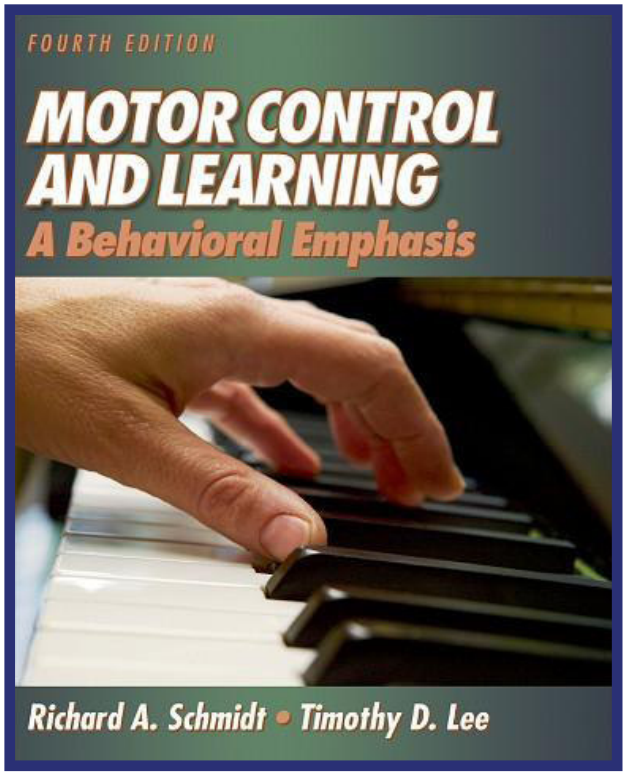
Motor Learning

Principles of Practice and Learning



By: Richard Schmidt and Timothy Lee

MOTOR PROGRAMS: BASIS OF GOLF SWING

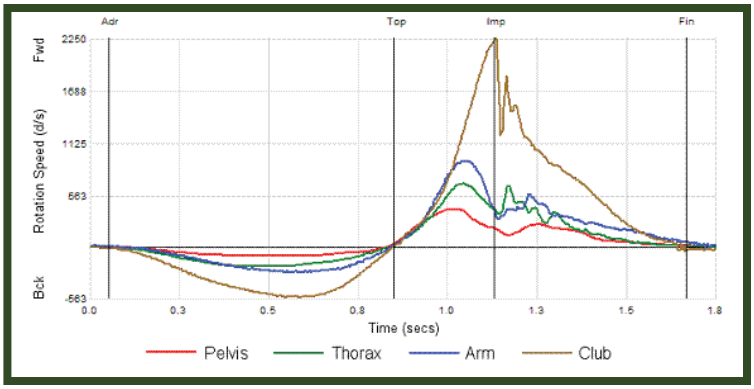
Outline of Main Topics

- Motor programs: basis of the golf swing
- Features of learning motor programs
- Fundamentals of the performance vs. learning distinction
- Conditions of practice and motor learning
- Feedback and instruction in motor learning
- Some conundrums of practice and learning
- Specificity of learning
- Breakout session

Motor programs: basis of the golf swing

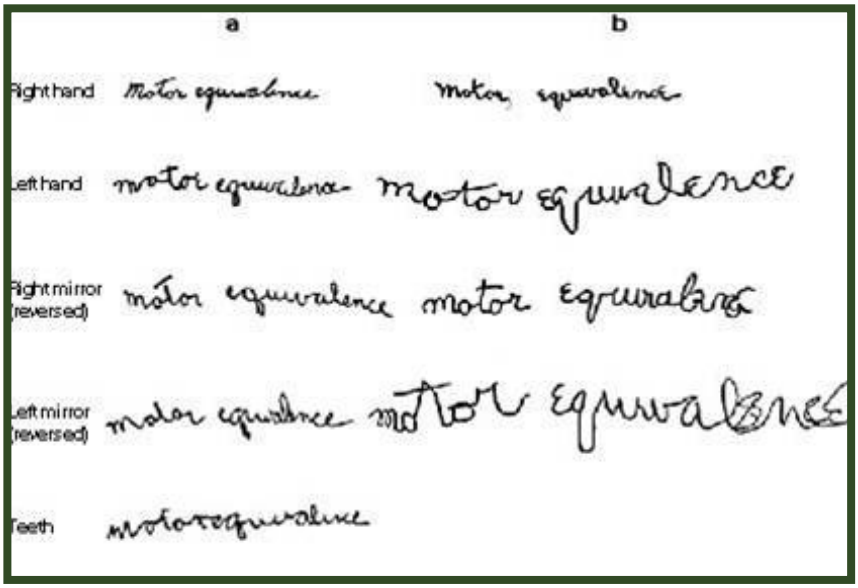
Kinematic Sequence of an Effective Swing

- Downswing characterized by following unwinding of peak velocities: pelvis - thorax - arm - club
- Represents a relatively steady state of
  - Ordering of events
  - Relative timing of events



