Biomechanical Analysis of Center of Mass During Martial Arts

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Study Goal

Study Question: Does practicing meditation decrease Center of Mass Acceleration Jerk Variability (COMA-JV)?

Study Process: Participants were sectioned into two groups. The Experimental group had meditation incorporated into their martial arts practice while the Control did not. Participants then performed a basic martial arts form weekly for three weeks while being recorded by a Motion Capture (MOCAP) system. Where biomechanics and calculus were used to calculate COMA-JV, Area Under the Curve, and Three peak Average. This was then compared to an ultimate control variable.

Participants

Two groups of two participants each were sourced from the AME 294 Class: Martial Arts Meets Motion Capture. These students were untrained in Tang Soo Do and Ki-Gong. Additionally, a master instructor in Tang Soo Do participated as a "Gold Standard" for comparison.

Background
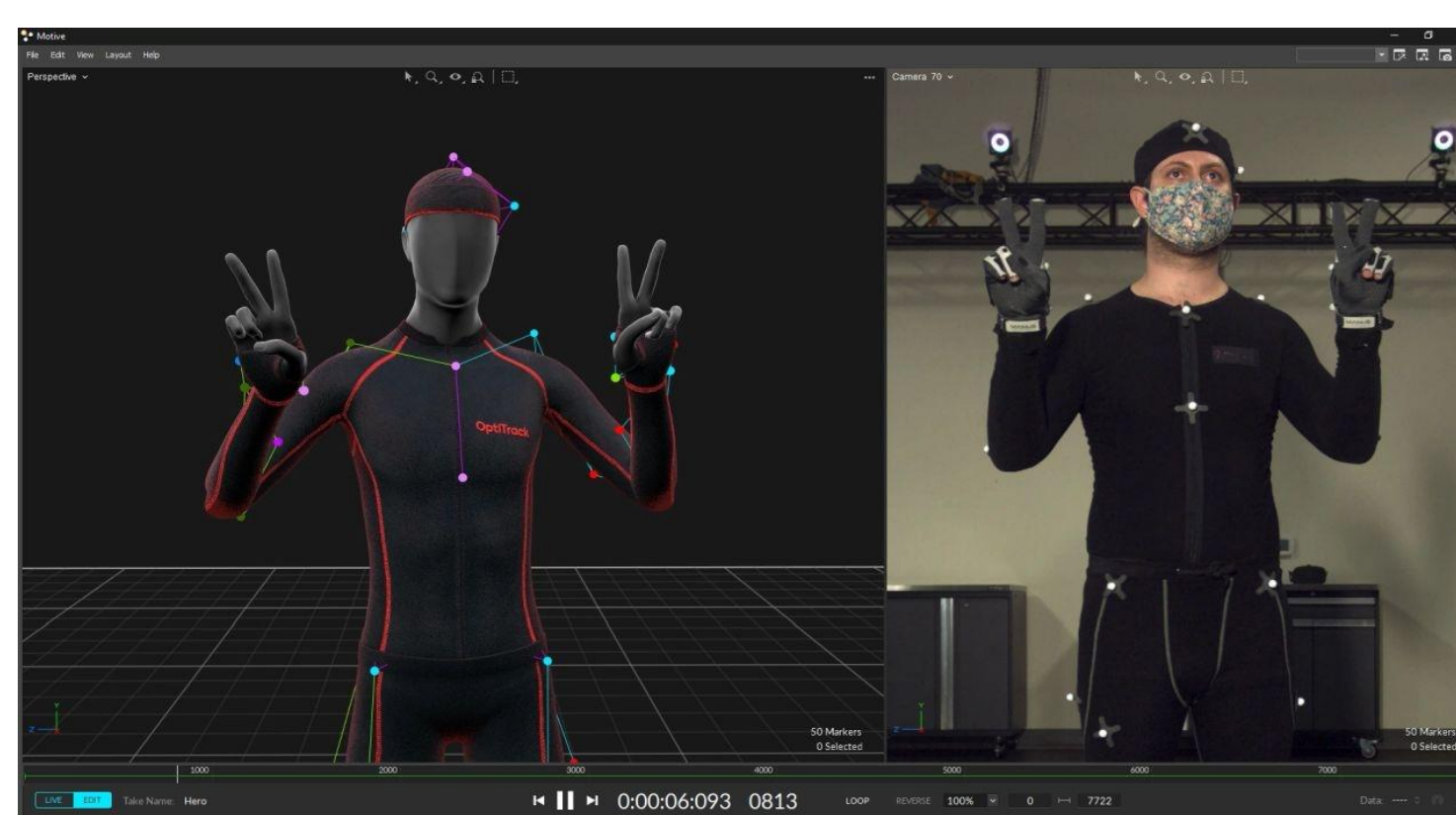
Figure 1: Optitrack Motion Capture in Use [1]

Motion Capture technology is the backbone of video game development, mainstream movies, and animation. In addition to these fields it has also been used as a tool for biomechanical analysis of complex activities for years utilizing inverse kinematics. The concept at work is simple; roughly 20 - 30 infrared (IR) cameras are placed around a room, objects or people move in front of them while wearing markers made from IR reflecting material. The IR light reflected by these markers is then picked up -

Background - Continued

- by the cameras and recreated in a digital 3D space. Here the positional and movement data of these markers can be assigned joints, object names, and attributes thus allowing for replicas to be constructed.

