A CONSTRAINTS-LED APPROACH FOR DETERMINING SPEED-ACCURACY TRADE-OFF IN INTERNATIONAL BADMINTON PLAYERS PERFORMING THE FOREHAND SMASH

Idrees Afzal, Harley Towler, Stuart McErlain-Naylor, Michael Hiley, and Mark King

Loughborough University, SSEHS, Leicestershire, UK

@lborosportsbiom i.afzal@lboro.ac.uk

Introduction

The forehand smash in badminton is a skill which requires elite performers to gauge and determine the most appropriate speed-accuracy trade-off (SATO) given the task, environment and individual constraints (1, 2). Fitts' law (3) has often been characterised as an adept model for understanding SATO. Manipulation of constraints such as a target for accuracy has become a common coaching practise (4).

Purpose: The aim of this study is to determine and compare what SATO relationships international badminton players utilise when confronted with three constraint practises: maximal speed (MS) towards the direction of a target; maximal speed aiming to hit the centre of three shuttlecock tubes (TUBE); and maximal speed aiming to hit the centre of a circular target placed flat on the ground (TAR).

Figure 1. 3D motion capture setup; flat target and shuttlecock tubes

Figure 2. Racket 3M retro-reflective tape marker setup with

Methods

Fifty-two (males:29; females:23) international badminton players training/competing at the Glasgow BWF World Championships (2017) participated in the study. Racket-shuttlecock kinematics were collected using a Vicon 3D Motion Analysis System (400 Hz; OMG Plc, Oxford, UK). A ⌀ 3m target (Podium 4 Sport) was placed flat on the centre line of the opposite side of the court to score accuracy (zero: centre circle=most accurate; five: out of bounds/net=least accurate) (5). Using percentage trade-off between constraints a combination of two twostep cluster analyses were used to identify clusters. A mixed ANOVA was used to analyse group*constraint interaction.

*Percentage trade-off = 100-(TUBE/MS*100)*

Results

Three SATO relationships with different magnitudes (high (H): < 90%; moderate (M): 90-97%; low (L): > 97%) were identified in the cluster analyses. Inverse relationship (IR); Alternative inverse relationship (AIR) and Linear relationship (LR). The mixed ANOVA revealed that group shuttlecock speed and accuracy score significantly differed across constraints ($p < 0.001$). The LLR group increased shuttlecock speed the most whilst improving spatial accuracy from the MS to the TUBE condition.

Loughborough University

EUROPEAN COLLEGE OF SPORT SCIENCE

References

1) Li S, et al., J Sports Sci (2017)
2) Shafizadeh M, J Sports Science (2019)
3) Fitts P, J of experimental, psychology (1954)
4) Fitzpatrick A, Human Movement Science (2018)
5) Hancock G, et al. Journal of Motor Behavior (1995)

Conclusion

Elite badminton players adopt different SATO relationships when attempting to meet task constraint goals. The tubes constraint can be used to enable players to smash faster and with more accuracy.

