Motor Learning Concepts for Developing Effective Practice Conditions: 2. PRACTICE CONDITIONS

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MOVEMENT PROBLEM-SOLVING BASED PRACTICE

Two Important Terms To Distinguish

Actions

- Goal-directed activities that involve body, head and/or limb movements
- Evaluated by whether or not "action goal" achieved

Movements

- What body, head, or limb segments do when an action is performed ["*technique*"]
- Evaluated by visual analysis or kinematics

The Distinction Between "Actions" and "Movements" – Examples

What are some "actions" that Alpine Skiers must perform?

Examples:
Turns
Pole placement
Starts

To successfully achieve the "action goals," which of these actions could be achieved with:

1. One set of "movements"?
2. A variety of "movements"?

MOVEMENT PROBLEM-SOLVING BASED PRACTICE *(cont.)*

Movement Problem Solving Hypothesis

Motor skill learning is enhanced to the degree that practice conditions engage learners in ***movement problem solving***

The problem to be solved:
How to move to achieve the action goal

The problem solving activity:
Determining the movement characteristics that will enable achievement of the action goal

MOVEMENT PROBLEM-SOLVING BASED PRACTICE *(cont.)*

What is the basis for this hypothesis?

2 views about skill learning provide support

1. Gentile's stages of learning model
2. Bernstein's view of optimal practice conditions for skill learning

MOVEMENT PROBLEM-SOLVING BASED PRACTICE *(cont.)*

1. Review of key points of Gentile's model

***Initial stage*:** Learner's goal to acquire movement coordination characteristics well enough to allow some degree of success at achieving the action goal of the skill.

***Later stages*:** Learner's goals:

- Consistently achieve action goal
- Develop efficient use of energy
- Increase adaptability to performance conditions

MOVEMENT PROBLEM-SOLVING BASED PRACTICE *(cont.)*

Bernstein's View of Optimal Practice Conditions: The Concept of "Repetition Without Repetition"

"The processes of practice … consists in the gradual success of a search for optimal motor solutions to the appropriate problems. Because of this, **practice, when properly undertaken, does not consist in repeating the *means of solution* of a motor problem time after time, but in the *process of solving* this problem again and again** by techniques which we changed and perfected from repetition to repetition."

[N. Bernstein (1967, *The Co-ordination and Regulation of Movements*]

3 Practice Conditions that Promote Movement Problem Solving

1. Instructions that focus attention on "movement effects"
2. Discovery learning
3. Practice variability

Practice Condition 1: Instructions to Focus Attention

When you give instructions to an athlete during a practice session, what do you tell him/her to "think about" or "concentrate on"?

Practice Condition 1: Instructions to Focus Attention on Movement Effects

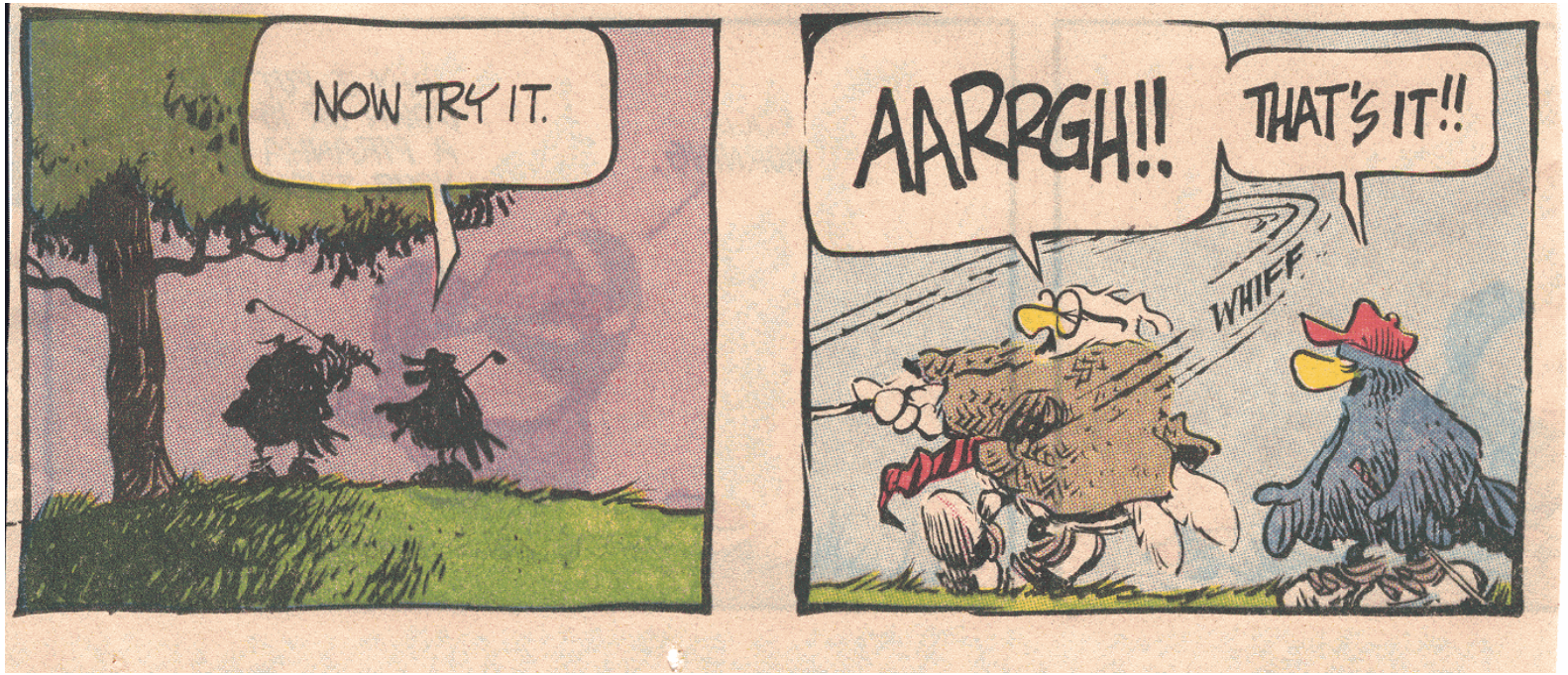
"Action effect hypothesis"

