

BACKGROUND

- Resistance training (RT) is typically prescribed relative to concentric max strength (1RM) however, force production during eccentric muscle actions can achieve 120-190% of concentric max strength. The eccentric phase of RT may be underloaded as result.
- Overloading (EO) or accentuating (AEL) the eccentric phase has shown to increase strength and explosiveness acutely and enhances explosiveness in short-term training.
- Eccentric-focused methods remain unpopular despite acute performance and training benefits.
- The physiological mechanisms behind acute performance and training are not well understood.
- The examination of neuromuscular behavior at varying intensities and comparing them to their concentric counterpart may lead to better understanding of the adaptive underpinnings.

PURPOSE

To compare muscle excitation over a range of intensities between eccentric-only and concentric back squats relative to action type max strength.

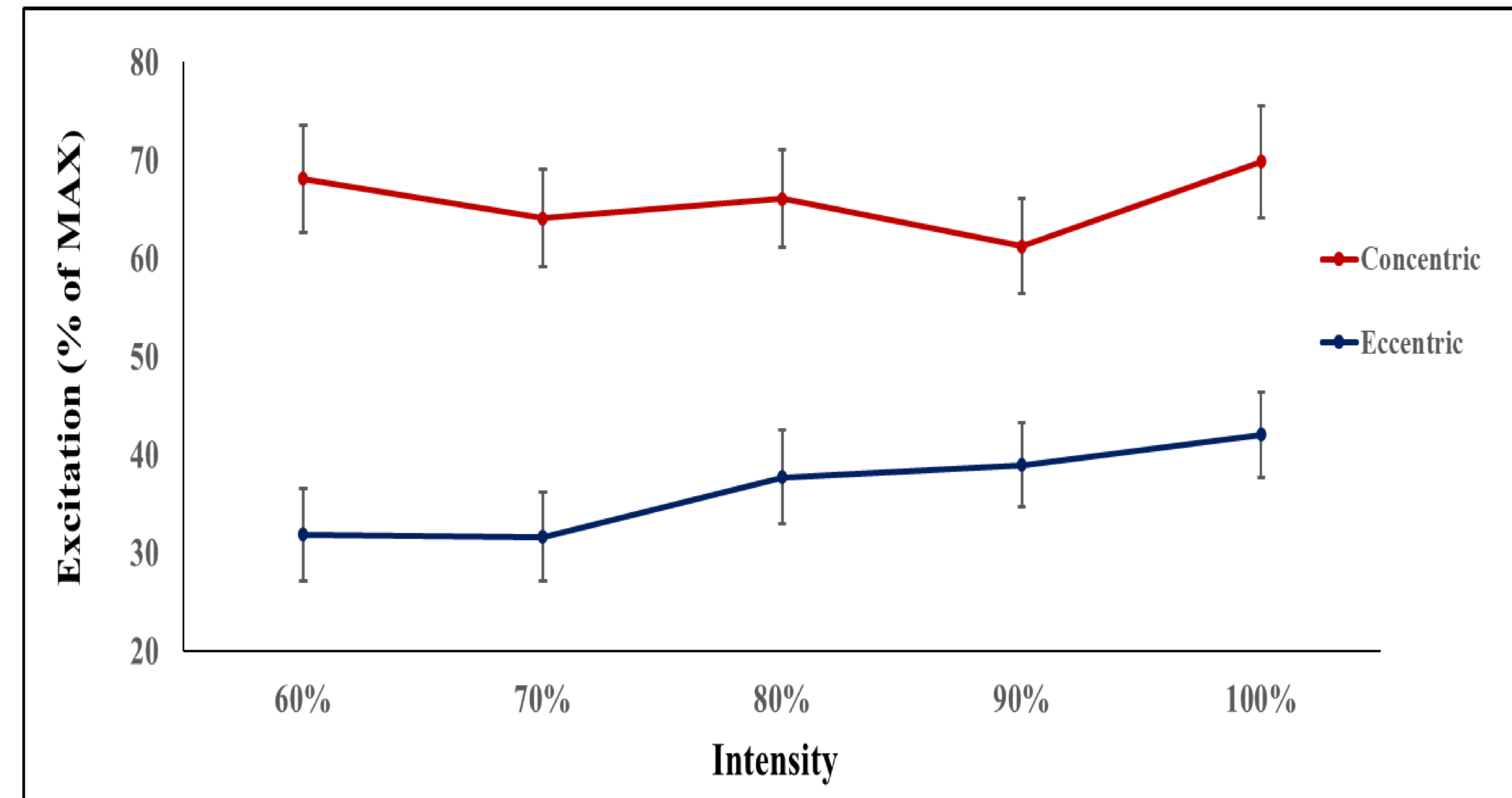
METHODS

- Thirty-one college-aged students [23 males (height:178.9± 7.7cm; mass:87.3±14.4kg; 1RM:143.3±37.0kg; Ecc1RM:172.7±42.8kg) and 8 females (height:165.2±7.2cm; mass:68.0±10.3kg; 1RM:86.2±12.7kg; Ecc1RM:103.2±11.8kg)] participated.
- **Day 1:** Subject's 1RM for concentric and eccentric-only 1RM (ecc1RM) were tested. Ecc1RMs were performed at a consistent rate of descent, to the cadence of a metronome, and over 3 seconds or more until the barbell was set on the safeties within the rack.
- **Days 2 & 3:** Subjects completed concentric (CON) conditions or eccentric-only conditions (ECC).
- Surface electromyography sensors were placed on the vastus lateralis (VL), biceps femoris (BF), and gluteus maximus (GM). Following a barbell-only warm-up of 10 repetitions, subjects performed a ramping repetition scheme at 60, 70, 80, 90, and 100% of max strength.
- Peak SEMG amplitudes were recorded at each intensity and normalized to the individuals' max amplitude displayed during the study.
- A 2x2x5 (Sex x Action x Intensity) Repeated Measures ANOVA was conducted for each muscle.

RESULTS

- Main effects of Action were observed for VL (Figure 1.) and BF, where CON was greater than ECC (VL: CON 73.39±23.8%, ECC 60.8±22.3%, $p=.008$; BF: CON 62.5±28.5%, ECC 42.4±27.7%, $p=.002$).
- For GM (Figure 5.), an Action x Sex interaction was observed ($p = .048$), whereby the mean difference between concentric and eccentric for males was greater (+34.23%) than females (+15.64%).

Figure 1. Mean & SE of Vastus Lateralis Excitation Relative to Action Type MAX



CONCLUSIONS

- Peak muscle excitation was lower for eccentric than concentric when normalizing loads to action type max strength.
- It seems that the additional forces, that can be produced eccentrically, are by means other than motor unit recruitment and increased rate coding.
- Possible explanations include:
 - 1) Crossbridge behavior, where more myosin heads are connected and passive, but are mechanically uncoupled instead of chemically uncoupled.
 - 2) Titin has been suggested to play more of an active role in producing tension within the sarcomere during lengthening.

PRACTICAL APPLICATION

- Eccentric-focused training seems to have drawbacks and benefits. Drawbacks include 1) fatiguing effects associated with EO and AEL, 2) that eccentric actions do not yield neuromuscular excitation to levels of concentric. Therefore, concentric actions should remain paired with eccentric.
- Benefits of eccentric-focused training include its association to muscle growth, acute strength gain, acute explosiveness gain, and explosiveness from training. However, the body of literature supporting these notions is limited and should further be elucidated.