ANALYSIS OF THE INFLUENCE OF DIFFERENT TREKKING BOOTS ON CHILDREN'S LOCOMOTOR ABILITY

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INTRODUCTION: The use of trekking boots by children has experienced a great increase in recent years. This type of footwear normally reduces the range of movements of ankle and foot joints which can alter children's gait. The boots are usually bigger and heavier than casual or school footwear, which can modify children's perception of the shoe and increase the energy cost, as observed in adults, (Jones *et al*., 1986; Robinson *et al*., 1986) and on the forces exerted by the muscles. All these changes can cause balance and performance problems in children, specially in the age range in which bony structures and neuromuscular systems are still developing. During these years the selection of correct footwear is a necessity to ensure correct physical and motor development.
This paper presents the results of a comparative analysis of the influence of three different trekking boots on children's motor skill and performance. This study consisted of an ability with fixed-goal tasks (FGTT) and a performance circuits.

METHODS: Three children's trekking boots were compared in this work. The boots had identical soles and midsoles. However, the design of the upper, insole, whole dimensions of the boot, weight and the lacing system showed some differences. Codes and characteristics of the boots are shown in Table 1.

Table 1. Characteristics of the test boots.

Code	Model	Lacing system	Weight (gr)
MUA	Blue leather	Velcro over normal lacing	433
MUM	Brown leather	Normal lacing with extra lateral hooks	435
MUC	Canvas-leather	Normal lacing	392

MUA and MUM were only different in the lacing system, being longer, heavier and more rigid than MUC. Ten children participated in this experiment (7 females, 3 males), age range 8 to 10 years. Each child performed 3 valid trials with each boot in a random order.
Two tests were carried out: a performance analysis and an obstacle FGTT circuit.
The **performance test** consisted on a course over a running circuit with obstacles which included starts, stops, forward and backward running and changes in direction of 90º and 45º to the right and to the left (Figure 1). Photocell barriers were set up at the start and finish of the circuit to register the time elapsed with a precision of 0.001 seconds. This technique allowed us to assess the effect of the three boots on children's performance, as reflected by differences in course time (Brizuela et al., 1997).
The **obstacle circuit** was used to study footwear influences on children's locomotor ability. The circuit consisted of 13 fixed goal tasks (FGTT) placed along a circuit delimited by red marks on the floor forming a restricted path (Figure 2).

The obstacles had similar properties, such as color, material, fragility, etc. They were different in dimensions and position.

Seven children (5 males, 2 females) from 7 to 10 years in age (mean age 8.4 years) participated in the test. Before each session the fit of the boots was checked and the child was instructed about the circuit, allowing only one trial prior to testing to avoid training effects. Each child performed three valid trials with each boot in random order, avoiding using the same boot in three consecutive trials. Total time to complete the circuit and total number of errors were recorded for each trial. The errors for each obstacle were visually quantified on a three-point scale from absence of error to large error.

In both tests children were adequately protected. Parents were informed about the experiments in advance and their written consent obtained.

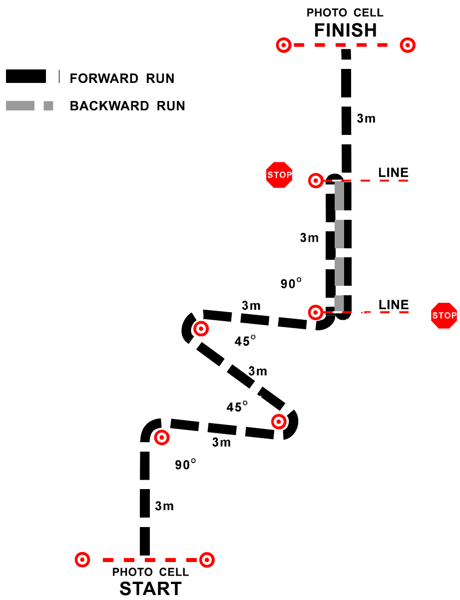

Figure 1. Performance course.

