ASSESSING THE RELATIONSHIP BETWEEN MOVEMENT PERFORMANCE AND BODY-SHAPE USING MoSh

Gwyneth B. Ross[1], Brittany Dowling[2], Nikolaus F. Troje[3], Ryan B. Graham[1]

[1]School of Human Kinetics, University of Ottawa, Ottawa, Ontario, Canada
[2]Motus Global, Rockville Centre, New York, USA
[3]Department of Psychology, Queen's University, Kingston, Ontario, Canada
Email: gwyneth.ross@uottawa.ca

INTRODUCTION

Movement screens are used to identify abnormal movement patterns that: i) are indicative of dysfunction, or ii) may increase risk of injury or hinder performance. Our previous research has been aimed at developing a data-driven framework to classify movement patterns using a principal component analysis (PCA)-based pattern recognition technique and machine learning [1]. Currently, the framework uses surface markers to analyze how the underlying rigid skeleton is behaving [1]. However, previous researchers have argued that when moving from surface markers to rigid skeleton representations important information regarding subtle surface motions is lost [2]. Therefore, previous researchers have developed a method called MoSh, which stands for Motion and Shape capture, which creates a 3D parametric body model based on a standard motion capture marker set (Figure 1) [2]. There is a female, male and gender-neutral model, each of which can be defined by 10 PC scores (beta values) [2]. By manipulating the 10 beta values, one can morph the body-shape of the animation. Therefore, the purpose of this study was to assess the relationship between body-shape (i.e. the 10 beta values) and movement performance (i.e. the percent likelihood of being an elite athlete, using criteria that we previously developed [1]).

METHODS

3-D whole-body kinematic data (i.e. 42 positional trajectories x 3 axes) from 204 male athletes varying in athletic skill level were collected during a drop jump using an 8-camera motion capture system (Motion Analysis, Santa Rosa, CA). Our previously developed framework was applied [1]. PCA was used as the feature selection technique, linear discriminant analysis (LDA) as the machine learner, and skill level (i.e. elite vs. novice) as the classifier with PC scores as the predictors. Finally, each athlete's data were projected onto the linear discriminant function to calculate the likelihood of being either an elite or novice athlete [1]. Using a single frame of the movement and the 42 markers, MoSh was then applied to fit a body-shape (represented by 10 beta values) to each athlete (Figure 1) [2]. To predict movement performance on body shape alone, the 10 beta-values were used to predict the percent likelihood an athlete was elite using linear regression.

RESULTS

For the drop-jump, there was a root mean square (RMSE) error of 0.24 and an R-Squared value of 0.21, suggesting that body-shape, calculated independently of movement, explains 21% of the variability of drop-jump movement performance.

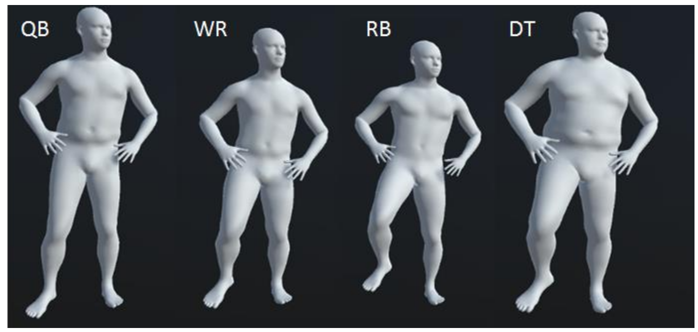

Figure 1. As an example, body-shapes using MoSh for four football players (quarterback (QB), wide receiver (WR), running back (RB) and defensive tackle (DT)) were created using 42 surface markers. Animations were created using the same marker positional data for all athletes, only manipulating the beta values to the values that were assigned to each athlete.

DISCUSSION / CONCLUSIONS

Since body-shape alone accounted for 21% of the variability of movement performance, it is important to consider body-shape in future movement assessment research and applications. A limitation of the current study was the exclusion of females. Due to Motus' marker set used in the movement screen, no markers were placed on the bust or buttocks, therefore calculated body-shapes for the females did not match actual body-shapes. Therefore, future research should place markers on the bust and buttocks for the inclusion of females to assess shape. In addition, future research should assess the relationship between body-shape and movement performance during other movements (e.g. bird-dog, T-balance, lunge, L-hop, step-down, and hop-down).

REFERENCES

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FUNDING

We would like to thank the Natural Sciences and Engineering Research Council of Canada (NSERC) for their continuous funding support throughout this project (R. Graham- RGPIN-2014-05560, G. Ross – PGSD3 - 504132 - 2017).