What we know about motor programs

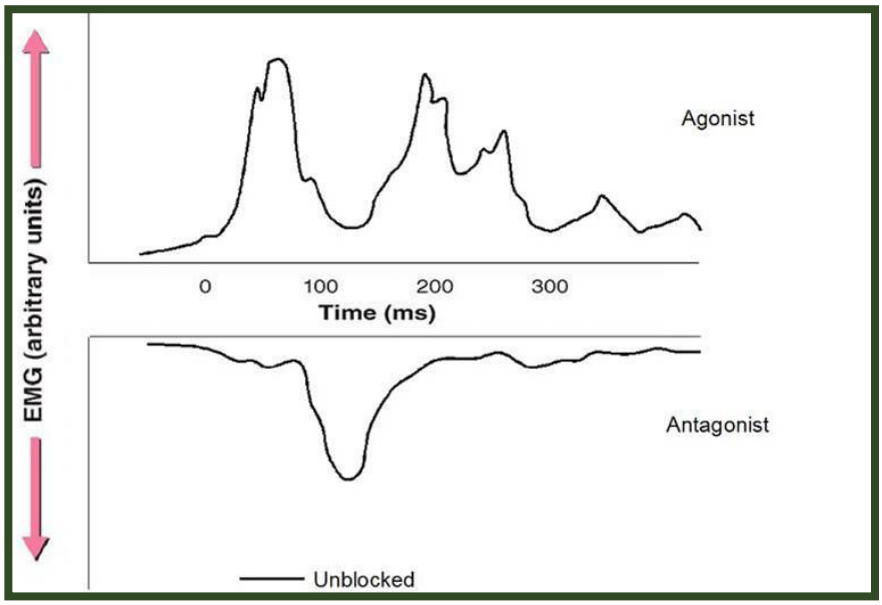
- Resides in the central nervous system (brain), not muscles

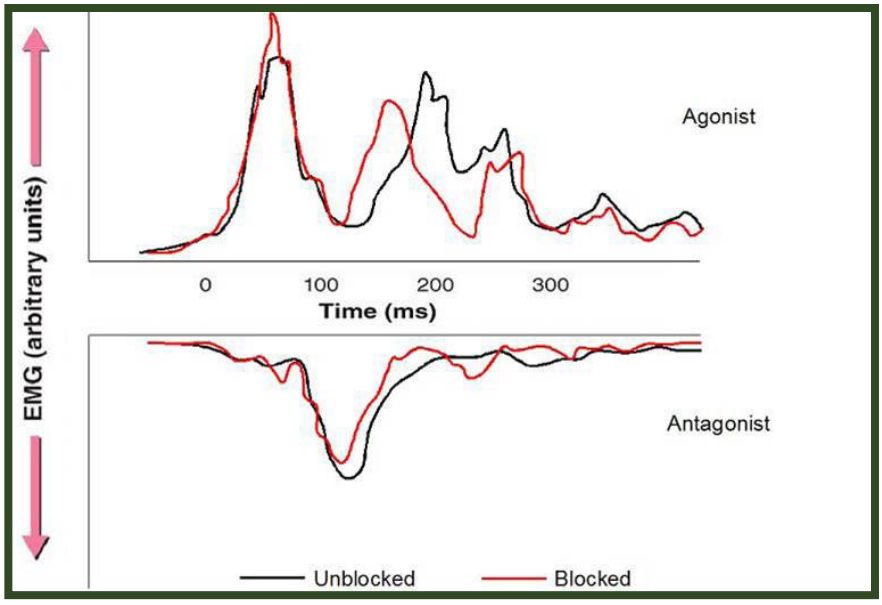


MOTOR PROGRAMS: BASIS OF GOLF SWING

What we know about motor programs

- Planned in advance and executed without many changes when triggered into action (Wadman et al.)

