CORE Training Devices Executive Summary

PURPOSE

To determine which core exercise or device elicits the greatest muscular activity as well as participants' perception of each exercise or device. Three-dimensional surface muscle activity was measured on 8 muscles from the shoulder to hip for 2 body weight exercises and 5 devices.

PRIMARY FINDINGS

- The Stealth Core Trainer produced the greatest muscle activity compared to the Dynamic Forearm Plank, Bosu, Roller, Ab Dolly, and mPad in the Upper Rectus Abdominus, Lower Rectus Abdominus, and External Oblique.
- Despite the greater activity during the Stealth Core Trainer condition, the participants did not perceive their effort as greater than the Dynamic Forearm Plank, Roller Board, Ab Dolly, and mPad.
- Each participant ranked the Stealth Core Trainer with the greatest Enjoyment rating and the mean score was significantly different than the Dynamic Forearm Plank, Roller Board, and mPad.

METHODS

Participants:

15 individuals (10 women, 5 men) completed all the conditions (age: 30.63 years $\pm$ 8.05; height: 1.69 meters $\pm$ 0.05; mass: 68.25 kilograms $\pm$ 15.86)

Inclusion Criteria: age 18-50 years, currently meeting the ACSM weekly guidelines for physical activity of 150 minutes of moderate-intensity cardiorespiratory exercise, 2-3 days of major muscle group resistance exercise, and 2-3 days of flexibility exercises

Protocol:

Electromyography (EMG) signals were measured using a biopotential recorder (IX-BIO8, iWorx, Dover, NH, USA) with the associated software (LabScribe 2.3; iWorx) at an analog-to-digital conversion rate of 2,000 Hz at 16-bit resolution after being amplified (x1000). The recorded signals were filtered using a zero-lag dual-pass, sixth-order 10–500 Hz band-pass Butterworth filter. The surface EMG signals were full-wave rectified and relative muscle activity was determined by creating a linear envelope using a low-pass, fourth-order Butterworth filter with a cut-off frequency of 6 Hz. Fifty millimeter bipolar, silver-silver chloride, surface electrodes, (SKINTACT, Inverness, FL) with an inter-electrode distance of 2 cm (adhesive overlapping) in the direction of the muscle fibers were placed over 8 muscles of the upper body and core. A single ground electrode was also attached to the acromion process. Prior to electrode placement, skin was prepared and a series of measurements was completed to locate the muscle centers of

the right anterior deltoid (anterior lateral side of the upper arm 4 cm below the clavicle, parallel to muscle fibers), bilateral upper rectus abdominus (vertically, 2 cm lateral and 2 cm superior of the umbilicus), right lower rectus abdominus (vertically, 2 cm lateral of the umbilicus), bilateral external oblique (directly superior from the anterior superior iliac spine, halfway between the iliac crest and the ribs at a medially oblique angle) and bilateral erector spinae (vertically 2 cm lateral of the lumbar spine). The position of the electrodes was verified with a series of flexion and extension exercises suggested by Cram and Kasman (1998).

Once the electrodes were attached, the participants completed a 5-minute progressive intensity (50, 100, 150, 200 W for 75 seconds each) warm up on a stationary bike as well as 16 trunk flexion and extension repetitions. Next, the exercises were completed beginning and ending with a static forearm plank. The order of the remaining 6 exercises was randomized.

- Dynamic Forearm Plank, 30-second forearm plank lifting diagonal limb pairs
- Bosu, 30-second static forearm plank
- Roller Board, 30-second dynamic forearm plank (2 s left, 2 s right)
- Ab Dolly, 30-second dynamic forearm plank (2 s forward, 2 s back)
- Modern Movement M-Pad, 30-second M-Track app
- Stealth Body Fitness Trainer, 30-second Stealth app

For the determination of mean activity, we created linear envelopes from the EMG signals and calculated the mean EMG amplitude (mEMG) for each 4-second eccentric and concentric phase or 30-second bout. In order to compare conditions between participants, we normalized the activity of each muscle to a static hover.

For the determination of statistical significance, a repeated-measures ANOVA was completed for each of the individual muscles normalized to the static forearm plank, 8 x 6 (muscle x exercise condition). Finally, we performed Newman-Kuels post hoc tests to analyze pairwise comparisons in EMG recruitment between exercise conditions when the main effects were significant, defined as $p \leq 0.05$.

RESULTS

Figure 1. Upper Rectus Abdominus activity (mean ± standard deviation) for the 6 core conditions normalized to the static forearm plank. The Stealth Core Trainer elicited nearly 2 times the activity of the static forearm plank. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

