McMaster University

SCIENCE

Department of Kinesiology

Models of skill acquisition

KINESIOL 1E03 - Motor control and learning

Laura St. Germain
Fall 2022 Week 6
Lecture 13

Test 2

- Tuesday November 1 (multiple choice) and Thursday November 3 (fill in the blank and short answer)
- Bring a **pencil** for the scantron
- Bring student ID
- Student's who's last names start with **N-Z** will be writing in a different room
    - November 1: Canadian Martyrs Testing Centre
    - November 3: T12 room 123

Review from last lecture

Motor learning

> Motor learning is a **set of processes** resulting from **practice or experience** causing **relatively permanent gains** in the **capability for skilled performance**.

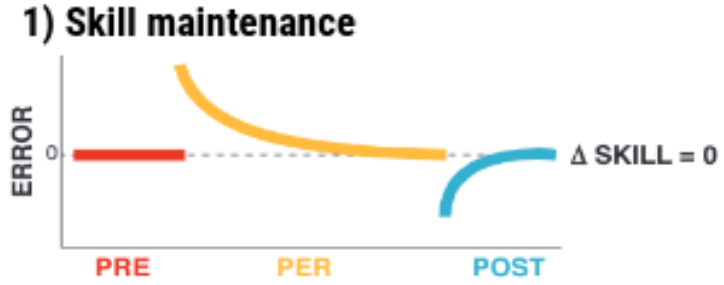
Motor learning is an umbrella term but there are (at least) two main types

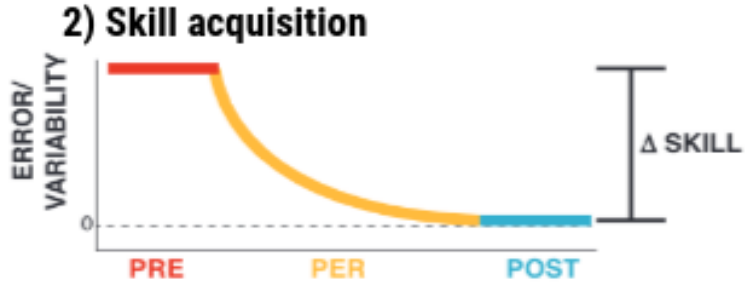
SKILL ACQUISITION: the processes by which an individual acquires the ability to identify an appropriate movement goal given a particular task context, select the correction action given a sensory stimulus and/or the current state of the body and the world, and execute that action with accuracy and precision

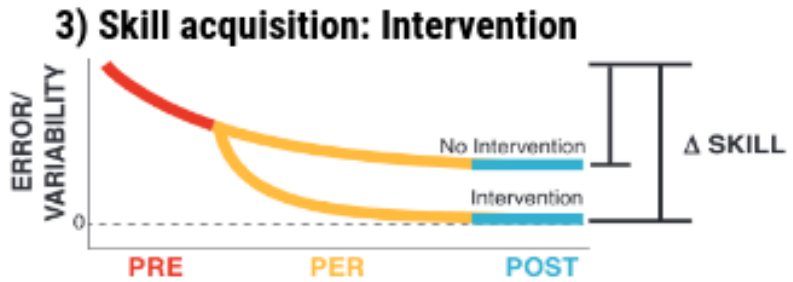
SKILL MAINTENANCE: the ability to maintain performance levels of existing skills under changing conditions

Krakauer et al. 2019 (https://doi.org/10.1002/cphy.c170043)

Summary: Ways to study motor learning







Adapted from Sternad 2015 (https://doi.org/10.1016/j.cobeha.2018.01.004)

We can observe 7 performance characteristics during the learning process

We need to rely on methods that can separate the relatively permanent effects from transient ones

Performance-learning paradox

- a high level of performance in practice **does not** mean an individual has learned the task
- a low level of performance in practice **does not** mean an individual has not learned the task
- To avoid being a victim of this paradox, we must rely on performance in **retention** and **transfer** tests when making evidence-based recommendations

Any questions?