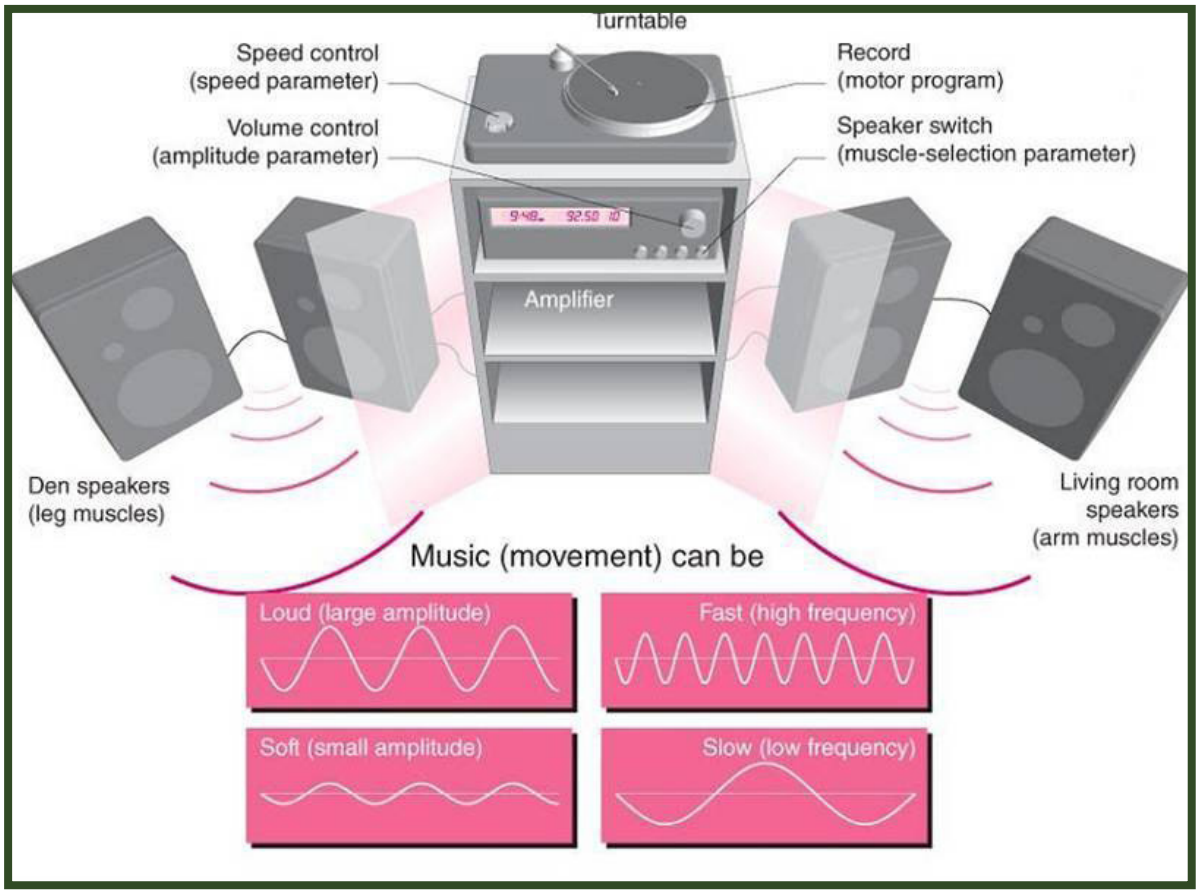




"If you take a fast, lousy swing and slow it down, what you've got left is a slow, lousy swing."
- Hank Haney

MOTOR PROGRAMS: BASIS OF GOLF SWING

Phonograph Record Analogy:



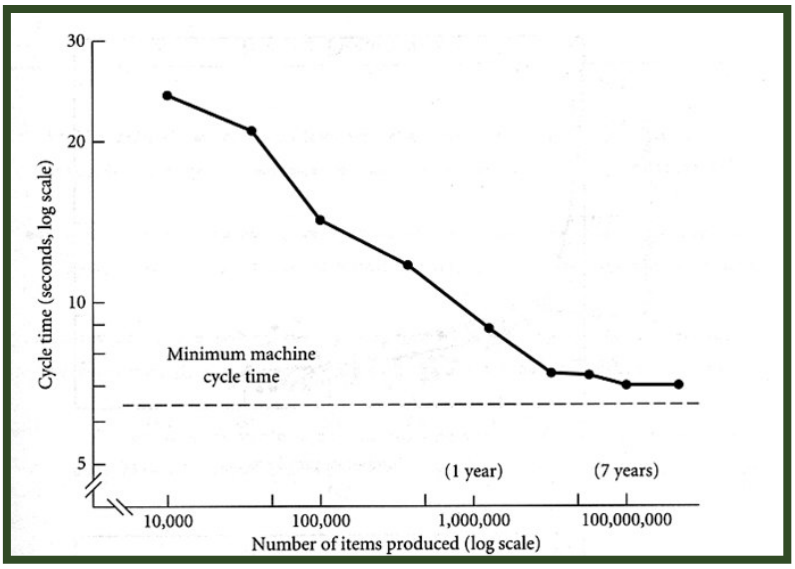
Notes on Motor Programs: Basis of the Golf Swing:

FEATURES OF LEARNING MOTOR PROGRAMS

Features of Learning Motor Programs

Learning Motor Programs is Different than Learning Other Information

- Factual information -- what did you learn today?
- Motor learning -- a process that never ends



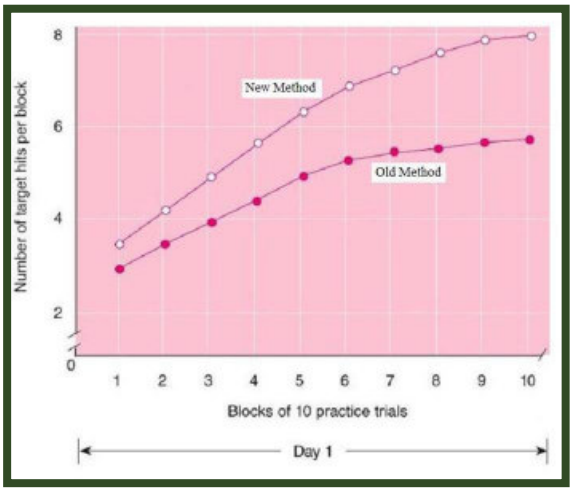
- Constraint-induced therapy in stroke patients

- Retention of motor skills is much better and more enduring than factual information

