



The Truth on Fitness: **Must Strength Exercises be Specific to be Effective?**

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Must Strength Exercises be Specific to be Effective?

Among the many concepts that exist within the functional training continuum, one of the more common is the notion of specificity. In a sense, this may be the defining characteristic of functional training.

Specificity has many facets, but one theory says that for a strength training exercise to improve a daily activity or sport skill, it should be specific to that skill, by reproducing its movement patterns in a realistic context. Otherwise, the strength we gain has little applicability to function or performance, and therefore, has less value. In this context, specificity is synonymous with transfer, meaning that the strength we develop in the weight room must transfer to the world outside the gym. Put into the vernacular, one might say "I don't do that in real life, so I'm not going to do it in the weight room."

But what is it, exactly, that we're transferring? Is it the movement itself, or some other intrinsic property of the training regimen? Must all elements of the exercise match exactly those of the performance task, or are an essential few enough to improve motor function? More fundamentally, as it relates to skill, is strength training any more effective than simple practice of the chosen skill? Even if we create strength exercises that perfectly replicate the conditions experienced in the execution of a motor task, will it even make a difference? If not, then what is the value of strength development?

Unfortunately, answers to these questions are somewhat scarce, as there is not an abundance of literature examining the transfer of strength to movement skill. But, there is a body of evidence on the periphery of this subject, which, combined with the few existing studies, may help to explain the nature of strength, specificity, and skill.

In a recent study of sports performance transfer (Szymanski, et al, 2007), groups of baseball players performed two different training regimens to determine their effects on torso rotational strength and bat speed. One group engaged in traditional strength training exercises, including squats, bench press, rows, and isolated elbow exercises. The second group completed the same strength training routine, but in addition, performed dynamic medicine ball exercises that simulated body motion during a baseball swing.

The results showed that the group which included medicine ball work increased torso rotational strength and bat speed to a greater extent than the traditional strength group. The implication here is that loaded movements which replicate the performance conditions are more effective at improving performance than

basic strength training exercises alone. In other words, the specificity principle applies; in order for strength to transfer to performance, the movement must be similar and specific to the actual task.

This is a reasonable conclusion; that transfer must be produced by simulated movement. But how can we confirm this? One way, is to see if strength training exercises, with simulated movements, can improve performance in a more skill-based task. For certainly, if we're simulating a movement against load, then the quality of that movement ought to improve.

Surprisingly, there is little in the literature that examines this issue. One study that did, however, was conducted by Berger and Coppedge in 1973. The authors studied the relationship between strength gains and movement accuracy in a basketball shooting task. The required skill was to shoot baskets from 15, 20 and 25 feet. Subjects who engaged in strength training exercises, including overhead press and wrist curls — emulating the shoulder and wrist movements of the basketball shot — only demonstrated improvements in shooting accuracy at the 25-foot position. A group that only practiced the task, however, improved at all distances. The authors concluded that generally, movement-specific strength enhancement had no impact on movement accuracy, except in those conditions in which force production was a necessary component of the skill.

Thus, the findings of Berger and Coppedge challenge the notion of movement specific training effects. But maybe, one could argue, the exercises performed by these subjects, while similar in joint motion, were not really the same as the shooting pattern, in terms of timing and coordination. Perhaps we should examine something that more closely simulates the movement task, as in the baseball study by Szymanski et al. This, however, is where the movement specificity theory actually begins to falter.

For example, Hasson and colleagues (2002) examined the correlation between squat strength and vertical jump in volleyball players. Clearly, squatting and jumping involve similar, if not identical, joint kinematics, but the authors noted a very low correlation ($r = .30$) between the two variables. In another study of field-based performance, Jullien and associates (2008) evaluated the effects of squat training on running and agility in soccer players, once again referencing the similarity of the movements. The authors discovered that the strength training exercises did nothing to improve straight or shuttle sprints. Agility did improve somewhat, but not as much as a group practicing agility alone.

Evidently, the idea that strength is transferred only when it is paired with simulated movement is not so compelling. Compounding these findings, are studies examining this question from the opposite perspective. Can exercises, with little or no similarity to a motor task, improve performance in that task? Although one might assume not, the evidence suggests otherwise.

Schwendel and Thorland (1992), for instance, also conducted a bat velocity study, much in the same way as Szymanski et al. Interestingly, the exercises they performed were traditional movements, such as bench press, lat pull, leg press, leg extension and curl, etc., which had little similarity, if any, to the actual baseball swing. In this case, however, subjects in the weight training group did significantly increase their bat speed.

Likewise, Terzis and associates (2008) examined the effects of strength training on shot-putting capability, and found the highest correlation between shot put performance and bench press strength, a movement with less resemblance to this skill than Berger's overhead press had to shooting basketballs.