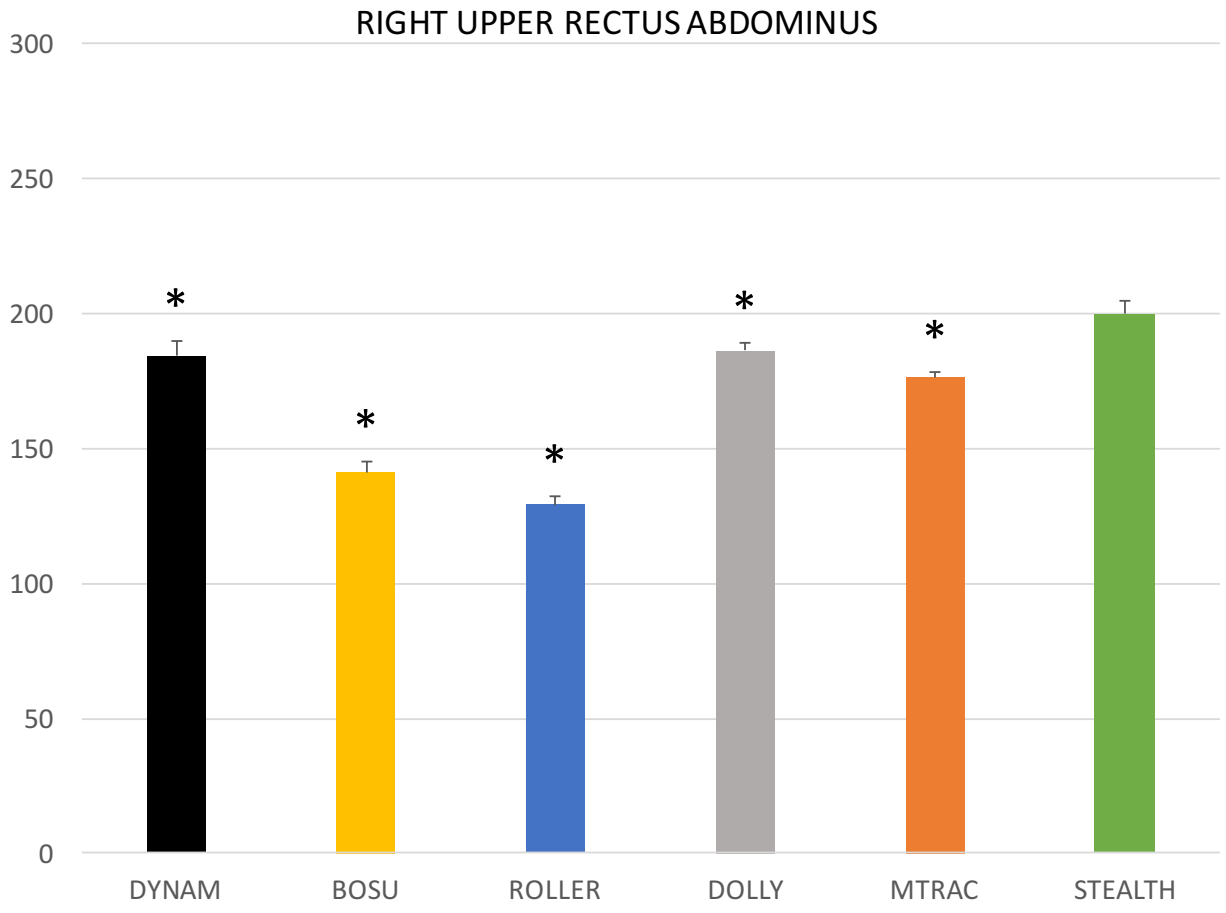


Figure 2. Lower Rectus Abdominus activity (mean ± standard deviation) for the 6 core conditions normalized to the static forearm plank. The Stealth Core Trainer elicited nearly 2 times the activity of the static forearm plank. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