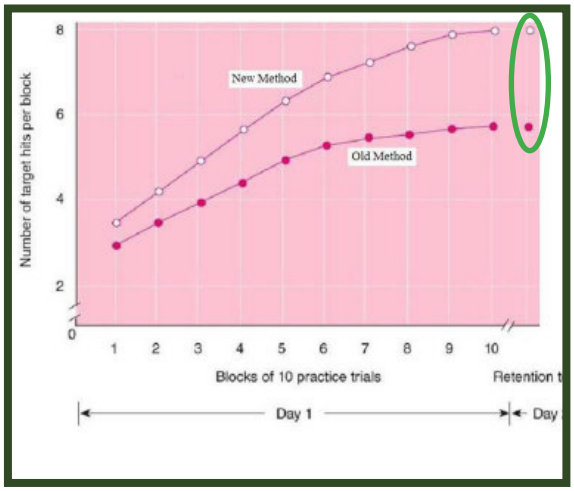
PERFORMANCE VS. LEARNING DISTINCTION

Fundamentals of the Performance vs. Learning Distinction

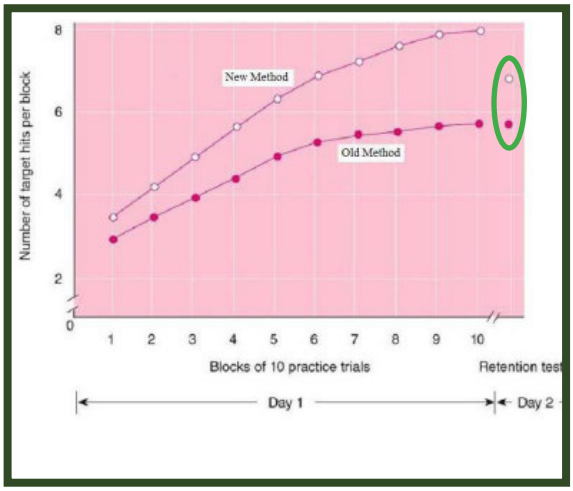
- Fundamental basis for evaluating motor learning research experiments AND teaching effectiveness
- Changes that occur during practice can be temporary or permanent
- Assumptions about learning must be based on permanent changes
- Tests (e.g., exams) are used to assess classroom learning; tests for motor learning are called "retention" tests
- In golf, practice occurs on the range but the true test of learning occurs on the course



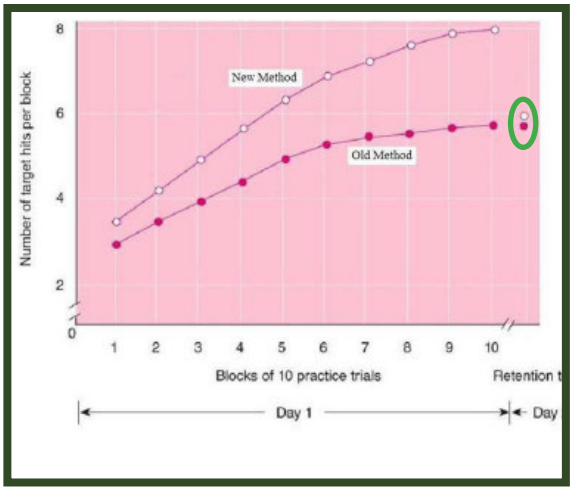
A practice curve - plot of performance scores over attempts, or blocks of attempts.



Retention test resulting in similar results as seen in practice.



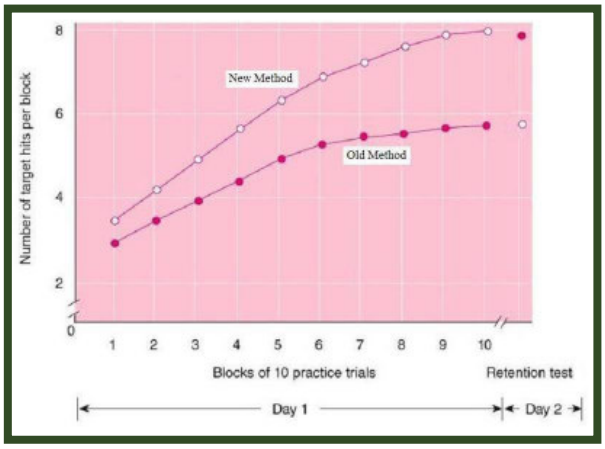
Retention test resulting in reduced size of difference between practice methods.



Retention test resulting in no difference between practice methods.

PERFORMANCE VS. LEARNING DISTINCTION

Fundamentals of the Performance vs. Learning Distinction



Retention test resulting in reversed differences, compared to practice.

- Some causes of temporary changes in performance:
  - Fatigue
  - Boredom
- Some causes of permanent changes (learning):
  - Amount of practice (if done effectively)
  - Augmented feedback (if provided effectively)

CONDITIONS OF PRACTICE AND MOTOR LEARNING

Conditions of Practice and Motor Learning

Consider the Typical Practice Session on a Driving Range

Outdated Metaphors

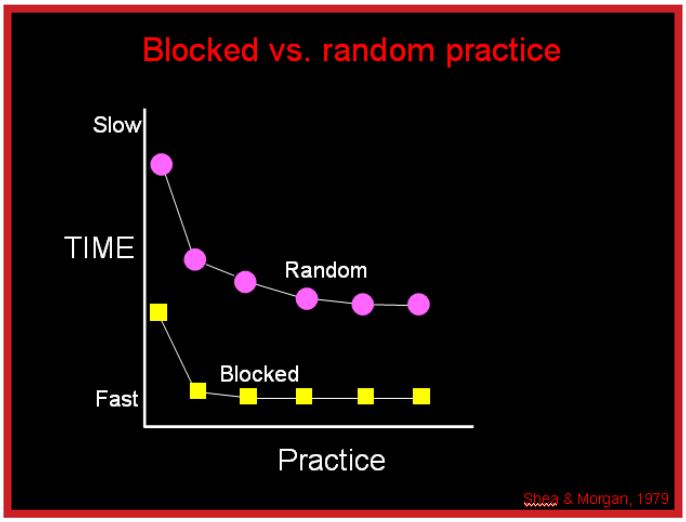
- "Grooving" the skill, as in digging a deeper groove in a phonograph record
- "Stamping it in"
- "Water running down a mound of dirt digs progressively deeper streams"
- These all suggest the notion that repetitiveness is key

