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Teaching Proper Technique in the Squat Exercise Through Psychological Modeling

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ABSTRACT

The purpose of this article is to present a multifaceted understanding of the processes underlying psychological modeling and their relationships to learning the free weight squat exercise. In order to benefit from the favorable training adaptations afforded by the barbell squat, performing the exercise with proper technique is absolutely crucial. Proper visual demonstration or modeling is vital for learning a complex motor skill such as the squat. Visual demonstration conveys a vast array of informational cues that are far more relevant to facilitate an observer's motor skill acquisition than information conveyed through verbal instruction. Successful performance of the squat exercise depends on the ability to hold visual symbols in memory for a short interval of time and maintain internal descriptions of the relevant biomechanical factors necessary to execute the motor task efficiently. There are, of course, many factors that influence motor skill acquisition. However, the focus of this article is on those factors directly related to the nature of the modeling process and the effect that process has on learning to perform the squat exercise.

Introduction

Squats, perhaps more than any other resistance exercise must be performed properly. The considerable amount of weight used, in such a multiple joint movement, can result in a variety of injuries to the knees and lower back. However most of these injuries occur when people squat with improper form and technique. Many misconceptions concerning the squat are brought about by ignorance and false information. Adaptations to squatting include but are not limited to the following: 1. Muscles are strengthened far beyond the norm, making injury less likely to occur. 2. Bone density and strength are increased; especially if the stress is applied longitudinally (This is accomplished best by following the outline on proper technique in the subsequent paragraph). 3. Ligaments, tendons, and connective tissues are increased in thickness, viscoelasticity, and tensile strength, making injury far less likely. Since the squat is a full-body exercise, it elicits one of the highest hormonal responses provided by resistance exercises. Hormonal actions that influence the adaptations to the squat exercise include, but are not limited to, improved force production, stimulation of cartilage growth, and enhanced size (Fleck & Kraemer, 1987). Performing the squat exercise with proper technique is crucial in order to benefit from these favorable adaptations.

Teaching proper form to a student requires visual demonstration by the instructor. The literature in the area of motor skill performance as it relates to or is affected by modeling primarily considers visual perception of the modeled information as a mediating variable on behavior, but what ensues between perception and behavior does not appear to be fully addressed. Apparently, a myriad of intermediary components is essential in transforming the patterns of movement demonstrated by the model into appropriate actions to be accomplished by the learner. These components will be discussed following a brief description of proper technique in executing the barbell squat exercise.

Proper Technique

Squatting with proper technique ensures that the quadriceps, biceps femoris, gluteals, and erector spinae receive an overload stress appropriate for development of muscular strength and hypertrophy. The following list will serve as a guideline for the novice lifter:

1. Bar placement should be approximately 1-3 inches below the anterior deltoid. The lower the bar placement, the lower the center of gravity, and the easier the lift will be as long as the bar is not placed exceedingly low on the shoulders, then it becomes difficult to keep the torso erect and puts undue stress on the shoulder joints.
2. Even a slight variation in foot spacing causes a significant change in muscle involvement and places the lifter at a biomechanical disadvantage. Generally, the feet should be slightly wider than shoulder width. This will increase the availability and usage of the larger and more powerful muscles. Also, this stance will enable the lifter to arrive at a parallel position much earlier than with a narrow stance, thus shortening the distance traveled and consequently doing less mechanical work.
3. The lifter should start the descent by leading with the hips rather than the knees. If the lifter should bend the knees before shifting the hips backwards, then the shins will not be perpendicular to the floor. Keeping the lower legs straight, which is one of the most difficult skills to master, minimizes the stress on the knees by keeping the knee joint directly over the foot which also keeps power centered under the bar.
4. Heels should be flat on the floor for the entire duration of the lift. Raising the heels up predisposes the knees to injury and shifts the lifters center of gravity forward which forces the lower back to compensate and places the lower back in a precarious position. The erector spinae should be the stabilizing muscle that keeps the torso erect; it should not become the primary mover in the squat. The legs, gluteals, and hips are more powerful than the lower back.
5. The lifter should have fully inhaled while starting the descent. The breath should be expelled when the "sticking point" is reached in the ascent, which is typically around

thirty degrees of extension. This technique will increase interstitial leverage and aid in keeping the torso erect by forcing the chest out in front of the bar.

