

SPECIAL SUPPLEMENT TO IMPACT CHAPTER 5 - MOTOR SKILL DEVELOPMENT

Full text of Dr. Peter Vint's and Bill Neville's comments regarding Motor Skill Learning Theory, for your reference in this 4 page handout.

DR. PETER VINT, USOC SPORTS SCIENCE DIVISION – CHAPTER 5 COMMENTS:

Much of what I have to say may or may not “fit” in this book but forms much of my opinion of the content, which I believe is generally good (and accurate), but often is way too strictly defined and fails to include other elements of skill acquisition and motor learning. This statement comes from the realization that:

- 1) A very **large portion of motor learning theory has been founded upon novel, highly constrained (single joint, single plane), and very simple motor tasks** (rotary pursuit, light tracking/interception, targeting tasks) that may have little relation to the complex motor skills involved with sport.
 - a. From an experimental standpoint, there are some very good reasons for this.
 - b. However, I believe the “strictness” with which we apply these findings should be “softened”;
- 2) The same **body of research has largely neglected to comment on “motivational” issues related to skill development** and this is one of my major points of contention with such a straightforward presentation of this material.
 - a. For a true novice, just playing cross the net games might be boring and frustrating and could lead to less satisfaction – even though according to “theory” this would be the most specific and transferrable way to develop such skills.
 - b. I believe there needs to be some **consideration that these concepts are more appropriately and pragmatic applied as written once a fundamental level of skill has been demonstrated.**
 - c. For the novice, high repetition and frequent feedback on some “part skill” tasks can promote motor skill development AND maintain and even foster the motivation needed to step into a more sport specific “whole skill” practice;
- 3) Again, for some very good and understandable experimental reasons, a very large part of feedback and practice design theory has been based on the manipulation of “knowledge of results” (which athletes largely know and have intrinsic access to) and not “knowledge of performance” (which coaches try to utilize).
 - a. Therefore, while I believe there are some likely truisms that may apply equally (probably a bad word) between what we know about how knowledge of results-based feedback works and what we think we might know about how knowledge of performance-based feedback works, the relationships are not strongly developed in the latter.
 - b. I state this again in the context of the “strictness” or “narrowness” in which we sometimes convey the ideas that have come from this field.

That said, here are my comments:

Sure, learning quickly would be really great. However, the **literature is clear in stating that the deepest and therefore “best” learning (as indicated by performance retention under varied conditions) is usually accomplished by a process called ‘IMPLICIT LEARNING’ – where the learner comes to understand a principle, or concept, or relationship in a deeply personal way. That is, they have their own ‘Eureka!’ moment.** Unfortunately, this process may take much longer than other types of learning. ‘**EXPLICIT LEARNING**’, on the other hand, is a process by which the learner may in fact be able to perform a given task or recite a given principle more quickly, but the level of demonstrated learning is far less complete and retained for a far shorter period of time.

By way of example, assume we want an athlete to improve his or her middle blocking performance, and in particular, his/her ability to read the play to improve the speed and accuracy of their initial decision making.

IMPLICIT LEARNING:

In this scenario, **the coach would define the skill and expected outcome for the Middle Blocker: “You need to read the play so you can make faster and more accurate decisions,”** but they effectively leave it to the athlete to determine how to do that on their own or to figure out to what information they must attend. Hopefully, the athletes would figure it out and by doing so on their own, they would come away with a very strong and robust understanding of this aspect of the game. Unfortunately, it may take a long time for this to happen and perhaps it never would.

EXPLICIT LEARNING:

In this case, **the coach not only defines the skill and expected outcome, but also defines the stimulus and response for the Middle Blocker. “When you see this, do that.”** No attention is given toward the Middle Blocker understanding or actually internalizing the cue, just a superficial “if-then” response. This is generally a learning technique that can yield very rapid changes in performance (and therefore useful during in-game, time-out situations) but results in very poor retention and very shallow understanding. The latter may cause athletes to resort back to prior habits under conditions of stress and anxiety.

GUIDED DISCOVERY:

In this third option, **the coach defines the skill and expected outcome, and also provides some guidance on which cues to focus on without explicitly stating the cause-effect relationship. “Watch what happens when the setter arches his/her back...”** By providing “hints” to the Middle Blocker without giving a “rule,” the athlete is still able to “discover” the answer and learn the relationship in their own more meaningful way. The advantage of this approach is that it typically takes less time than **IMPLICIT LEARNING** and may yield results that are comparable to those obtained under **IMPLICIT LEARNING**.