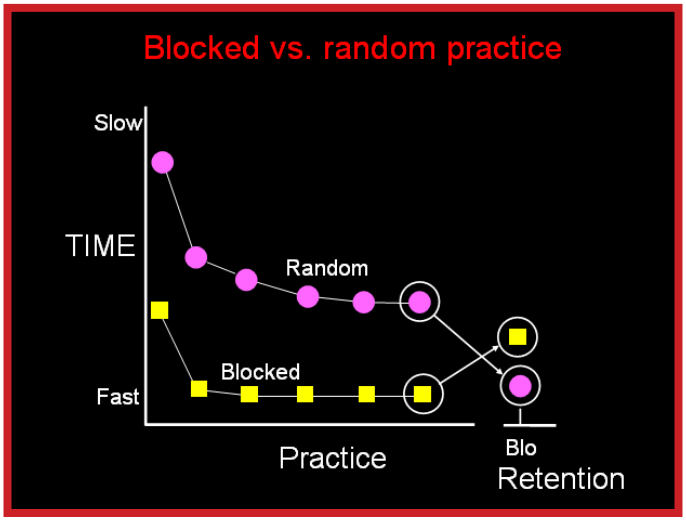
Research suggests something very different!

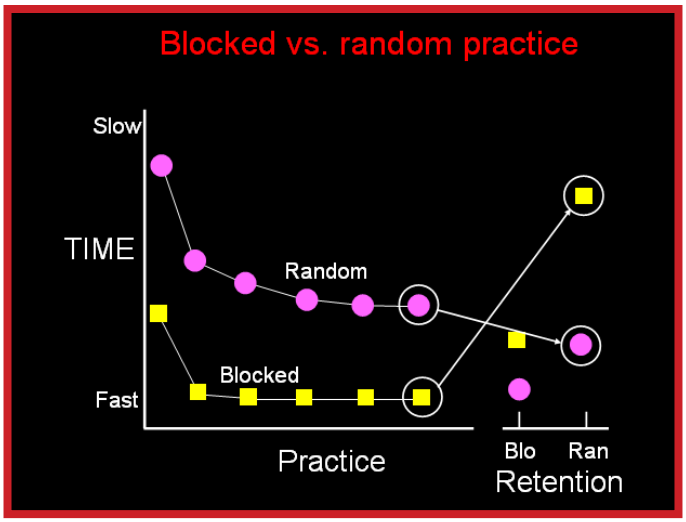
Blocked vs. random practice

- 3 tasks to practice, 18 attempts per task
- blocked practice: AAA…BBB…CCC
- random practice: ACBCBCAAB…
- same "amount" of total practice,
- same retention and transfer tests

Blocked vs. Random Practice





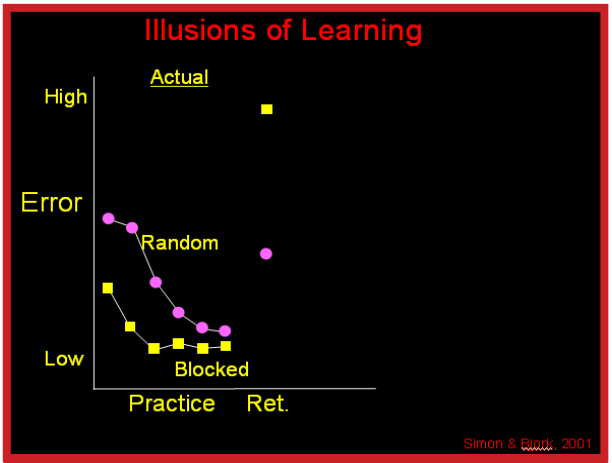


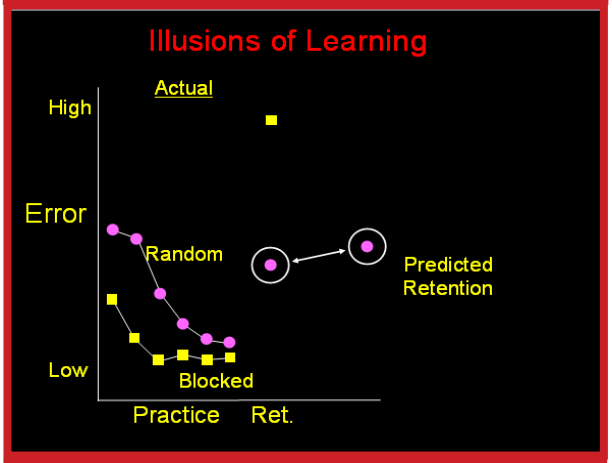
Illusions of Learning

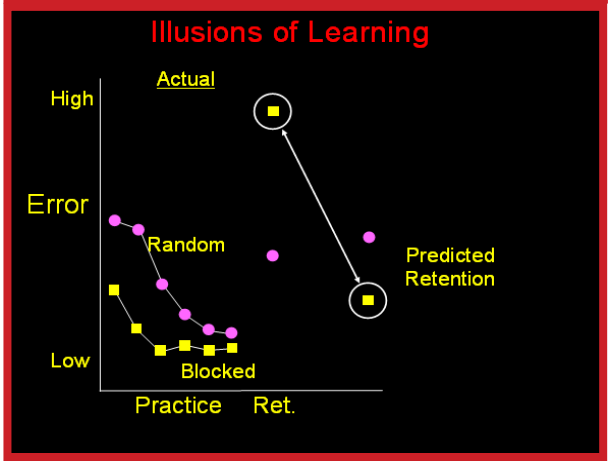
Judgments about learning are often confused with judgments about performance

- How often have you heard something like this?