Just like
RIDING
a bike

Learning objectives

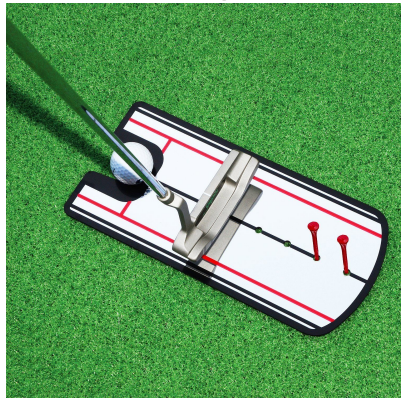
1. Identify and describe the **basic recipe** for a motor learning experiment/intervention.
2. Compare and contrast **retention** and **transfer** tests.
3. Compare and contrast **Fitts'** and **Bernstein's** models of skill acquisition.

Take-home message:

Models of skill acquisition can help us recognize areas to focus on during practice and skill acquisition, retention, and transfer depend on many factors.

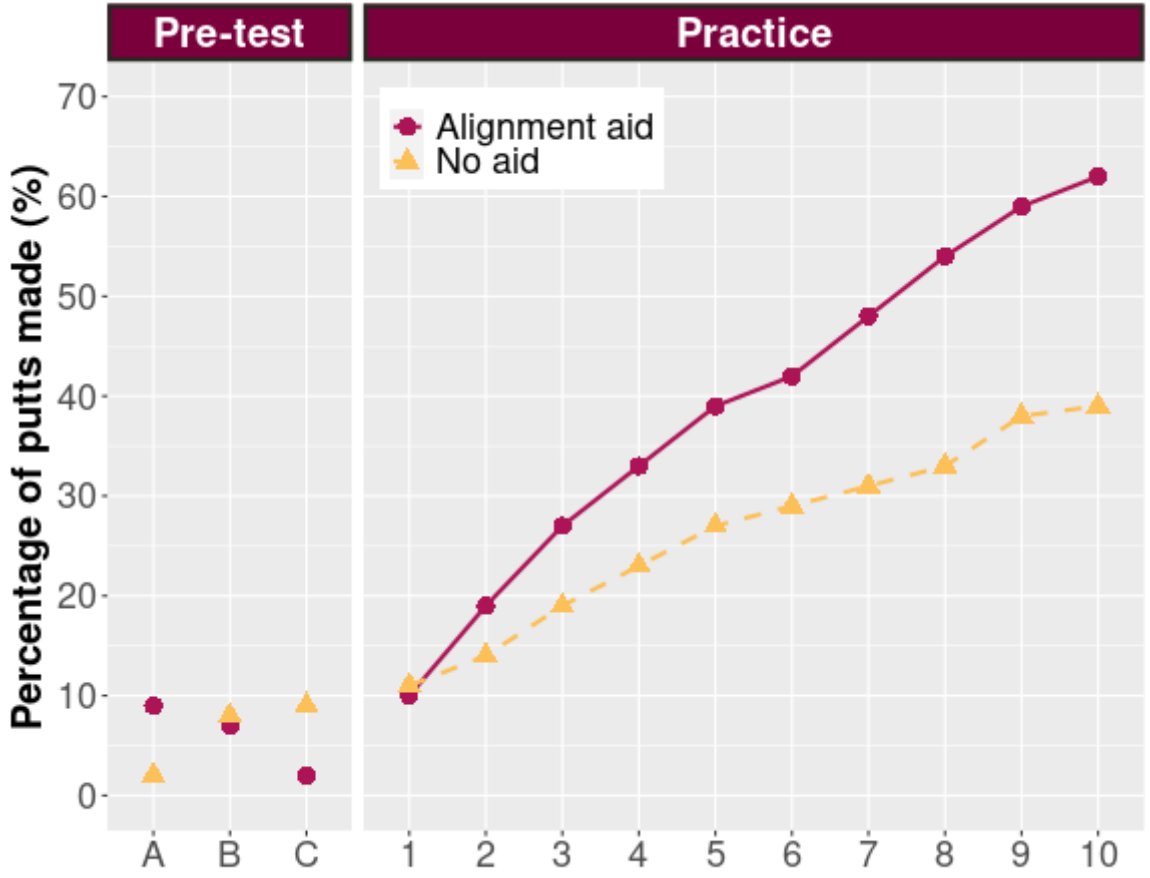
How to design a motor learning experiment

Group 1: Alignment aid



Group 2: No aid

Adapted from Schmidt & Lee 2011



How to design a motor learning experiment

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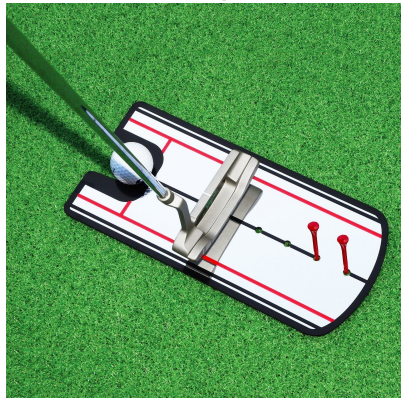

