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# How variability could shape perceptual-motor expertise in 4x100 m relay?

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The optimization of perceptual-motor expertise is a very challenging issue for both coaches and athletes. A recurring question that can be asked is to what extent training sessions must be performed in stable conditions, in which the athlete is exposed to task constraints mimicking those encountered in competition, or conversely under extremely variable conditions, to be more effective? In this study we were interested in a very specific skill, namely the synchronization of runners' race in 4x100 m relay. Relay performance is based on the ability of the team to coordinate the race of the athletes to maximize the speed of the baton exchange. To optimize the passing of the baton, athletes can place a go-mark on the ground approximately 8 m from their starting position to initiate their run when the giver crosses this mark. This synchronization task is not trivial and relies on the ability of athletes to anticipate the passage of the partner on the go-mark. Moreover, to our knowledge, no feedback-based procedures were proposed to train this task. The aim of our study is precisely to investigate the influence of the variability of training conditions on athletes' anticipation abilities, in an immersive virtual environment. The athletes were equipped with a virtual reality headset to be immersed in a virtual stadium at the receiver's position. They were instructed to initiate their race when the avatar of their partner passed over the go-mark. A learning protocol including a pre-test, an acquisition phase and both retention and transfer tests (assessments done under conditions different from those for which they had been trained) have been used. Two groups of participants, namely 'stable' and 'variable', practicing athletics at a regional level, have been tested. The first group performed the task under stable conditions, i.e., with the go-mark always placed at the same distance and in the presence of an avatar always arriving at maximum speed. The second group performed the task under variable conditions, i.e., with a variable go-mark position and in the presence of an avatar whose speed varied. Both groups received systematic extrinsic feedback about their performance after each trial in the acquisition phase. Several dependent variables have been used to characterize the participants' behavior, including the timing error and the gaze strategies.

The results revealed that the 'stable' group learned the task better than the 'variable' group when tested in the reference task. Conversely during the transfer tests, the 'variable' group outperformed the 'stable' group.

These results reveal the added value associated with the use of variability in practice conditions to acquire robust perceptual-motor skills.

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