

Mind–muscle connection revisited: do 100 studies about beanbag tossing, stick balancing, and dart throwing have any relevance for strength training?

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We welcome the additional perspective of our original research raised by Halperin and Vigotsky, demonstrating that interpretation is in the eye of the beholder. Halperin and Vigotsky felt that our article lacked a discussion of the effects of such training on performance. The reason for not devoting a discussion on this topic in our article was very straightforward; this was not the purpose of the study nor was the study designed to do so. Our study evaluated whether focusing on using specific muscles—the triceps and pectoralis, respectively—during bench press from 20 to 80 % of 1 repetition maximum (RM) could selectively activate these muscles compared with a control condition of regular bench press. We were especially interested in investigating the association between intensity and the magnitude of selective activation, expecting decreased ability to selectively activate the respective muscles with increasing relative intensity. As stated in the Introduction of our article, this is a common training principle within bodybuilding, i.e. focusing on squeezing specific muscles to increase intensity of muscle contraction and enhance the pump with the long-term goal of muscular hypertrophy. Our results show that focusing on using specific muscles increases

muscle activity at relative loads between 20 and 60 % of 1 RM, but not at 80 % of 1 RM during bench press. Thus, the basic premise for this type of training—i.e. that intensity of contraction can be increased by focusing on the specific muscles—holds true using light to moderate loads, which is congruent with practical experience. Because this was a cross-sectional laboratory study, we did not investigate whether this led to better long-term outcomes in terms of muscle hypertrophy or maximal strength.

Halperin and Vigotsky direct their focus in letter to the Editor based on a single sentence that mentions ‘performance’ in the Introduction of our article, and remind us that more than 100 similar studies have already been performed referencing the narrative review by Wulf from 2013. We believe that it is clear from context of our article that we did not measure or focus on long-term gains in performance in this particular study. Halperin and Vigotsky continue to cite some of the studies from the narrative review by Wulf which deals with attentional focus and motor learning during various tasks such as beanbag tossing, dart throwing, stick balancing, golf, frisbee throwing, piano playing, different sports, and some strength training tasks. We would like to stress, however, that the majority of the 100 studies that Halperin and Vigotsky refer to does not concern actual strength training. Only a handful of these studies used typical strength training exercises and only one used bench press, while most of the other strength training studies were based on single-joint movements such as the biceps curl. Nevertheless, the review by Wulf shows for example that having an internal focus is associated with fewer repetitions during strength training exercises compared with having an external focus—and in that sense a lower acute ‘performance’ of repetitions. This is not surprising and in complete agreement with the results of our study. That is, focusing on using a specific muscle increases EMG activity, i.e.

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intensity of muscle contraction. For example, in our study, using 60 % of the pre-determined 1 RM, intensities of muscle contraction of the pectoralis—as estimated by normalized EMG—were 56 % when focusing on lifting the bar (external focus) and 65 % when focusing on contracting the pectoralis muscle (internal focus). Because intensity of muscle contraction is inversely related to the number of repetitions that can be performed, fewer repetitions to failure would of course be expected when focusing on using a specific muscle at a certain absolute load.

When discussing performance, Halperin and Vigotsky fail to distinguish between acute and long-term effects. The strength training studies of movement efficiency in the review by Wulf seem to have evaluated acute effects. A relevant question to ask is whether the higher intensity of muscle contraction and concomitantly fewer repetitions when focusing on a specific muscle really lead to negative long-term effects as suggested by Halperin and Vigotsky. By contrast, acute reduction of ‘performance’ in terms of fewer repetitions to failure—due to increased intensity of

muscle contraction when focusing on contracting a specific muscle—may even be beneficial for some types of long-term gains. Furthermore, performance is a word that will always live in a specific context. Long-term gains in performance are defined in different ways by a bodybuilder, a weightlifter, and a patient-seeking relief of pain. However, because of the nature of our study, i.e. a cross-sectional laboratory study, we have avoided speculating in greater detail about the possible long-term benefits and/or harms. What our study does show is that intensity of muscle contraction can be increased by the mind–muscle approach at light to moderate loads using a real strength training exercise such as the bench press. Properly designed randomized controlled trials investigating the long-term effects of the mind–muscle approach using real strength training exercises are very welcomed. In our opinion, studies on beanbag tossing, stick balancing, and dart throwing have little if any relevance for people engaged in serious strength training.