INTRODUCTION
The Centers for Disease Control and Prevention define mild traumatic brain injuries (mTBI) as a head injury that results from a blunt trauma or acceleration or deceleration forces that includes any period of disorientation, dysfunction of memory around the time of the injury, or loss of consciousness less than 30 minutes. While mTBIs, or concussion, is typically associated with athletics, head trauma is hugely prevalent in the battlefield and combat training, as evidenced by 294,010 documented cases of mTBI in the Department of Defense between 2000 and 2016 [1]. The long term significance of these injuries is not well understood as few studies have investigated veterans with chronic symptoms. However, there is some evidence to suggest veterans sustaining a TBI continue to have worse symptoms when compared to healthy controls even years removed from the injury. This idea was explored earlier in adults with TBI and found 40% of adults with TBI had more than two neurological symptoms one year after a head injury, and 53% had at least one [2]. Recent studies performed in our laboratory utilizing gait analysis in individuals sustaining an acute mTBI have shown that a significant gait impairment exists when tested under a dual-task paradigm (walking while performing a concurrent cognitive task). We found subjects with concussion have a greater medial-lateral (M-L) displacement of their whole body center of mass (COM) relative to matched control subjects that exists up to two months post-injury. This dual-task paradigm in which subjects perform a concurrent auditory Stroop test is thought to challenge a subject’s ability to appropriately allocate limited attentional resources. As it has been shown that veteran subjects with chronic mTBI continue to suffer from subjective symptoms, it is reasonable to believe they may also continue to exhibit impairment in their gait stability when tested under a dual-task condition. The purpose of this study is compare the gait stability of veteran subjects with chronic mTBI to that of an acutely concussed young adults. We hypothesize that the veteran subjects with chronic mTBI, with lingering symptoms of post-concussion syndrome, will show deficits with in dual-task gait stability similar to the acutely concussed subjects.

METHODS
Subjects included eight veterans with chronic mTBI (1F; 32.3 ± 6.5 years old) and 20 acutely concussed young adults (10F; 21.4 ± 4.6 years). Acutely concussed young adults underwent five testing sessions: within 72 hours, 1 week, 2 weeks, 1 month, 2 months. Veterans performed the same assessment during a single visit. The average length of time since injury for veterans is 3.5±1.7 years. All subjects walked barefoot at a comfortable speed along a walkway under 2 conditions: walking with undivided attention (single-task) and walking while concurrently completing a continuous auditory Stroop test (dual-task). This Stroop test consisted of the subject listening to 4 auditory stimuli: the recorded words “high” or “low”, each spoken in either a high pitch or low pitch. Subjects were instructed to correctly identify the pitch of the word, regardless of the word spoken [3]. Multiple trials were completed for each of the two conditions. A set of 29 retro-reflective markers were placed on bony landmarks of the subject, and whole body motion analysis was performed using a 10-camera motion analysis system. External markers and estimated joint centers were used to calculate the COM position for each individual body segment. Whole body COM position data were then calculated as the weighted sum of all body segments, with 13 segments representing the whole body. For each trial, data were analyzed for 1 gait cycle, defined as heel strike to heel strike of the same limb [4].

RESULTS AND DISCUSSION
The M-L displacement during dual-task walking for all subject groups are shown below. We performed a Welch’s t-test for independent observations in order to compare dual-task M-L displacement between veterans with chronic mTBI and acutely injured young adults. Results of the analysis indicated a p-value of $p = .229$, indicating that the difference is not significant.

CONCLUSIONS
The veterans with chronic mTBI and acutely concussed young adults demonstrated a similar amount of M-L COM displacement during dual-task walking. This supports our hypothesis that there is a similar gait balance control impairment in veterans with chronic symptoms that is evident when tested under a dual-task paradigm. While limitations to this study include a small sample size and high variance in the veteran group, these results suggest dynamic gait instability along with subjective symptoms may exist for an extended period, possibly contributing to increased disability in this population.

REFERENCES