

# Effects of increased attention allocation on postural stability related to history of concussion



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## Introduction

Postural stability impairments are among the most common symptoms following a concussion. These impairments can be exacerbated by dividing an individual's attention between concurrent cognitive tasks and a balance assessment. Traditionally, problems maintaining balance stemming from a concussion are generally declared resolved within two weeks of the initial injury. However, the balance assessments utilized for concussion screenings are often subjective in nature with error-based grading scales. Therefore, these screenings only detect balance impairments that are gross in nature. However, more advanced techniques of measuring postural stability have revealed deficits in stability during assessments of balance and gait several months following a concussion. However, the objective extent to which concussion impairs proper allocation of attention during balance assessments has not been identified in the literature.

## Aims

The aim of this study was to assess the influence of concurrent cognitive tasks on postural stability in relation to prior history of concussion. The purpose of this study is to expand on the current literature in order to determine if concussion has chronic implications for allocation of attentional resources

## Methods

### Participants

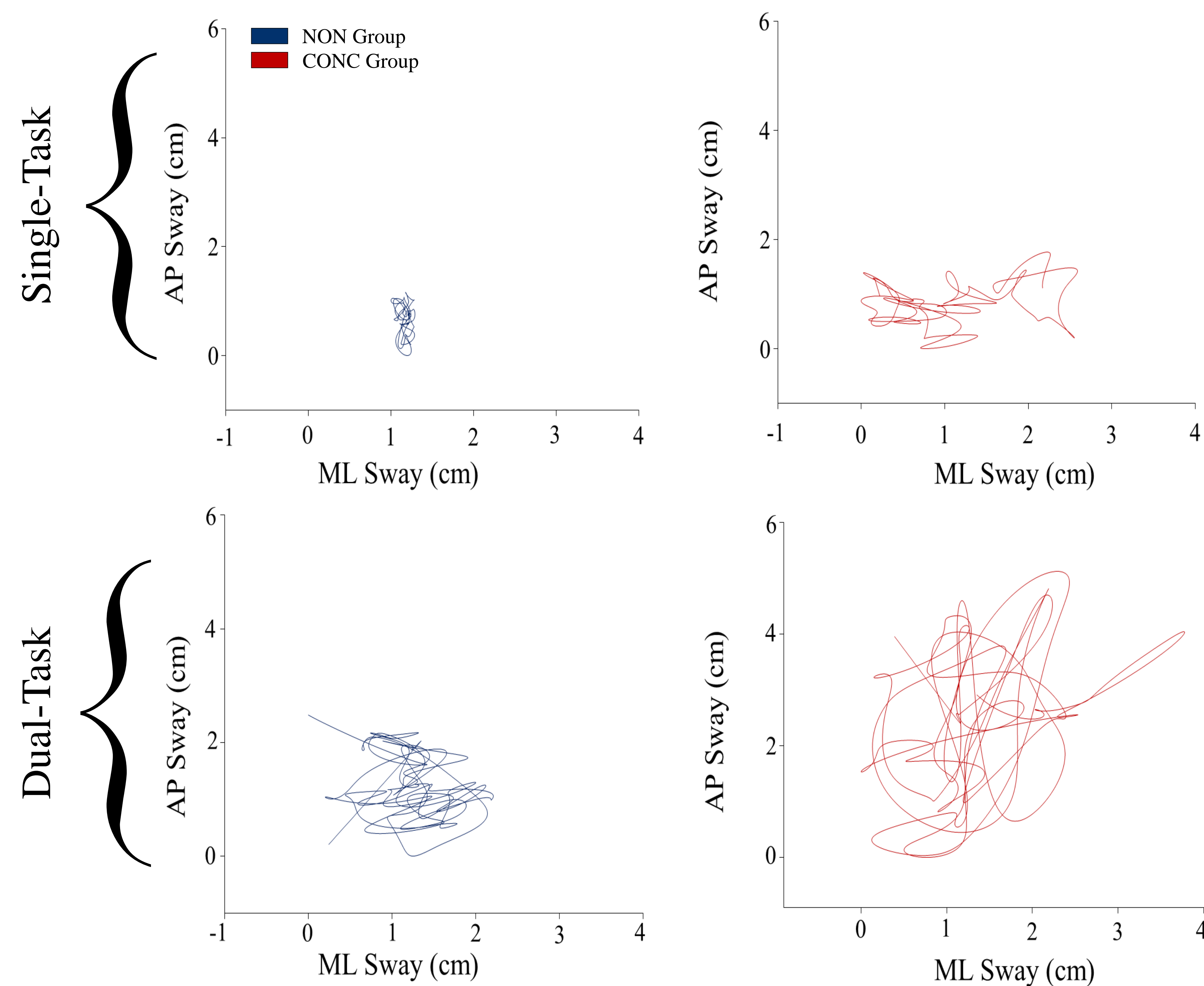
Fifty-four healthy adults were recruited to participate in the study and were divided into two groups based on whether they reported having been previously diagnosed with one or multiple concussions (n=27) or having no prior history of concussion (n=27).