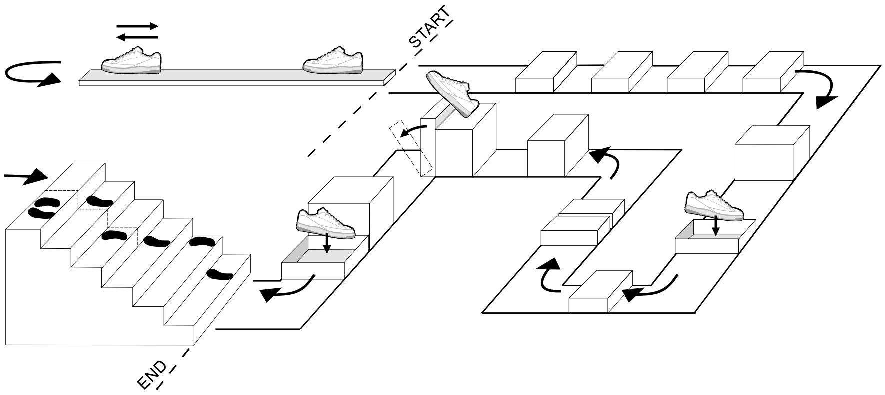

Figure 2. Obstacle circuit.

Analysis of variance (ANOVA) was done for the time to complete the performance course considering the boots and trial order as factors to assess boot influence on performance as well as children's accommodation. Analysis of variance (ANOVA) was done to study the boots' influence on total time in the obstacle circuit. Non-parametric analysis of variance (Kruskal-Wallis) was done to study the influence of both each boot and of the longer boots (MUM and MUA) with respect to the shorter ones (MUC) on the total number of errors. Cross tabulation with a Chi square test of significance level, and Somers' d test were used to analyze the relationship between boots and errors. This analysis was done for each boot and between long and short footwear. SPSS 7.5.2 and Statgraphics plus 2.1 for Windows were used for the statistical analysis. A test power study was done for all the variables investigated to evaluate the probability of finding statistically significant differences of a given size.

RESULTS: There were no significant differences in the time taken to complete the performance course for the three boots, which indicates that the models did not influence the children's performance. In fact, if these differences exist, they must be smaller than 2%, which is negligible. However, it was observed that the time to complete the course decreased considerably in the second and third trials when using the model with velcro (MUA), whilst there was no significant decrease in the other models. This indicates that children's accommodation is better for this boot.
A high frequency of errors was observed in many of the tasks in the FGTT circuit. The more frequent errors were related to backward walking, over a bar and downstairs; and to precision tasks. There were no significant differences between boots either in the total time taken to complete the ability circuit, or in the total number of errors when comparing boots.
The total number of errors was greater with the longer boots (p=0.027). There were not significant differences in the frequency of errors for each task when comparing boots.
Results of Cross Tabulation are showed in Table 2 for longer shoes and in Table 3 for each boot. Attributable percentages for the most frequent errors related to each task are presented (p is the significance level for the Chi square test).

Table 2. Cross tabulation for longer boots.

Error	Attributable percentage
High 1	-11.1 (p=0.245)
High with positioning	-13.9 (p=0.231)
Backward bar	-22.2 (p=0.096)
Normal turn	-11.1 (p=0.186)

Results showed that the use of longer boots was related to some errors in gestures which included foot raising and accuracy in the final position of the foot, besides medium-lateral movement and inward rotation of the toecap.
When comparing the influence of three boots separately, the Somers' d test presented the results shown in table 3.

Table 3. Cross tabulation results for each boot.

Error	MUA	MUM	MUC
High 1	13.9 (0.158)	---	-11.1 (0.245)
High with positioning	---	---	-13.9 (0.237)
Backward bar	---	27.8 (0.041)	-22.2 (0.096)
Normal turn	13.9 (0.103)	---	-11.1 (0.186)
High with hit	16.7 (0.124)	---	---
Forward bar	---	16.7 (0.087)	---
Normal x4	---	16.7 (0.124)	---

It is interesting to note the negative association between the MUC boot (lighter, smaller and more flexible) and some errors, whilst positive attributable percentages were observed for the other boots. Therefore the MUC boot was related to the absence of errors in those obstacles. The MUM boot was related to errors in the bar (*backward* – significant – and *forward*) and with *normal x 4*, probably due to balance and size perception problems. The MUA model was related to more complex actions such as raising the foot, hitting, turning, jumping, etc.
The significance of the differences found (p) was small, probably due to the fact that the influence of wearing boots on children's ability was greater than that of differences among the boots.

CONCLUSIONS: Few differences were found among the boots analyzed. Significant differences found showed that longer, heavier, and more rigid models were associated with poorer ability in children.
However, of the two larger models, the one with velcro showed better accommodation in the performance course as well as an association to errors in more complex tasks, whilst the other (MUM), with lateral hooks, was related to errors arising from balance and shoe size perception problems. These differences were due only to the different system of lacing which is related to rearfoot support.
The main influence on children's motor ability and performance seemed to be the fact of wearing boots with little influence in their design, mainly due to the fitting of the rearfoot. It will be very interesting to carry out the same tests with different levels of ankle support to study its influence on motor ability and performance.

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