Muscle proteins are constantly and simultaneously being synthesized and degraded. This 'turnover' provides for a mechanism of constant maintenance and greater potential for changes in protein pool size. The two most potent stimuli for enhancing muscle protein synthesis (MPS) are exercise and provision of protein. While protein feeding and exercise are independent stimulators of MPS they are additive in their effect and when combined over longer periods of time sum to result in expansion of a protein pool, the most obvious example of which is muscle fibre hypertrophy with resistive exercise (Phillips et al., 2005). The traditional dichotomy for the phenotypic adaptation induced by exercise is that endurance exercise does not lead to hypertrophy but instead results in expansion of the mitochondrial protein pool. On the other hand resistance exercise leads to muscle fibre hypertrophy (i.e., expansion of the myofibrillar protein pool) and does not change mitochondrial content. Our work has shown that in the untrained state the response to exercise is, however, rather generic and that both protein pools expand, at least acutely (Wilkinson et al., 2008). With increased specificity and time spent training with one particular exercise mode the response is 'honed' and the protein pools that are synthesized become specific (Wilkinson et al., 2008). With a focus on resistive exercise, since it is a potent countermeasure to atrophy even in small doses and an effective countermeasure to sarcopenic muscle loss, we have shown that various paradigms of resistance exercise that are non-traditional are actually effective in stimulating MPS (Burd et al., 2010; Burd et al., 2012a) and also in promoting hypertrophy (Mitchell et al., 2012). In combination with our work on optimal sources of protein to promote MPS (Tang et al., 2009; Burd et al., 2012b) we are now beginning to understand that rapidly digested high-leucine content proteins such as whey protein are remarkably effective in stimulating MPS (Tang et al., 2009; Burd et al., 2012b); we propose that this phenomenon is explained by the 'leucine trigger' hypothesis. According to this thesis the rise in intramuscular free leucine, likely through mTOR signalling, stimulates MPS. Noteworthy is the fact that slowly digested or low leucine-containing proteins are ineffective in stimulating MPS. Recent data in conditions of extreme hypertrophy, weight loss, and specific meal composition will be discussed.