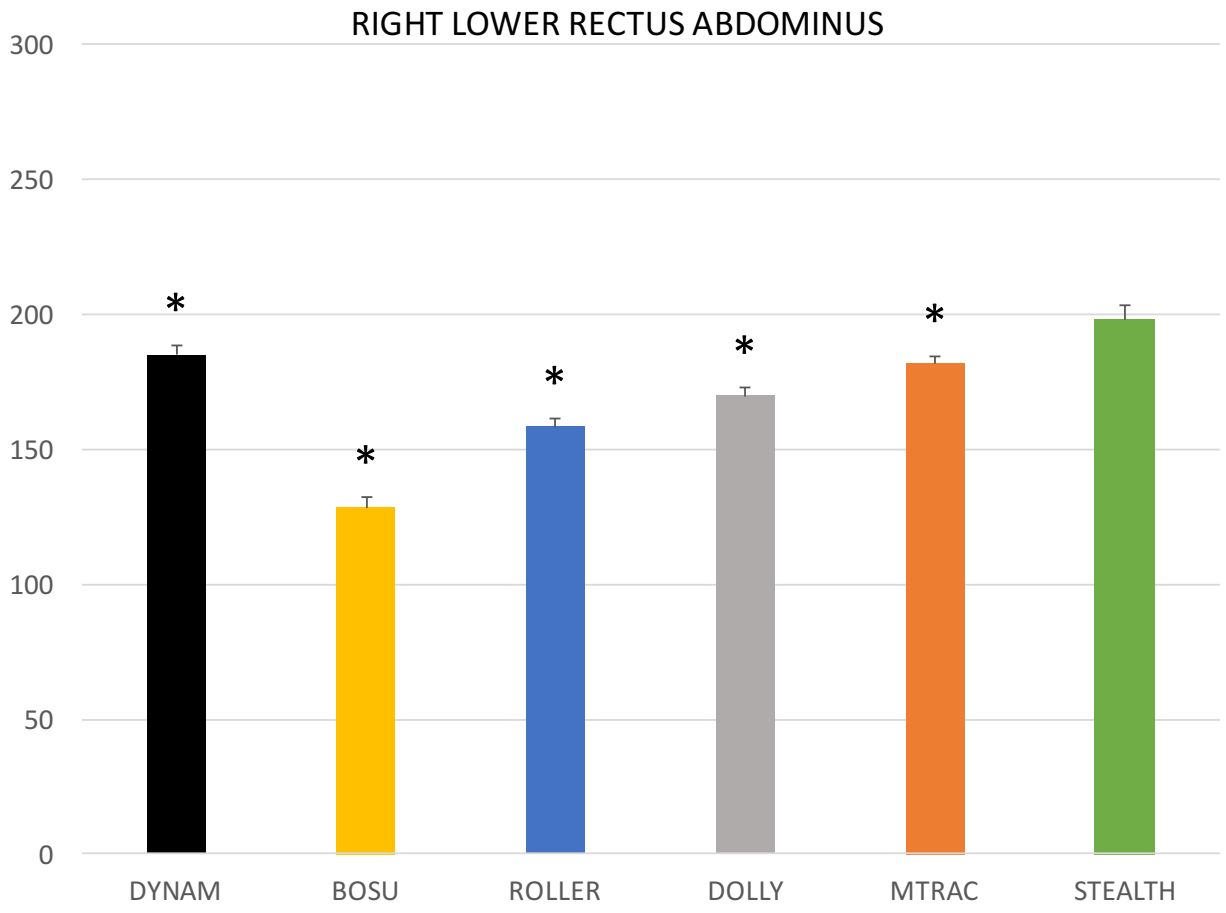


Figure 3. Right External Oblique activity (mean ± standard deviation) for the 6 core conditions normalized to the static forearm plank. The Stealth Core Trainer elicited activity that was 75% greater than the static forearm plank. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

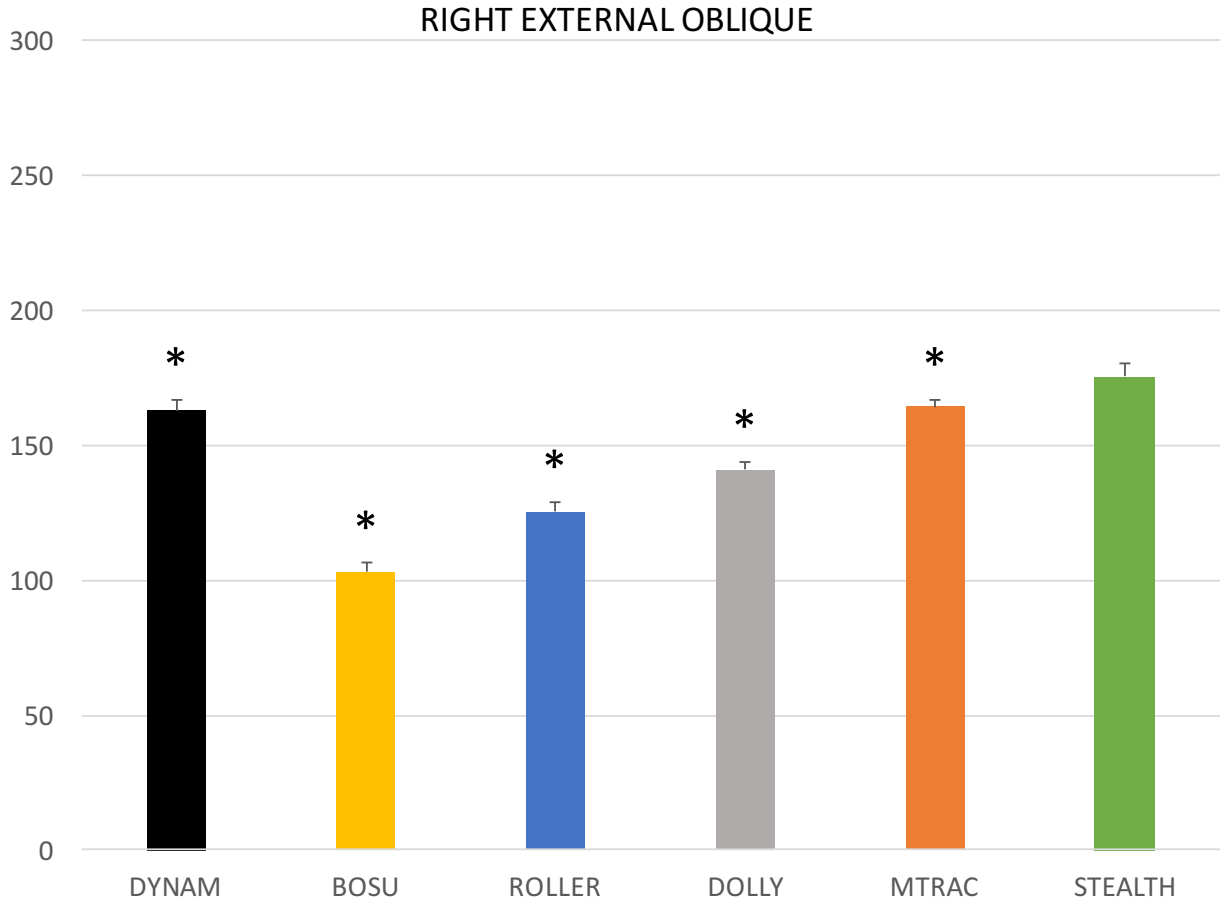


Figure 4. Lumbar Erector Spinae activity (mean ± standard deviation) for the 6 core conditions normalized to the static forearm plank. The Stealth Core Trainer and the Dynamic Forearm Plank elicited over 2 times the activity of the static forearm plank. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