Focusing attention on the intended effect of movements ("action effect") results in better skill learning and performance than focusing attention on the specific movements

[Wulf & Prinz (2001, *Psychonomic Bulletin & Review*)]

Example of Attention Focus on Movements

Attention Focus on Movements (cont.)



Example of Research Investigating Attention Focus Effect on Learning

Wulf, Lauterbach, & Toole (1999, *RQES*)

Task: Golf pitch shot
9-iron to pitch ball 15 m to target (45 cm radius)
Scoring = 5-4-3-2-1-0 points [target + rings]
Practice: 80 trials
Test: 30-trial retention test 1 day after practice

Instructions:

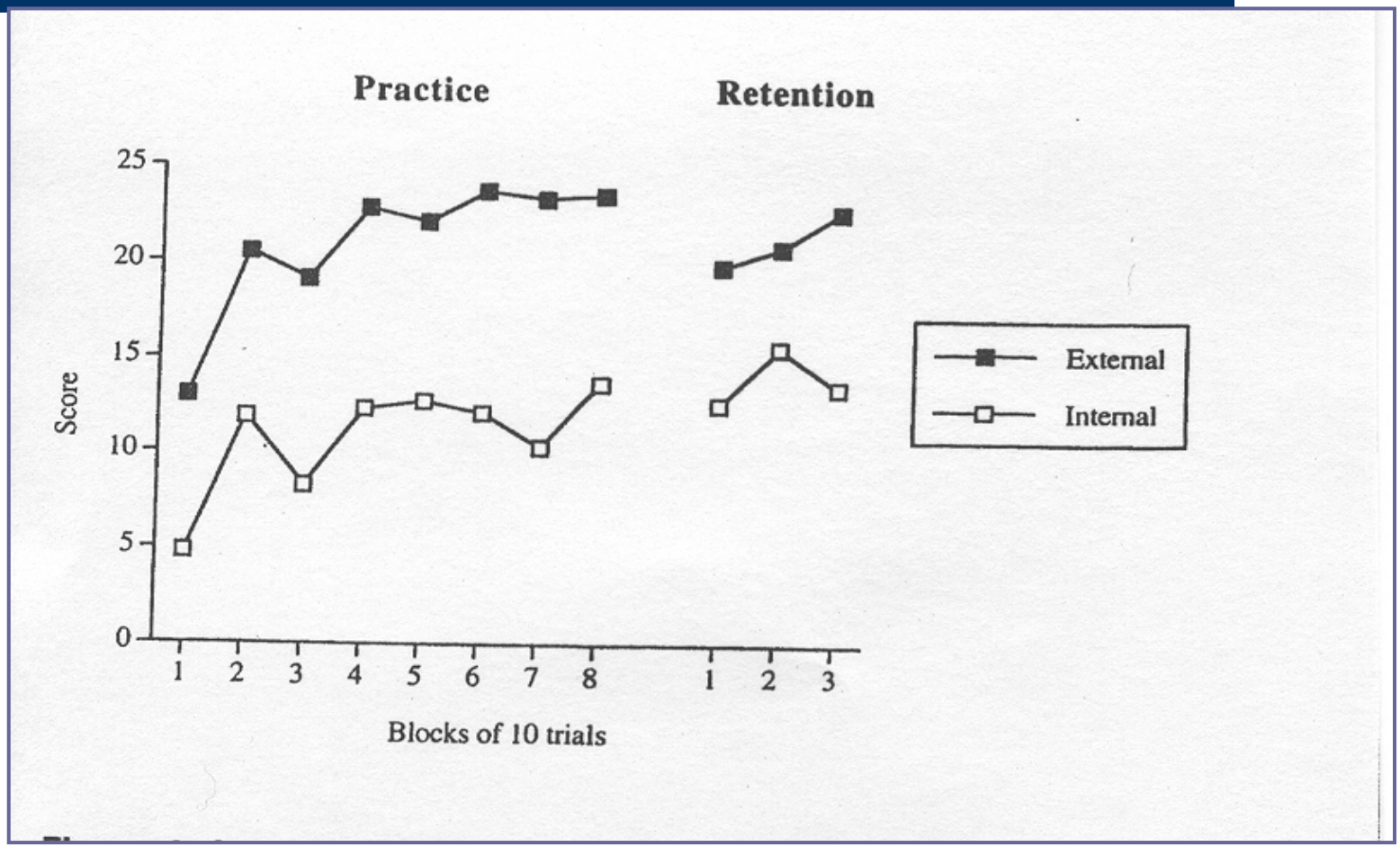
Movement Effect ("External") Focus

Focus attention on golf club movement ("*move like a pendulum*")

Internal Focus

Focus attention on arm movements

Wulf, Lauterbach, & Toole Experiment: Results



A Dance Teacher's Use of Attention Focus on Movement Effect

Suzanne Farrell teaches ballet to experienced students and professional dancers by instructing them to concentrate on the "effect" they want to create with their movements rather than on the movements they use to create the effect they want.

--Acocella, J. (2003, January 6) *The New Yorker*, pp. 48-61.

Practice Condition 1: Instructions to Focus Attention on Movement Effects *(cont.)*

What are some examples of how you could (or do) implement instructions specifying a "movement effects attention focus" into:

1. Practice situations
2. Competition situations

Practice Condition 2: Discovery Learning

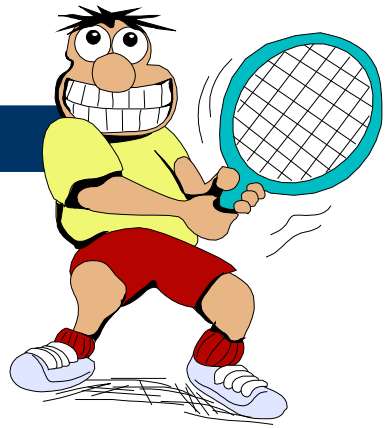
Discovery learning occurs when the learner:

- Knows the action goal
- Has a minimum amount of information specifying how to move
- Must "discover" the optimal ways to move to achieve the action goal