"I was hitting it so well on the practice tee, then I got out on the course and everything went south!"





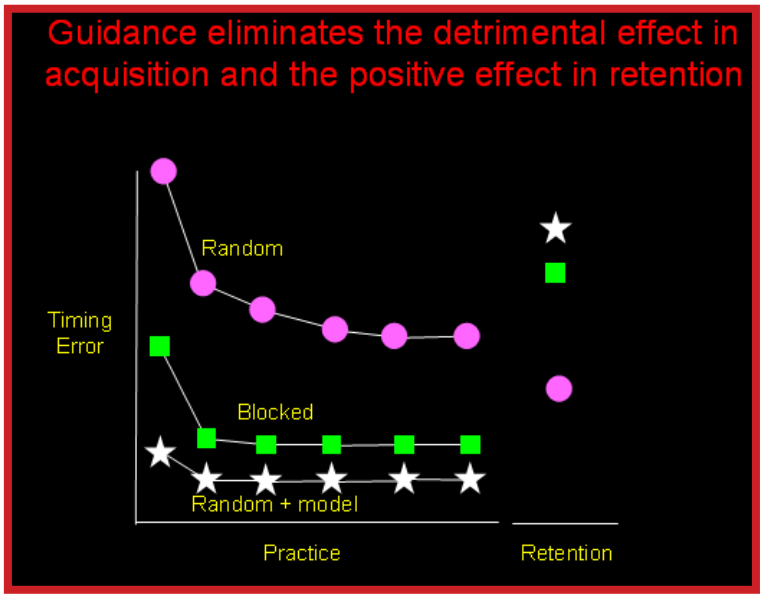


Illusions of Learning

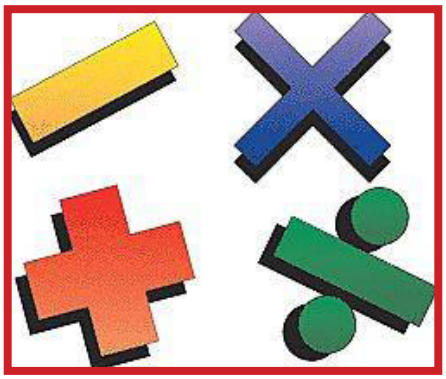
- Simon & Bjork (2001) – blocked group severely overestimated retention performance
- Implications of false metamemory judgments?
  - Overestimate skill level (take risks?)
  - May stop practice to soon
  - More apt to take shortcuts to facilitate performance gains -- shortcuts that benefit practice but not learning
  - Illusions of competence can lead to dangerous situations as well as frustration

Caveat: blocked vs. random practice is not the real issue

- Random practice benefit can easily be eliminated
- Blocked practice detriment can easily be overcome
- More important issue is understanding why these effects occur and how to avoid or promote them.



- Why do blocked/random differences occur?
- Think of it as solving math problems.



FEEDBACK AND INSTRUCTION IN MOTOR LEARNING

Feedback and Instruction in Motor Learning

Intrinsic Feedback in Golf

- Refers to the information received directly through your senses

Visual - *seeing where the ball has gone*
Hearing - *sound of club making contact (with ball, ground, sand)*
Proprioceptive - *feeling of the swing path; feel of the club/ball contact*
Tactile - *contact of the club by the fingers and hands*

Augmented Feedback in Golf

- Information that is provided by means of an external source
- Instructor comments and suggestions
- Video and pictures
- Auditory information
- Physically-restrictive guidance tools

Outdated Thinking

Researchers, teachers, coaches, and everyone else used to think that:
"Anything you did with feedback to make it:

- as frequent as possible
- as immediate as possible
- as informational as possible
- and generally, as useful for correcting errors as possible...

would be beneficial for motor-skill learning."

Intrinsic Feedback

- Available during practice and in "test" situations (games, performances, operations, etc.)

Augmented Feedback

- Represents an artificial addition to intrinsic feedback -- not normally available in test situations, usually only in practice
- It serves to "augment" the intrinsic information
- Goal for learning is to understand how to use intrinsic feedback in test situations
- Augmented feedback can facilitate that goal, but it can also get in the way of that goal

FEEDBACK AND INSTRUCTION IN MOTOR LEARNING

Common Faults about which to provide Augmented Feedback

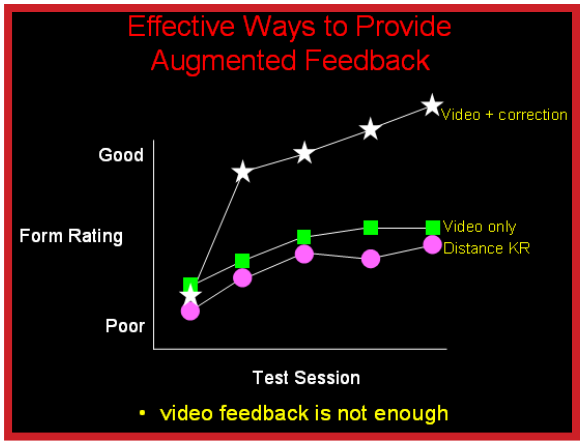
Augmented feedback *can be* provided about many different things at various points during the swing:

- Position: grip, joints, angles, etc.
- Kinematics: time-dependent motions of body parts (velocity, acceleration)
- Kinetic: relation between forces and motions (e.g., ground reaction forces)

What are the most important faults and how do you provide feedback about them?

