

“The influence of coordination training in immersive virtual reality on the reaction speed of mixed martial arts fighter”

Summary

The high level of motor reaction ability is crucial for achieving success in competitive martial arts. This aspect is particularly important for mixed martial arts athletes who compete in various planes and positions using diverse and modified techniques borrowed from different striking or grappling disciplines. The constant development of training methods and tools is making sports training becomes more innovative through the use of various digital technologies and computer systems. One of the innovative tools that support sports training is immersive virtual reality (VR), an artificially created environment in which a person is disconnected from the visual and auditory stimuli of the real environment and instead receives images and sound, as well as tactile sensations of the simulated world. From the available literature, it appears that initial attempts are being made to use VR both to construct reliable motor tests and to create training programs to teach movement skills and develop motor abilities. The shortage of reports attesting to the effectiveness of this type of training, especially in relation to the coordination sphere of human motor abilities and the potential and innovation of VR, has become the cause for conducting it's own research.

The aim of this study is to evaluate the impact of coordination motor ability training of mixed martial arts (MMA) athletes in VR on their level of reaction speed as assessed by tests performed in virtual and real environments.

The following research questions were proposed in the study:

1. Will a several-week (4 or 8 weeks) coordination training in a virtual environment improve the reaction speed (simple and complex) of MMA athletes in VR?
2. Will a several-week (4 or 8 weeks) coordination training in VR improve the reaction speed (simple and complex) of MMA athletes in the real environment
3. Does the length of the training period in VR determine the level of reaction speed (simple and complex) of MMA athletes?

The study was conducted in a group of 36 experienced MMA athletes who were randomly divided into two equal groups: an experimental group that performed 30-minute additional coordination training in VR (2 times a week) and a control group that did not participate in the additional VR training. The total duration of the experiment was eight weeks. During this period, all athletes participated in regular MMA training. The control and experimental groups

trained in 90-minute group sessions that took place four times a week under the supervision of the same leading trainer. All subjects were tested for reaction speed at the beginning of the intervention (I measurement), after four weeks (II measurement), and after eight weeks of examination (III measurement). The studies included: measurements made in VR, classical computer tests, tests using the BlazePod training system, and the popular ruler drop method. In VR, three types of tests were conducted. The first one involved reacting to light stimuli by pressing the controller button and evaluated simple and complex reaction. The second one was a VR-recreated known "ruler drop method" test is evaluating simple reaction to a moving object. The third one involved dynamic arm extension in response to a light signal and was based on one of the movement patterns aimed at the sport discipline trained by the tested athletes. In this test, in addition to measuring simple and complex reaction speed, you could also evaluate its components (reaction time and movement time).

To carry out statistical analyses, a parametric analysis of variance with repeated measurements or non-parametric ANOVA Friedman were used, which were supplemented with appropriate post-hoc Tukey or Dunn tests.

Relative gains in measurement data were also calculated. All statistical analyses were conducted on average values.

Based on the studies and analyses, the following conclusions were drawn:

1. Under the influence of coordination training in a virtual environment, the observed outcome is improvement in the speed of simple and complex reactions to visual stimuli in MMA fighters assessed by using various tests implemented in VR. Significant improvement in results is observed both after four and eight weeks of exercise.
2. Coordination training in VR significantly improves the speed of simple and complex reactions to visual stimuli in MMA fighters assessed in real-world environments based on the specific pattern of upper limb extension specific to this sport. When assessing the impact of coordination training in VR on the improvement of motor skills using classical computer tests based on fine motor skills (finger movements), despite the faster reactions of athletes, no statistically significant improvement in results was observed.
3. The length of the coordination training period in a virtual environment affects the level of speed of simple and complex reactions to visual stimuli in MMA fighters. In most test tasks, a clearer improvement in these motor skills was observed after eight weeks rather than after four weeks of exercise.

4. The improvement in reaction speed of experienced MMA fighters under the influence of a relatively short training intervention in VR suggests that coordination exercises performed in a virtual environment are an effective training tool even for advanced athletes.