

Supported Focus Companion

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

Source-supported focus teaching; remaining qualification requirements are held

Original teaching and practice · exercises.lol

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Communication · supported focus

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

Scope and prerequisites

Supported HL focus. First assessment 2026; current SL/HL brief acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

Exercise physiology: responses and recovery

■ What would explain this observation?

- Heart rate increases during a short exercise bout, then recovers. This time course connects energy demand, oxygen transport and cardiovascular regulation.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Cardiac output** is heart rate multiplied by **stroke volume**. Ventilation supports gas exchange, while blood transport delivers oxygen to working tissues. ATP demand changes as muscle activity changes.
- cardiac output: Blood volume pumped per minute; stroke volume: Blood volume pumped per beat.



■ Choose evidence that can test it

- An acute response occurs during or soon after exercise. A training adaptation develops over repeated sessions. A lower post-exercise heart rate cannot alone establish greater fitness without comparable workload and participant conditions.
- Use voluntary informed participation, school supervision and an approved low-intensity protocol. Record baseline, a standardized workload and timed recovery measurements. Stop for discomfort and do not use maximal exertion or health diagnosis as a classroom task.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: heart rate is 120 beats per minute and stroke volume 80 millilitres per beat. Cardiac output = heart rate $\times$ stroke volume = $120 \times 80 = 9,600$ millilitres per minute = 9.6 litres per minute.

Example:

Heart rate is 100 beats/min and stroke volume is 70 mL/beat. Find cardiac output in L/min. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- A heart-rate monitor measures one response, not every dimension of performance. Hydration, stress, medication and recent activity can confound comparisons.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A single heart-rate reading proves a person fitness level. This claim is false: A heart-rate monitor measures one response, not every dimension of performance. Hydration, stress, medication and recent activity can confound comparisons.

Key:

Exercise physiology: responses and recovery: An acute response occurs during or soon after exercise. A training adaptation develops over repeated sessions. A lower post-exercise heart rate cannot alone establish greater fitness without comparable workload and participant conditions.

Hydration and nutrition · supported focus

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

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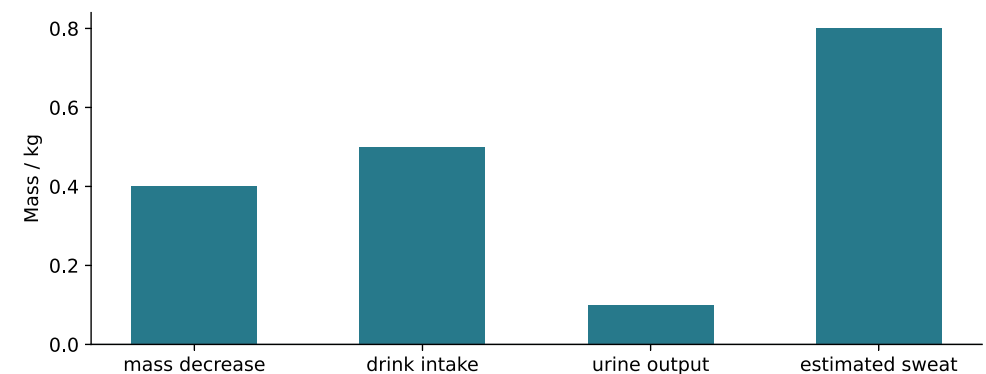
Hydration: interpret balance without forcing dehydration

■ What would explain this observation?

- Body mass can change during activity, but the change is not a direct measurement of sweat alone. Drinking, urine, clothing and scale uncertainty affect the estimate.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Water balance** compares inputs and outputs. During exercise, heat production can increase sweating, while thirst and hormonal regulation contribute to fluid balance. Hydration needs vary with activity, environment and the person; a classroom calculation cannot prescribe a universal intake or diagnose a health condition.
- water balance: Relationship between water inputs, outputs and storage; **sweat rate** : Sweat volume lost per unit time under stated conditions.



■ Choose evidence that can test it

- For a simplified field estimate, sweat loss in kilograms is approximately pre-activity mass minus post-activity mass plus drink mass minus urine mass. Express the estimate per hour only after recording duration. This approximation omits some respiratory and metabolic mass changes and assumes comparable dry clothing and a suitable balance.
- Analyse fictional or consented teacher-approved low-risk data. Record balance resolution, time, intake and whether clothing conditions match. Students need not exercise or disclose personal body mass. Never restrict drinking or induce dehydration to create a result. Compare uncertainties and alternative explanations before interpreting a difference.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: fictional mass is 60.0 kg before and 59.6 kg after one hour; drink intake is 0.50 kg and urine output 0.10 kg. Estimated sweat loss = $60.0 - 59.6 + 0.50 - 0.10 = 0.80$ kg, approximately 0.80 L using 1 kg/L. The 0.40 kg body-mass decrease alone would underestimate this modelled loss.

