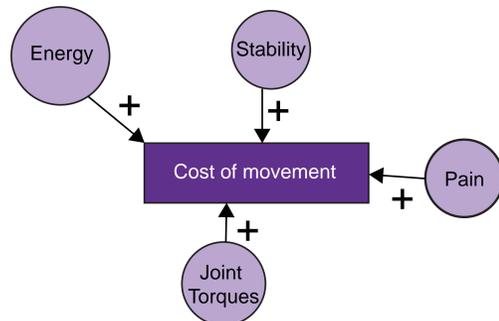


Introduction

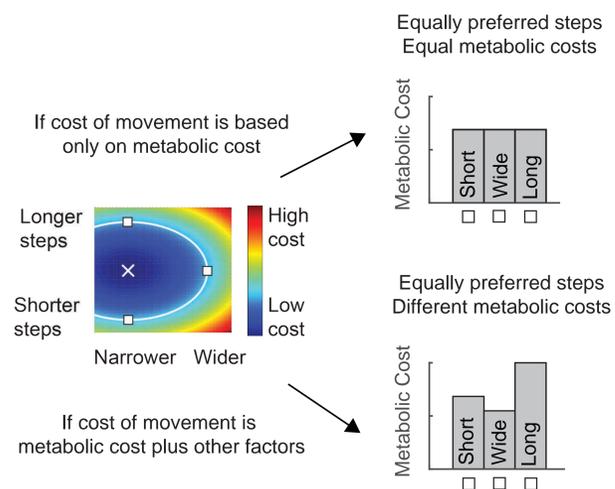
Healthy young adults' preferred walking speed, step length, and step width minimize metabolic cost.^{1,2}

However, a person's most preferred movement may simultaneously satisfy underlying objectives beyond metabolic cost.



Examining the choice between distinct stepping patterns, which have different biomechanical and energetic consequences, can provide insight into the relevant objectives.

If metabolic cost is the only underlying objective, then people should equally prefer step length-width patterns of equal metabolic cost.



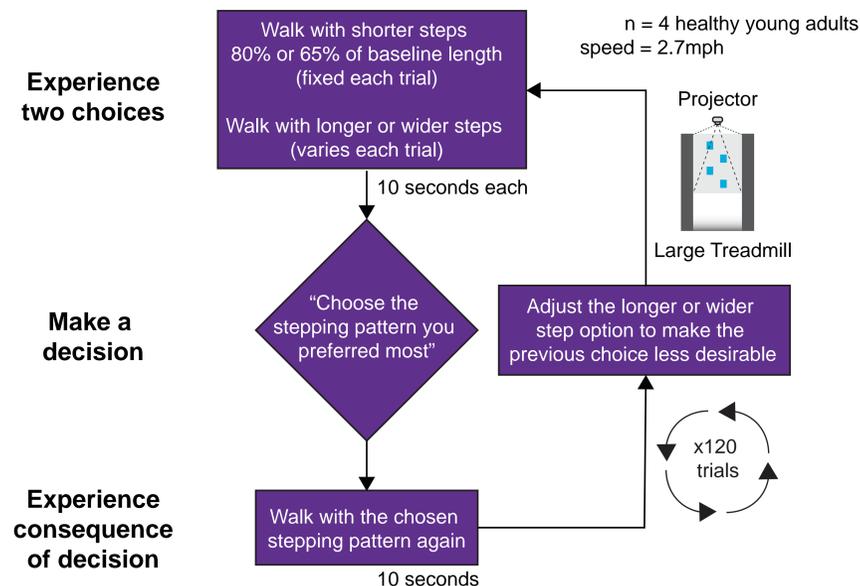
The "X" is a person's baseline step length-width pattern (lowest cost). The white contour is an indifference curve - a curve of equal cost. Squares are shorter, wider, and longer steps on one indifference curve.

Objective: test if metabolic cost explains a person's step length width preferences outside of their normal stepping pattern.

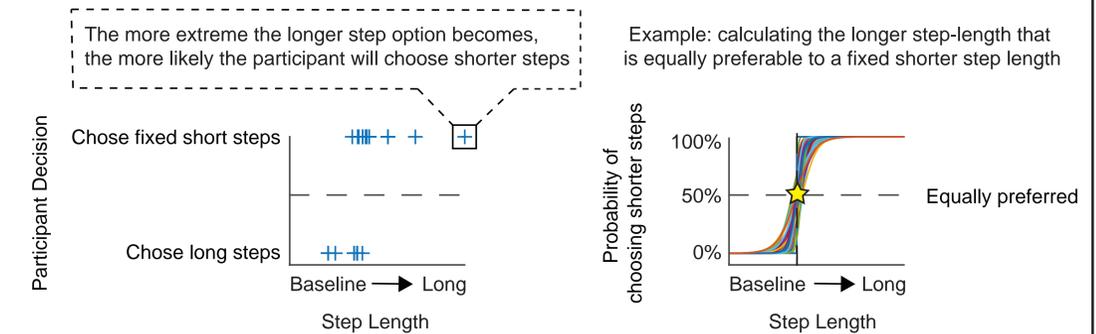
Hypothesis: metabolic cost cannot fully account for a person's step length-width preferences.

