

# StepuP: Steps against the burden of Parkinson's Disease

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EU Joint Programme – Neurodegenerative Disease Research

Amsterdam  
Movement  
Sciences



# **Training foot placement control**

$$FP = \beta_1 \cdot P_{COM(i)} + \beta_2 \cdot V_{COM(i)} + \varepsilon$$

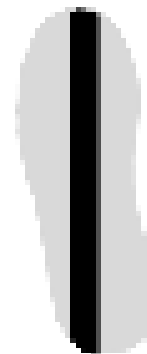
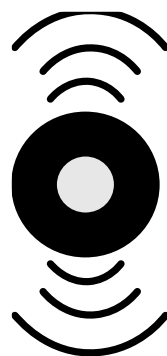
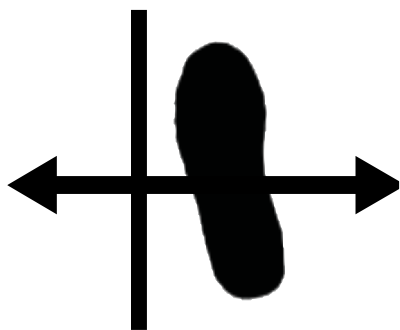
$$FP = \beta_1 \cdot P_{COM(i)} + \beta_2 \cdot V_{COM(i)} + \varepsilon$$