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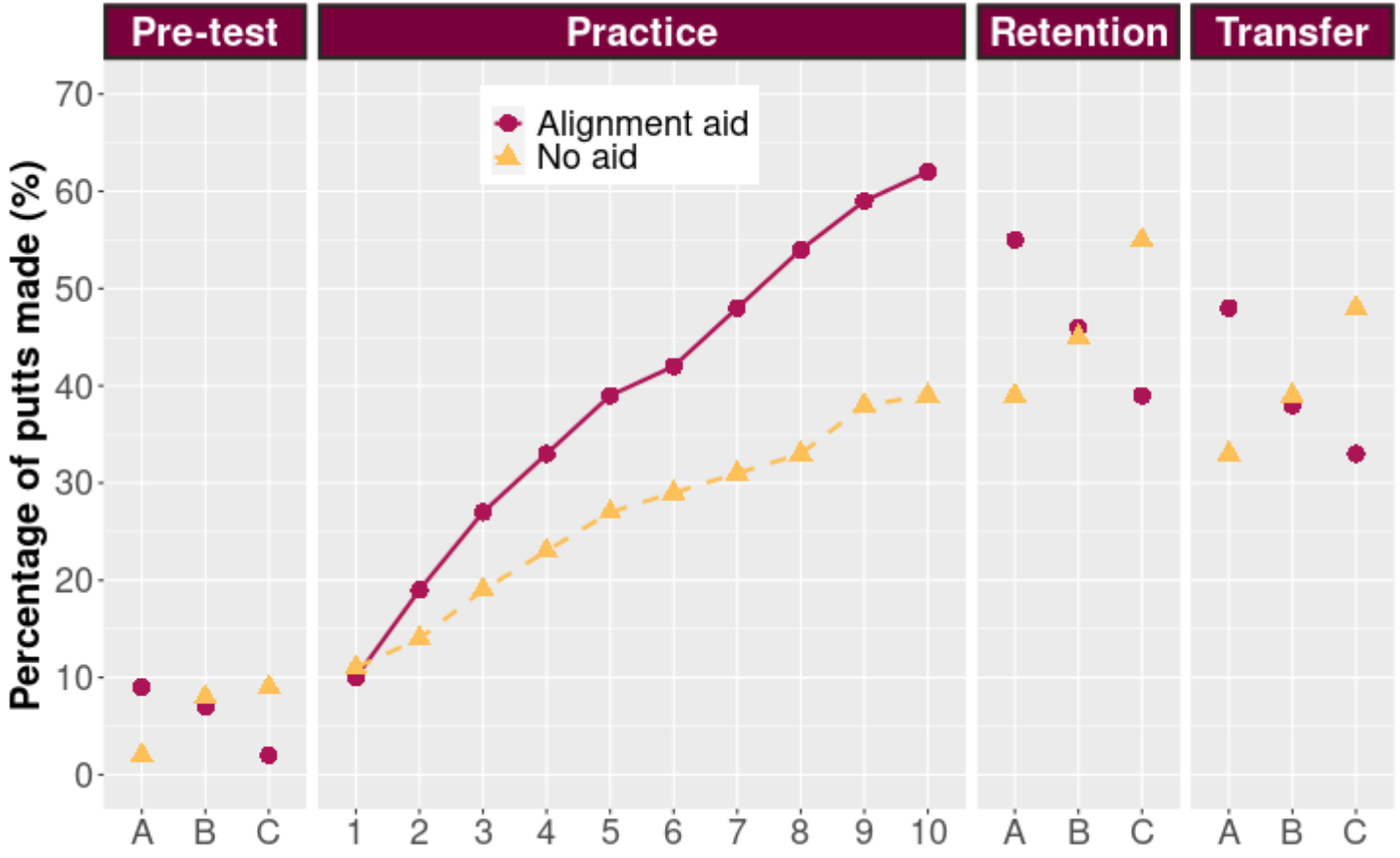


Adapted from Schmidt & Lee 2011

We must use retention or transfer tests to measure whether a skill has been learned