Methods

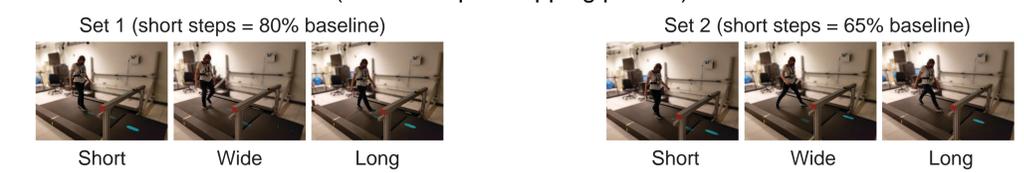
Step 1: Participants repeatedly choose between step length-width options (two-alternative forced-choice paradigm)



Step 2: Calculate equally preferred stepping patterns (50% chance of choosing one stepping pattern over another)

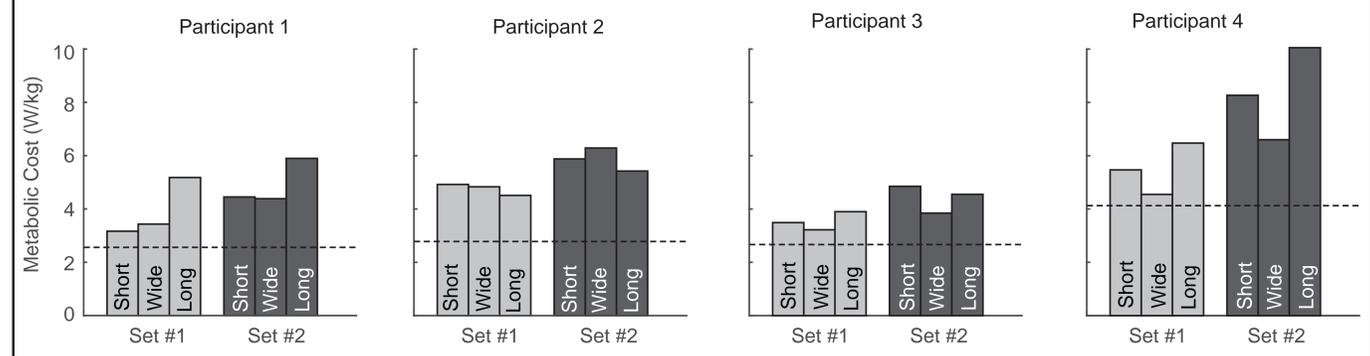


Step 3: Measure energy expenditure for equally preferred stepping patterns (6 minutes per stepping pattern)



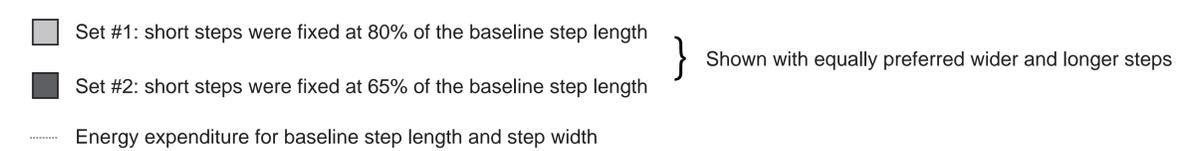
Results

- We were able to find equally preferred short, long, and wide steps using a two-alternative forced-choice paradigm.
- Metabolic cost was not always the same for equally preferred short, long, and wide steps. See participants 1 and 4 for notable differences.



"The short steps were annoying, it was lot of work to keep up with them." *"The long steps were tough on the quads."* *"I was worried about the impact on my knees with the wide steps... the short steps had a good rhythm."* *"The wide steps made my hips sore."*

Equally preferred stepping patterns



Discussion

Metabolic cost cannot fully explain why a person chooses one step length-width pattern over another.

There are likely other factors that also influence a person's choice of step length and step width such as stability, joint torques, or comfort.

Models and analyses of human locomotion should consider factors in addition to metabolic cost.

References

- Donelan JM, et al. Proc of the Royal Society B: Biological Sciences, 268, 1985-1992, 2001.
- Zarrugh MY, Radcliffe CW, European Journal of Applied Physiology 38, 215-223, 1978.

Acknowledgements

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