

Motor learning

International Baccalaureate · IB Diploma · Sports, Exercise and Health Science · HL

Scope and prerequisites

This handout covers selected HL topics for the course first assessed in 2026; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

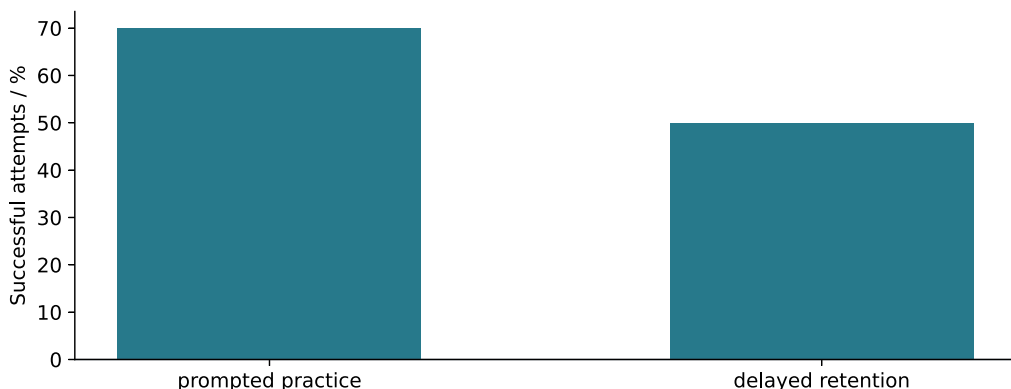
Motor control: feedback, timing and evidence

■ What would explain this observation?

- A learner adjusts a slow movement after seeing an error, but a very fast action may end before visual feedback can change it. Timing constrains the role of feedback.

■ Build the model

- Open-loop control emphasizes a pre-organized command during an action; closed-loop control uses feedback to compare the result with a goal and modify control.
- Many sporting actions combine feedforward preparation with feedback.
- Intrinsic feedback arises from the performer's sensory information, while **augmented feedback** is additional information supplied by another source.
- augmented feedback: Additional task information supplied beyond the performer's own sensory feedback.
- **knowledge of results** : Feedback about the outcome of an action.



A fall from 70% to 50% is 20 percentage points, not a 20% relative decline

■ Choose evidence that can test it

- Distinguish knowledge of results from knowledge of performance.
- A score reports the outcome; a description of arm position reports movement features.
- Feedback can guide practice, yet immediate success with continuous prompts may not persist when prompts are removed.
- Retention and transfer therefore provide stronger learning evidence than one practice score.

In the lab: Use a voluntary, low-risk seated target or tracing task. Define the outcome, keep practice opportunities equal, give an agreed feedback schedule and assess delayed performance without feedback. Counterbalance group order where feasible and use anonymous records. Do not claim the task completely models elite performance.

■ Work from known quantities

- Known: one trial provides 20 attempts and 14 successes, or 70%.
- A delayed no-feedback test provides 20 attempts and 10 successes, or 50%.
- The decline is 20 percentage points, not a 20% relative decline; relative decline is $(14-10)/14 \times 100$, approximately 28.6%.
- The observation supports investigating dependence on prompts, not a guaranteed explanation.

Your turn: Success rate changes from 80% in practice to 55% in retention. Find the decrease in percentage points.

■ Check the conclusion and its limits

- Open-loop and closed-loop are models, not a claim that an athlete's nervous system uses only one mechanism.
- Feedback timing, task complexity and sensory availability affect what can be inferred.

Not true: A strong score with continuous prompts proves lasting motor learning. Prompted performance includes the prompt's help. When prompts stop, scores often fall, so a strong practice score is evidence of learning only if a delayed unassisted test confirms it.

Key:

- Open-loop control emphasizes a pre-organized command during an action; closed-loop control uses feedback to compare the result with a goal and modify control.
- Distinguish knowledge of results from knowledge of performance.