Modeling

Modeling is an effective means of conveying relevant information to facilitate an observer's motor skill acquisition (Gould & Roberts, 1981). The literature in the area of modeling primarily considers visual perception as a mediating variable on behavior. Visual demonstrations of motor tasks are retained by the learner in the form of cognitive representations, which may be construed as "mental blueprints" providing an essential link between perception and action. The brain not only categorizes these non-language representations; it also builds successive layers of categories such as shape, movement, and sequence. In this way, the learner organizes visual information, events, and their relationships.

The significance of the modeling process lies in its effect on the behavior of the observer. Particular events and attributes are singled out for observing and describing what exactly ensues between perception and action. So, it is crucial to demonstrate proper technique to the observer in the most effective manner, especially when one considers the many people in various weight rooms that are using bad technique, thereby setting a bad example to those observers. It is evident that the observer somehow retains the modeled action and can later replicate what was seen in the absence of verbal instruction (Williams, 1994). When the trainer gives too many verbal cues, it causes the trainee to think about too many things. This may result in confusion and attenuate performance. Too many instructions make it difficult for the student to totally isolate one strategy from another. In doing so, some of the information is lost. It may be that the student is using various combinations of strategies and cannot be focused into using the most effective one. Therefore, it is important that verbal instruction be as clear and parsimonious as possible. The trainer should demonstrate the squat exercise with the learner standing behind him or her. This type of visual modeling facilitates motor skill reproduction. However, there is a multiplicity of variables and co-actors that are linked to observational learning which will be expounded upon within the remaining sections of this article.

Bandura (1986) suggests that behavior is mediated by exposure to the model and that repeated exposure to the model will improve the quality of the cognitive representation which will, in turn, facilitate performance. The concept of modeling is presumed to be controlled by four sub-components: "Attention", a conjecture that people cannot learn much by observation unless they attend to, and perceive accurately the significant features of the modeled behavior. "Retention", where it is submitted that people cannot be influenced by observation if they do not remember it. "Motor reproduction process", which is the conversion of symbolic representations into appropriate actions. "Motivation" which proposes that people are more likely to adopt a modeled behavior if it results in rewarding consequences (Bandura, 1977a). According to Martens, Burwitz, and Zuckerman (1976), the successfulness of the modeling process is limited by the difficulty of the motor task. This relationship between modeling and performance is predicated on two circumstances: an accurate perception of what is to be accomplished by way of strategy or technique, and the ability of the learner to reproduce the demonstrated action (Burwitz & Newell, 1972).

Why are some people better at solving math problems than others, and why are other people better at performing motor tasks the first time they attempt them? Owing to the disparity in motor performance among clients and trainees learning to use free-weights may be a result of certain individuals generating false assumptions from the way in which they process and record the modeled information. Imagery perceptions are as important in understanding modeling as non-imagery perceptions are for understanding mathematics. These perceptions give the student a reference point from which he or she can improve performance. The instructor should give immediate visual feedback by demonstrating the movement with an emphasis on correcting existing mistakes or replaying videotape of the student's performance, thereby providing visual assessment of the motor task in a timely manner.

According to Adams (1986), this knowledge of results enables the observer to correct errors in movement technique. The greater the accuracy of the cognitive representation of the modeled action, the greater the skill acquisition will be in the subsequent reproductions of it (Carrol & Bandura, 1985). This is consistent with the schema theory proposed by Schmidt (1975), which states that sensory consequences and actual outcomes, for a given set of initial conditions, could be related by the subject. This expected sensory consequence for an intended movement could be generated even if that expectation required interpolating among previous entries in order to perform a novel movement.

Visualization and Imagery

Imagery is a pervasive form of experience and is clearly important for all individuals interested in the acquisition of free-weight lifting skills. The effectiveness of imagery techniques has been demonstrated in studies regarding sport tasks of accuracy, concentration, and strength (Noel, 1980; Lee & White, 1990). The physiological and psychological benefits from practicing visualization improve athletic performance, and have a direct application to the increase of strength (Murphy, Woolfolk, & Budney, 1988). Imagery rehearsal of the desired sequence of sensory-motor behavior units involved in a good performance has been used both by itself and as a part of multiple models (e.g., visuo-motor behavior rehearsal, which combines imagery, relaxation, and actual performance; Suinn, 1980). Although the data are somewhat mixed, the weight of the evidence favors mental practice as productively cultivating athletic performance (Feltz & Landers, 1983).

An interesting point to consider is that individual differences in imagery ability can influence motor task performance. Subjects with greater imagery ability achieve higher scores in replicating movement patterns than do subjects of lesser imagery ability (Ryan & Simons, 1982; Goss, 1986). Experimental research has indicated that "high imagers" exhibited significantly greater recall scores than "low imagers" (Housner, 1984). Visual imagery facilitates the short-term retention of visually presented sequences of movement.

Imagery may have a functional role in the free recall of movement information, especially when imagery techniques are introduced to subjects after they have had some practice in demonstrating the correct movement pattern of the motor skill. Otherwise, imagery can have an adverse effect on performance (Singer, Flora, & Abourezek, 1989; Woolfolk, Parrish, & Murphy, 1985). In other words, it is possible for a trainee to mentally rehearse the execution of proper technique and retain the image of the correct motor pattern. Likewise, it is possible for a trainee to mentally rehearse the execution of poor technique and retain the image of the incorrect motor pattern. Clearly, it has been demonstrated that mental practice enhances performance (Grouios, 1992). However, there still exists the misconception that once mental practice is learned, it can be used in an appropriate situation with a reliable frequency. Teaching someone mental practice techniques is one thing, teaching them to be able to initiate those techniques in specific situations such as learning to perform the squat exercise requires a close examination of technique and appropriate feedback in order to correct mistakes.

Mirrors: An Inappropriate Visual Modeling Orientation

Upon visiting almost any fitness center, at least two things will be evident. Either people do not perform the squat exercise at all, or many of those who do, perform it incorrectly. This is due to false information and improper instruction. Another problem is that people learn to squat while looking at their refection in a mirror. Although mirrors do provide a modicum of necessary feedback as to how one is progressing in terms of appearance, they are an inappropriate orientation for observing the execution of a motor task, especially one as complex as the squat exercise. You wouldn't teach someone how to approach a bowling lane while facing a mirror, or demonstrate a tennis serve while facing the learner. Learning to squat in front of a mirror is not consistent with the notion of acquiring a cognitive representation through observational learning. A cognitive representation has two basic functions.

One is to regulate movement production, and the other is to serve as a standard of corrections for the detection of error between the cognitive representation and response-produced feedback (Adams, 1986). While it may be possible to detect error in the movement of a reflection in a mirror, it is impossible to construct an accurate cognitive representation and correct the error through the immediate feedback from a mirror. The learner should be able to use his or her cognitive representation as a reference of correctness in order to form a hypothesis about how to perform the movement better. This is accomplished most effectively by modeling via visual demonstration from the instructor and/or implementing videotaped performance for assessing proper technique in the barbell squat.

Closing Remarks

The free-weight squat is an open-chain, multi-joint, full-body movement, with a higher level of complexity compared to resistance exercises on machines. Therefore, the additional demands on balance, control, and technique make the squat a very challenging skill to acquire and an even more challenging skill to teach. The four modeling processes "attention", "retention", "motor reproduction", and "motivation" outlined above, are necessary for the learner to acquire proper technique in the squat through observational learning. The learner must understand the purpose of a physical action such as squatting, practice organizing the sequential movements, and receive further demonstration of the same task in conjunction with mental rehearsal in order to enhance performance. The relevant aspects of proper technique are most effectively conveyed to the student by visual demonstration because it provides a complete symbolic representation of the kinematic information in the complex sequential components in the action pattern of the barbell squat.

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