### Postural Stability Measures

Center-of-pressure (COP) during quiet standing was recorded using a force plate (Bertec Corporation, Columbus, OH) recording at 50 Hz. Participants stood on the force plate while looking straight ahead. Conditions for evaluation were four combinations produced by manipulating the participant's base of support by having them stand on their dominant leg and/or by adding a concurrent cognitive task during the trial. The resulting four conditions were as follows:

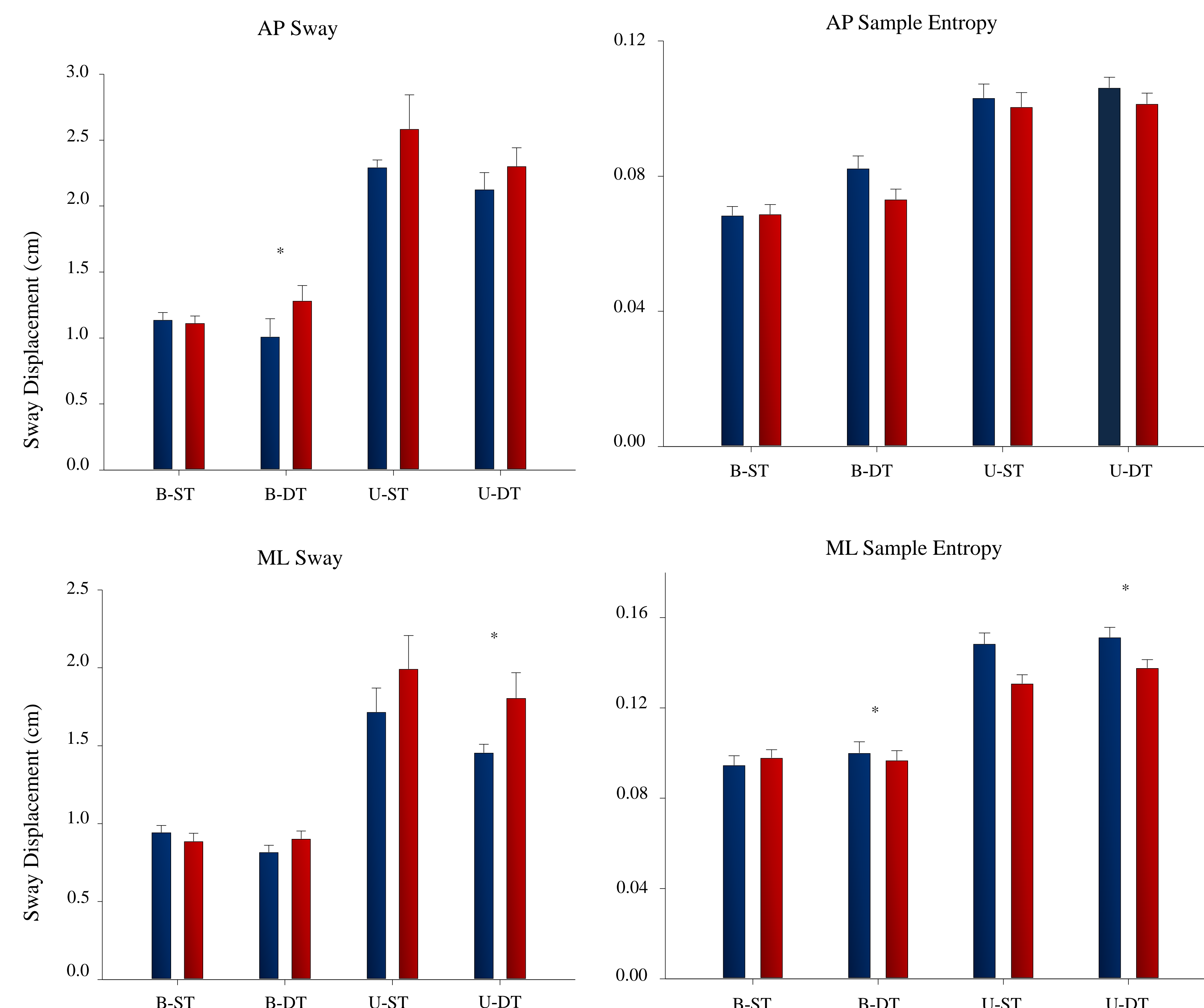
1. Bipedal, single-task (B-ST)
2. Bipedal, dual-task (B-DT)
3. Unipedal, single task (U-ST)
4. Unipedal, dual-task (U-DT)

## Results



### Center of Pressure Tracings

- There was a significant group and condition effect for COP elliptical area representing a 95 percent confidence interval.
- Individuals with a prior history of concussion demonstrated greater sway area under dual-task conditions compared to healthy controls.
  - Effect was found under both bipedal and unipedal stance.
- Corresponding measures of sway velocity indicated that those with history of concussion sway slower than healthy controls under bipedal stance.
  - Indicative of increasing stiffness via muscle tension.
  - Slower sway could be a means to counteract a decreased inability to correct instability.



### Mean Sway Displacement

- Mean COP displacement increased in unipedal stance for both groups under both single and dual-task conditions.
- Individuals with history of concussion exhibited significantly greater sway displacement under dual-task conditions under both stance conditions.
  - Bipedal: greater anteroposterior sway
  - Unipedal: greater mediolateral sway

### Sample Entropy

- Individuals with history of concussion displayed lower sample entropy (greater regularity) of their sway in the mediolateral plane under dual-task conditions.
- There were no significant differences in sample entropy between groups in the anterior-posterior plane.

## Conclusions

Overall, our results indicate that concussion is associated with impairments of attentional allocation long years beyond the determination of medical clearance by current clinical standards. By challenging the attentional demand for maintaining upright posture with the use of a concurrent cognitive task, we observed that individuals with a history of concussion demonstrated significant reductions in standing postural stability as measured by center-of-pressure displacement and sample entropy in both the anteroposterior and mediolateral planes. Interestingly, we did not detect significant differences based on concussion history under single-task conditions for any metric. These findings indicate dual-task conditions could potentially be a useful tool in a clinical setting when screening for deficits associated with concussion and that these deficits persist years after current screening measure indicate a full recovery has been achieved.