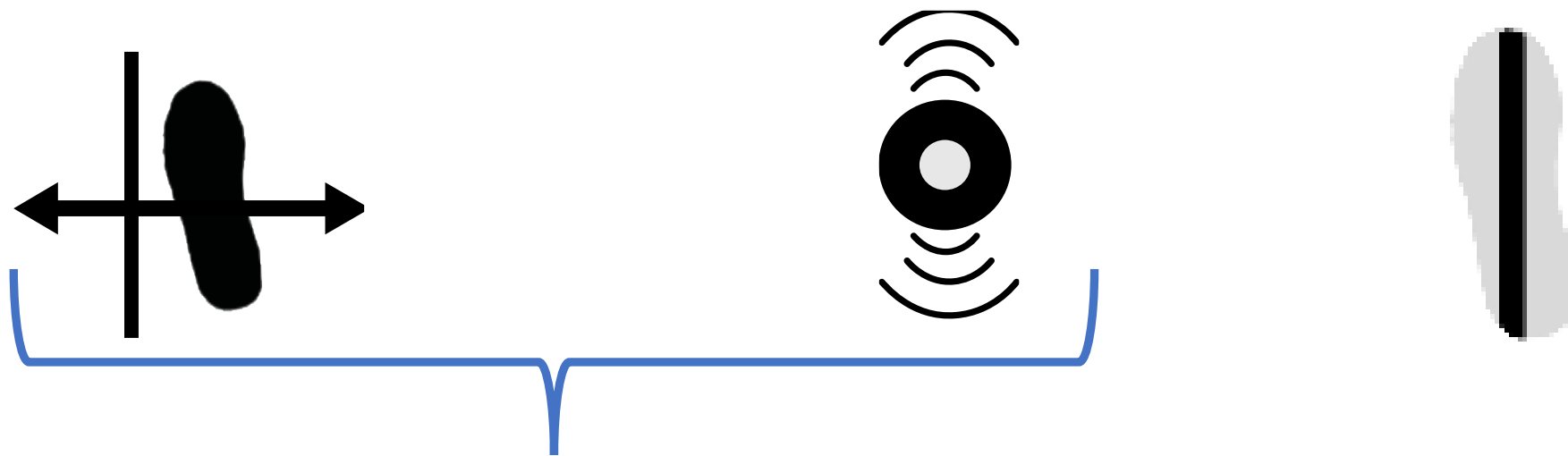
Relative explained variance

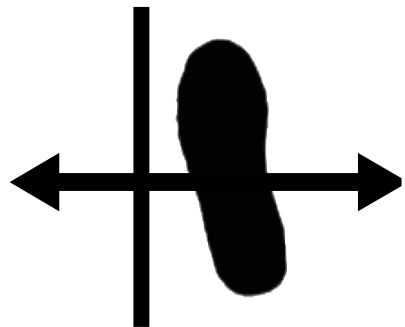
**R<sup>2</sup>**

% explained foot placement variance

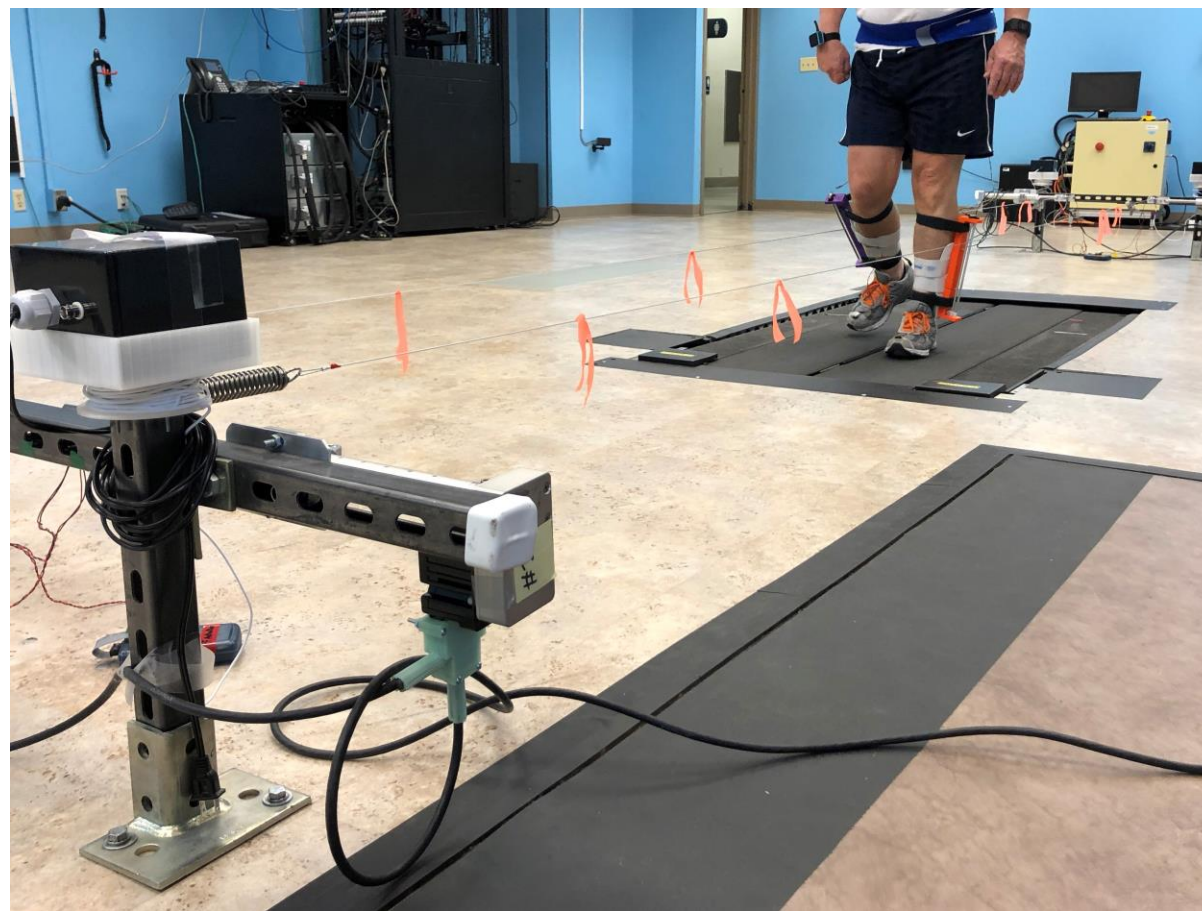
The degree of foot placement control

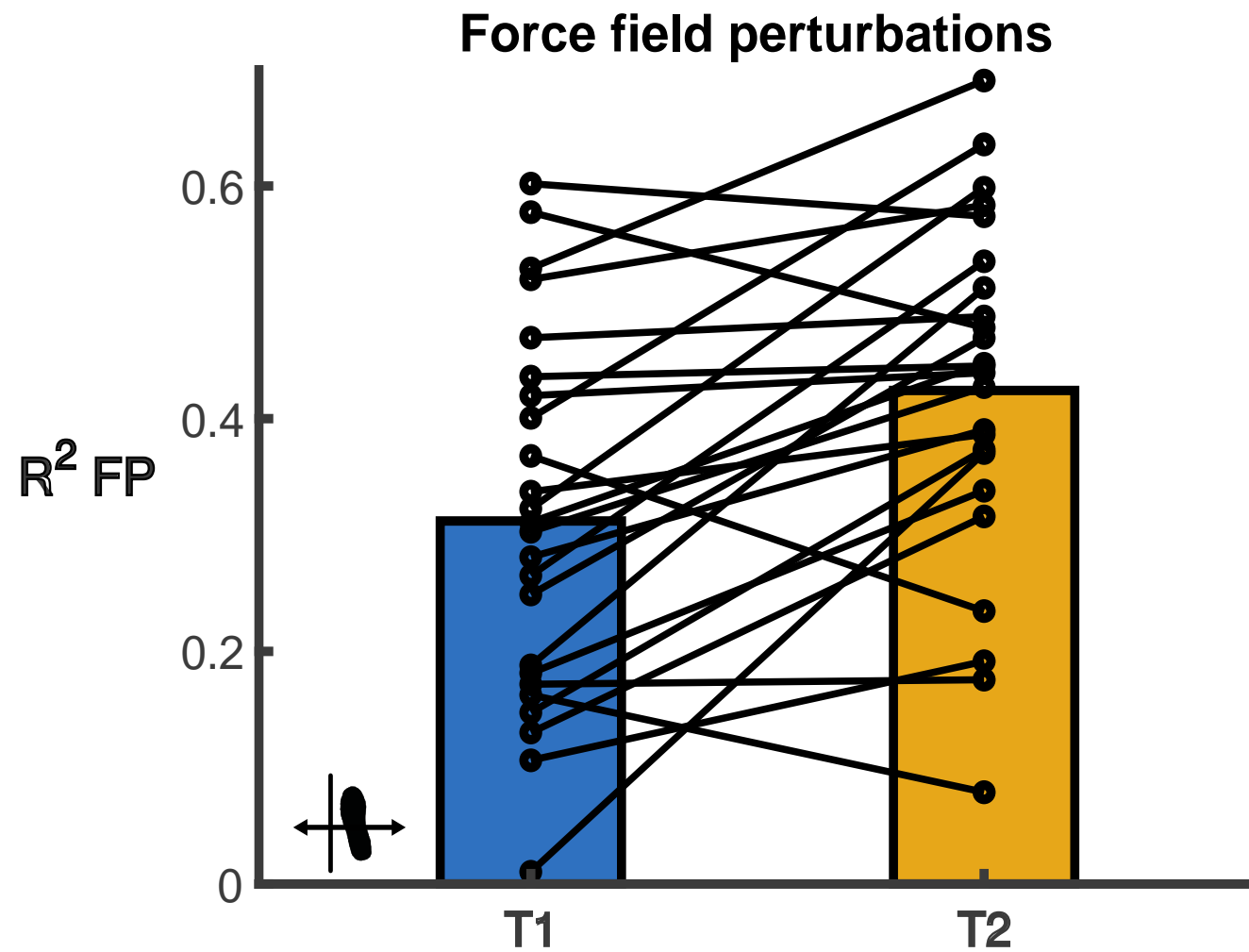
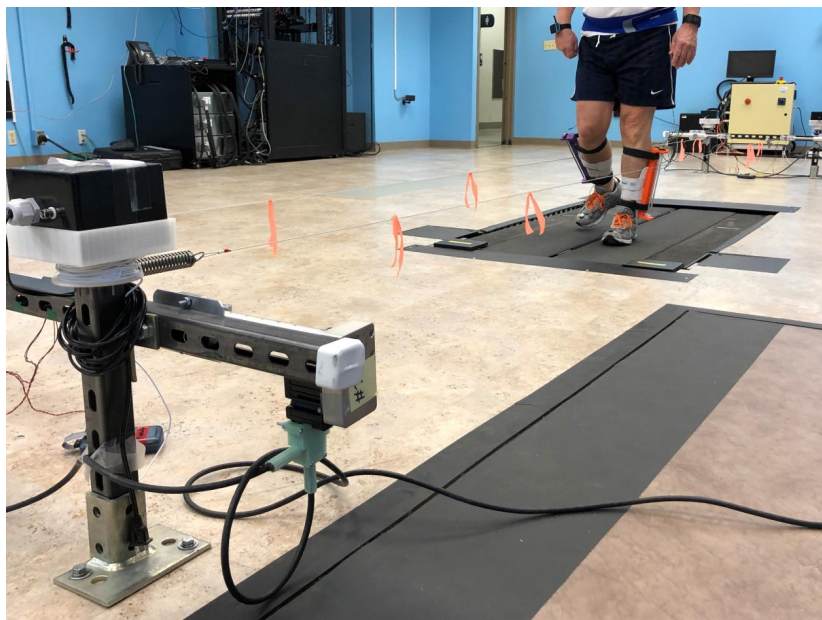
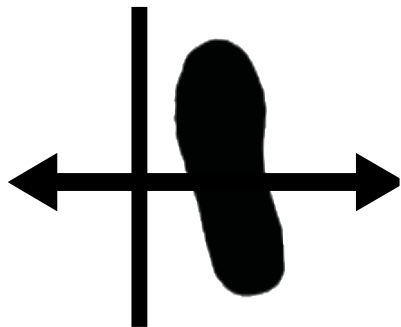




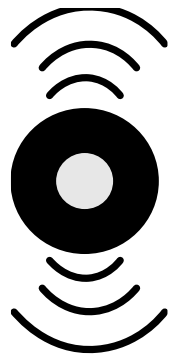


$$FP = \beta_1 \cdot P_{COM(i)} + \beta_2 \cdot V_{COM(i)} + \varepsilon$$

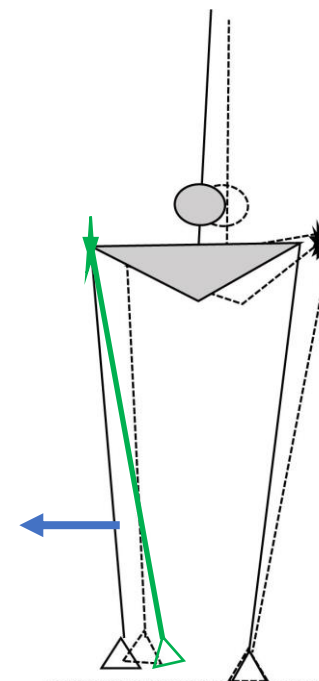
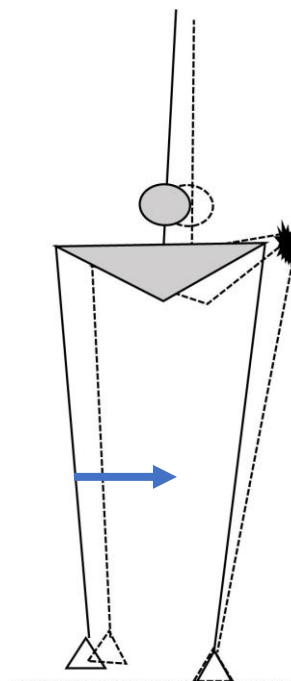




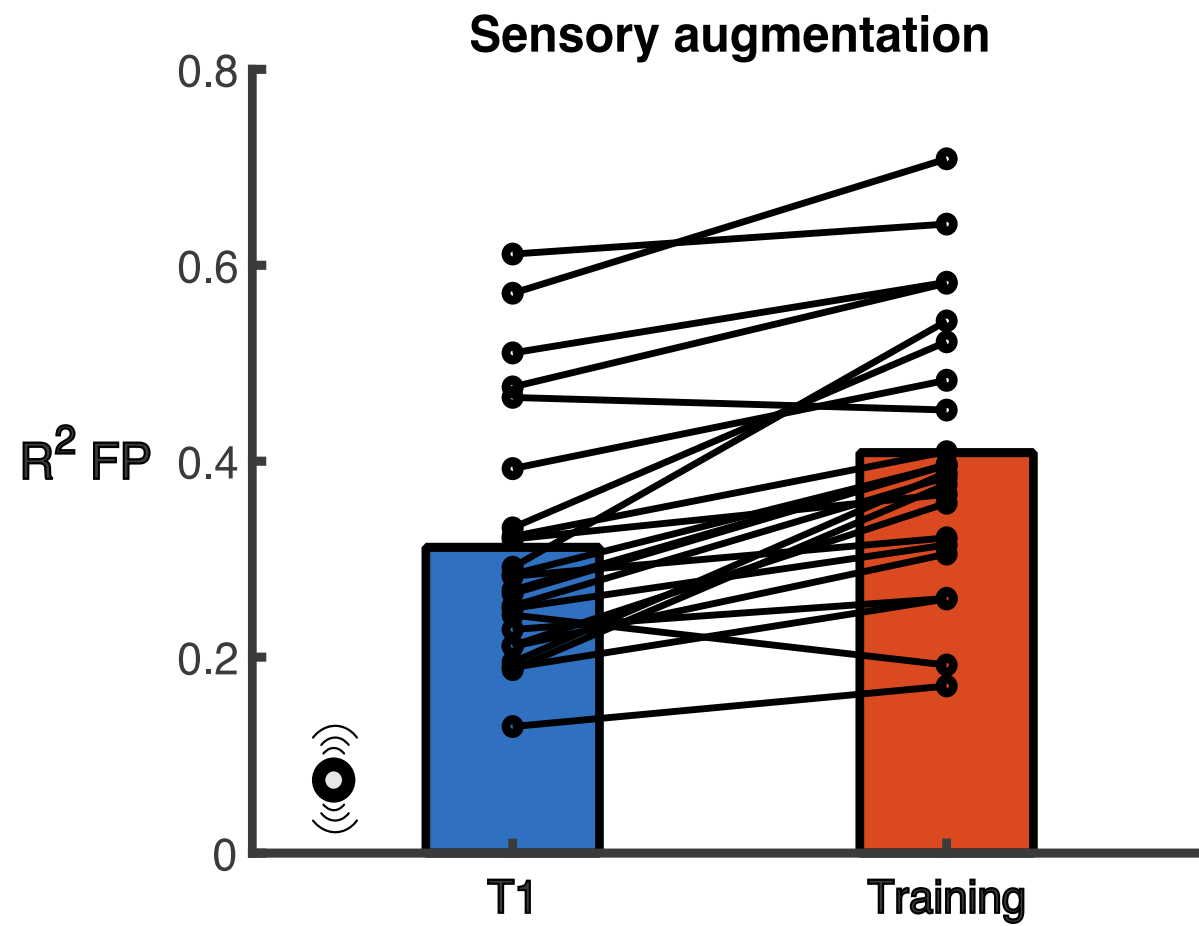
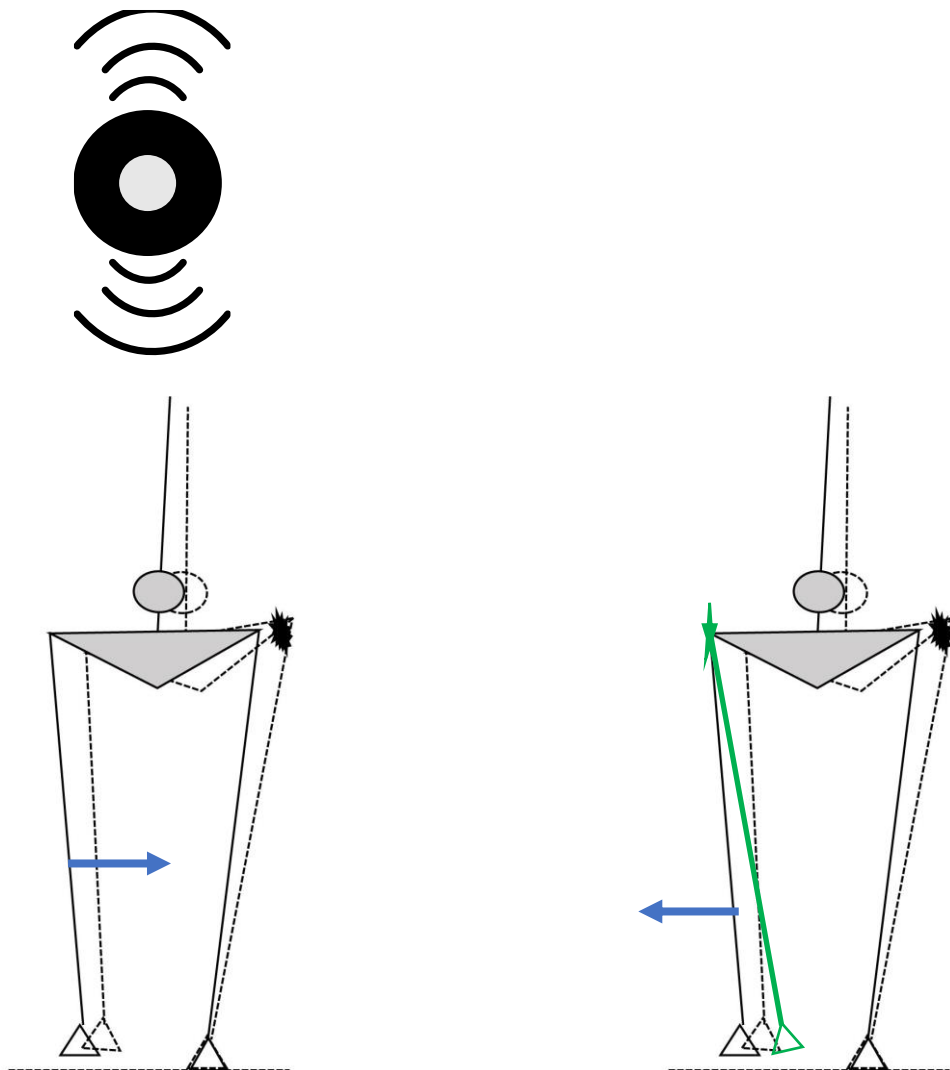


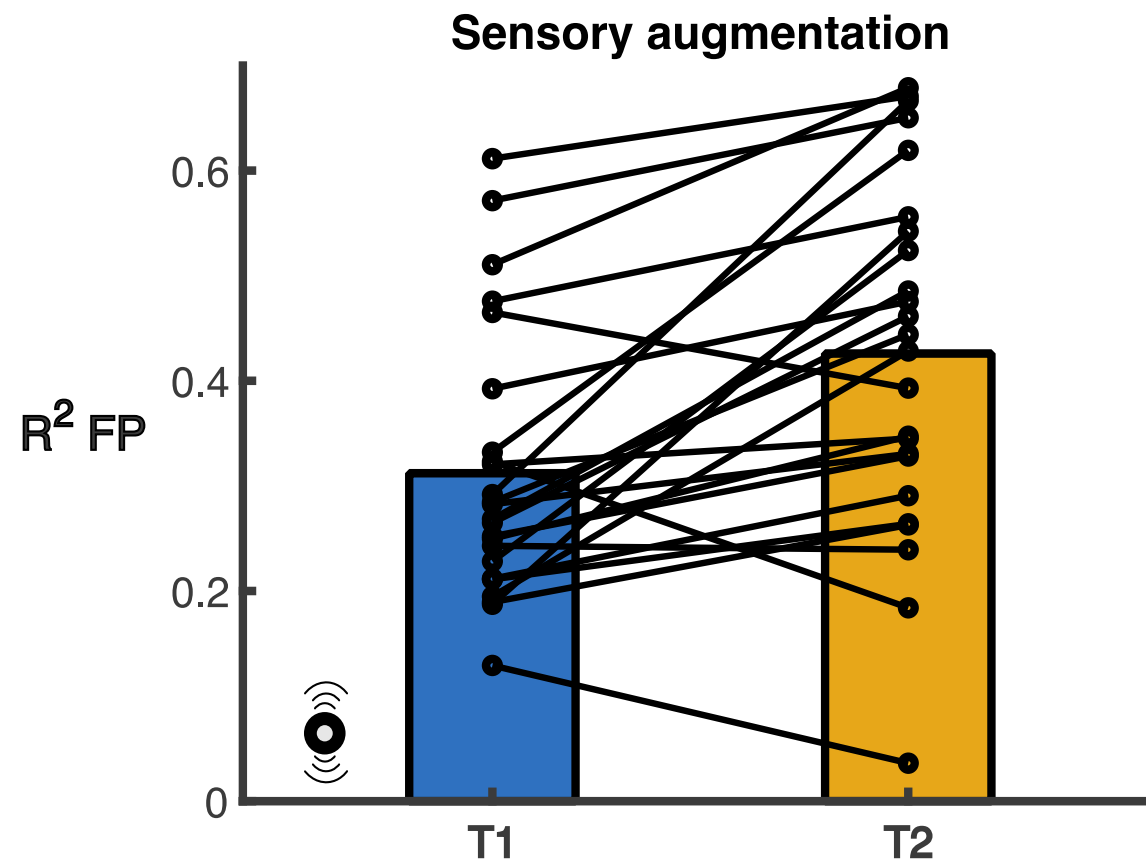
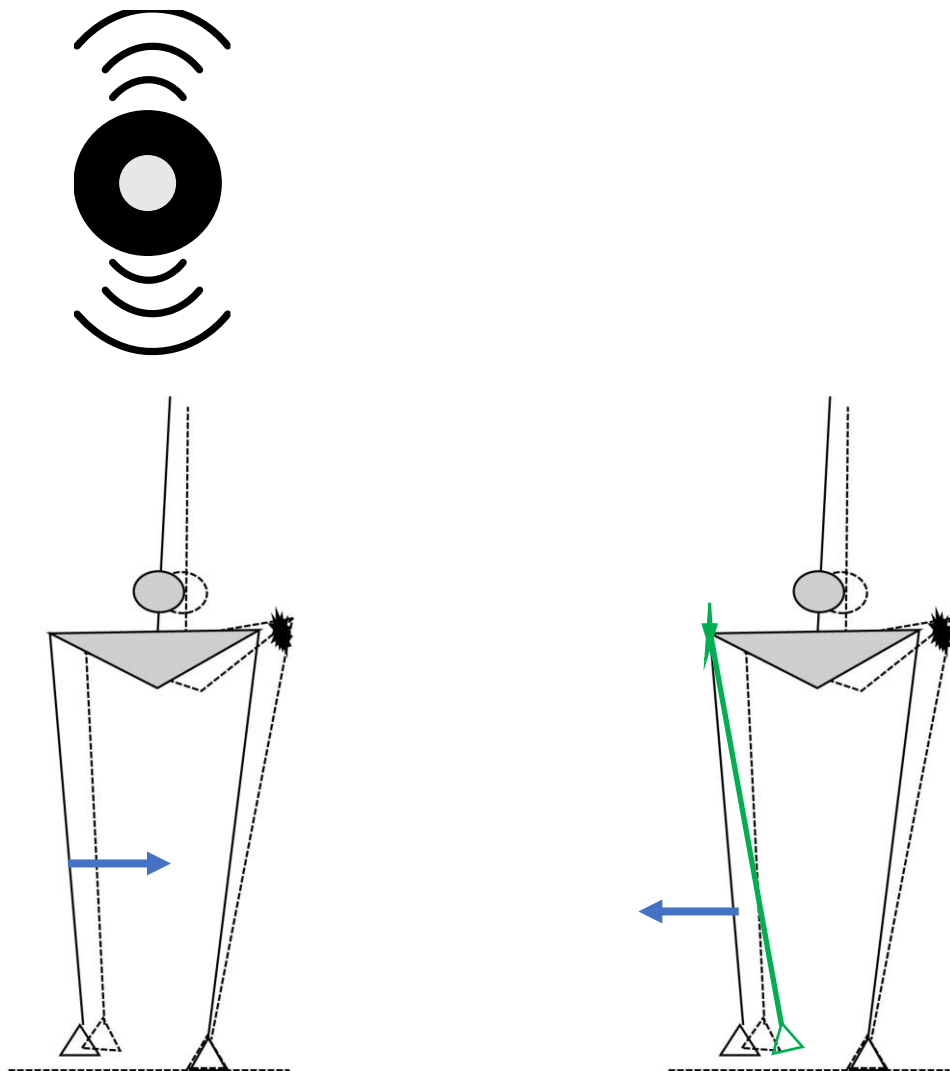