Example:

Fictional mass changes from 70.0 to 69.7 kg, with 0.40 kg drink and 0.10 kg urine in one hour. Estimate sweat loss. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- A change in mass is not necessarily a change in body fat. A modelled sweat estimate does not justify fluid restriction, diagnosis, or a one-size-fits-all sports recommendation.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Body-mass change during an activity directly measures sweat loss without other information. This claim is false: A change in mass is not necessarily a change in body fat. A modelled sweat estimate does not justify fluid restriction, diagnosis, or a one-size-fits-all sports recommendation.

Key:

Hydration: interpret balance without forcing dehydration: For a simplified field esti-

mate, sweat loss in kilograms is approximately pre-activity mass minus post-activity mass plus drink mass minus urine mass. Express the estimate per hour only after recording duration. This approximation omits some respiratory and metabolic mass changes and assumes comparable dry clothing and a suitable balance.

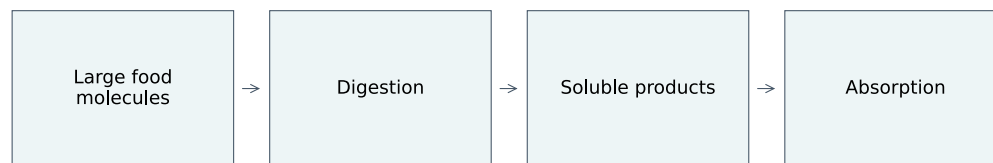
Digestion , transport and health evidence

■ What would explain this observation?

- Two foods can have the same mass but provide different nutrients. A health claim must distinguish the nutrient measured from the health outcome inferred.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Large insoluble food molecules are digested into smaller soluble molecules. Carbohydrases form sugars, proteases form amino acids, and lipases form fatty acids and glycerol. Bile emulsifies lipids and helps neutralize acidic stomach contents.
- **digestion**: Breakdown of large food molecules; **absorption** : Movement of soluble products into the body.



■ Choose evidence that can test it

- Absorption moves soluble products into blood or lymph. Thin exchange surfaces and a large surface area shorten diffusion paths and increase transfer. Enzyme activity and transport are different processes.
 - Use Benedict reagent with controlled heating for reducing sugars, iodine for starch, Biuret reagent for protein, and the ethanol emulsion test for lipids. Keep ethanol away from flames. Use positive and negative controls.
-

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 6 of 24 study participants report a condition. Proportion = cases / total. Percentage = $6/24 \times 100 = 25\%$. The percentage describes this sample. It does not establish that one food caused the condition; confounders and how the sample was chosen matter.

Example:

9 of 36 participants report an outcome. Calculate the percentage. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Bile is not an enzyme. A positive food test identifies a component under the test conditions; it does not show that a food is healthy or unhealthy in every diet.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A correlation between diet and illness proves causation. This claim is false: Bile is not an enzyme. A positive food test identifies a component under the test conditions; it does not show that a food is healthy or unhealthy in every diet.

Key:

Digestion, transport and health evidence: Absorption moves soluble products into blood or lymph. Thin exchange surfaces and a large surface area shorten diffusion paths and increase transfer. Enzyme activity and transport are different processes.

Generating movement in the body · supported focus

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

Scope and prerequisites

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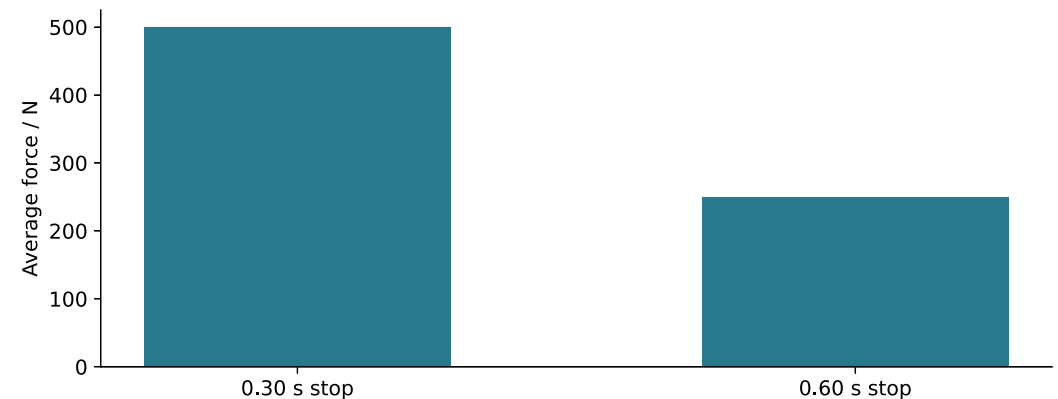
Biomechanics: movement and impulse

■ What would explain this observation?

- Landing with bent knees increases the time over which momentum changes. The movement can reduce average impact force for the same momentum change.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Joint movement results from muscle forces acting through lever systems. The centre of mass and **base of support** affect stability. **Impulse** connects force-time evidence to momentum change.
- impulse: Force integrated over time, equal to momentum change; base of support: The area supporting a body.



