Differences in performance and kinematics when catching under block versus random temporal constraints

Tijtgat, P.[1], *De Clercq, D.*[1], *Bennett, S.*[2], *Savelsbergh, G.*[3,4], *& Lenoir, M.*[1]

[1]Department of Movement and Sports Sciences, Ghent University, Belgium

[2] Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, United Kingdom

[3] Institute for Biomedical Research into Human Movement and Health, Manchester Metropolitan University, United Kingdom

[4] Research Institute MOVE, Faculty of Human Movement Sciences, VU Amsterdam, the Netherlands

The impact of varying temporal constraints has revealed interesting insights in the control of interceptive behaviour (Laurent et al., 1994; Mazyn et al., 2006). However, because these experiments were conducted with velocity-manipulations arranged in blocks, a pre-programmed mode of control based on advance knowledge of previous trials, might have been favoured, hence leaving little challenge for the online control of the movement. The purpose of this experiment was to compare catching performance and kinematics under varying temporal constraints either under trial-by-trial variation or in a block design. Balls were launched from a distance of 8.4m by a ball-projection machine with adjustable launching speed (Speeds: 9.3, 11.3, 13.4, 15.9 m/s). Launching angle was mechanically adjusted so that the balls arrived above the right shoulder of the participant, who adopted an upright standing position. The catching movement was tracked with a 3D motion capturing system (Qualisys, Sweden) at 240Hz. Fifteen qualified ball catchers caught 160 balls with their preferred hand at the 4 ball speeds. Eight participants started with 4 blocks of 20 trials at the same speed, followed by 80 balls in which the order of ball speed was randomised, the other 7 caught first under random varying trials, followed by block trials. ANOVA analyses with repeated measures on Catching order (first block-first random), Condition (block-random) and Speed were conducted on catching scores and kinematic variables in order to examine possible differences between catching under random or block temporal constraints. As expected, catching performance decreased with increasing temporal constraints ($p<.001$). Interaction effects indicate that random performance did not take advantage of an occurring learning effect caused by the order of catching ($p=.37$), while

block catching did ($p<.005$). Significant interactions for dependent variables: movement time ($p<.005$), latency ($p<.001$), peak of wrist velocity ($p<.05$), time of peak wrist velocity ($p<.001$) and coefficient of straightness ($p<.001$) reveal a clear adaptation to temporal constraints during blocked catching, while this adaptation was less visible when catching under trial-by-trial varying speeds. Both the catching performance and kinematic variables provide evidence that there are differences in control when catching under blocked and randomised temporal constraints. It seems that when catching under trial-by-trial changing temporal constraints, as it is in real life, an initial ballistic response is followed by visual feedback driven on-line control. Advance knowledge of a given temporal constraint appears to permit specific adaptations. Towards an ecological perspective, methodologies with trial-by-trial variance are encouraged, because a catching trial might be controlled differently depending on its context - embed in blocks of the same (temporal) condition or not.

References

Laurent, M., Montagne, G., & Savelsbergh, G. J. P. (1994). The Control and Coordination of One-Handed Catching - the Effect of Temporal Constraints. *Experimental Brain Research, 101*, 314-322.

Mazyn, L. I. N., Montagne, G., Savelsbergh, G. J. P., & Lenoir, M. (2006). Reorganization of catching coordination under varying temporal constraints. *Motor Control, 10*, 143-159.