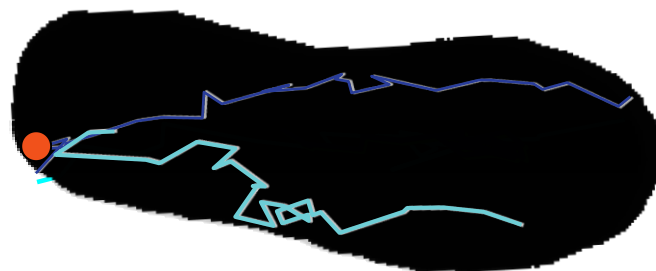
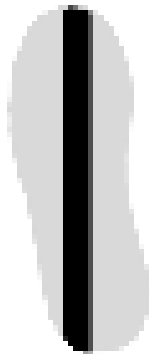
*Knapp et al. (2021)*  
*Van Leeuwen et al. (preprint)*

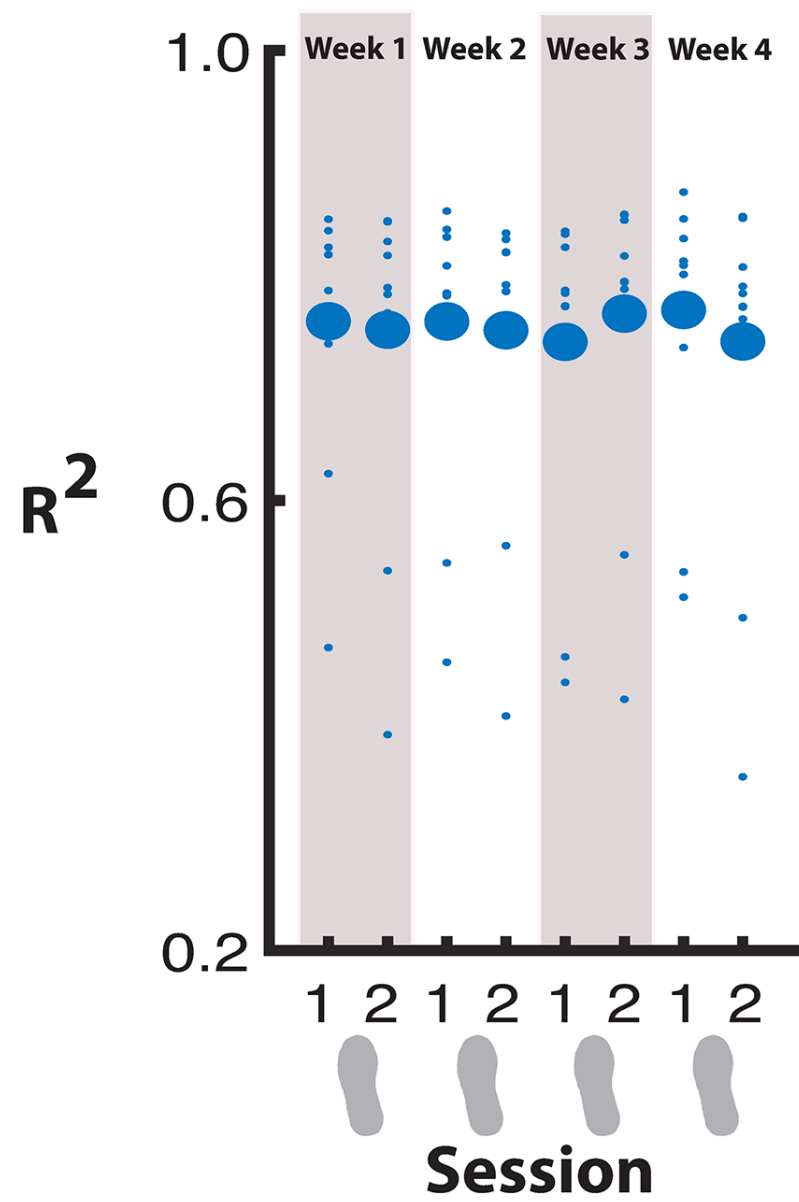


*Arvin et al. (2018)*

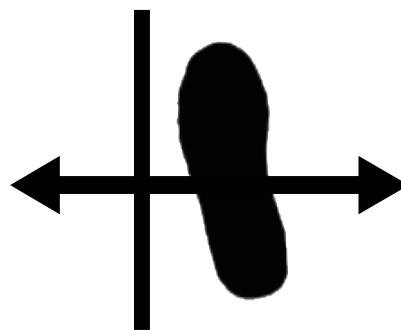




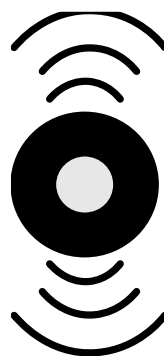




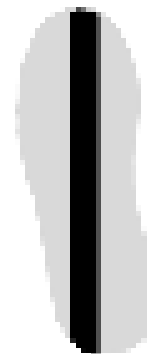
$R^2 \uparrow$



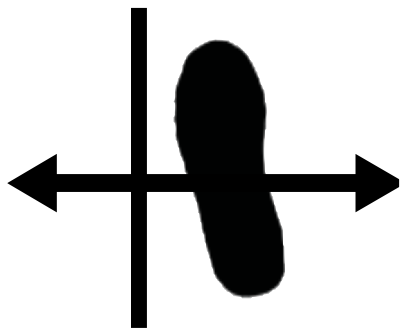
$R^2 \uparrow$



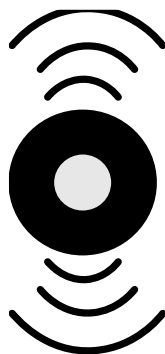
$R^2 =$



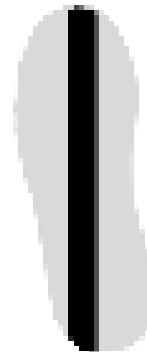
$R^2 \uparrow$