Retention tests

- Assesses the **permanence** or **persistence** of the skill
- Occurs after a period of **no practice** (rule of thumb is minimum of 24 hours)
- Are performed under a **common level** of the manipulated practice variable
- Include the **same task** as the pre-test and acquisition phases

Transfer tests

- Assesses the **adaptability** or **flexibility** of the skill
- Occurs after a period of **no practice** (rule of thumb is minimum of 24 hours)
- Are performed under a **common level** of the manipulated practice variable
- Include a **novel variation** of the task included in pre-test and acquisition

Models give us a general guideline to understand the learning process, but the stages are not always clear cut

Beginner | **Trained** | **Elite**

Performance Ability

Fitts' model: Cognitive stage

- Low level of **familiarity** with action
- **Talk** through steps or sequences of movements
- No **error correction** mechanism
- **What** am I trying to accomplish?
- **How** do I accomplish it?

Source: https://www.henryford.com/-/media/henry-ford-blog/images/mobile-interior-banner-images/2016/04/little-girl-playing-soccer.jpg

Fitts' model: Associative stage

- **Refine** movement patterns
- A **process** or **mechanics** focus
- Account for the **context**
- **Error correction** for big or obvious errors
- **How** can I accomplish my goal more consistently?

https://dra9kbpogvft0.cloudfront.net/images/2020/11/1/web_yaple.jpg

Fitts' model: Autonomous stage

- **Perform** action with low conscious control
- Sophisticated **error correction** mechanism
  - can detect, recognize, and correct even very small errors
- **High** quality movements
- Seeking **mastery**
- **Deliberately** try to avoid arrested development

https://www.thestar.com/content/dam/thestar/sports/olympics/2021/08/06/olympic-gold-gives-canadian-soccer-goalkeeper-stephanie-labb-licence-to-thrill/labbe_sixth_save.jpg

Bernstein's model: Reduce degrees of freedom

- Focused on the most **rudimentary** aspects of movement
- Decrease movement complexity by **"freezing"** (i.e., not moving) individual joints
- Adopt an **inefficient** movement pattern

Source: https://www.rocketice.com/wp-content/uploads/2016/07/Curly-hair-sisters-in-ice-skating-lessons-opt.jpg

Bernstein's model: Release degrees of freedom

- Increase movement complexity by **"un-freezing"** (i.e., moving) individual joints
- Begin to leverage **intersegmental** dynamics
- This **minimizes** energy cost
- This **maximizes** force of movement

Source: https://lavioletteism.files.wordpress.com/2012/11/wpid-caron.jpg

Bernstein's model: Exploit passive dynamics

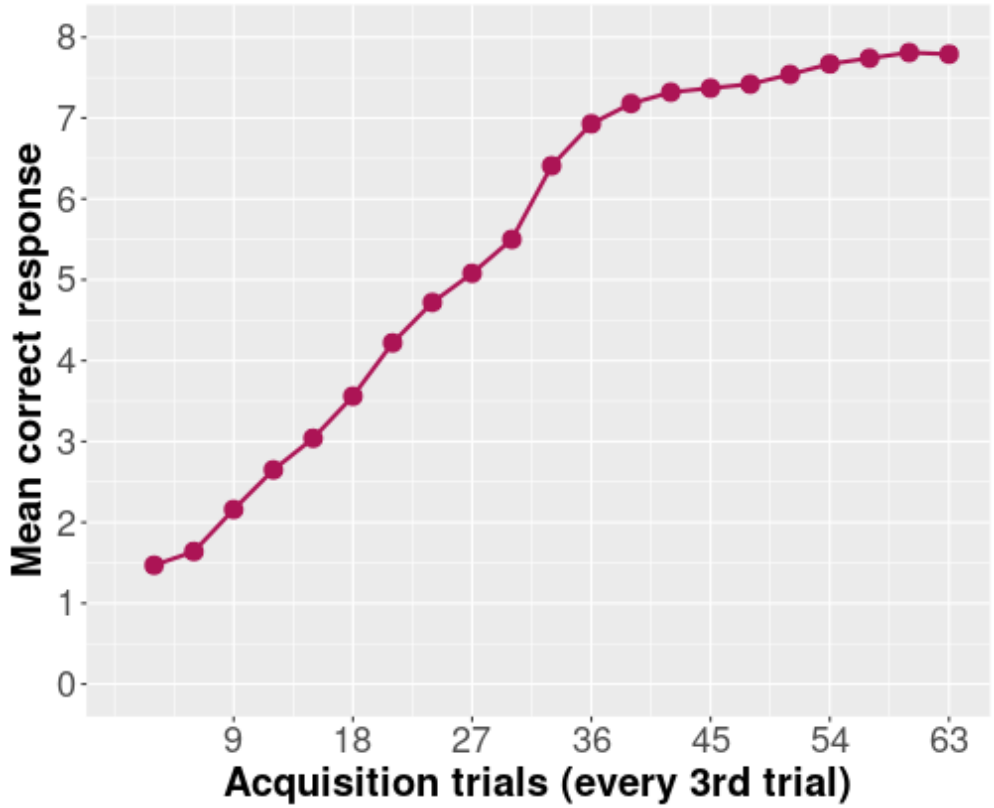
- Generate movements that **best satisfy** the task goal
- These movements also **minimize** energy cost
- Make use of **"free energy"**
- From **spring-like** properties of muscles, **intersegmental** energy transfers