- Watch for: open-loop and closed-loop are models, not a claim that an athlete's nervous system uses only one mechanism.

■ Write from a fall of 30 percentage points

- A practice success rate is 60 percent. A delayed no-feedback test is 30 percent.
- Find the fall in percentage points. A prompted practice score does not prove lasting learning.

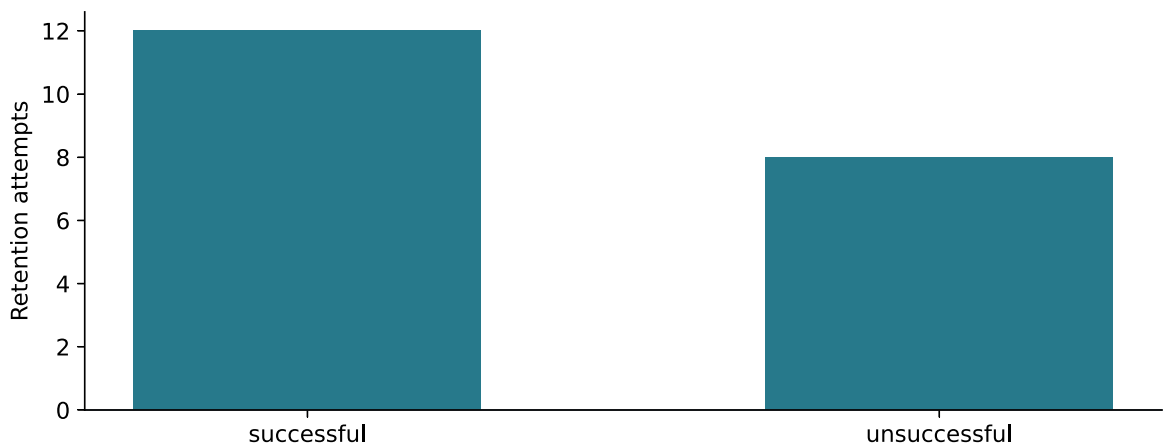
Motor learning, feedback and retention

■ What would explain this observation?

- A learner performs well while a coach gives constant instructions, then struggles the next day. Immediate performance and retained learning are different outcomes.

■ Build the model

- Motor learning is a relatively lasting change in movement capability from practice.
- **Knowledge of results** concerns the outcome; knowledge of performance concerns movement quality.
- **retention:** Persistence of learning after a delay.
- knowledge of results: Feedback about the task outcome.



$$\text{Retention accuracy} = 12 \div 20 \times 100 = 60\%$$

■ Choose evidence that can test it

- A retention test after a delay and without the same assistance can provide evidence of learning.
- Practice conditions, prior experience and task difficulty need control before comparing feedback methods.

In the lab: Use a low-risk target task, equal practice time, random or balanced assignment, and a delayed retention test. Record outcome accuracy separately from movement quality. Seek consent and avoid labels about a participant ability or personality.

■ **Work from known quantities**

- Known: 12 of 20 throws hit a target during retention.
- Accuracy = successful attempts/total attempts $\times 100 = 12/20 \times 100 = 60\%$.
- Another group at 70% is not automatically superior without sample variability and comparable starting performance.

Your turn: 15 of 25 retention attempts succeed. Find success percentage.

■ **Check the conclusion and its limits**

- More feedback is not always better for independent performance.
- A short-term improvement alone does not demonstrate a lasting learning change.

Not true: High performance during guided practice always proves lasting motor learning. Guided practice props up performance; when the guidance is removed, performance often drops. Lasting learning is shown by delayed, unassisted retention - which is why the retention test exists.

Key:

- Motor learning is a relatively lasting change in movement capability from practice.
- A retention test after a delay and without the same assistance can provide evidence of learning.
- Watch for: more feedback is not always better for independent performance.

■ **Write from 80 percent retention accuracy**

- 16 of 20 throws hit the target during retention.
- Find the success percentage. Guided practice does not prove lasting learning.