2 Research Examples – Illustrate 2 different "discovery learning" strategies:

- Farrow & Abernethy (2002, *JSS*) -Tennis skill
- Klumpp & Magill (2004, ACSM) - Fitting a hearing aid

Farrow & Abernethy (2002): Discovery Learning for a Tennis Skill



Task: Predict direction of tennis serves (as a receiver of serves)

Subjects: Boys (12 - 17 yrs old)

[Average 4 yrs competitive tennis experience]

Practice conditions: Viewed temporally occluded videotapes of serves to the receiver's right or left (-900, -600, -300, 0, +300 ms); & Physically practiced receiving serves

Practice: 4 weeks @ 3 days/wk (600 trials)

Farrow & Abernethy Experiment: Instruction Conditions

1. **Explicit movement related instructions**
   - Relationship between specific advance information sources in opponent's serving movement and serve direction
   - These sources highlighted during practice
   - Presented information in instructional video, verbally, in writing, and in diagrams
2. **Non-explicit instructions [*Discovery learning*]**
   - No information about any advance information source
   - Task goal = Estimate speed of each serve [*established an incidental learning situation for serve direction prediction*]

Farrow & Abernethy Experiment: Results

Comparison of Performance Before and After Practice Sessions:

Improvement in direction prediction accuracy for **Discovery Learning but not for Explicit Instructions**

- Improvement at 300 ms before contact

Klumpp & Magill (2004): Discovery Learning for Fitting a Hearing Aid

Task: Correctly insert an In-The-Ear (ITE) type of hearing aid shell

Instruction conditions

- Explicit movement instructions with demonstration
- Action goal instructions (Discovery Learning)