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BADMINTON TUBES CONSTRAINT

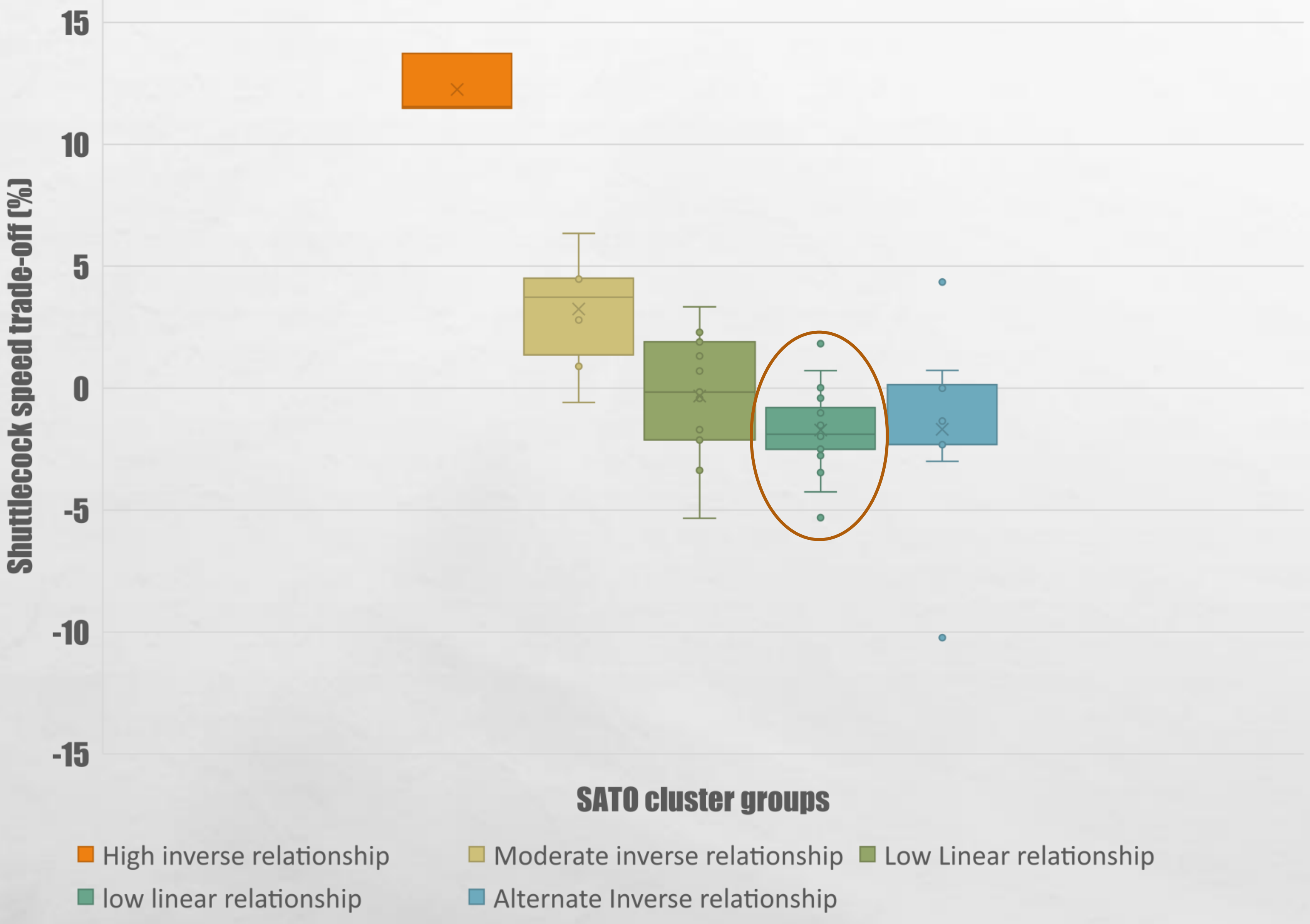

Figure 3.

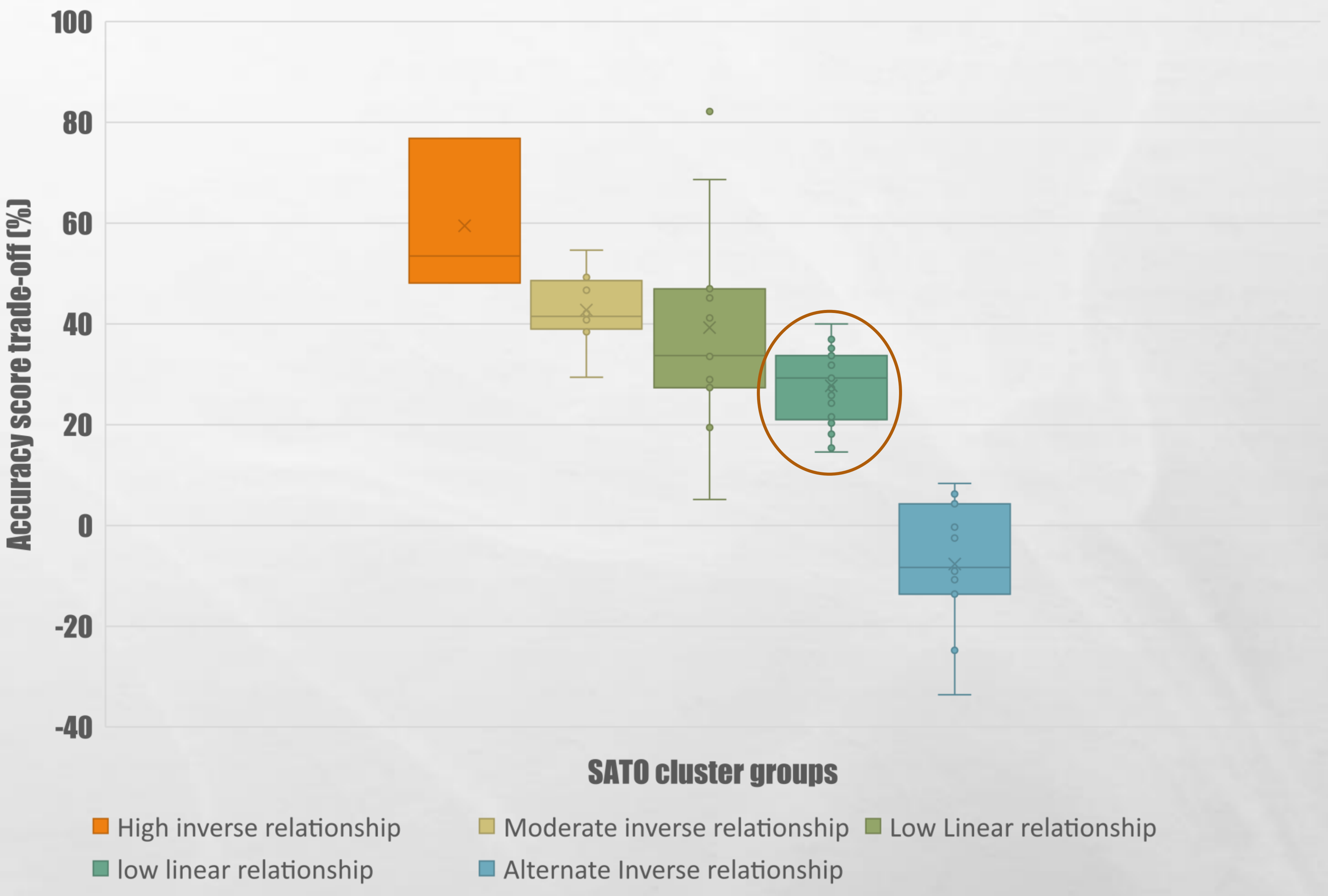

Figure 4.

FUTURE DIRECTIONS

- MOVEMENT VARIABILITY AND KINEMATICS
- CONFLICTING SPATIO-TEMPORAL CONSTRAINTS
- SATO AS A TOOL FOR PERFORMANCE ASSESSMENT
- REPRESENTATIVE LEARNING DESIGN
- BWF TOURNAMENT MATCH ANALYSIS

i.afzal@lboro.ac.uk @lborosportsbiom

Figure 5. Badminton smash anatomical landmark marker set up