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$R^2 =$



$$R^2 = 1 - \frac{\text{unexplained variance}}{\text{total fp variance}}$$



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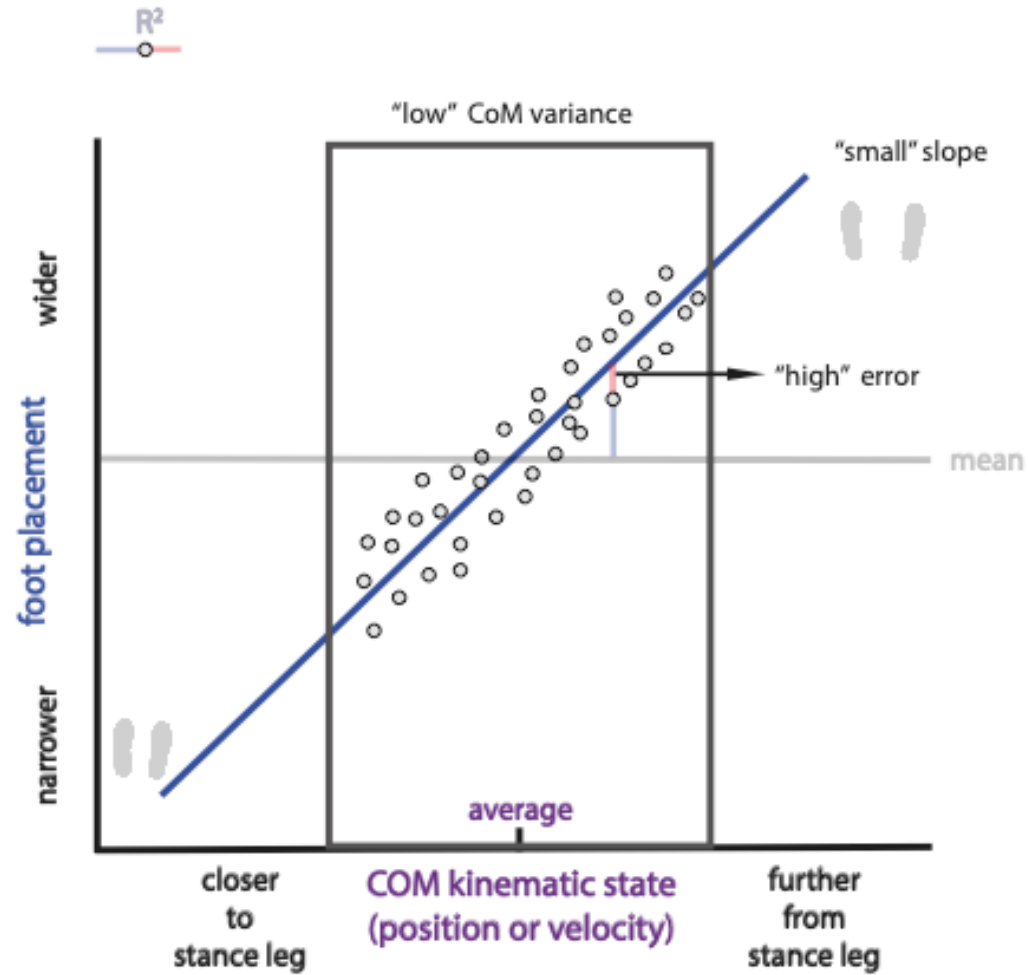
$$R^2 = 1 - \frac{\text{unexplained fp variance}}{\text{total fp variance}}$$

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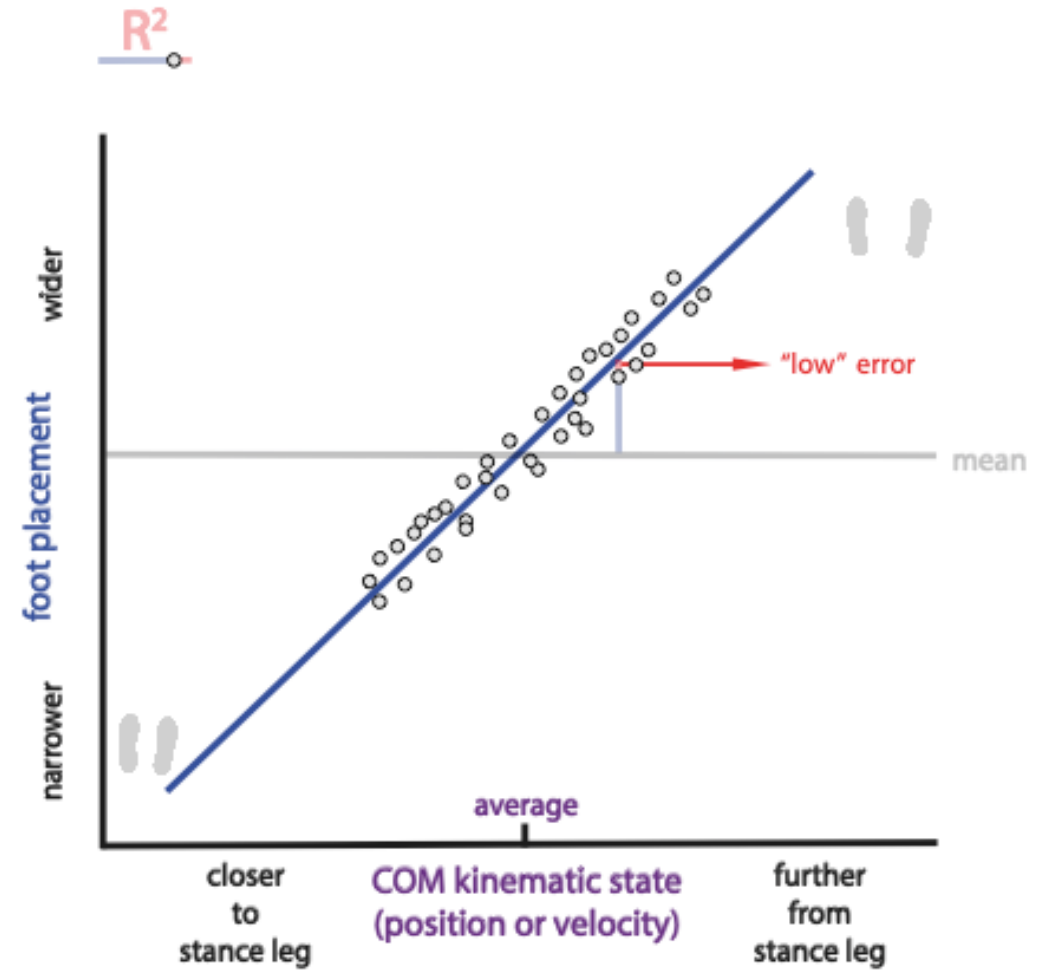
Foot placement precision

A.

## Foot placement model



B.

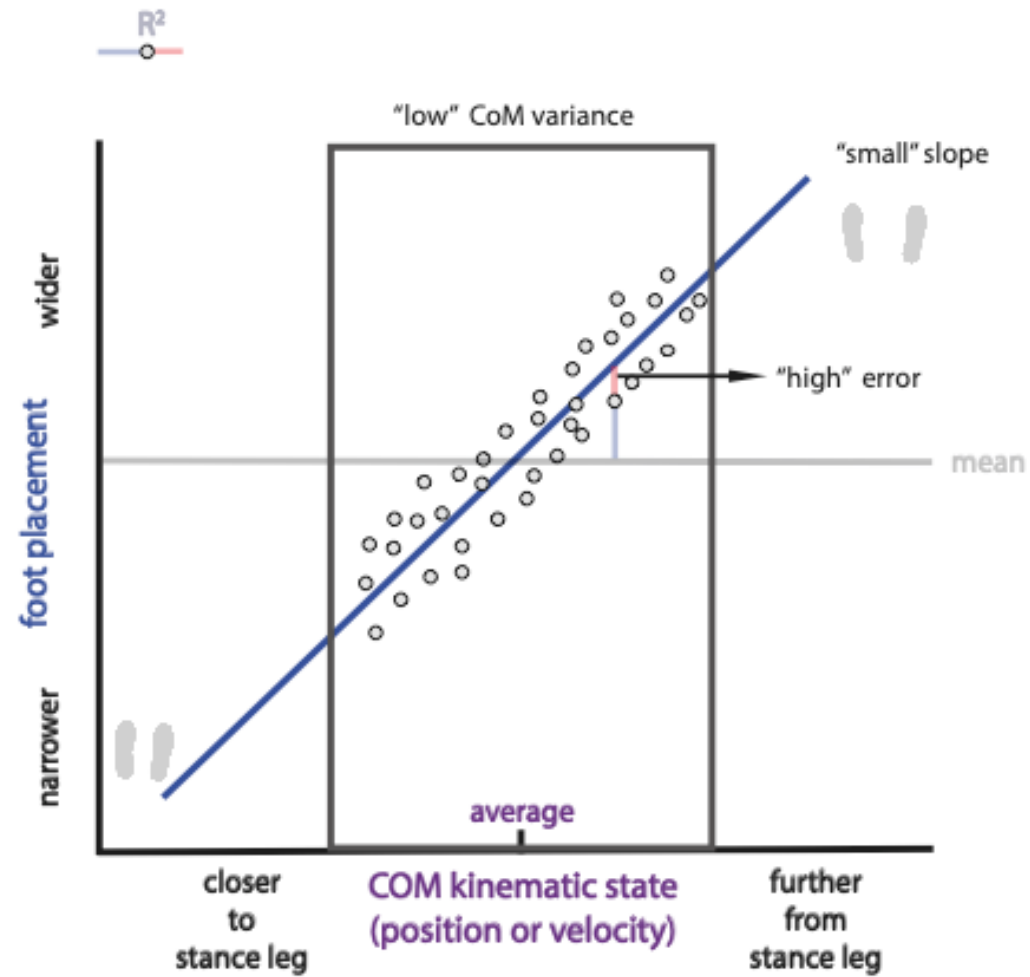
Lower **foot placement error** can increase  $R^2$ 