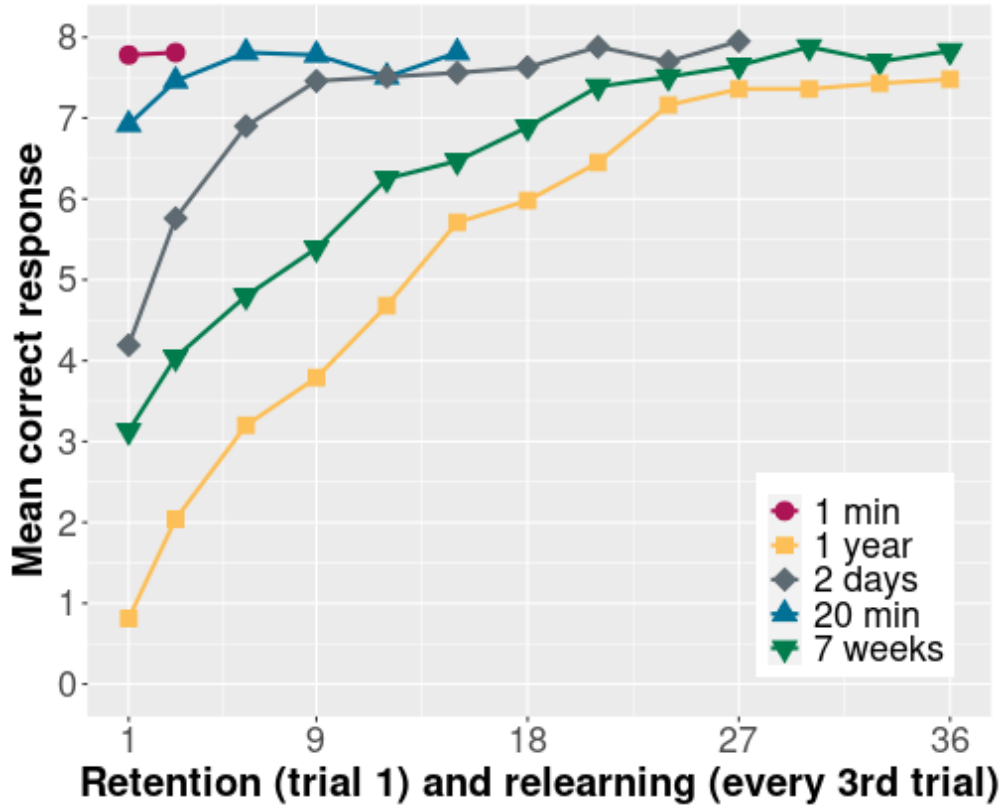
https://lastwordonsports.com/hockey/wp-content/uploads/sites/11/2020/08/gettyimages-1263767979-594x594-2.jpg

How long do we retain learned motor skills?

RETENTION INTERVAL: A period of time where no **further practice** is undertaken. During this time, **"motor forgetting"** may occur, leading to **reduced** performance. Alternatively, **consolidation** may occur, leading to **improved or maintained** performance.