The discussion on “**SPECIFICITY vs. GENERALITY**” is perhaps somewhat more limited than it needs to be. While the **general message here is that specific practice is required (or best) to perform a specific motor task in a specific situation, I would contend that the practice design literature also shows that such specificity can be quite limiting.** I believe we sometimes make the mistake of failing to synthesize the “specific vs. general” concept with that of “**CONSTANT vs. VARIABLE**” practice. While constant practice can be useful for execution of skills in constant environments, **variable practice tends to extend the “motor schema” (if you subscribe to this concept) and facilitates more robust and higher level performances in “different” situations/environments.** I like to relate this idea to that of “specific vs. general” practice or experience. **Those who are trained in narrow and specific performances may in fact develop to be quite talented, but those who are trained in broader and more varied performances, while lacking perhaps some of the nuanced technical execution, are often able to perform at equal or higher levels because of they have used their bodies in more varied ways and developed a more comprehensive (albeit “general”) set of motor abilities.** See my comments below regarding the “generalized” vs. “specific motor program.”

Under the same discussion, the Savelsberg quote is getting at something called “**PERCEPTION-ACTION COUPLING.**” That is, **learning is more effective when all components (cognitive, perceptual, and motor) of skill are included in its execution** and I think more accurately pertains to the “**WHOLE vs. PART**” discussion. It can also be tied to the “decision making” discussion as simply watching video and talking about a response is less effective than a more immersive activity where the athlete actually physically executes the appropriate response.

The discussion on “**RANDOM vs. BLOCKED**” practice and the introduction of “variable practice” appears to mix concepts. **RANDOM vs. BLOCKED practice pertains to the distribution of repetitions on a given motor task (or drill).** Serving 20 times in a row would be indicative of blocked practice. Serving 2 times, then passing a few times, then serving 3 times then...is indicative of random practice. “**VARIABLE vs. CONSTANT**” practice pertains to the **conditions in which the skills are performed.** Serving 20 times in a row from the same side of the net is blocked *and* constant. Serving 2 times, then passing a few times, then serving 3 times from the other side of the net then...is indicative of random *and* variable practice. When teams practice on the same court in the same direction with the same balls at the same time of day, it is constant. When they practice on different courts or on different sides or at different times of day or with different balls or against different teams, it is more random. The example of passing (coming from the same place and going to the same place) is more consistent with the description of “constant vs. variable” practice, not blocked vs. random (which would be interspersing this drill with serving, attacking, etc.) throughout the practice.

Along these same lines, the discussion of “**MASSED vs. DISTRIBUTED practice**” appears a bit too closely tied with “blocked-random practice.” However, in the literature, “**MASSED vs. DISTRIBUTED**” more conventionally relates to “**work-rest**” ratios (time between repetitions or drills) while the latter relates to the distribution of repetitions (20 serves in a row vs. a few throughout different parts of the entire practice). The example used in the Manual intermingles the two concepts, which can be done, but I wanted to suggest that the terminology be clarified.

The following is just a comment... just adding some information:

I understand the message but don't completely agree with the Gallwey quote - “too much instruction is worse than none.” But, this gets to the “knowledge of results” vs. “knowledge of performance” issue. If “instruction” is construed to mean “feedback”, then providing no feedback is almost always worse than providing even marginally effective (too wordy albeit correct) feedback. By the way, I am not contending the point that too much, too detailed feedback is bad – it is (although “advanced” performers can sift through the noise to get whatever they need out of the feedback). However, a player who serves a ball out knows they served out (knowledge of performance) and they don't need information from the coach on this. Here, providing too much instruction on the “performance” (toss too low/high/forward/backward, contact point too low...) may be in fact be worse than no instruction at all, but more because the latter requires the athletes to “figure out” the problem on their own. This is implicit learning and it is very deep and very robust but may take a long time.

I'd like to see a bit more **discussion on some best practices of feedback and the goal of having the athletes becoming more “active learners.”** This can tie directly into the concepts of practice design (mass-distributed; constant-variable; blocked-random) as well as feedback (frequency, “bandwidth” [coach on the average], athlete-controlled, etc.).

With regard to questions on general motor programs and transfer I have the following comments.

