What level of analysis to detect expertise during basketball shooting in a virtual reality ?

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Introduction

Although virtual reality allows detailed analysis of sports movements, how interesting each level of analysis is to coaches and scientists? In basketball shooting, body kinematics and the ball success rate are at the ends of the complexity continuum. We investigated these variables to explore players' expertise during shooting with a basketball simulator.

Methods

12 experienced (8 females) and 10 novice (5 females) basketball players were instructed to naturally throw an instrumented ball to swish in a stereoscopically rendered virtual basket. We randomly manipulated the distance of the basket relative to the player (3.225, 4.225, and 5.225 m), while keeping the surrounding environment unchanged. We measured the success rate and body kinematics during 3 shots performed at each distance.

Results

Concerning success rate, the two way-ANOVA (group × distance) with repeated measures on distance, revealed a significant main effect of expertise ($F(1, 21) = 22.934$, $p < 0.05$, $\eta^2p = 0.52$), a significant main effect of distance ($F(2, 42) = 31.252$, $p < 0.05$, $\eta^2p = 0.60$), and no significant expertise × distance interaction ($F(2, 42) = 1.73$, $p > 0.05$, $\eta^2p = 0.08$). Post-hoc tests showed that experienced players had significantly higher success rate than novice players (45.00 ± 3.44 vs. 23.07 ± 3.02 %, $p < 0.05$). Post-hoc tests also revealed significant different success rates across distances (58.46 ± 4.42, 40.32 ± 6.55, and 3.33 ± 1.93 % for the 3.225, 4.225, and 5.225 m distances; $ps < 0.05$). Concerning kinematics, multivariate tests showed that expertise affected movement patterns ($F(10, 45) = 4.02$, $p < 0.001$; Pillai's Trace = 0.47; $\eta^2p = 0.31$; [experienced vs. novice] movement duration: 1.13±0.38 vs. 1.29±0.47 s, hand angle: 148.61±9.45 vs. 150.40±8.78 ∘, elbow angle: 123.49±16.55 vs. 125.29±13.12∘, knee angle:

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158.78±6.47 vs. 160.18±8.24○, foot angle: 115.40±11.18 vs. 121.54±12.14○, shoulder angle: 122.83±12.98 vs. 113.63±9.92○, and trunk rotation: 93.65±6.26 vs. 90.40±4.55○). However, distance did not affect the kinematic parameters statistically significantly ($p > 0.05$).

Discussion

Both success rate and body kinematics allowed detecting the players' expertise. However, body kinematics failed to reflect any behavioral adjustments while adapting to the changes in distance. While advanced mathematical descriptions can help scientists in understanding how the whole-body kinematics are controlled when adapting to distance (Ibáñez-Gijón et al., 2016), one wonders about the cost of such complex procedures for coaches when the success rate offers sufficient sensitivity. the shot regulation observed in novice and experienced players as a function of egocentric basket distance manipulation suggest that the basket carries sufficient sources of visual information and nuances the role of visual information sources provided by other parts of the environment (Stöckel & Breslin, 2013).

References

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