Klumpp & Magill Experiment *(cont.)*

Participants: 10 female college-age students (M=22.5 yr.) with no previous hearing aid experience

Practice session:
Attempt insertion until 3 consecutive correct
- preferred hand side

Tests:
Retention and Bilateral transfer
- 4 days after practice
- No instructions

Klumpp & Magill Experiment: *Results*

Practice Performance

Explicit Instruction group performed better

Retention test Performance

No statistical difference between groups

Bilateral Transfer Test Performance

Discovery Learning - Significantly more correct insertions

Practice Condition 2: Discovery Learning *(cont.)*

The 2 experiments just discussed illustrate 2 different strategies for implementing discovery learning in practice situations:

1. Tennis skill learning experiment used an "incidental learning" strategy

2. Hearing aid experiment used a "movement effects attention focus" strategy

Strategy 3 - Use of "images" to describe how to perform a skill

- A strategy we discussed in attention focus

e.g. golf swing – move arms like a pendulum

Practice Condition 2: Discovery Learning *(cont.)*

Discovery learning strategies have in common:

- Minimum amount of specific information given about correct movements
- The correct movements are discovered during practice

What are some examples of how you could (or do) implement Discovery Learning practice conditions for your athletes?

Practice Condition 3: Practice Variability

Practice variability = The **variety** of movement and/or performance context characteristics the learner experiences while practicing a skill

Practice Condition 3: Practice Variability *(cont.)*

What Can Be Varied in Practice?

1) **Skill variations** that will be required in "test" conditions
2) **Physical conditions** in which the skill is performed
3) **Situations** in which the skill is performed

Research evidence shows:
More variability of these characteristics in practice is better than less for learning – especially when the "test" conditions are not entirely predictable

Practice Condition 3: Practice Variability *(cont.)*

Notable irony:
More practice variability leads to more performance errors in practice than less variability – but fewer errors during "test" performance

Practice Condition 3: Practice Variability *(cont.)*

Many options for organizing the practice of several variations of a skill, context, etc.

Which schedule leads to better learning?

2 examples:

1) Practice all repetitions of each variation in its own block of practice trials [*Blocked practice schedule*]
2) Practice all repetitions of each variation randomly [*Random practice schedule*]

The answer is found in the "contextual interference effect"

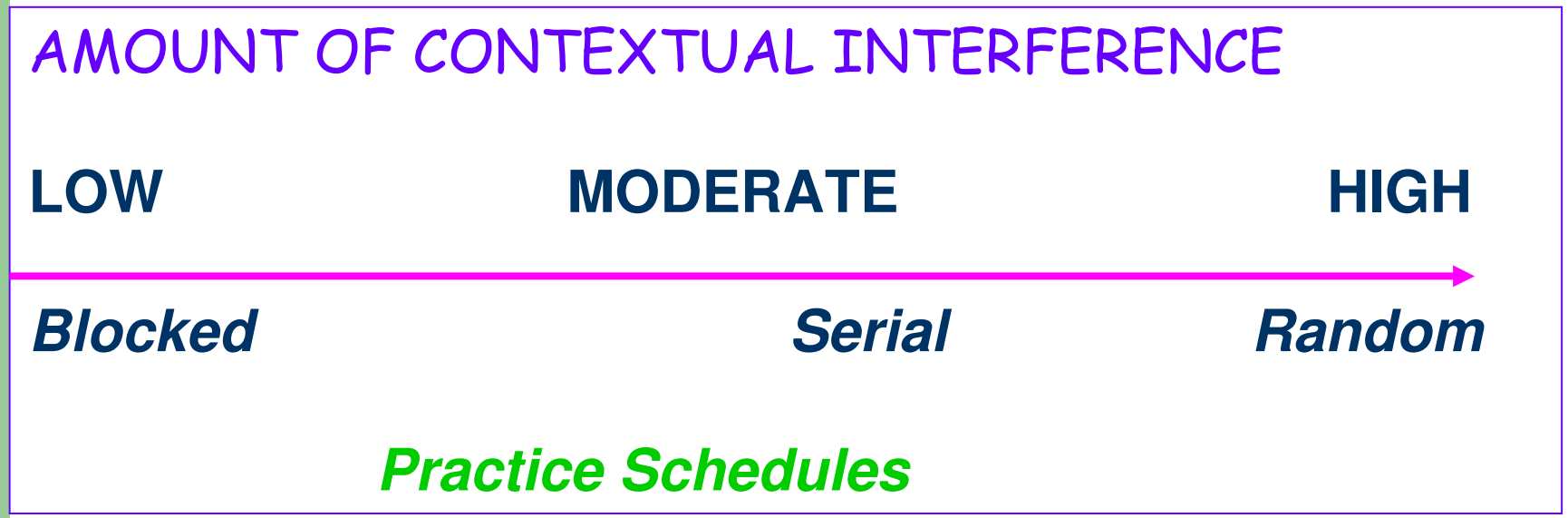
Practice Condition 3: Practice Variability *(cont.)*