Increased foot placement precision

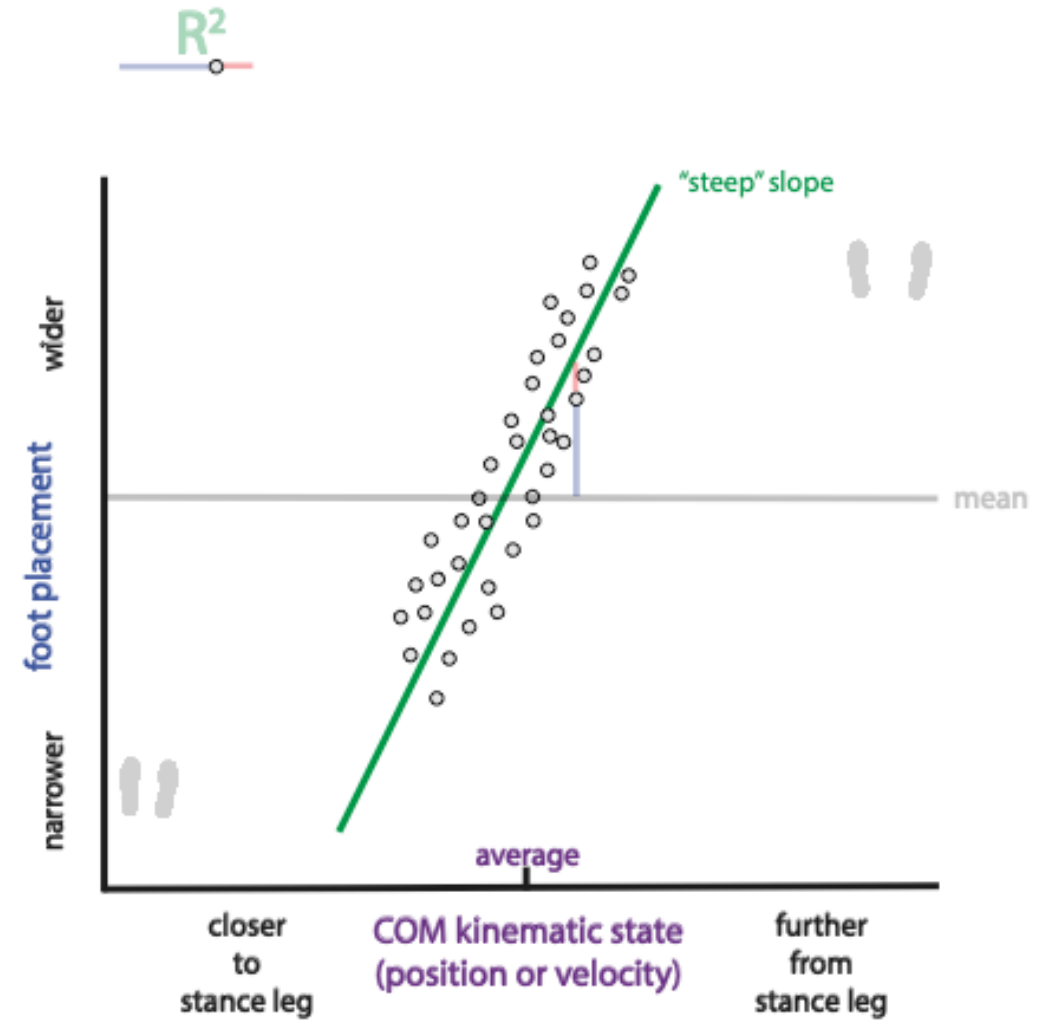
$$R^2 = 1 - \frac{\text{unexplained fp variance}}{\text{total fp variance}}$$

