The mythological story of the association of lifting maximal amount of weight and muscle mass gain during resistance training has been perpetuated for a very long time. Passed on from gym meatheads, athletes, to coaches, moms, dads, even children can identify and promote this after watching a Saturday morning Incredible Hulk cartoon. Big muscles are made by lifting big weights, right? Not necessarily. The beautiful aspect of science is that it is continually evolving and self-assessed; meaning during a certain period a researched idea of something as simple as eggs may be harmful to health via cholesterol, then found to be pro-health the next. The only way to truly know or stay current is to keep updated on the science; the same is true in regards to exercise science and resistance training.

Before I go into detail about muscle growth or readily known as hypertrophy, it needs to be defined first. Hypertrophy is categorized into chronic (long-term) and acute (short-term) effects. Long-term effects would be where the muscle(s) that are trained accumulate contractile and non-contractile proteins or bigger muscle in response to resistance training. While conversely, short-term hypertrophy is an accumulation of fluid (edema) and glycogen stores. However, actual muscle protein gains is debatable [1, 2]. The resistance training of hypertrophic-goal oriented style below has been proposed by ACSM in a position stand paper via resistance training recommendations suggested for optimal muscle mass (hypertrophy) gain [3]:

**Resistance exercise for novice and intermediate individuals:**

a) Moderate loading of: 70–85% of 1RM for 8–12 repetitions per set for 1-3 sets per resistance exercise.

b) Rest periods of: 1-2 min between sets.

c) Frequency of: 2–3 days a week (when training the total body each workout).
**Resistance exercise for advanced training individuals:**

a) An intensity or loading range of: 70–100% of 1 RM for 1–12 repetitions per set for 3-6 sets per resistance exercise in periodized manner. The majority of training devoted to 6–12 repetition range and less training devoted to 1–6 repetition range (strength training).

b) Rest periods of: 2-3 min may be used with heavy loading for fundamental/multi-joint exercises and 1–2 min may be used for other exercises of moderate to moderately high intensity.

c) Frequency of: 4-6 days a week. Muscle group split routines (1-3 muscle groups trained per workout) are common to elicit a higher volume per muscle group.

To give an idea of what 70-85% of 1 repetition max is (1RM) let us assume your flat barbell bench press is 100 lbs. 70% of that would be 70 lbs. As you guessed, 85% is 85 lbs. Seems fairly easy, yet the prescribed amount of repetitions is 7-12 by three sets; this becomes more taxing than previously thought; especially if your 1RM happens to be 70 lbs. Your bench press with an optimal form to complete one repetition would be limited.

**So what does this all mean and why should you care?** There is newer science that has investigated that lower intensities (i.e. ~30% of 1RM) have similar muscle gains as does the 70% or greater training intensities. Mitchell, et al. (2012) observed young men (~21 yrs.) who engaged in 10 wk of unilateral (one leg) knee extension. Each leg of the person was randomized into two of the three possible training regiments: each were performed to voluntary failure at 1 set of 80% of 1RM (80% x 1); three sets of knee extension performed to the point of fatigue at 80% of 1RM (80% x 3); or three sets performed to the point of fatigue with 30% of 1RM (30% x 3). Results? Using MRI technique, which is the gold standard for composition and tissue imaging, they showed no volume or muscle mass gain differences after 10 wk of training between the 30% and 80% groups.

**What does this mean?** As long as exercise is performed to failure, lighter weight induces like muscle gains similar to heavier weights [4]. In another like study using unilateral
knee extensions and lighter weight training compared to blood flow restriction (BFR) also known as occlusion training; which is a newer mode that has shown promise as an additive factor in resistance training that may be useful in older or rehabilitating populations. Each person was submitted into 5 conditions for 8 wk of training: (1) $1 \times 20\%$ of 1RM, (2) $3 \times 20\%$ of 1RM, (3) $1 \times 50\%$ of 1RM, (4) $3 \times 50\%$ of 1RM, and (5) control (CT). Similarly, using MRI to measure muscle volume of the leg aka cross-sectional area (CSA) were the same across each condition compared to the control group.

**What does this mean?** Again, it has been shown that lighter weights or intensities 20-50\% of 1RM with or without occlusion when trained till failure have an effect on muscle mass gain during 8 wk of training [5].

When your training partner teases you about the lightweights, tell them about the size principle!

Now the questions, I hope you are thinking and asking yourself: **How does lighter weight training to failure induce muscle mass growth?** Great question, the theory is based on an old paper by Henneman in 1965 [6] and later a resistance training based review by Carpinelli [7] that when resistance is used which is less than the NSCA prescription for hypertrophy training of 67-85\% [8] and trained to failure this affects the motor neuron (the nerve that controls your muscle contraction) size principle. The size
principle essentially states that in theory, more motor units will be recruited for a contraction for heavier weights (i.e. 80-90% of 1RM) than for lighter weights (~20-30 % 1RM). However, using a submaximal resistance that would require submaximal contractions, to the point of fatigue may also result in the recruitment of additional, higher threshold motor units. Higher threshold neurons that require higher intensities to stimulate and recruit type II muscle fiber. It has been well studied that type II fiber types (IIa-IIx) have a greater potential for muscle growth than does type I fiber type. **To put this simply the size principle states when you are in the gym weight training with lighter weights and you train until contractional muscle failure your central nerve system (CNS) is 1st stimulating and recruiting type I muscle fiber to do the job. As fatigue sets in these fibers and they are unable to maintain the work, the CNS dictates the higher threshold type II fibers to take over and type II fiber stimulus.**
The % fiber types found in specific training regiments

References


