# Can Shifting Focus of Attention Change the Way You Run?

## 1. Proposal Narrative

### A. Abstract

Previous research has investigated various methods of gait retraining to reduce the risk of overuse injuries in endurance runners. However, there is limited research on the effectiveness of using verbal cues and different attentional foci to retrain running gaits. The purpose of this research study is to compare the efficacy of various attentional focus strategies on altering running biomechanics. We will recruit 30, habitually rearfoot striking runners to participate in this study. Each participant will be given either extrinsic feedback, internal verbal cues, or external verbal cues to focus their attention on a specific aspect of their running. The extrinsic feedback will be provided in the form of an auditory beep. The external and internal verbal cue focuses the runner's attention on their environment or bodily movements, respectively. We hypothesize that the extrinsic feedback and internal verbal cue conditions will elicit a more optimal foot strike and running gait than the external verbal cue condition. This study will contribute to the currently limited body of research on how shifting focus of attention can alter one's running gait, which may reduce the risk of future injury.

### B. Background/Statement of the Problem/Significance of the Project

Although distance running is a popular form of exercise, approximately 37-56% of runners sustain an overuse injury each year (Kulmala et al., 2013). There are a variety of factors that may lead to an overuse injury; one of which is the runner's biomechanics. Several studies have shown that a greater vertical ground reaction force (vGRF) loading rate, or the rate at which

the force from the ground is transferred into the lower extremity, is positively correlated with an increased risk of overuse running injuries such as patellofemoral pain, tibial stress fractures, plantar fasciitis, and knee osteoarthritis (Cheung & Davis, 2011; Daoud et al., 2012; Davis & Futrell, 2016; Hreljac, 2004; Kulmala et al., 2013). Consequently, studies that focus on running gait retraining aim to reduce the vGRF loading rate while maintaining proper form. A possible method of accomplishing this is by changing the foot strike pattern, or the region of the foot that first strikes the ground with each step. There is evidence that shifting from a rearfoot strike running technique to a forefoot strike running technique reduces the rate of loading, therefore reducing the risk of an overuse injury (Daoud et al., 2012; Davis & Futrell, 2016; Kulmala et al., 2013)

To accomplish this change in running technique, researchers aim to manipulate one's running biomechanics through instructions or feedback; this is referred to as gait retraining. Gait retraining is not novel; several studies have investigated methods to effectively change various biomechanical features of running gaits (Crowell & Davis, 2011; Davis & Futrell, 2016). However, the majority of recreational runners may not have access to a laboratory setting or expensive equipment to accomplish this. This is why the concept of providing verbal cues to retrain running gaits is a recent and favorable area of exploration.

Some studies have shown that verbal cues may be effective in altering gait biomechanics (Moore et al., 2019; Zimmermann & Bakker, 2019). However, it is unknown whether different types of verbal cues are more effective in altering running biomechanical variables, such as forces and foot strike patterns. Previous research on motor skill learning identifies two primary types of verbal cues: external and internal (Wulf & Prinz, 2001). External cues direct the

learner's attention to the effects of their movement on the environment, whereas internal cues direct the learner's attention to their own bodily movements (Moore et al., 2019; Wulf & Prinz, 2001). Many studies have compared the effectiveness of these two types of verbal cues on different activities and consistently found that the external focus of attention was more effective for learning the optimal movement of the skill (Wulf & Prinz, 2001). However, only one study to date has directly compared the effectiveness of external and internal verbal cues on foot strike modification during running, and the researchers found that the internal cue elicited a more optimal foot strike (Moore et al., 2019). This finding disrupts the consensus of the previous related literature, therefore there must be further investigation into this concept.

**C. Objectives / Specific Aims**

The purpose of this study is to compare the effectiveness of extrinsic feedback and different types of verbal cues on foot strike modification and other biomechanical variables while running. The results of this study will benefit runners, coaches, and clinicians by providing a more comprehensive understanding of how shifting focus of attention can alter one's running biomechanics and reduce the risk for injury.

**D. Methods**

We will recruit 30 individuals for this study, with ages ranging from 18 to 50 years. In order to be eligible to participate in this study, participants must be rearfoot strike runners that can run continuously for 35 minutes at a consistent, self-selected pace. All participants will be provided with an informed consent form to review and sign at their first session.