$$FP = \beta_1 \cdot P_{COM(i)} + \beta_2 \cdot V_{COM(i)} + \varepsilon$$

# A. Foot placement model



Higher gain ( $\beta$ ) can increase  $R^2$



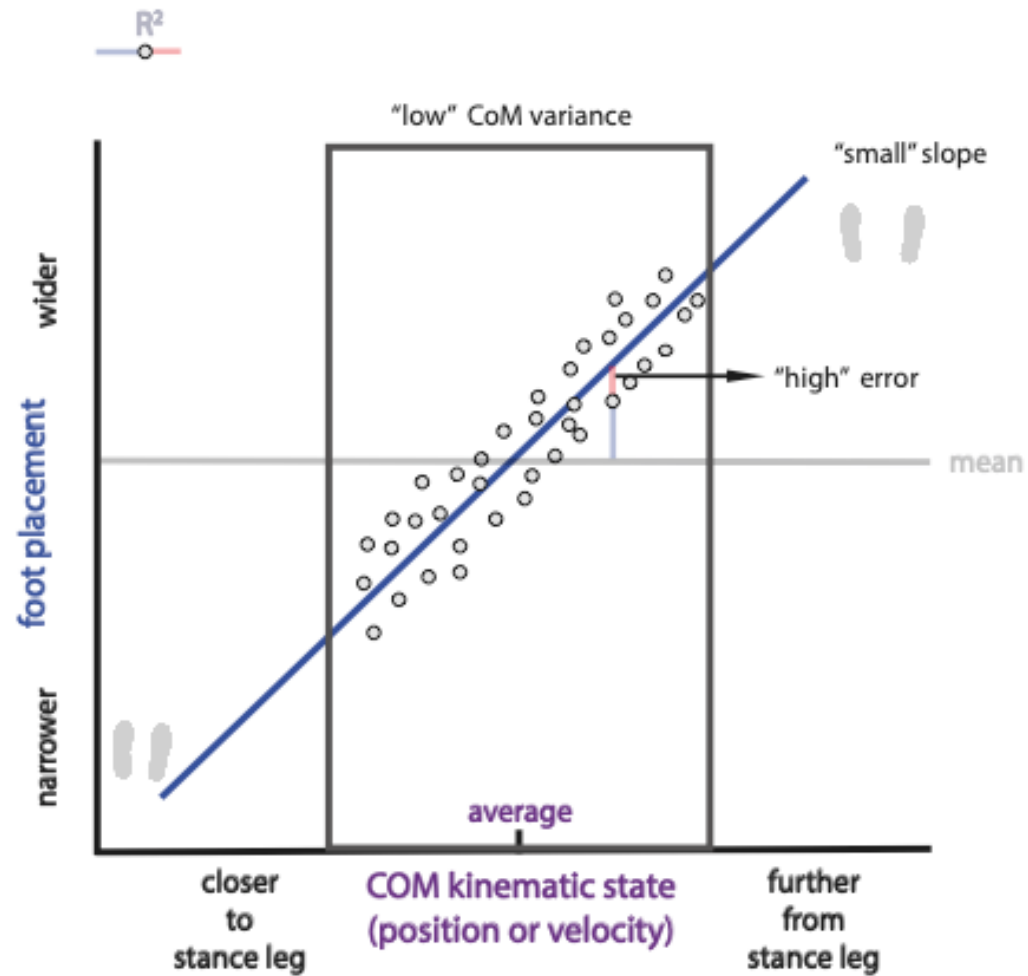
Stronger foot placement response

$$R^2 = 1 - \frac{\text{unexplained fp variance}}{\text{total fp variance}}$$

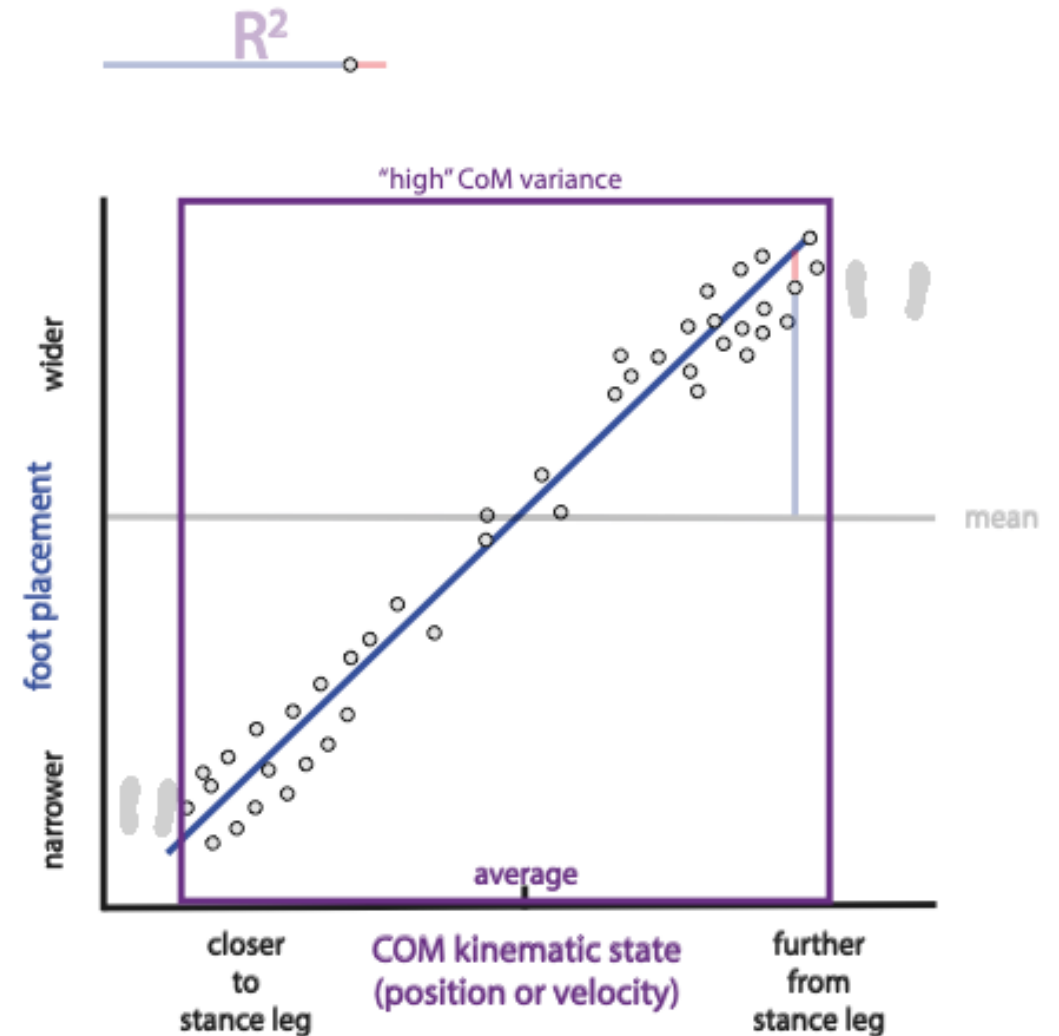
$$FP = \beta_1 \cdot P_{COM(i)} + \beta_2 \cdot V_{COM(i)} + \varepsilon$$

A.

## Foot placement model

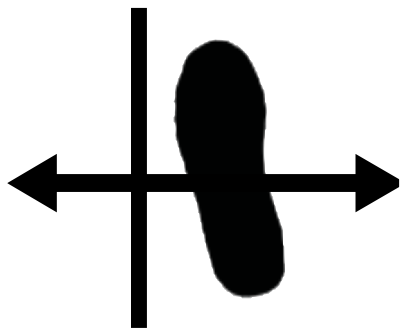


Higher CoM variance can increase  $R^2$

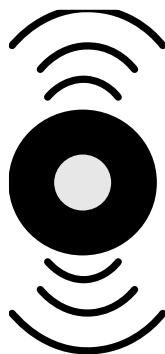


Larger contribution/relying more on foot placement control

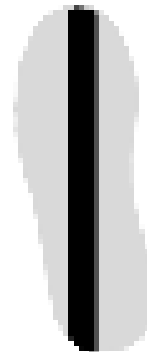
$R^2 \uparrow$



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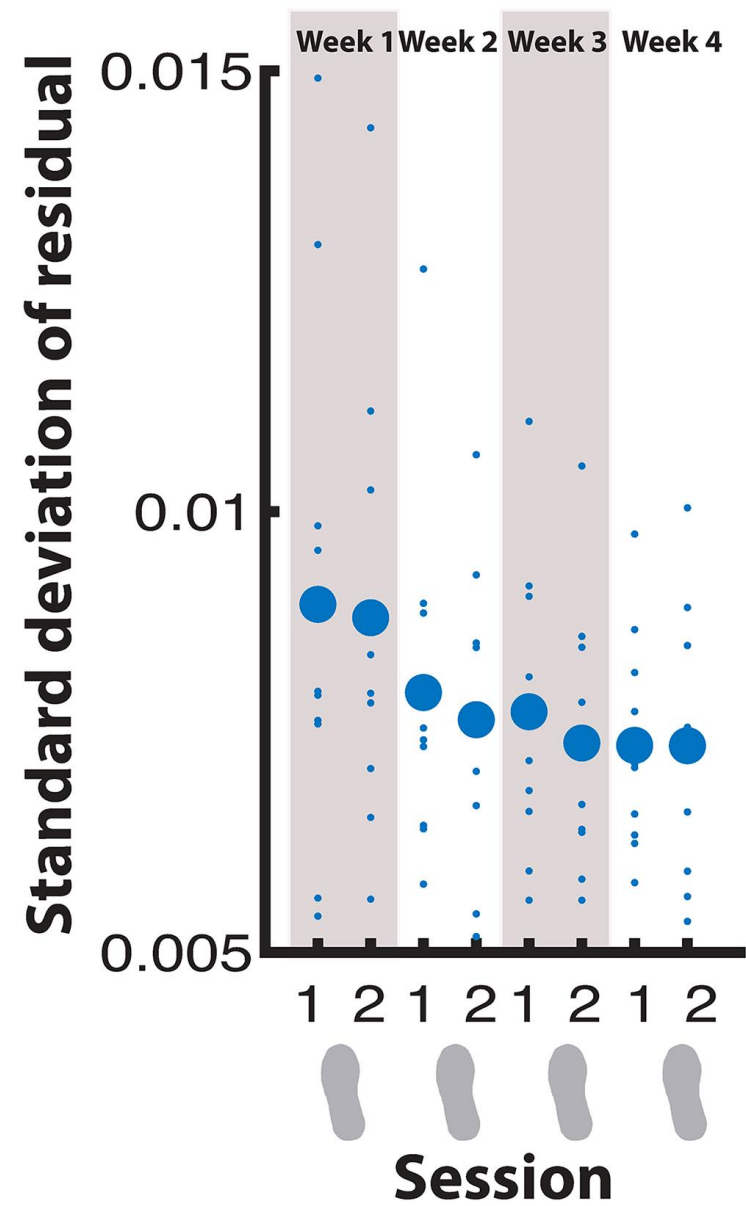


