Mediolateral gait stability maintained: By limiting the ankle strategy, can foot placement be trained?

Laura Hoogstad, Moira van Leeuwen, Jaap H. van Dieën, Sjoerd M. Bruijn

Introduction

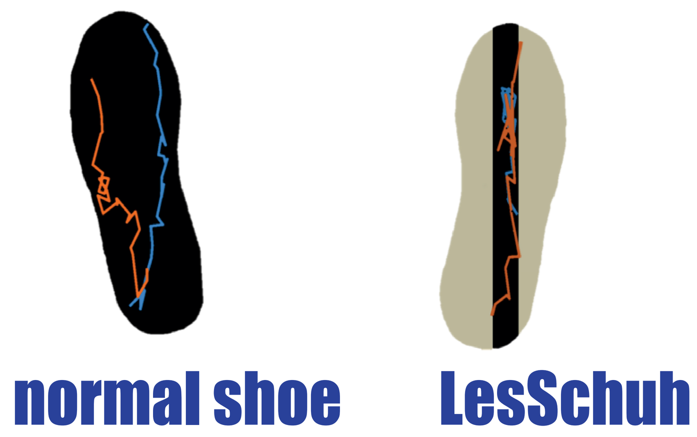
Ageing negatively affects the coordination between CoM motion and foot placement [1]. Foot placement becomes more accurate immediately after a session in which it is mechanically perturbed [2]. In previous (unpublished) work, we found that constraining humans to use the ankle strategy using special shoes (LesSchuh, Figure 1a) causes decreased foot placement accuracy. As such, walking on these shoes could also be seen as walking with perturbed foot placement, which could lead to increased foot placement accuracy after walking with LesSchuh.

Methods

19 healthy subjects
26 ± 7 yr
69 ± 10 kg
1.175 ± 0.11 m

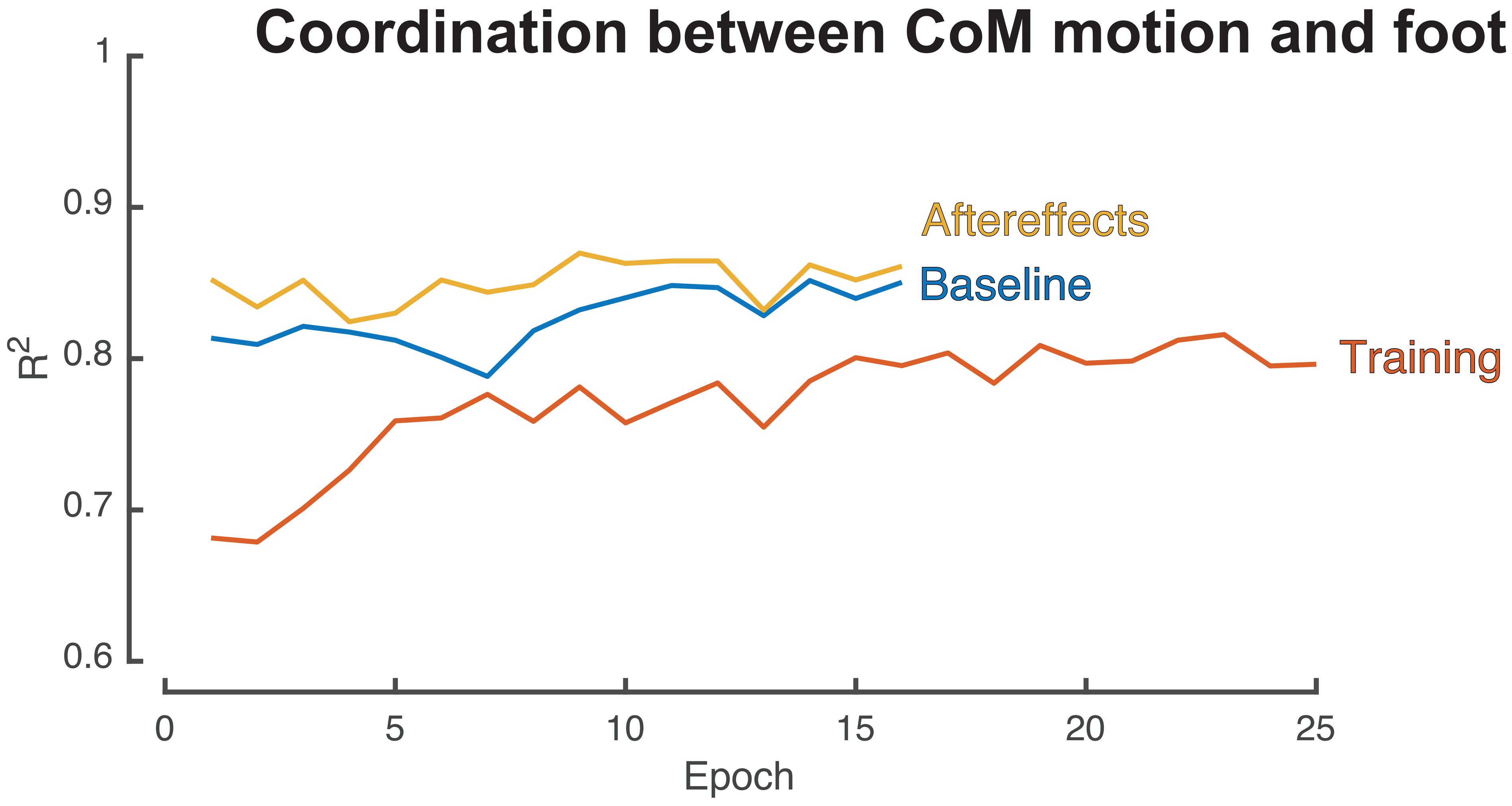
3 conditions
Baseline (10 min)
Training (15 min)
After effects (10 min)