Each participant will individually attend three 60-minute sessions, with each session separated by 24 to 72 hours. Each session will involve a 35-minute continuous run, including a 5-minute warm-up, at a self-selected speed. The first session will include shoe fitting and baseline data collection. Participants will be fitted with a standard pair of neutral shoes (New Balance Fresh Foam 980, New Balance, Inc., Boston, MA) in Exercise and Sport Biomechanics Laboratory. Additionally, participant's height and weight will be measured and recorded. This session will be used to determine if the participant is categorized as a habitual rearfoot strike runner and qualifies to participate in the study. If the participant does not qualify, their participation in the study will be discontinued. Qualified runners will be given a 5-minute warm up period to determine their self-selected speed. Once the participant is running comfortably and ready to begin the 30-minute session, time will start and a 10-second data collection period will occur every 10 minutes. Data will be collected with the digital camera (Lumix DMC-FZ200, Panasonic, Inc., Osaka, Japan). At the end of the session, the participant will be given the option to cool-down for 3 minutes.

In the second session, participants will be randomly assigned to one of three experimental conditions: internal focus of attention, external focus of attention, or extrinsic feedback. The internal and external focus of attention groups will be provided verbal cues to direct their attention towards a specific aspect of their running. For the internal focus of attention, we will be using the verbal cue, "land on the ball of your foot," to focus the runner's attention on their own bodily movements. For the external focus of attention, we will be using the verbal cue, "run quietly," to focus the runner's attention toward their environment, and in this case, the sound of their footsteps on the treadmill. To compare the effectiveness of verbal cues with more

conventional types of gait retraining, a third group will be provided extrinsic auditory feedback. This condition will not be provided any verbal cues, but rather a preferred, audible "beep" when the runner successfully takes a step with a midfoot or forefoot strike, rather than a rearfoot strike. This will be accomplished by using a force sensor insole (Loadsol, Novel Electronics, Inc., St. Paul, MN) and a pressure sensor pad connected to a potentiometer and speakers. Feedback or verbal cues will be provided every two minutes throughout this 30-minute run. For the extrinsic feedback condition, auditory feedback will be provided for 10 seconds at each 2-minute interval. For a more detailed layout of the timetable for each session, see *Appendix A*.

The third and final session that participants will attend serves to measure the runners' gait retraining retention. This session will be similar to the layout of the first session in that no cues or feedback will be provided, but data collection will still occur at the same times as the first and second sessions.

The variables that will be measured include peak vertical ground reaction force (vGRF), vGRF loading rate, foot angle at initial contact, shank angle at initial contact, and cadence. Foot angle will be defined as the angle between the running surface and the foot segment, which is represented by the imaginary line segment connecting the head of the 5th metatarsal and the calcaneus. The shank angle will be the angle measured between the perpendicular of the running surface and the shank segment, which is defined as the imaginary line segment that connects the lateral femoral condyle to the lateral malleolus. Cadence will be measured in steps per minute.

Data will be analyzed using SPSS software. For each dependent variable, a separate 3-way repeated measures (Group x Day x Running Phase) ANOVA will be performed to detect

statistically significant differences. For the statistically significant findings, appropriate post-hoc pairwise comparisons will be performed.

**E. Final Products and Dissemination**

The final product of this study will be a poster that will be presented at the 2021 University of Wisconsin - La Crosse Research and Creativity Symposium.

**F. Budget justification**

Supplies Total: $1000

- Participant incentives ($15 x 30 participants = $450): Each participant will receive $15 as an incentive to participate; this will be provided at the conclusion of the third session.
- Pressure pad ($300): This pressure pad will be used as the audio feedback device for the extrinsic auditory feedback condition. This pad fits in the heel of the shoe and senses the pressure the runner exerts on their heel while running.
- Two 256GB flash drives ($50 x 2 flash drives = $100): Used to store the video footage from each of the participants' sessions.
- Powerflex elastic tape ($75): The Powerflex elastic tape will be used to secure the reflective markers on the participants which will be placed at bony landmarks to allow us to accurately measure joint angles.
- 128GB SD card ($50): Used to hold the footage until we transfer it to a flash drive.
- Printing cost for final presentation poster ($25)

Student scholarship: $1000

- This scholarship is to cover time spent in the biomechanics lab with test subjects and analyzing data.