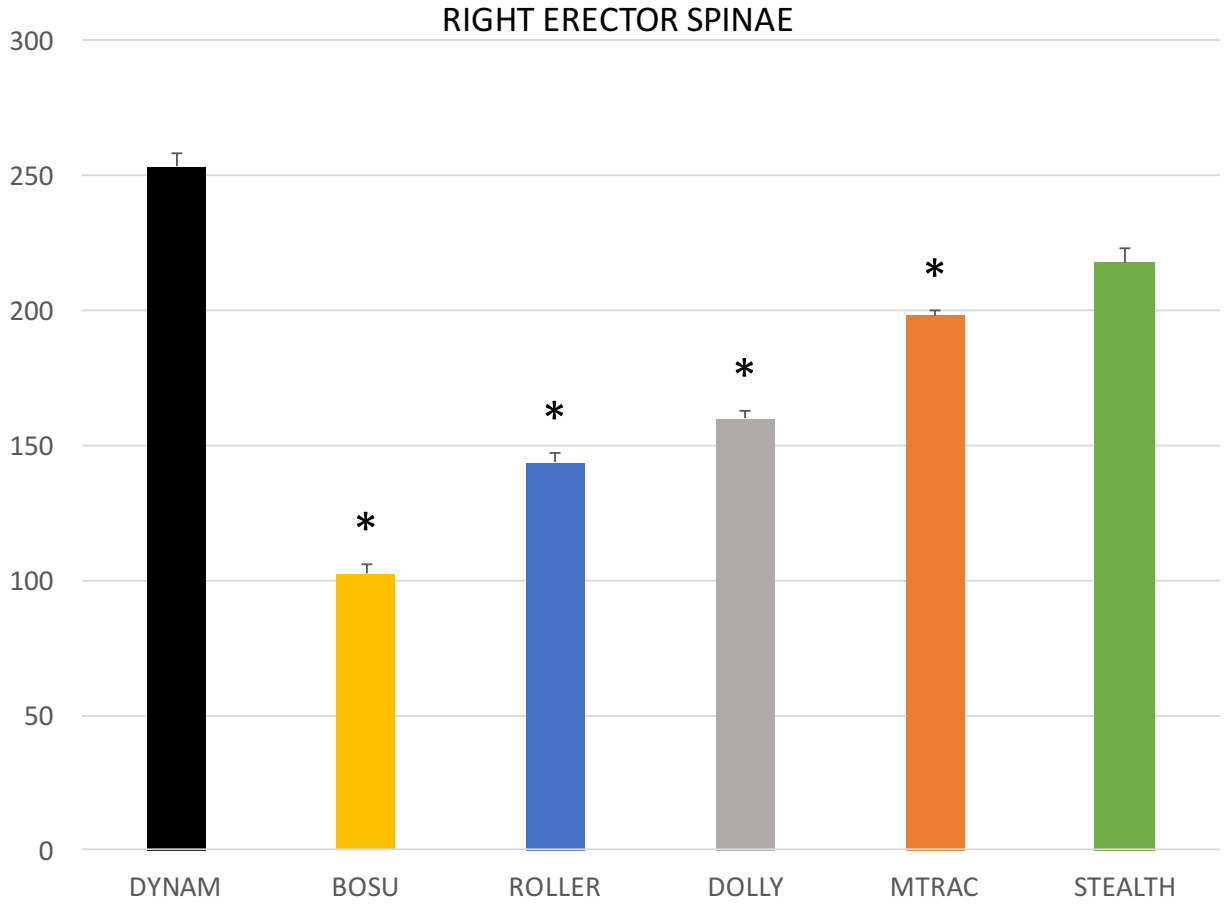


Figure 5. Anterior Deltoid activity (mean ± standard deviation) for the 6 core conditions normalized to the static forearm plank. The Stealth Core Trainer elicited over 2 times the activity of the static forearm plank. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