Bandwidth Feedback

- Provide augmented feedback only about "significant" errors -- when an error exceeds a relative tolerance for being correct.

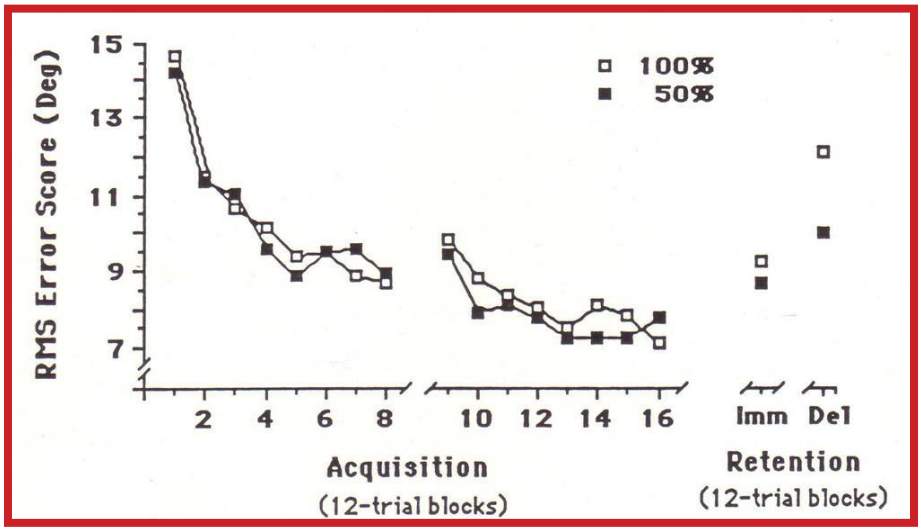


Advantages of Bandwidth Feedback

- Combines corrective feedback with positive comments.
- Reduces amount of corrective fb (good for learning)***.
- Can set the parameters to suit the learner.
- Effective for performance and learning.