**References**

Cheung, R. T., & Davis, I. S. (2011). Landing pattern modification to improve patellofemoral pain in runners: a case series. *Journal of orthopaedic & sports physical therapy*, *41*(12), 914-919.

Ching, E., An, W. W. K., Au, I. P. H., Zhang, J. H., Chan, Z. Y., Shum, G., & Cheung, R. T. (2018). Impact loading during distracted running before and after auditory gait retraining. *International journal of sports medicine*, *39*(14), 1075-1080.

Crowell, H. P., & Davis, I. S. (2011). Gait retraining to reduce lower extremity loading in runners. *Clinical biomechanics*, *26*(1), 78-83.

Daoud, A. I., Geissler, G. J., Wang, F., Saretsky, J., Daoud, Y. A., & Lieberman, D. E. (2012). Foot strike and injury rates in endurance runners: a retrospective study. *Medicine & Science in Sports & Exercise*, *44*(7), 1325-1334.

Davis, I. S., & Futrell, E. (2016). Gait retraining: altering the fingerprint of gait. *Physical Medicine and Rehabilitation Clinics*, *27*(1), 339-355.

Hreljac, A. (2004). Impact and overuse injuries in runners. *Medicine & Science in Sports & Exercise*, *36*(5), 845-849.

Kulmala, J. P., Avela, J. A. N. N. E., Pasanen, K. A. T. I., & Parkkari, J. A. R. I. (2013). Forefoot strikers exhibit lower running-induced knee loading than rearfoot strikers. *Medicine & Science in Sports & Exercise*, *45*(12), 2306-2313.

Moore, I. S., Phillips, D. J., Ashford, K. J., Mullen, R., Goom, T., & Gittoes, M. R. (2019). An interdisciplinary examination of attentional focus strategies used during running gait retraining. *Scandinavian journal of medicine & science in sports*, *29*(10), 1572-1582.

Wulf, G., & Prinz, W. (2001). Directing attention to movement effects enhances learning: A review. *Psychonomic bulletin & review*, *8*(4), 648-660.

Zimmermann, W. O., & Bakker, E. W. P. (2019). Reducing vertical ground reaction forces: The relative importance of three gait retraining cues. *Clinical Biomechanics*, *69*, 16-20.

*Appendix A: Timetable of the three sessions*

| Time | First Session | Second Session | Third Session |
|---|---|---|---|
| Warm up (5 min) | Determine self-selected speed | Walk 4 min, use 1 minute to get to running speed | Walk 4 min, use 1 minute to get to running speed |
| 0:00 | Data collection starts | Data collection starts | Data collection starts |
| 0:10 | Data collection ends | Data collection ends | Data collection ends |
| 2:00 | | Verbal cue or feedback | |
| 4:00 | | Verbal cue or feedback | |
| 6:00 | | Verbal cue or feedback | |
| 8:00 | | Verbal cue or feedback | |
| 9:50 | Data collection starts | Data collection starts | Data collection starts |
| 10:00 | Data collection ends | Data collection ends; provide verbal cue or 10 seconds of feedback | Data collection ends |
| 12:00 | | Verbal cue or feedback | |
| 14:00 | | Verbal cue or feedback | |
| 16:00 | | Verbal cue or feedback | |
| 18:00 | | Verbal cue or feedback | |
| 19:50 | Data collection starts | Data collection starts | Data collection starts |
| 20:00 | Data collection ends | Data collection ends; provide verbal cue or feedback | Data collection ends |
| 22:00 | | Verbal cue or feedback | |
| 24:00 | | Verbal cue or feedback | |
| 26:00 | | Verbal cue or feedback | |
| 28:00 | | Verbal cue or feedback | |
| 29:50 | Data collection starts | Data collection starts | Data collection starts |
| 30:00 | Data collection ends; session ends; participant provided optional cool-down | | |