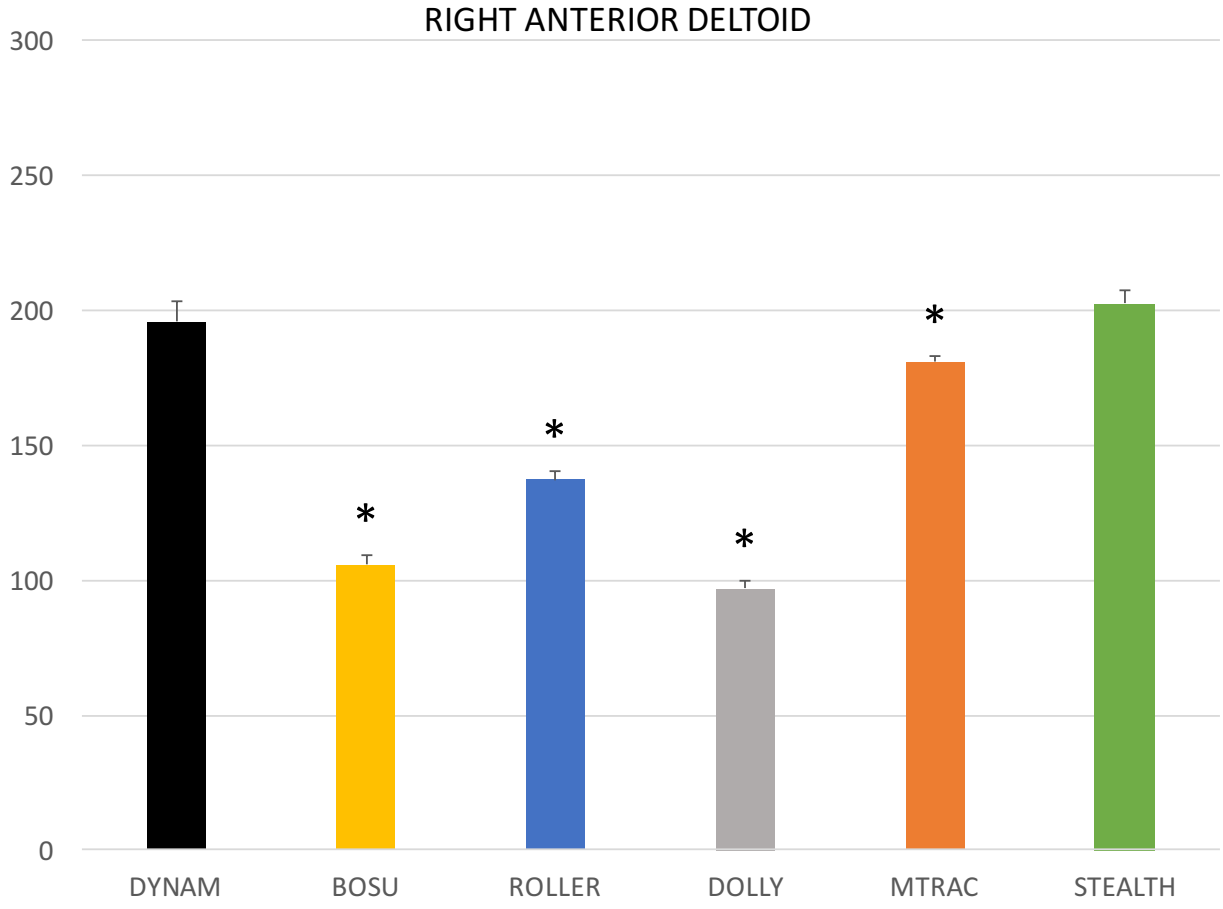


Figure 6. Rate of Perceived Exertion (scale 1-20, mean ± standard deviation) for the 6 core conditions. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