After years of research, I have decided that I don't completely subscribe or adhere to any single, formal, or precise definition of “motor program.” I **do** believe there is **sufficient evidence to state that we are capable of generating voluntary, stereotypical motor responses to achieve a given result.** If some like to call this a “generalized motor program,” then great. I am not sure there is sufficient evidence to state conclusively that there is a “specific motor program” for every motor response we elicit. I also **do** believe **there is sufficient evidence to state that motor variability is a good thing and that athletes should be encouraged to “explore” this space by playing live games and by being coached by coaches who promote environmental and situational variability.** This is compatible with what Schmidt calls “**schema theory**” which essentially accounts for an ability to execute a **generalized motor response (an attack) in a number of novel ways and under a number of novel conditions (set's high/low; tight/off; fast/slow).** When I see an attacker correctly adjust to a poorly set ball (or poorly timed approach), I do NOT believe they are calling up a unique “specific motor program” for that particular condition. Rather, I believe **they are able to elicit an appropriate motor response by drawing upon a pool of available and compatible motor abilities. It's still an attack – it's just a bit different this time than it was last time.** The broader the repertoire, the more adaptable the response can be. This repertoire may be extended directly through variability in training conditions – which I believe can include participation in other sports.

I agree that there may not be DIRECT 1 to 1 transfer between a baseball pitcher's ability to attack a volleyball, but there is likely to be some POSITIVE transfer. A baseball player who has never played volleyball is likely to be more capable of learning to attack a volleyball with an “ideal” form than a wrestler who has a less mature “overhand throwing pattern.” Put in the context of a volleyball practice, **I would still prefer to teach the wrestler-turned-volleyball player to attack a volleyball rather than throw a ball then learn to attack a ball, but there are some similarities, which can in fact, and do, transfer.**

In reading this body literature, I have come away with the understanding that positive transfer is good; negative transfer is bad; and greater positive transfer is better than less positive transfer. So, progression **drills should be designed to maximize positive transfer and minimize (if not completely eliminate) negative transfer.** Some progressions may be more similar to the actual skill of attacking and should therefore promote greater transfer.

One last point...a number of these issues have theoretical ideals but practical limitations. An example:

Ideally, practice designs should be random and variable. Particularly for athletes who have a good working skill base, we should not have extended periods of blocked practice (e.g., 20 serves in a row). Realistically, however, the time coaches have in a gym is limited and trying to get through say 5-8 drills in a 2 hour practice can be

challenging enough. When we advocate now that they take those 5-8 drills and break them up into random chunks (2 serves here, 5 passes there, 3 blocks here, 1 serve there), we bring time management issues to the forefront. **This is not to say that we should shy away from these recommendations, because they are the RIGHT ONES!!!** Rather, coaches may need some real-world guidance, discussion and examples of how to design random, variable practices including equipment changes/positions/configurations, etc. Experiences in designing and working through a random/variable practice with coaches on the floor (or even in the classroom would be very valuable.

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On "Principles" vs. "Laws": "Principles" refers to guidelines - with thought. "Laws" are absolutes - meaning no further research, study, is required.

The more I work with this stuff the more I do believe in transfer. However, my definition is a bit different. I have discovered people with *athletic/sports experience better know how to learn and prioritize key information*. I like Peter's example of the baseball player and the wrestler - and completely agree. The general motor program of throwing certainly lends itself to the *application* of hitting. Likewise, a wrestler* (who never has thrown objects other than humans) who is enlightened by the opportunity to play volleyball, needs to focus on learning how to *spike* over learning how to *throw* - but throwing certainly wouldn't hurt. However, the wrestler brings an aggressive, competitive mindset, knows how to learn and how to apply athletic skills. (Or, of course, the wrestler could be a chunky midget with no neck, short arms and legs, a broken nose, and can't jump, therefore, may be a candidate for the team manager position.)

I think there is one absolute: there *aren't any* - other than natural laws (the effects of gravity, rain is wet, etc).

I think we must focus on explaining/defining to new coaches the terms and applications of blocked, constant, variable, and random practice; the importance of guiding principles and keys chunking information; the importance of positive, reinforcing feedback (verbal and non-verbal). As well as the importance of "studying the important aspects of coaching," and knowing how to choose what best fits their style. I also think we should promote and live by two very sound principles:

- 1) "Simpler is Better", and
- 2) "The Game Teaches the Game." (Also, can be loosely translated as "Players teach players how to play. Coaches guide the process.")

** Bill is a proud papa of a wrestler who also is quite a good volleyball player, and certainly not a "midget."*

The USOC Coaching Education department will be issuing further findings and comments on this subject in the coming months and USAV-Coaching Education will share those findings as they become available on the website at www.volleyball.teamusa.org under the Resources tab, then click on the Education/IMPACT/Articles links.