Contextual Interference (CI)
Memory and performance disruption that results from practicing multiple skills in the "context" of a practice session

Contextual interference **effect**
A learning phenomenon in which more interference during practice leads to better learning than less interference

Practice Condition 3: Practice Variability *(cont.)*

A continuum of the **amount of contextual interference** with ***practice schedules*** associated with each amount of interference:



Practice Condition 3: Practice Variability *(cont.)*

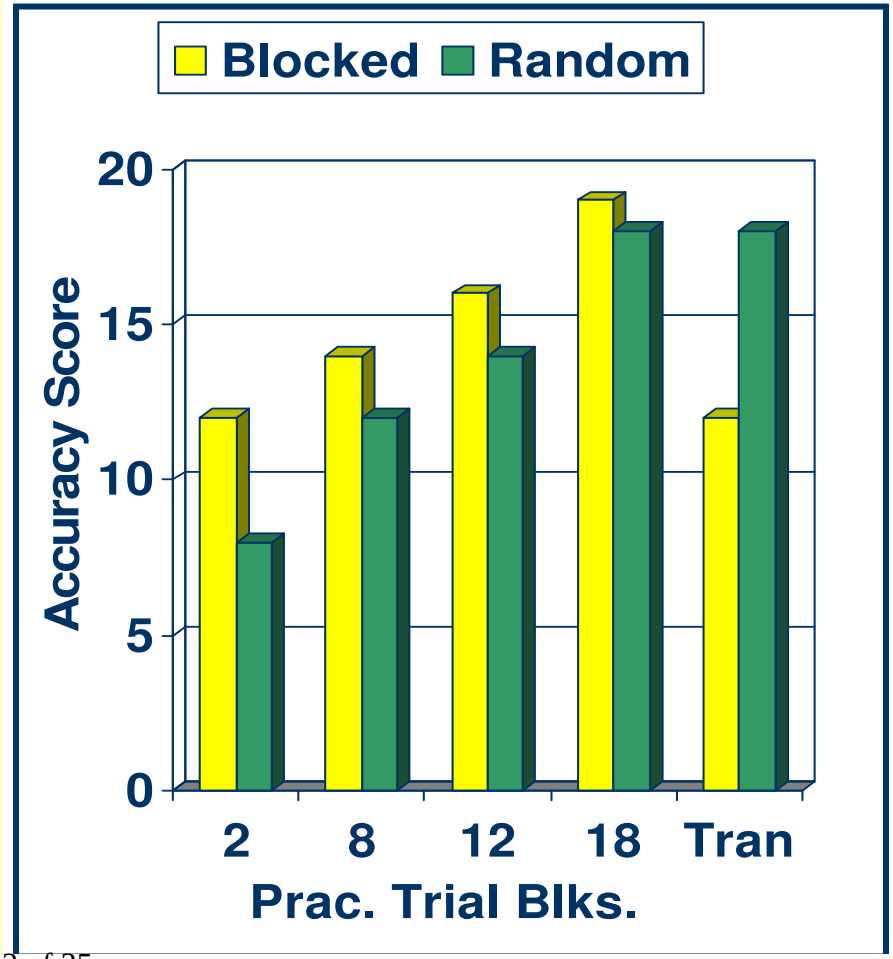
CI Effect:
Typical Results of Research

Low CI practice schedules perform better during practice than High CI schedules
High CI practice schedules perform better on post-practice tests than Low CI schedules, *i.e.*,
result in better learning

Research Example Demonstrating the Contextual Interference Effect

Goode & Magill
(1986, *RQES*)

- Beginners learning 3 badminton serves
- Practice = 36 trials/day; 3 days/wk; 3 wks = 108 trials/serve (324 total)
- Blocked schedule
  1 serve each day/wk
- Random schedule
  3 serves every day in random order



Practice Condition 3: Practice Variability *(cont.)*

Does the concept of the importance of practice variability contradict our conclusion earlier concerning the importance of practice – test similarity (i.e. practice specificity)?

Practice Condition 3: Practice Variability – Examples

What are some examples of how you could (or do) include "practice variability" in practice sessions for your athletes?