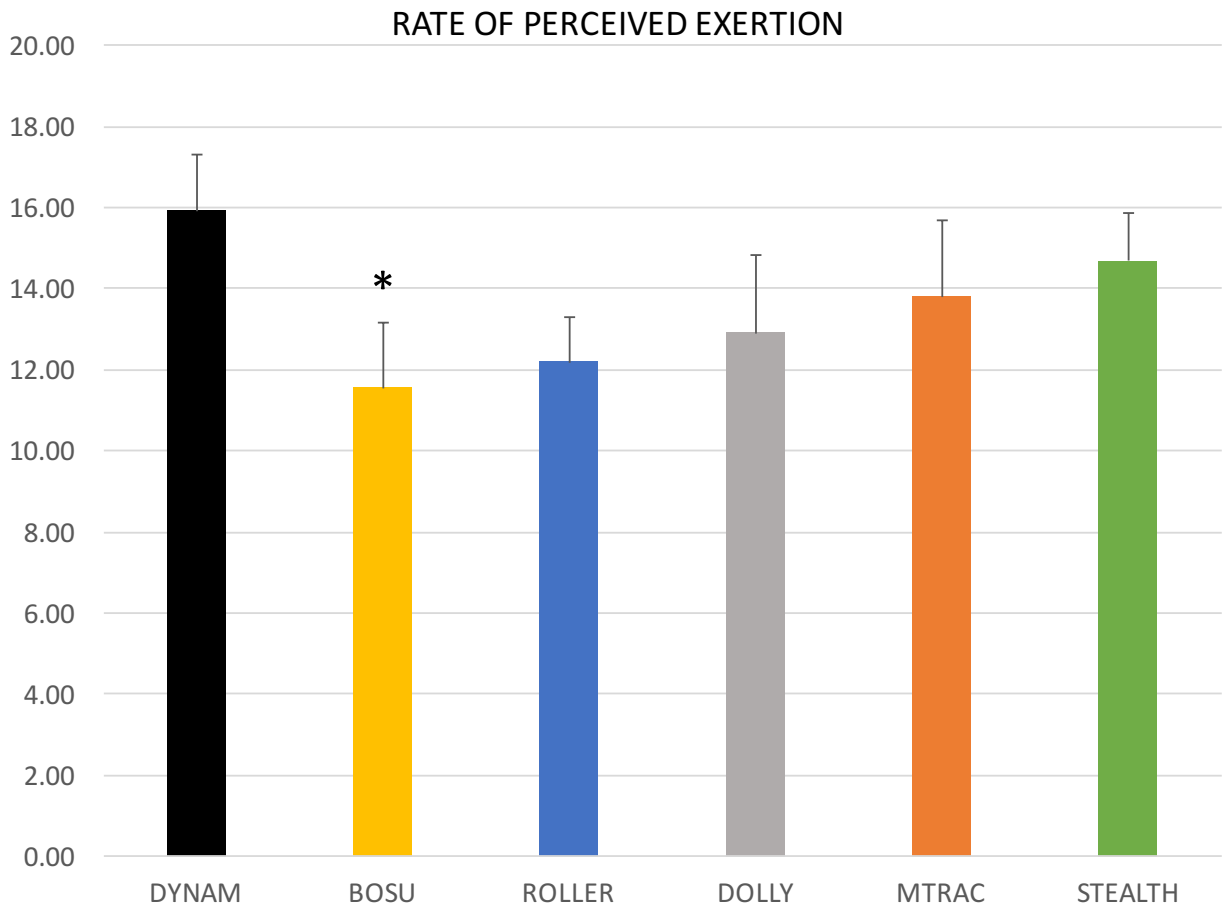


Figure 7. Enjoyment (scale 1-7, mean ± standard deviation) for the 6 core conditions. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

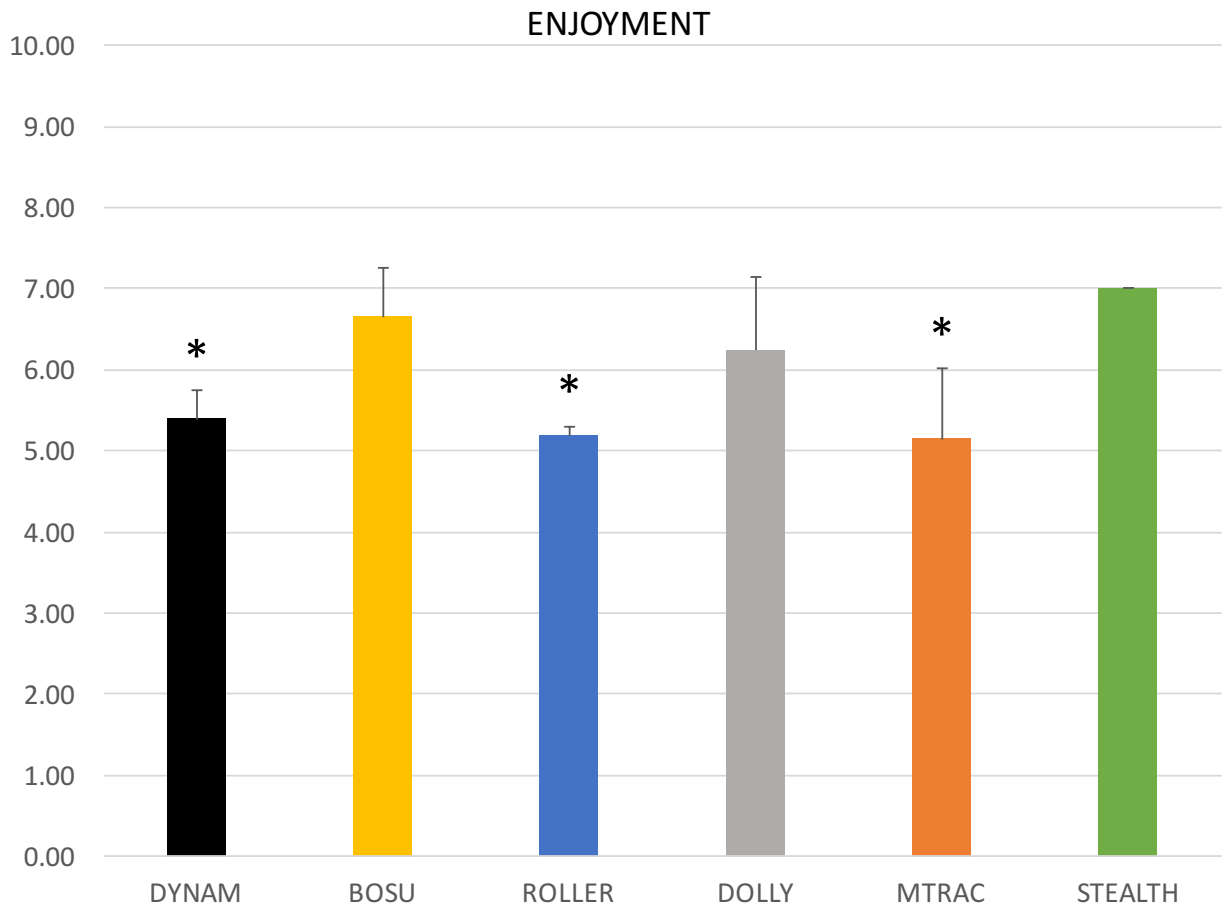


Figure 8. Difficulty Completing the Task as Directed (scale 1-7, mean ± standard deviation) for the 6 core conditions. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.