COMA-JV is an important measurement often used to quantify overrall uniformity and steadiness in motion. The assumption moving forward into this project was that the more experienced a martial artist, the lower this value should be.
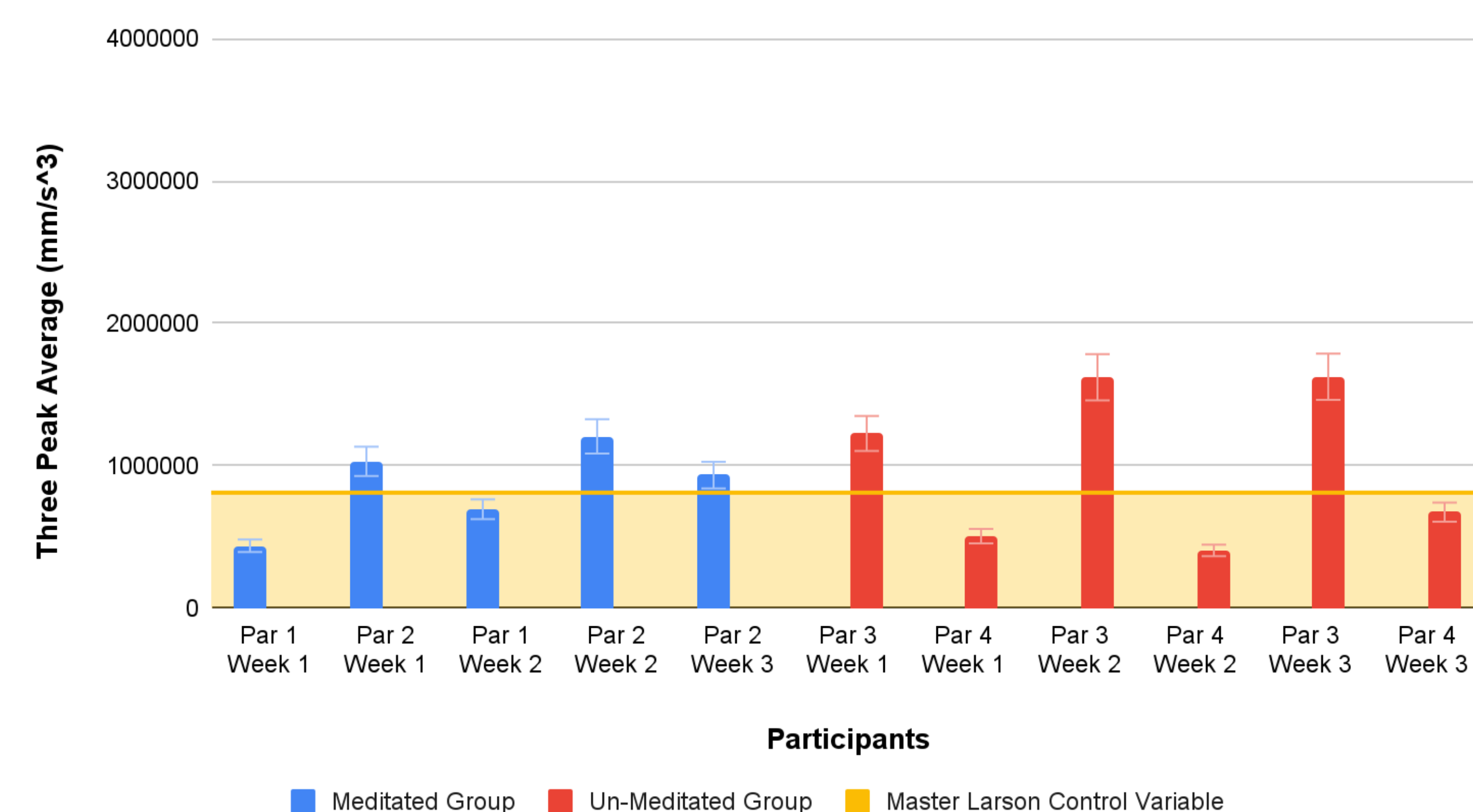
Results
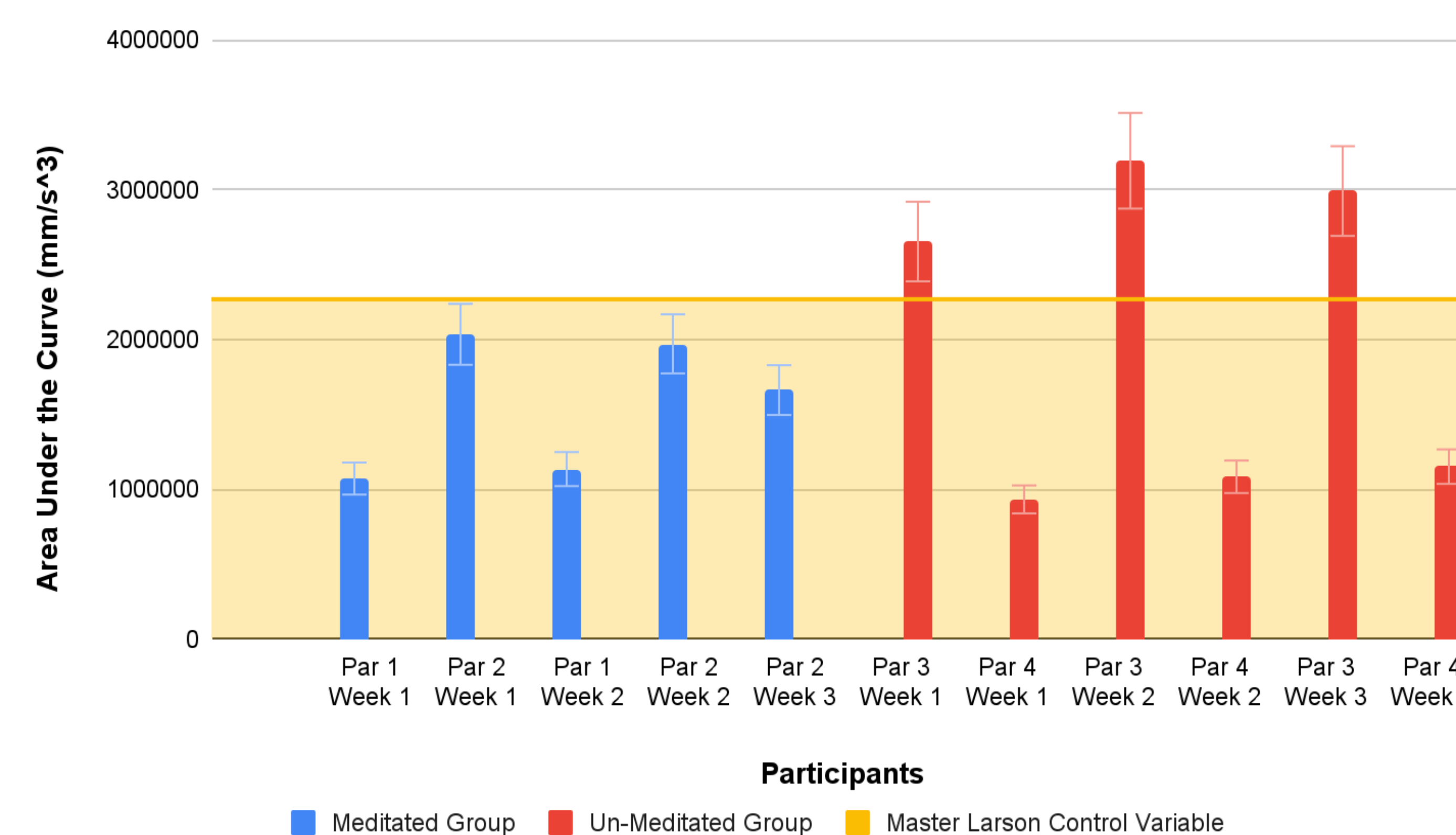
Figure 2: Area Under the Curve Results

Figure 3: Three Peak Average Results

Statistical Verification

95% Confidence intervals for the two groups for Area Under the Curve were found to be: Meditated CI = [-3,497,168.48, 6,490,880.19], Un-Meditated CI = [-1,289,103.09, 5,292,593.24]. For Three Peak Average these values were found to be: Meditated CI = [-2,308,988.44, 3,932,335.97], Un-Meditated CI = [-5108674.54, 7128311.75.

Interpretations

Due to the fact that all of the calculated confidence intervals cross zero and include Master Larson's Values, it can be safely said that there is no statistical significance between the three groups.

Possible reasons for this may include but are not limited to: too small of a sample size, underpowered data collection, time restrictions, and a misconception on COMA Variability development in Tang Soo Do Practitioners.

Future Directions

To reconduct the study a more in-depth biomechanical analysis would be used, with increased participant numbers, increased time constraints, and adjustment of the hypothesis to lower extrema in COMA Jerk Variability correlating to meditative state.

Acknowledgements

References

[1] YouTube. (n.d.-a). *Animation World Network*. YouTube. https://www.youtube.com/@AWN-AnimationWorldNetwork/featured

Mission Statement

This project was designed with the intention of increasing motion capture expertise to support a future career in Voice Over and MOCAP acting.