How can we claim movement specificity, associated with medicine ball rotations and bat velocity, when at the same time, bench press and lat pull accomplish the same thing? How is that we witness no improvement in basketball shooting performance after strength training with similar movements, while we see improved shot put performance from a dissimilar exercise? What can account for the differences in these studies?

The answer is, coincidentally, embedded in the comments of Berger and Coppedge, who claimed that there was transfer of strength when the task required significant force output. Herein lies the common thread throughout all of these studies, and more.

Let's begin by comparing the two baseball studies. Why did Szymanski and others show bat speed improvement only in the medicine ball group while Schwendel and Thorland demonstrated increased bat speed in a machine-trained group? The answer is not in the movement, but in the intensity of the training loads, the velocity of the strength training exercises, and ultimately, in the strength and power which were produced.

The medicine ball exercises were done at a very high velocity in the former study, while the strength training exercises were performed with lighter loads and slower speeds. By contrast, even though Schwendel's subjects used machines, they trained with higher loads and greater movement velocities. Thus, they developed more power, which was successfully transferred to bat speed. The actual movements were less important than the ability to generate force.

Hasson and colleagues, who discovered a low correlation between squat strength and jump height, suggest that strength at faster velocities is necessary in order to produce better performance. This argument is echoed by Wisloff, et al (2004), who did see correlations between squat strength, jumps, and sprints in soccer players, but concluded that "the highest correlation occurred when acceleration during strength training was the greatest." The authors recommend emphasizing rate of tension development during training, in order to evoke the greatest amount of transfer.

Similar findings have been reported by Marques et al (2007) and van den Tillaar (2004), indicating that training velocity and rate of tension development had the most significant impact on performance in throwing tasks.

Indeed, specificity of velocity has been acknowledged for decades. A seminal article by Moffroid and Whipple (1970) showed us that strength gains are specific to the speed at which strength is garnered. Later, Behm and Sale (1993) reiterated this concept, but added that velocity-specific strength gains are influenced by the intended, not actual, movement speed. Thus, to swing a bat faster, we must train at higher velocities, with or without movement specificity, because doing so, simply gives the system the capacity to generate power.

Accordingly, Hatfield and colleagues (2006) reported that slow training velocities in the squat did not have a positive effect on athletic performance, while the same exercise, performed at higher speeds, improved strength, power, and athletic prowess. Murray et al (2007) revealed that even isolated knee extension exercises can significantly improve long jump performance, so long as those exercises are done at a high velocity.

So, the various studies mentioned here, despite their dissimilarities, have in common the fact that performance improved when subjects trained with higher velocities, encouraging greater power development, regardless of whether there was specificity of movement. Thus, the specificity that emerges time and time again, is not necessarily associated with the patterns of movement, but instead, with the velocity of movement, rate of tension development, and the subsequent power developed during training. All of these are intrinsic characteristics of muscular contraction, and not examples of the movements themselves.

The irony is that in our attempts to enhance function by engaging in increasingly complex and challenging loaded movement patterns, we are, in fact, doing the very antithesis of what the central nervous system does to resolve complex movement problems. There are, indeed, far too many variables for which the system must account, if it is to specify each and every element of a movement pattern. So the system, according to Vernon Brooks (1986), attempts to reduce its complexity, rather than increase it.

In tasks, for example, in which subjects were required to move both hands, simultaneously, to various sized targets, positioned in random places and at asymmetrical distances (Kelso, 1979), or in which subjects had to simultaneously move objects of different masses to targets at fixed distances (Gachoud, et al, 1983), the system resolved the problem through a process of simplification. In these, and in almost every other instance like them, the nervous system controlled the movement so that all limbs reached their targets at exactly the same time. In other words, the system controlled the velocity of the movements in order to accomplish the task. Thus, by specifying velocity, we improve motor performance.

The truth is that specificity does exist, but in the velocity of movement, not necessarily in the movement itself. Provided that we are moving the appropriate limbs in the right general direction, then we are introducing all of the movement specificity that we need. According to Kelso, Gachoud, and others, all that is necessary is to specify the starting position, ending position, and movement speed, and the central nervous system will take care of the rest. It is, after all, an extremely sophisticated and elegant problem-solving mechanism.

Lastly, as it relates to the development of skill, we are better off divesting ourselves from the notion that we should improve performance in the weight room by loading complex movement patterns. As Jullien and colleagues noted in their study of squats and field-based performance, “strength is important, but practicing skills is equally, if not more important.” To wit; let’s build strength and power in the weight room, and leave the movement specificity to practice on the fields and courts.

Perhaps, if we pay greater attention to the manner in which the human system resolves movement issues, rather than dictating the way in which we want it to coordinate movement, we’ll create more effective solutions for strength, function, and performance.

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