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Effect of boot shape on performance and perception of football movements

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Introduction

Football boots are an important interface between a player and a playing surface. Whilst much research addresses the outsole and stud-surface interaction [1], boots must also support interactions between a player's foot, insole, and upper, to ensure performance and comfort. Foot morphology comprises inter- and intra-individual variation; sex and ethnicity are key factors of this [2]. Thus, for mass-produced boots, foot morphology variation can lead to a suboptimal fit and discomfort; 76% of footballers experience discomfort around the heel region alone [2]. The understanding of boot shape on the performance and perception of football movement is limited. This study assessed the effect of boot shape for individuals with wide feet on the performance and perception of football movement tasks.

Method

The Research Ethics Committee of Sheffield Hallam University approved all procedures (ER29361857). Local football clubs were approached; of 137 players, four participants (mass = 91.3 ± 12.0 kg, stature = 1.90 ± 0.10 m) presenting with wide feet (e.g., players wore larger sized boots to accommodate foot width) were recruited and completed assessments. Participants were provided with two pairs of boots; Boot A represented an 'off-the-shelf' shape, and Boot B accommodated wider feet, created by changes to both the outsole and upper. Participants were given one pair of boots (blinded, random order) and completed a boot perception questionnaire. Participants then undertook a modified Illinois agility test ($n = 3$) as well as 90° ($n = 5$) and 180° ($n = 5$) cutting tasks (left and right feet; target speed: $3.5 \text{ m}\cdot\text{s}^{-1}$) on 3G turf, before completing a performance perception questionnaire. All assessments were repeated with the second pair of boots. A 24-camera 3D motion capture system (operating at 200 Hz; Qualisys, Sweden) recorded lower-limb marker trajectories to estimate contact times during cutting tasks [3]. Questionnaire responses (normalised Likert scales), agility times, and contact times were compared using a one-way ANOVA (alpha set to 0.05) using MATLAB (2023a, MathWorks, USA). Effect sizes were calculated as $ES_B = (\bar{x}_1 - \bar{x}_2) / S_p$ and interpreted as small (0.2), moderate (0.5), and large (> 0.8) effect sizes.



Figure 1. Participant completing modified Illinois agility test on indoor, 3G turf.

Results

Agility performance time did not differ between boots (Table 1). Contact time was longer for Boot B during 90° cuts, but not during 180° cuts (Table 1). No boot or performance differences

were perceived between boots; however large and moderate effect sizes toward the perceived improvement of boot fit and comfort, and movement performance (e.g., rotation and sliding traction, overall performance and running) were observed for Boot B (Table1).

Table 1. Modified Illinois agility time, boot-turf contact times, and perception responses.

	Measure	Boot A	Boot B	P	ES _B
Movement tasks	Modified Illinois time (s)	15.22 ± 0.77	15.38 ± 0.95	0.67	-0.20
	90° cut contact time (s)	0.28 ± 0.03	0.30 ± 0.05	0.01*	-0.78‡
	180° cut contact time (s)	0.40 ± 0.05	0.41 ± 0.06	0.92	-0.02
Boot perception	'Fit' (%)	70.00 ± 11.55	77.50 ± 12.58	0.41	-0.65‡
	'Comfort' (%)	67.50 ± 15.00	80.00 ± 16.33	0.30	-0.83†
Performance perception	'Traction acceleration' (%)	70.00 ± 11.55	75.00 ± 10.00	0.54	-0.43
	'Traction deceleration' (%)	70.00 ± 11.55	75.00 ± 11.55	0.54	-0.43
	'Traction slide' (%)	60.00 ± 16.33	75.00 ± 19.15	0.28	-0.92†
	'Traction rotation' (%)	65.00 ± 10.00	70.00 ± 20.00	0.67	-0.50‡
	'Overall control' (%)	75.00 ± 10.00	80.00 ± 16.33	0.62	-0.87†
	'Overall performance' (%)	70.00 ± 11.55	80.00 ± 16.33	0.62	-0.50‡
	'Perception running' (%)	65.00 ± 10.00	75.00 ± 19.15	0.39	-1.00†
'Perception performance' (%)	72.50 ± 17.08	85.00 ± 12.91	0.29	-0.73‡	

*Significant difference between boots ($P < 0.05$). † and ‡ indicate large and moderate between boot effect sizes, respectively.

Discussion and conclusion

Prior experience is linked to comfort perception [4]. In running, those with wide feet often prefer tight-fitting shoes [5]. Whilst different foot widths offered by commercially available shoes can be perceived, fit perception and foot geometry is not correlated [6]. Research often parameterises shoe modifications [4], thus inter- and intra-individual foot morphologies can confound findings. In this study, Boot B accommodated foot width through outsole and upper modifications to aid understanding of boot shape in the performance and perception of football movement. Boot B increased contact time for 90° cuts and possibly contributed to toward longer agility time trends (small effect size, Table 1). However, large and moderate effect sizes for improved boot perception (e.g., fit, comfort) and performance (e.g., traction, control, running) were observed for Boot B (Table 1). Boot B improved perception of fit, comfort, and performance, when compared to a typical boot or experience. However, 90° cut performance time was reduced; longitudinal research is required to understand any adaptation to the foot-, boot-, and surface-interaction afforded by different boot shapes.

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