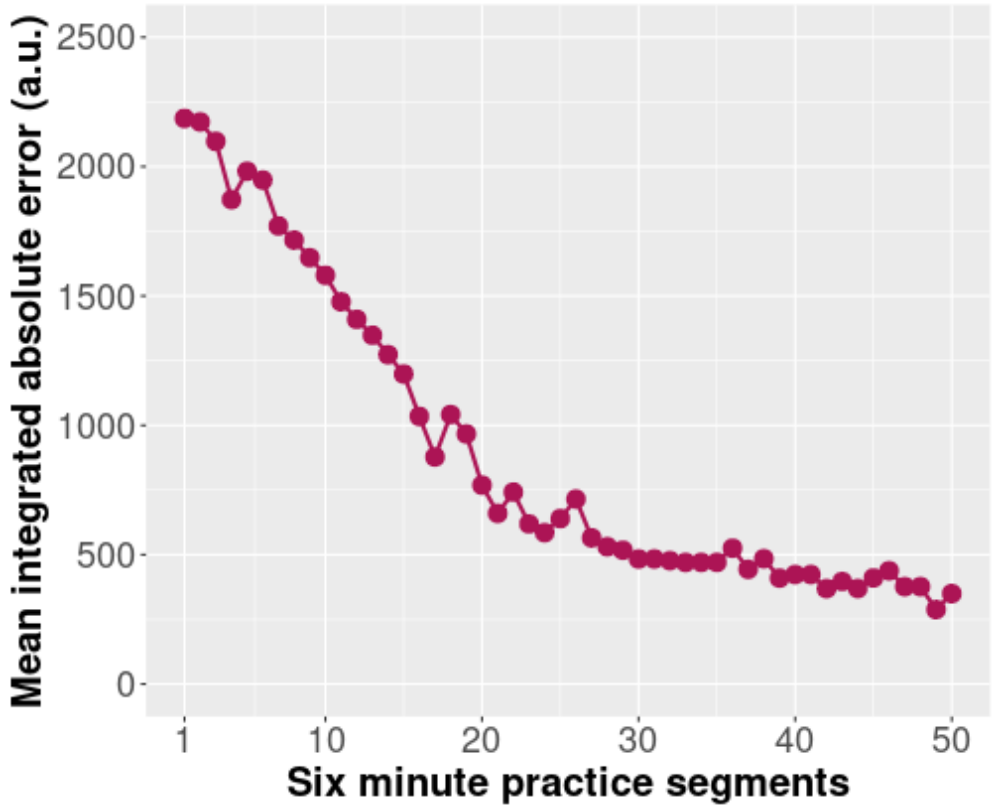
The retention interval has a significant impact on the retention of discrete motor skills

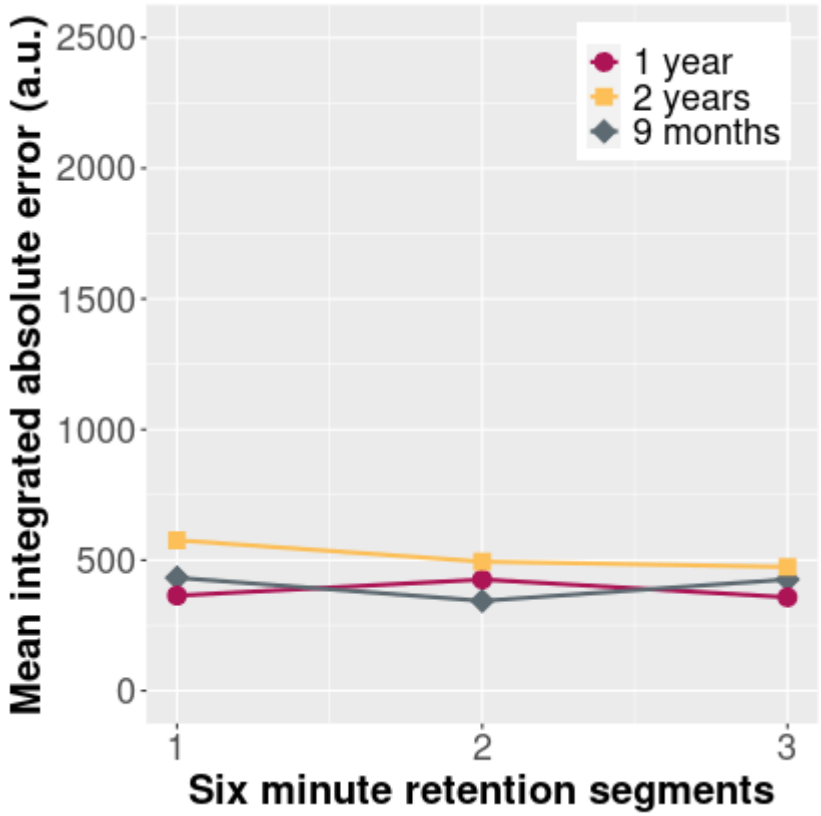




Adapted from Neumans and Ammons 1957 (https://doi.org/10.1037/h0041719) through plot digitization