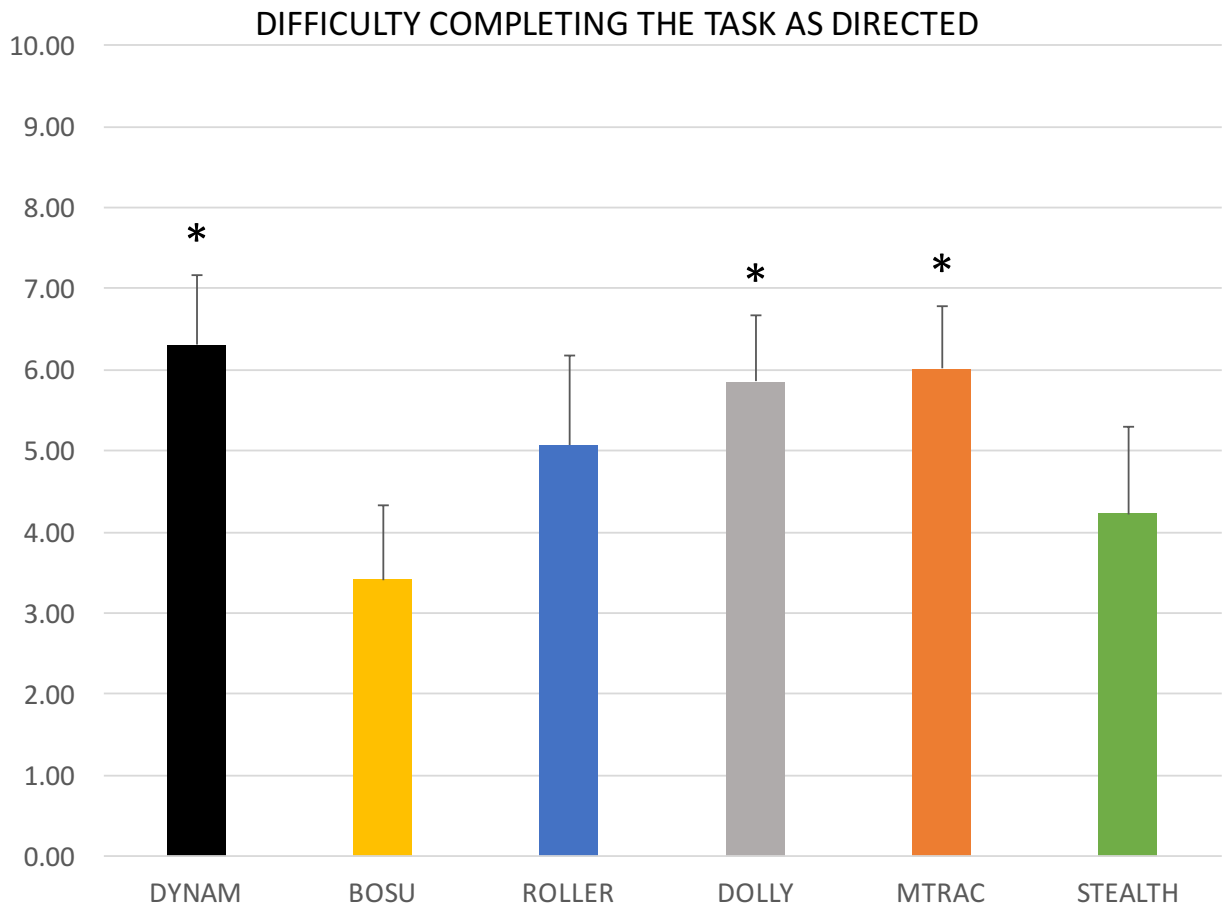
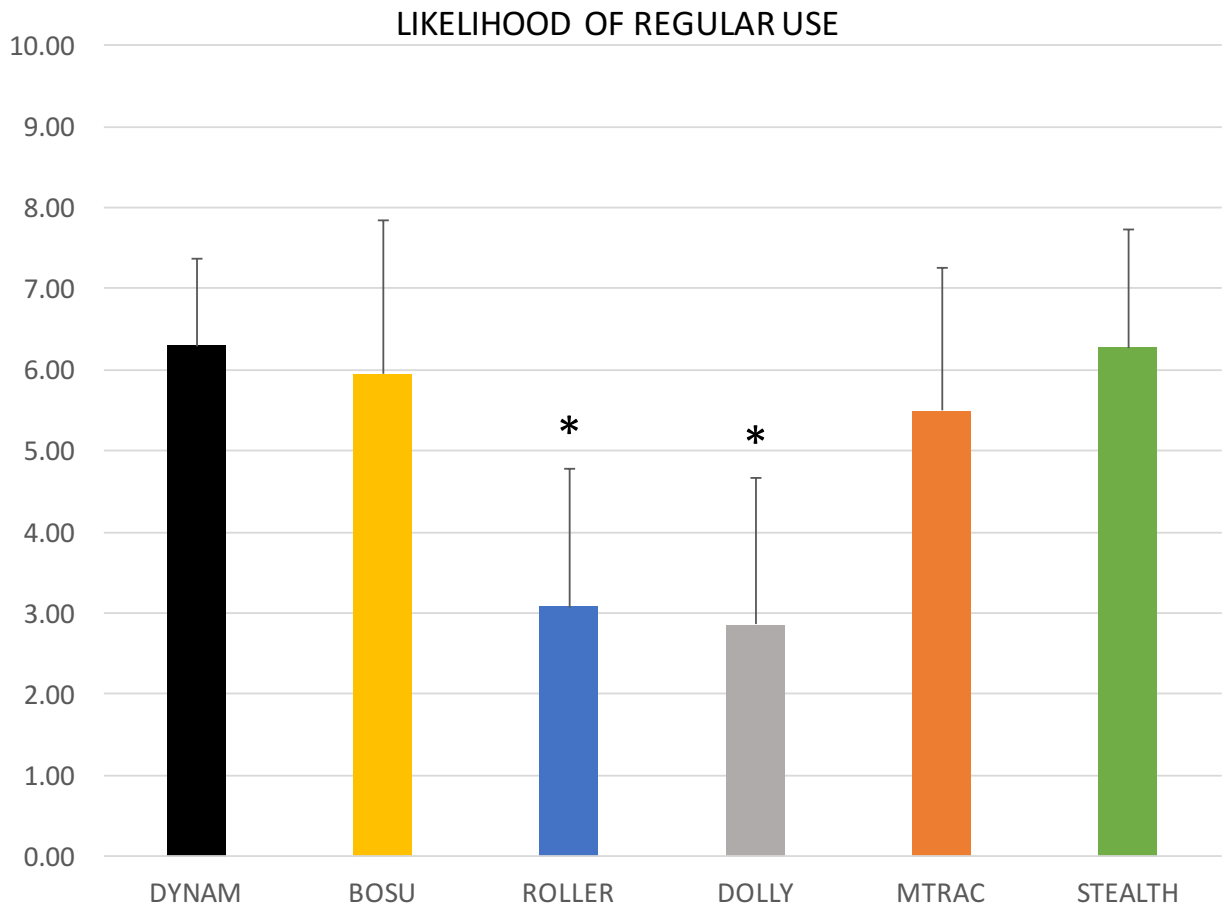
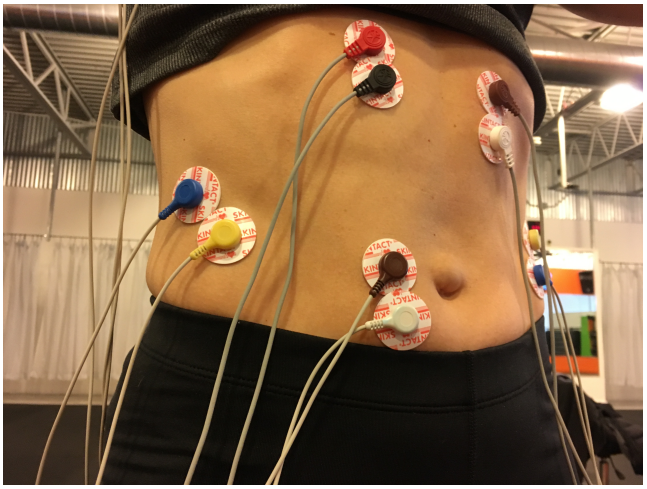
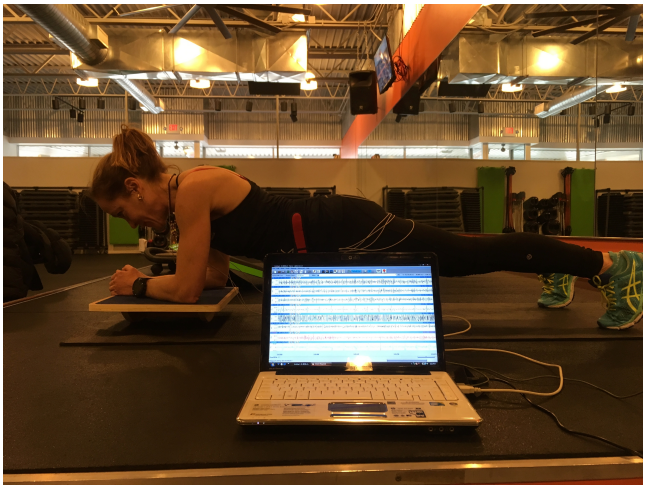
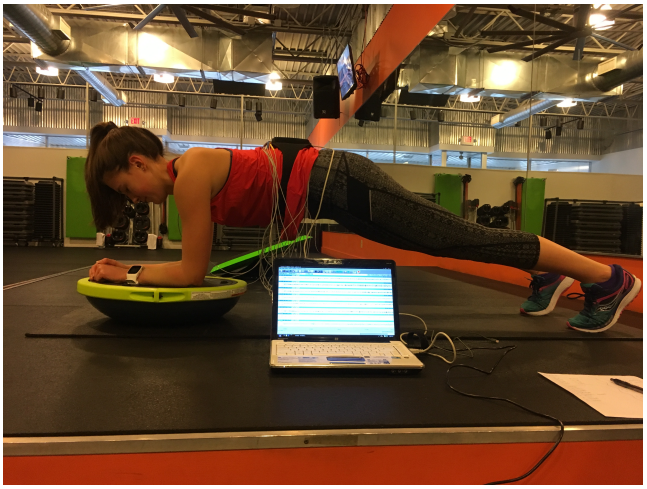


Figure 9. Likelihood of Regular Use (scale 1-7, mean ± standard deviation) for the 6 core conditions. An asterisk indicates a statistical difference of $p < 0.05$ between the Stealth Core Trainer and the respective condition.



PHOTOS: