The Science & Application of Coaching Cues

What many deem an “art” is quite scientific and it goes without saying many times “artistic” expressions are labeled as such because we do not yet have full command over the science behind them. One thing scientific research does is expedite the trial and error process by evaluating what was once, or is, professional doctrine and standard operating procedure. This article will elucidate the literature regarding scientific mechanisms of coaching cues and then propose applications based on a blending of science, mentored experiences, as well as my own time out in the trenches.

The same effort we place on programming optimal physiological or biomechanical adaptation should also be placed on how we communicate the intent. Indeed, poor verbal instructions by the coach can severely depress the motor performance of the athletes he is working with. Changing anywhere from one or two words to a whole sentence when teaching novel motor tasks or reinforcing old ones, can have significant effects on our athletes body movements. The following key concepts and proceeding applications can help a coach attain more desirable motor outcomes.

Concept #1 - Attentional Focus of Cues

Whether you’re teaching athletes a new exercise/drill or reinforcing an already learned movement pattern you end up invoking one, two, or both types attentional focus strategies – “internal” and/or “external” (Wulf 2007). An internal focus occurs when the athlete is thinking about one of their own body parts or one of their specific movements during execution of a movement task. An external focus of attention occurs when the athletes thinks about the effect of their movement while executing a performance. Simply, internal refers to the performer’s body part movements and external refers to the movement’s effect. Here are some examples followed by explanation:

<table>
<thead>
<tr>
<th>Exercise/Movement</th>
<th>Internal (body part)</th>
<th>External (effect/environment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinting</td>
<td>&quot;Extend the hip”</td>
<td>&quot;Push the floor behind you“</td>
</tr>
<tr>
<td>Overhead Med.Ball Throw</td>
<td>Focus on Arm Swing</td>
<td>Focus on Med.Ball</td>
</tr>
<tr>
<td>Power Clean</td>
<td>&quot;Move hands and arms closer to body“</td>
<td>&quot;Bring the bar in“</td>
</tr>
<tr>
<td>Snatch</td>
<td>&quot;Extend the hips and pull the bar upward near your body“</td>
<td>&quot;Throw the bar into the ceiling above you“</td>
</tr>
<tr>
<td>Spreading The Floor</td>
<td>&quot;Shift the weight of your body to the outside of your feet“</td>
<td>&quot;Rip the floor apart underneath you”</td>
</tr>
<tr>
<td>Neck Packing</td>
<td>&quot;Retract head” or &quot;tuck chin“</td>
<td>&quot;Make a surprised look“</td>
</tr>
<tr>
<td>Exercise</td>
<td>Cues</td>
<td>Notes</td>
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<td>--------------------------------</td>
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<tr>
<td><strong>Hip Hinge</strong></td>
<td>“Flexing hips at waist”</td>
<td>“Pretend a rope around your waist is pulling you backward” or “look out the window”</td>
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<tr>
<td><strong>Jumping/Hoping</strong></td>
<td>Focus on minimizing ground contact time</td>
<td>Focus on trying to touch the ceiling</td>
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<tr>
<td><strong>Supine Bench Throws</strong></td>
<td>Extending the elbows fast</td>
<td>Trying to hit the ceiling with the ball</td>
</tr>
<tr>
<td><strong>Front Squat</strong></td>
<td>“extend hips at the top”</td>
<td>“pop at the top” or “the plates/bar should rattle at the top”</td>
</tr>
<tr>
<td><strong>Core Work</strong></td>
<td>“Squeeze your abs”</td>
<td>“Pretend like you’re about to get punched in the stomach”</td>
</tr>
<tr>
<td><strong>Posture</strong></td>
<td>“Retract and depress shoulder blades”</td>
<td>“Stand tall with proud chest”</td>
</tr>
<tr>
<td><strong>Posture</strong></td>
<td>“Extend your lumbar spine”</td>
<td>“Arch your low back” or “ghetto booty”</td>
</tr>
<tr>
<td><strong>Scap. Pushup</strong></td>
<td>“Protract” or “push hands into ground”</td>
<td>“Push your body away from the floor/world”</td>
</tr>
<tr>
<td><strong>Pullup</strong></td>
<td>“retract and depress shoulder blades”</td>
<td>“Pull your shoulder blades into back pockets”</td>
</tr>
<tr>
<td><strong>Dynamic Effort Deadlifts in Powerlifting</strong></td>
<td>Focus on lifting/moving body as fast as possible</td>
<td>Timing how long it takes to stand up</td>
</tr>
<tr>
<td><strong>Deadlift Finish</strong></td>
<td>“get your hips through! Squeeze your glutes!”</td>
<td>“Midnight thrust at the top!”</td>
</tr>
</tbody>
</table>

In the end the goal of coaching cues is motor outcome by guiding movements in a more efficient manner. Did the athlete actually move the medicine ball at top speed (external) or did they just focus on extending the elbows rapidly (internal) while the shoulders and rest of the body were not producing optimally because the athlete was so focused on her elbows? Did the athlete just extend their leg/hip quickly (internal) without applying much force into the ground to increase running speed or did he actually push into the ground behind them (external) making them move faster? Was the athlete objectively fast/quick/strong or do they just look pretty? The type of attentional focus the athlete adopts is severely influenced by you, the coach! Even subtle differences in instructions can make a big difference in movement outcome.

A plethora of research both past and present has demonstrated the superiority of externally focused cues on actual movement effects in a variety of motor tasks like agility maneuvers, exercises, sports skill, stability challenges, jumping, and much more using a number of measurements (seconds, inches, pass vs. fail, etc.) (Al-Abood et al. 2002, Marchant...
et al. 2009, Porter et al. 2010, Wulf 2008, Wulf et al. 1999, Wulf et al. 2003, Wu et al. 2011). While I could find the actual reference I can remember reading that Coach/Dr. Verkhoshanky did a study looking at depth jump performance where he told one group of athletes to “spend as little time on the ground with your feet as possible” and another group to “jump up as high as you can and grab the ball overhead” (he hung a ball over their head so they would attempt to grab it out of the air). The first group was obviously given internal cues (body part) and the second given external (effect). The study found the external cue resulted in far superior jump height.

Anecdotally, (though I’m sure there’s research on this equipment) when I test my athletes vertical jump I always get higher numbers using the Vertec than I do the Just Jump Mat.

External vs Internal Focus of Attention

Technology aside, I credit a large part my results to the fact the Vertec uses an externally focused task (touching highest marker above you) while the Just Jump uses an internally focused task (have to keep your knees and hips extended so air time does not influence outcome). At this point we might even be able to say the more externally focused a cue is the better the result, albeit this won’t work every single time. You can use whatever unit of measure you like (seconds, weights, inches, etc.) to conduct your own little experiment but we have a good deal of confidence empirically and anecdotally that an external attentional focus will result in superior effect of movements. Not only that, but this effect has been demonstrated in beginner and advanced athletes, male and female, under pressured performances, as well as patient populations (Landers et al. 2005, Porter and Anton 2011, Wulf 2008, Wulf 2007, Wulf et al. 2010, 2002, Wu et al. 2011).

Concept #2 - Feedback, Frequency of Cues, and Learning
I lump all these terms together in one concept because it is similar to the one above. After you’ve taught a new exercise or movement you then provide feedback. When desiring to change (via feedback) an athlete’s body mechanics it might seem counterintuitive to not reference body parts (internal focus), yet, most research consistently supports the notion that changing body mechanics immediately and permanently is best done via externally driven attentional focus \( (Wulf 2007) \). That being said, real world experience has already told us all that some internal cueing can be appropriate at times, especially if it’s in progression towards external cueing.

What separates this concept from the above is how frequently we should provide biofeedback to our athletes. Some would say “as they need it,” others try to provide minimal cueing so learners do not become dependent on it, while other coaches try to stay scheduled in cueing (i.e. immediately before, only after, etc.). Two studies in particular \( (Wulf et al. 2002, 2010) \) gave external coaching cues to one group after every single task performance (100% of the trails), after only some of the performances (33% of the trails), and then did the same thing with internal coaching cues to another group (100% and 33% of the time). Both studies had similar results – the more external cues the better the task was learned, the less they used internal cues the better the task was learned, and the more internal cues they used the worse the performers did on learning the movement task. In fact, the 100% external cueing group outperformed every other group on a transfer test of a different motor performance. In this case, more of a good thing (external cue) is a good thing.

**Constrained Action Hypothesis & Automaticity**

Now we understand in most (not all) situations an external focus of attention will bring about the most effective and efficient performance. But why? How? The mechanism is very interesting and not what you might think. Sports scientists call it the “constrained action hypothesis” \( (Wulf 2007) \). The hypothesis states that:

> “Consciously focusing on the movements of a motor action disrupts automatic motor control processes that regulate coordinated movements. When athletes actively focus and consciously control their movements, they interrupt automatic nonconscious motor behavior processes that normally control movements in an efficient manner. In contrast, directing attention externally to the movement **effects** allows the motor control system to naturally regulate and organize motor actions. As a result, movements are unconscious, fast, and reflexive.” \( (Wu et al. 2011) \).

When you think of “natural” and “reflexive” movements, be it in an exercise or agility maneuver, we want fluent movement that only recruits the muscles necessary to optimally achieve the task. Meaning, you do not want a lot of unrelated muscles activated that will cause “micro-chokes” in the movement and slow you down. Gray Cook refers to this phenomenon as “high threshold and low threshold” strategies. Essentially, when increased activity within a movement task occurs, we should desire an increase in motor unit recruitment **efficiency**, not just more motor units. This is calorically saving as well. For example, one study (Zachry et al.
2005) had athletes perform a basketball free throw where one group was given instructions to focus on wrist flexion (internal) while the other group was cued to focus on the rim of the basketball hoop (external). The internal group produced higher EMG activity than the external group in both the biceps and triceps, yet they were instructed specifically on wrist flexion. This is the “high threshold strategy” in action. One eye opening study (Wu et al. 2011) looked at forced produced and jump distance in the standing long jump. All subjects (n=21) underwent both internal and external coaching cues. On average, they found internally cued subjects produced similar but yet slightly higher peak force but did not jump as far as when externally cued (see graph below). Meaning – subjects when coached with an internal focus of attention produced more force in the jumping motion but actually jumped less distance than when coached externally!

Again, the reason is probably due to the mechanisms articulated above. The timing component of the jumping motion may have been different between jumps due to cueing which probably made the internally cued jumps less natural, impulsive, and reflexive. Studies like these demonstrate the efficacy of adopting externally driven coaching cues to facilitate greater movement effectiveness and efficiency.

Summary

As we already know, effective verbal cuing is a critical tool for maximizing motor performance of our athletes. While much of this piece revolved around how we communicate training protocols another appreciation is to factor in the impact of effective verbal instructions during testing and how it can alter the reliability of our results in things like vertical/broad jump testing, FMS scoring, etc. It’s also interesting to note that many ebooks, programs, etc. that give the reader very detailed testing protocols, set and rep schemes, and exercise descriptions, entirely ignore the effects of verbal instruction and feedback.

In the end, an internal focus can constrain the athlete’s motor program causing a conscious type of control and micro-choking episodes in movement that result in less efficient, less effective, and decreased learning outcomes in task performance be it an exercise, agility maneuver, a sports skill, or the like. Very frequent external cueing however can result in the utilization of automatic processes and reduced attentional demands that promote more reflexive and natural movement outcomes and overall better performance. As I said though, I feel there is a place for bits of internal cueing. As coaches, we need to be cognizant of the informational properties we give our athletes because it absolutely affects their movement depending on what we say, how we say it, and when we give it.

Applications & Disclaimers

So, whether we knew it or not we’ve all at one point utilized both internal and external coaching cues. How many times have you told an athlete to “squeeze your glutes/core” or “shoulders back and down” and it worked perfectly? Probably a good number of times. It’s not that internal cueing is “wrong” per se it’s just that we have plenty of reasons that external
Cueing is a bit better, especially in the long term of motor performance outcomes, which is essentially the majority of what we’re trying to accomplish with any training program we design. This does not mean your coaching cues need a complete overhaul and an “all or nothing” approach towards external cueing. It just means that in most cases we should *eventually end* with the athlete adopting an external focus of attention and an “effect-based” rather than “muscle-based” perspective of their own movement. For some movements if your intent is purely activating a certain muscle, for whatever reason, then internal serves the purpose. Therefore I propose the following when teaching a *new* motor task to one of our athletes (see below). Obviously if the frame of reference was bodybuilding I would use a lot more internal cueing because the goal would be more localized muscular activity and it is much less about performance outcomes of the overall movement.

| Coaching Cue Matrix for Novel Movements in a Sports Performance Context of Training |
|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| "Type" of Movement                   | Classical "Isolation/Activation," Mobility, or "Core Stability" Exercises | Agility Maneuvers                     | Compound Exercises for Strength, Impulse, Elasticity |
| Examples                             | Side-Lying External Rotation         | Front Plank                          | Cutting                              |
|                                      | Hip Bridge                           | Hip Flexor Mob.                      | Squat                                |
|                                      | Shoulder Packing                     | T-Spine Extension Mob.               | Squat                                |
|                                      |                                      |                                      |                                      |
| Level of Trainedness                 | Beginner                             | Internal or External                 | Progress from Internal to External   |
|                                      | Intermediate                         | Internal or External                 | External                             |
|                                      | Advanced                             | Internal or External                 | External                             |

*In this situation I almost always start with external cueing but regress to internal if necessary.*

Key Points:
- Note the examples that are underlined are links you can click on that provide videos to illustrate the point.
- This matrix represents how I view coaching athletes through a movement they have never done before. If referencing tasks that athletes already have a motor program for, I skew everything towards external.
- I stratified the categories and labels in a way that I thought most people reading this would understand. The terms used are not absolute nor must you fit your system into them. Grasp the science presented in this article and you can create your own matrix according to your own movement classifications so long as they adhere to the principles.

Examples:

- Using the matrix above, when teaching an athlete of any level the Hip Bridge I use internally driven cues such as the following:

  - http://www.youtube.com/watch?v=7WGbolmzl1A
  - “squeeze your glutes to lift your hips”
  - (while palpating) “try to relax your hamstrings”
  - “imagine a straight line from knee to hip to shoulder”
  - etc.

- Using the matrix above, when teaching most athletes the Front Plank I start external by saying things such as “pretend like you’re about to get punched in the stomach” and if I don’t see the kind of core activation I desire I’ll palpate with both hands and say “squeeze all this.” When teaching any kind of hip flexor stretch I most often poke their glutes and say “squeeze your glutes” (internal). For most T-Spine mobilizations into extension I usually palpate T4 and say “bend here but keep the ribs down” (internal) though in certain prone positions and provided the extension is coming from the right segments I like the cue “push yourself away from the floor” (external).

- Using the matrix above, when teaching an beginner level athlete the Crossover Step I progress from internally driven to external cues such as the following:

  - “drive your knee across your body”
  - “push the bottom leg into the ground hard”
    - once proficient -
  - “think of this as a sideways long jump”
“push the floor away from underneath you” (bottom leg)
“reach to the wall on the side of you” (top leg)
“stay low”
etc.

- Using the matrix above, when teaching most athletes basic compound exercises like squatting, deadlifting, bench pressing, various plyometric drills, etc. I try and foster an external focus of attention with my coaching cues as much as possible though, especially for intermediates, I’ll regress to an internal cue at times. Also, this is a great time to reference the implements being used (barbell, box, dumbbell, cone, bench, rack, etc.) for external cueing:

  o Squatting:
    - “Proud chest before the descent”
    - “spread the floor apart on the way down”
    - “sit back on a chair”
    - “Pop at the top”
    - “lockout”
    - “Bar/Plates should rattle at the top”
    - (when squatting to a box) “pretend you’re sitting on glass”
    - If doing some kind of “speed squat” you can time with a stopwatch how long it takes to go through the full range of motion. Be sure the athlete’s mechanics are correct before using this cue though.
    - Etc. Etc.

  o Benching:
    - (internal regression) “I should be able to slide my hand under your (low) back during the setup” (source)
    - “scrape the bar off the rack”
    - “stare at ceiling, not bar”
    - “rip the bar apart on the way down”
    - “drive into the ground”
    - “Press yourself into the bench while pushing the barbell up”
    - “squeeze the bar hard on the way up”
    - “drive the bar up slightly over your eyes”
    - “pop at the top”
    - “lockout”
    - “the plates should rattle at the top”
    - If doing some kind of “speed bench” you can time with a stopwatch how long it takes to go through the full range of motion. Be sure the athlete’s mechanics are correct before using this cue though.
    - Etc.

  o Deadlifting:
“ghetto booty before you pull” (referencing low back arch)
“grip and rip”
“push the floor down”
“blast yourself off the ground”
“pop at the top”
“lockout”
If doing some kind of “speed deadlift” you can time with a stopwatch how long it takes to go through the full range of motion. Be sure the athlete’s mechanics are correct before using this cue though.
Etc. Etc.

Jump/Hopping:
“land soft”
“land quickly” or “stick the landing”
“land soft and quick”
“touch the ceiling”
“reach up as high as you can”
“try to grab the ball above your head”
Etc.

Conclusion
As coaches we are continually questioning our methods, constantly seeking to get better at what we do. Understanding attentional focus, frequency, and feedback are key components of the informational properties that make up coaching cues. They key is to be creative while still adhering to the principles of motor learning. The link between what you finalize on paper and what is actualized in real life is you – the coach. How you communicated the intent and how the athlete perceives the training initiative determines what ends up happening. The options are endless and hopefully this article gets you better at what you do.

Addendum
To be abundantly clear, I first came across this information myself in original research published by Dr. Gabriele Wulf. As you’ll see from the reference list it dates as far back as 1999! This science has been around for quite some time and what’s novel here is that coaches are finally paying attention to it. After this article was originally published on StrengthCoach.com I got a number of emails from readers who really appreciated my thoughts. I was also encouraged to find out Nick Winkelman has been into this particular topic for many years now! Definitely check out Nick’s podcast episode (see reference) where he discusses his conclusions of Dr.Wulf’s
research. We talked on the phone and it turns out he’s thinking about doing Ph.D on this topic. How cool is that! Furthermore, my friend Brett Bartholomew told me he did his master’s degree thesis on “attentional focus.” Clearly, the profession is making moves and what we used to simply chalk up to be an "art" actually has plenty of supporting science.

References


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