The retention interval has a smaller impact on the retention of continuous motor skills





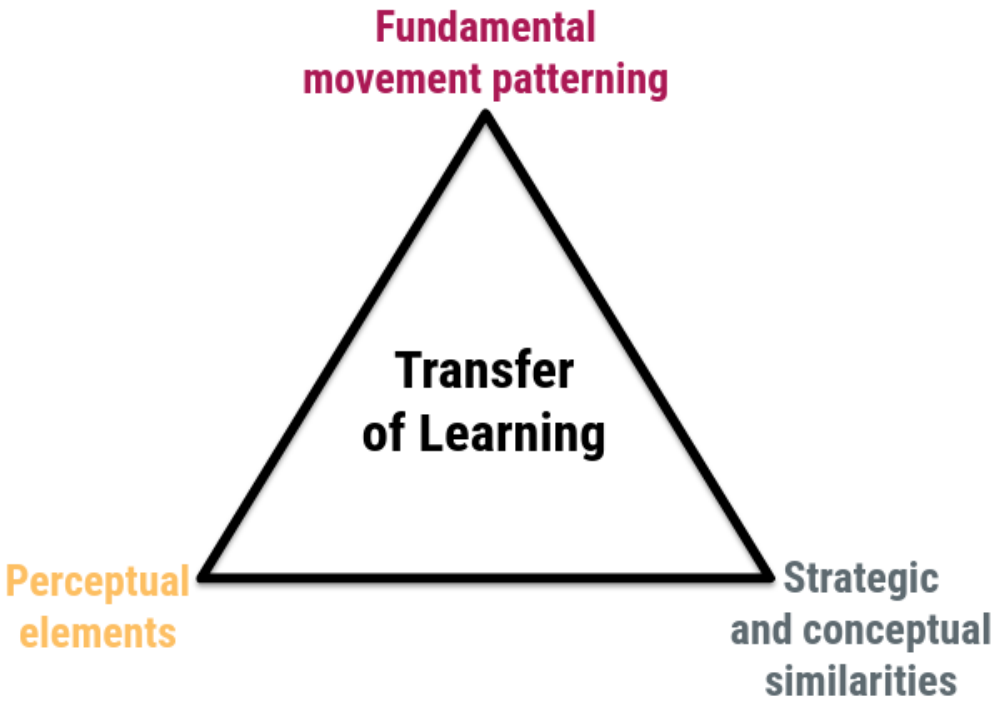
Adapted from Fleishman and Parker 1962 (https://doi.org/10.1037/h0041220) through plot digitization

There are 3 main similarity factors that can impact skill transfer

Transfer refers to the **gain or loss** in the capability to perform one task as a result of practice or experience **on another task**

We can classify transfer as:

- **Positive** transfer if it enhances performance in the other skill
- **Negative** transfer if it degrades performance
- **No** transfer if it does not affect performance



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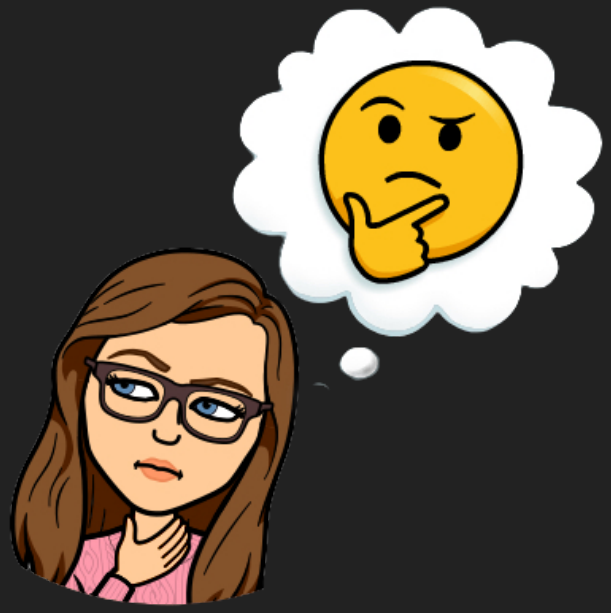
What questions do you have?



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