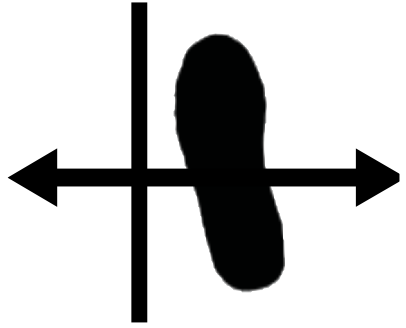
$R^2 =$





## Increased foot placement precision

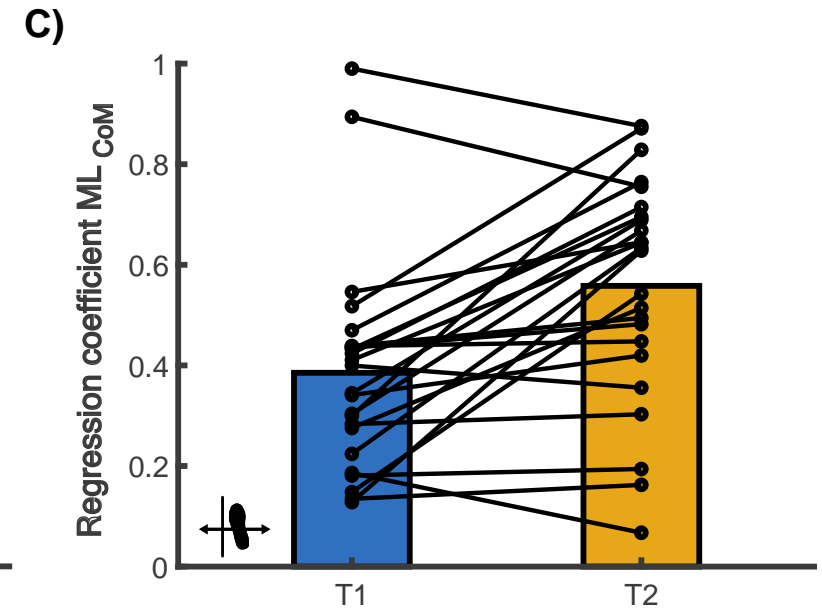
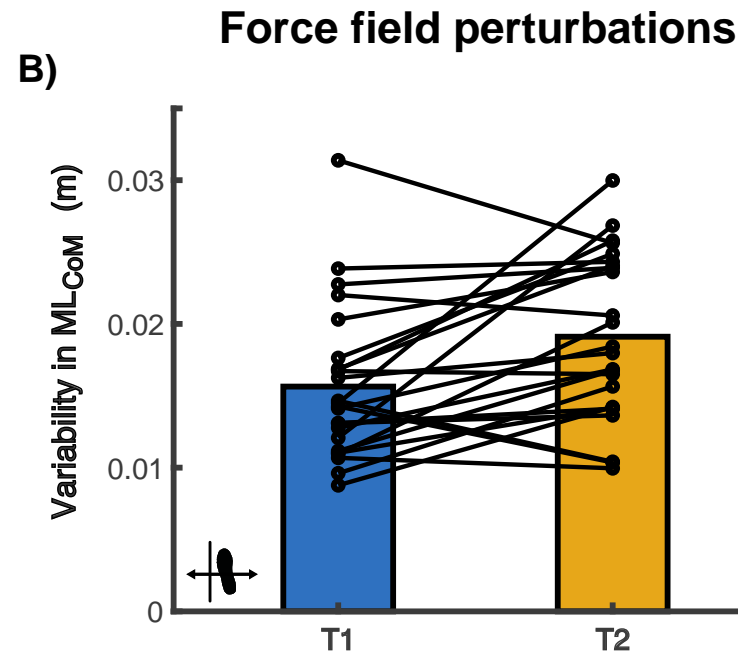
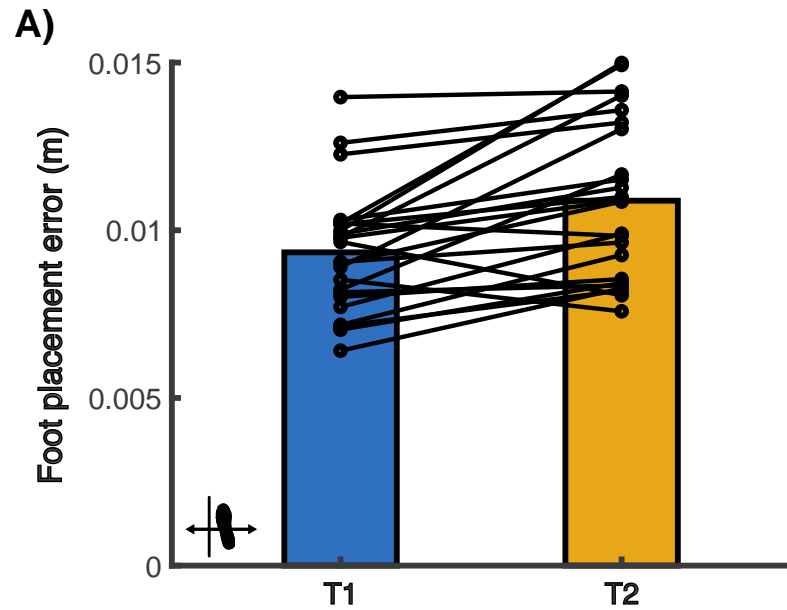




Decreased foot placement precision

Larger contribution/relying more on foot placement control

Stronger foot placement response

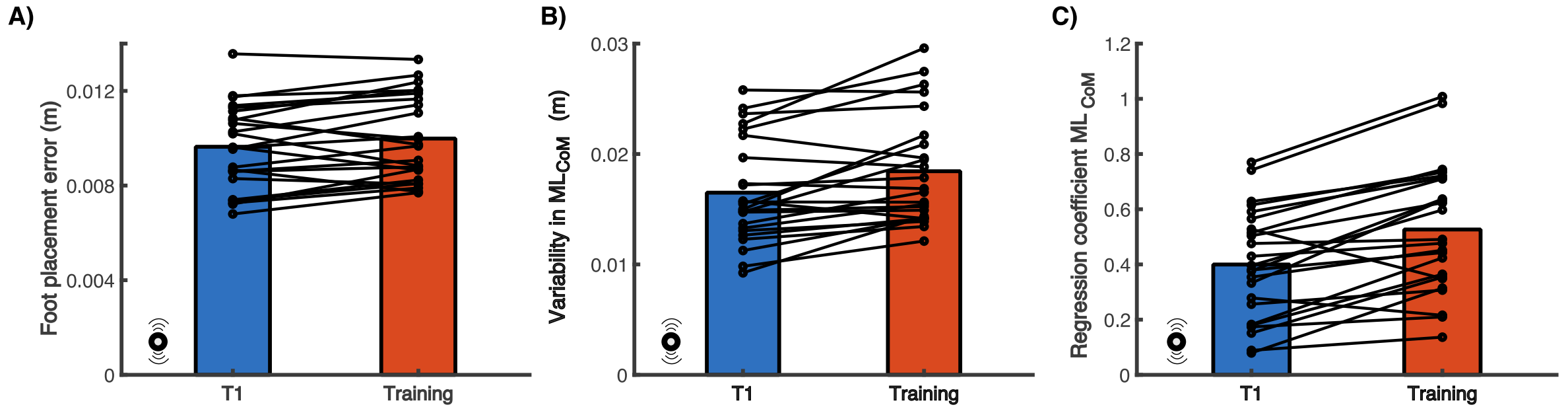




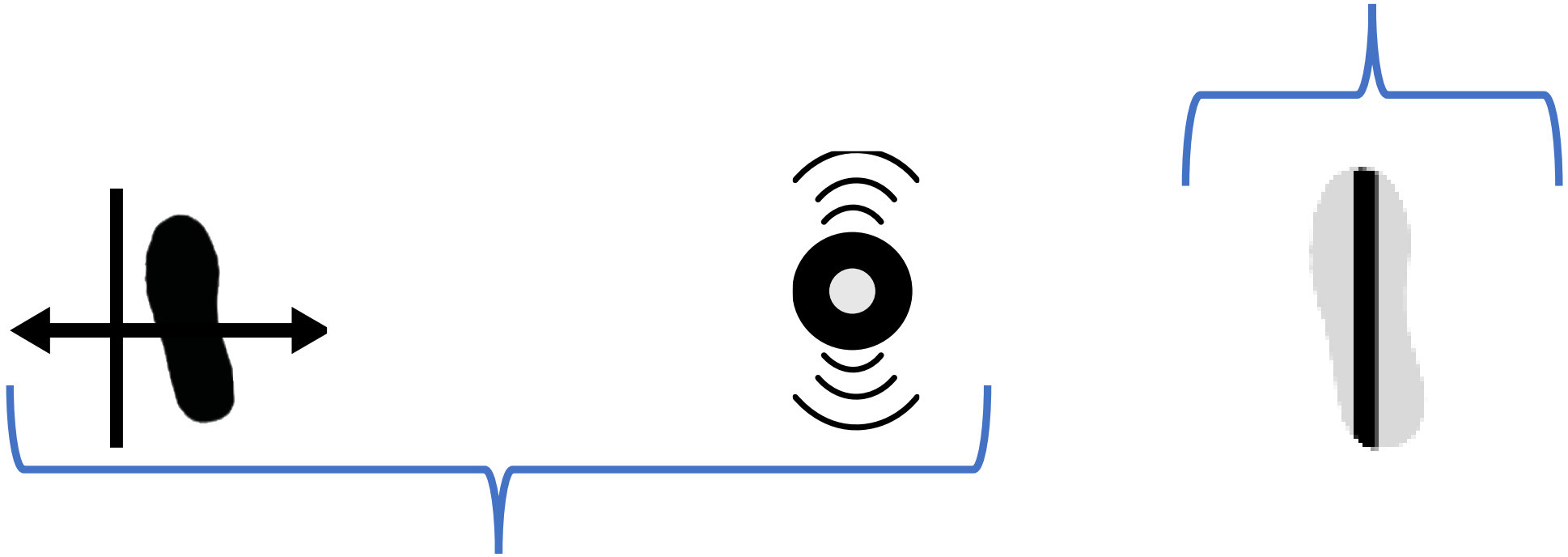
Larger contribution/relying more on foot placement control

Stronger foot placement response

### Sensory augmentation



Increased foot placement precision



Larger contribution/relying more on foot placement control

Stronger foot placement response