position of the virtual camera is consistent with the movement of avatar's head, but rotation of the virtual camera is consistent with the rotation of participant's head detected by the HMD. Third-Person view is that the position of the virtual camera is three meters behind the avatar, and rotation of the virtual camera is consistent with the rotation of participant's head.

Figure1: *First-Person view (top), Coach's view (middle), Third-Person view (Bottom) in golf motion*

3. Cognitive Simulation of Whole Body Movement

3.1 Objective

To investigate the relationship between motion characteristics and viewpoint for sports training, we measured the cognitive recall rate of whole body motion after the observation of avatar's sports motion.

3.2 Participants and Procedure

The participants were 14 university students (mean age of 23 years old). They sat on a seat and wore an HMD and headphones that are emitting white noise. They observed avatar's sports motion five times and closed eyes for 30 seconds. There were four sports types (walking, tennis,

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soccer, golf) and three viewpoint types (shown in 2.2). After presenting each trial, they rated cognitive recall rate of motor imagery as self and others movement on a visual analogue scale (VAS). The VAS spanned from 'cannot recall the movement at all' at the left end to 'can recall the movement completely' at the right end.

3.3 Result

The results of the cognitive recall rate of motor imagery as others movement are shown in Figure 2. Two-way analysis of variance (ANOVA) was performed on the factors of viewpoint and sports types. There was significant difference in viewpoint ($p=0.0001$) and marginally significant difference in sports types ($p=0.0593$).

The results of the cognitive recall rate of motor imagery as self-movement are shown in Figure 3, and also Two-way ANOVA was performed for the factors. There were significant differences in viewpoint ($p=0.0004$) and sports types ($p=0.0068$).

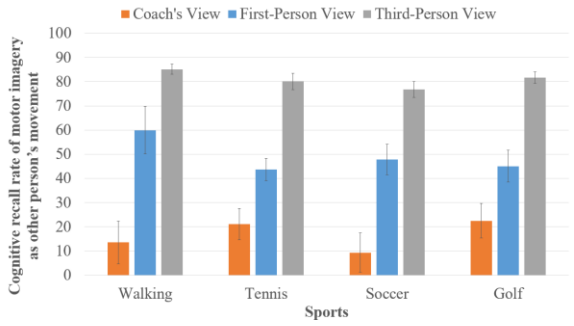

Figure 2: *Cognitive recall rate of motor imagery as other person's movement (VAS score)*

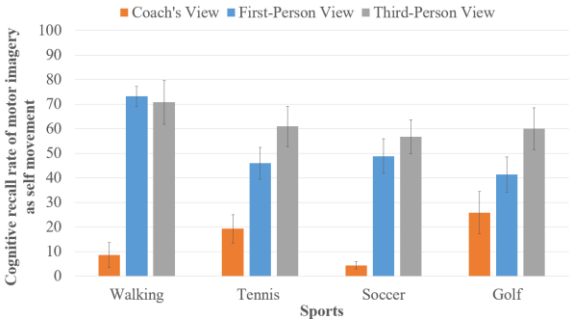

Figure 3: *Cognitive recall rate of motor imagery as self-movement (VAS score)*

4. Reproduction of Forearm Trajectory

4.1 Objective

Regarding the complex movement of body part, we evaluated the reproduction accuracy of forearm trajectory.

4.2 Participants and Procedure

The participants were 10 university students (mean age of 23 years old). They sat on a seat and wore an HMD and headphones that were emitting white noise. They observed the model movement in First-Person view or Third-Person view in three cycles. The model movement was a motion to move the arm toward three target positions from the state of extending right arm in the horizontal forward direction. After closing eyes 30 seconds, they held the position measurement sensor and reproduced the model movement by his/her own arm.

4.3 Result

The results are shown in Figure 4. T-test was performed on the factors of viewpoint and target position. First-Person View was significantly close to the target compared to the Third-Person view ($p=0.0055$).

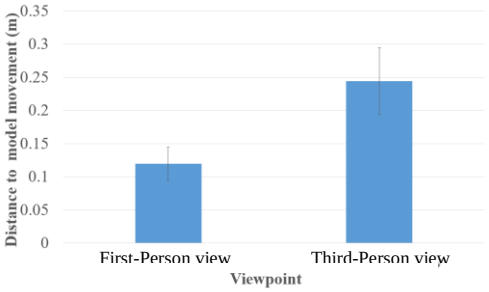

Figure 4: *Distance to model movement*

5. Discussion

From chapter 3, when grasping the motion trajectory of the whole body, it looks that Third-Person view was suitable. In addition, Coach's view was not suitable for these sports. Since the coach watches control target, the learner cannot watch their body motion. However, from chapter 4, it may be suggested that First-Person view is suitable when to grasp the motion trajectory of a body part.

6. Conclusion

The result of this study suggested that it is necessary to change viewpoint in accordance with the feature of sports. A further direction of this study will be construct a system that can provide more efficient sports learning and to investigate learning process more in detail.

References

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