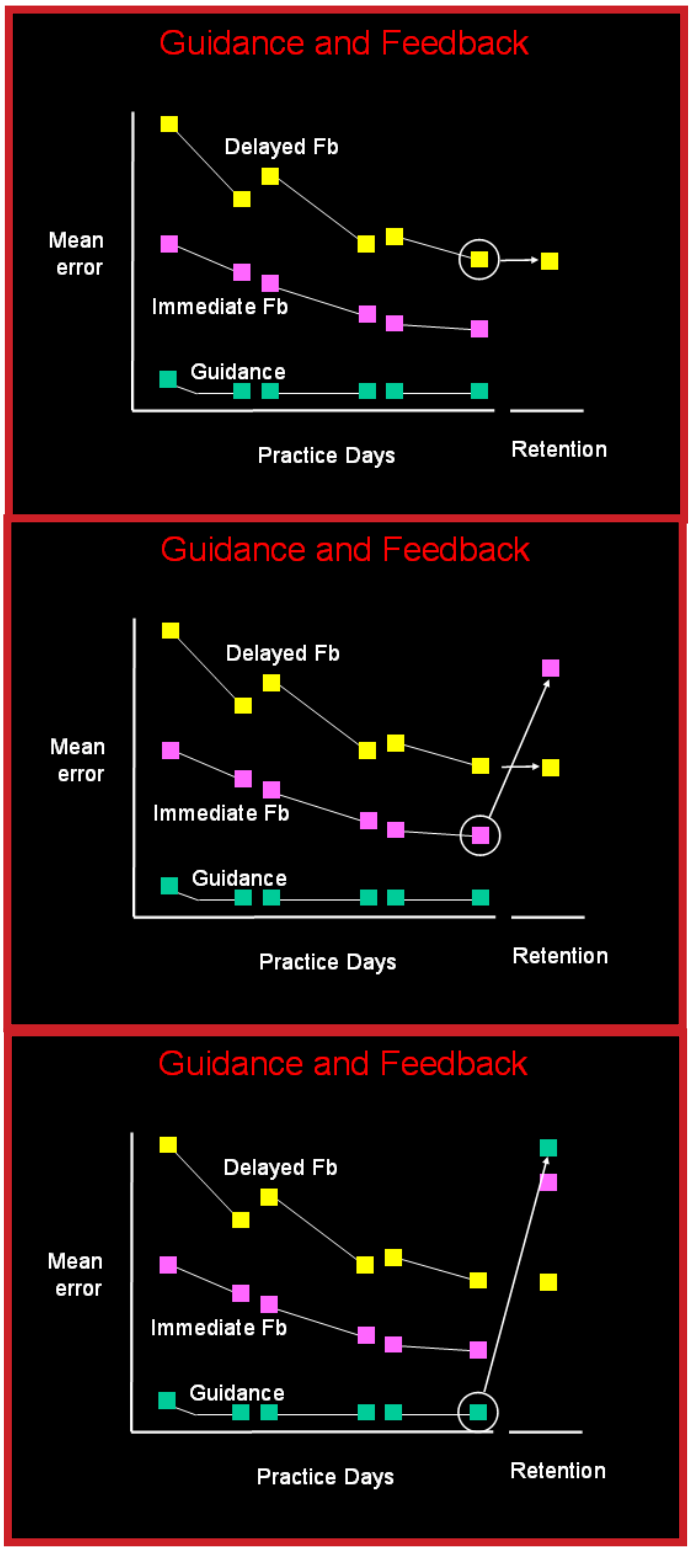
Reducing Amount of Feedback

- Simply reducing the amount of feedback provided to the learner has learning benefits



FEEDBACK AND INSTRUCTION IN MOTOR LEARNING

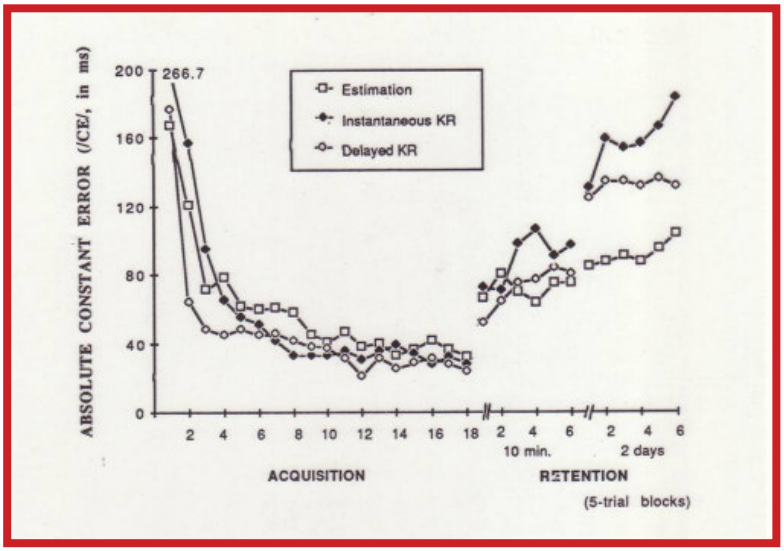
Avoid Excessive use of Concurrent Feedback, especially Guidance



Feedback and Conundrums

Self-estimated Feedback

- Encouraging error detection and identification is a difficult, but important process to becoming self-reliant on the course



Some conundrums of practice and learning

Conundrums

Q & A about some of these "counter-to-dogma" findings:

"What about the 10,000-hour rule?"

- Ericsson suggests that attainment of expertise is a matter of amount of practice -- 10,000 hours at a minimum.
  - Most golfers just want to get better.
  - Most have limited amounts of time for practice.
  - One hour of blocked practice vs. random practice, so what is 10,000 hours of blocked practice worth?

Is "bad" practice a "good" practice?

- Difficult practice conditions usually result in poor performance during practice.
  - Instructors need to educate the learner about the learning process - de-"myth"ifying the learner's views about learning.
  - "Do you want to become a good practicer or a good player?"

"Less bang for the buck?"

- Provided immediate feedback after every shot gives the learner the feeling they are getting the most "bang for their buck"
  - New augmented feedback ideas effectively "wean" the golfer away from the instructor.
  - Enables the learner with the power to self-evaluate, which is good for play on the course.

SPECIFICITY OF LEARNING

"But I was hitting it so well on the range"

Characteristics of Driving Range Practice (Christina, 2002)

- No pre-shot routine.
- Shots taken from good, flat lies.
- Shots hit repeatedly with the same club.
- Putts stroked repeatedly from same spot.
- Artificial aids used to align shot or swing.
- Comments given immediately after shot.

THEY SAID IT (HONEST)

David Shula, coach of the 0-7 Bengals: *"It's getting to the point that I don't know what to say."*

Sam Wyche, coach of the 1-5 Buccaneers: *"I told our players I don't know what happens on Friday night and Saturday because we see a whole different team on Sunday from what we see during the week. It's frustrating to me as a coach because I don't have an explanation. . . . I take the blame for it. For some reason, this team doesn't play as well as it practices."*

Deion Sanders, whose Falcons were 0-5 by the time his baseball season ended: *"This is more me. This is what I love. Baseball is more about me and football is about 'team,' and that's what I love."*

Compiled by Mark Heisler

Specificity of Learning

Perhaps the most over-arching principle of motor learning
explains much or all of the practice conditions and augmented feedback effects
keep this principle in focus during the small-group, breakout sessions

Topics to Discuss

One-ball rule of putting

- Putt with only one ball on the practice green, and never from the same spot

20/20 Practice

- Take 20 balls to the range and do not finish in less than 20 minutes

No-ball practice

- Walk around the park with your favorite club; stop periodically to take an imaginary shot that includes a full preshot routine and post-shot evaluation

Guidance as Evaluation

- Use your favorite guidance tool as a way to evaluate your performance after the stroke rather than to guide the stroke

Design a Practice Facility

- What motor learning principles would you build into your "ideal" practice facility?

Practice Range Games

- Design some competitions that a small group of golfers could play on the range that would facilitate learning

NOTES