Figure 1. LesSchuh, a shoe on which using the mediolateral ankle strategy is impossible. This is achieved by a flexible ridge along the sole, which makes the shoe resemble a skate. The flexible ridge allows for normal push off.



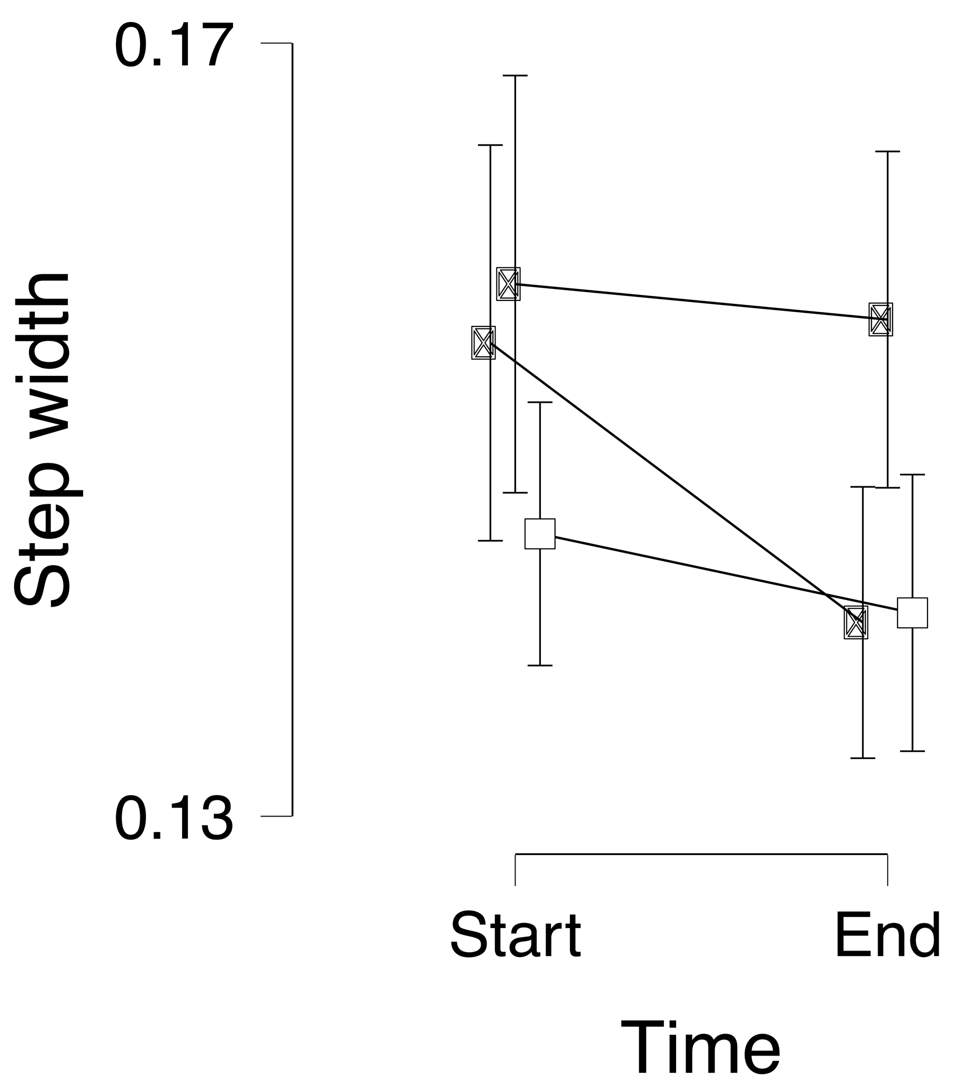
Results

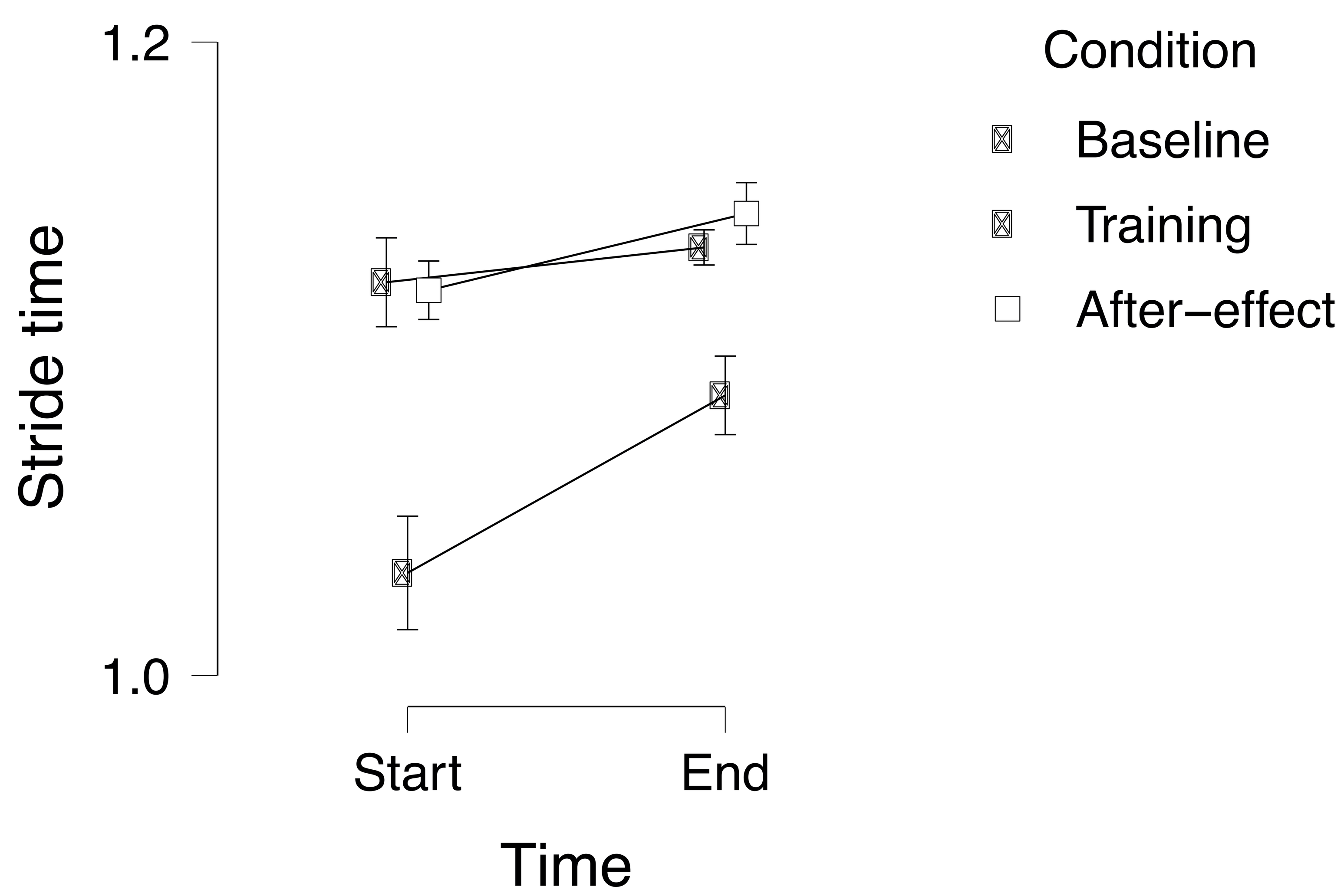
Coordination between CoM motion and foot placement



During the baseline condition, foot placement accuracy increased over epochs. Walking with the LesSchuh decreased foot placement accuracy initially, but this gradually improved over time. Clear aftereffects were present with the foot placement accuracy being higher than during the baseline illustrating the potential of the LesSchuh.

General adaptions; Step width and Strid time





Conclusions

Limiting the use of the ankle strategy does not directly lead to improved accuracy of foot placement, but rather deteriorates it (potentially through adverse effects on the controllability of foot placement). However, prolonged exposure to walking with a constrained ankle strategy may improve foot placement accuracy in normal walking.

References

2. Arvin, M., et al., Where to step? Contributions of stance leg muscle spindle afference to planning of mediolateral foot placement for balance control in young and older adults. Front Physiol, 2018. 9(1134.).
3. Heitkamp,L.N., et al., Application of a novel force-field to manipulate the relationship between pelvis motion and step width in human walking. 2019.

s.m.bruijn@gmail.com @sjoerdmb