■ Choose evidence that can test it

- A biomechanical analysis must define the segment, direction and phase of movement. Net force and a single muscle force are not interchangeable. A longer lever arm can change torque without changing applied force.
 - Use teacher-approved video of a safe movement with consent. Calibrate distance and time, identify frames consistently, and avoid making medical claims from a two-dimensional recording. Camera perspective can bias apparent joint angles.
-

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: momentum changes by 150 kg metres per second. Average force magnitude = momentum change/stopping time. For 0.30 s, force = $150/0.30 = 500$ N. For 0.60 s, force = $150/0.60 = 250$ N. This idealized average excludes the detail of a changing force curve.

Example:

Momentum change is 120 kg metres per second over 0.40 s. Find average force magnitude. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- The largest force is not the same as average force. A school movement study should not deliberately create high-impact landings to test a prediction.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A video from one angle proves the cause of a sports injury. This claim is false: The largest force is not the same as average force. A school movement study should not deliberately create high-impact landings to test a prediction.

Key:

Biomechanics: movement and impulse: A biomechanical analysis must define the segment, direction and phase of movement. Net force and a single muscle force are not interchangeable. A longer lever arm can change torque without changing applied force.

Injury · supported focus

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

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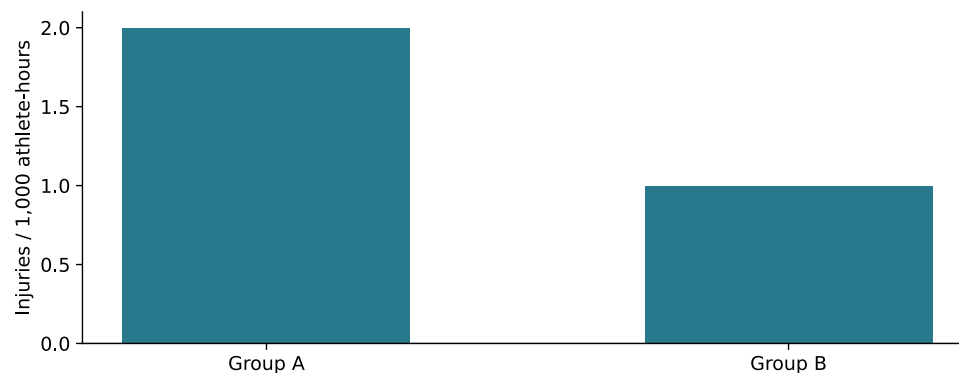
Injury evidence: compare exposure as well as counts

■ What would explain this observation?

- A team records more injuries after adding training sessions. A larger count does not necessarily mean a larger risk per hour of exposure.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
-

■ Build the model

- Injury surveillance requires an explicit injury definition, consistent recording and an exposure denominator. Acute injuries follow a particular event; overuse injuries can develop through repeated loading. Mechanism, tissue capacity, previous injury, equipment and environment can contribute, so one observed association rarely establishes a single cause.
- **incidence rate** : New events divided by a specified exposure measure;
overuse injury : Injury associated with repeated loading over time.



■ Choose evidence that can test it

- An incidence rate divides new injury events by exposure time, often expressed per 1,000 athlete-hours. Use the same case definition and exposure method in comparisons. Severity, recurrence and missing records also matter; two groups with equal incidence can have different time lost or different injury types.
 - Use anonymized fictional surveillance tables. Identify what counts as an injury and how training or match exposure was recorded. Calculate comparable rates, check sample sizes and reporting changes, and propose prevention hypotheses for qualified staff to evaluate. Students do not induce injuries, diagnose peers or decide return-to-play clearance.
-

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: group A has 6 injuries in 3,000 athlete-hours, rate 2 per 1,000 hours. Group B has 8 injuries in 8,000 athlete-hours, rate 1 per 1,000 hours. Group B has the larger count but the smaller recorded exposure-normalized rate. Different reporting systems or injury severity could still make the comparison misleading.

Example:

A fictional group records 9 injuries in 4,500 athlete-hours. Calculate injuries per 1,000 hours. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- A rate estimate from a small number of events is uncertain. A low recorded rate can reflect under-reporting, and exposure-normalized association is not proof of a prevention intervention's causal effect.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

The group with more recorded injuries necessarily has a greater injury rate per hour. This claim is false: A rate estimate from a small number of events is uncertain. A low recorded rate can reflect under-reporting, and exposure-normalized association is not proof of a prevention intervention's causal effect.

Key:

Injury evidence: compare exposure as well as counts: An incidence rate divides new injury events by exposure time, often expressed per 1,000 athlete-hours. Use the same

case definition and exposure method in comparisons. Severity, recurrence and missing records also matter; two groups with equal incidence can have different time lost or different injury types.

Individual differences · supported focus

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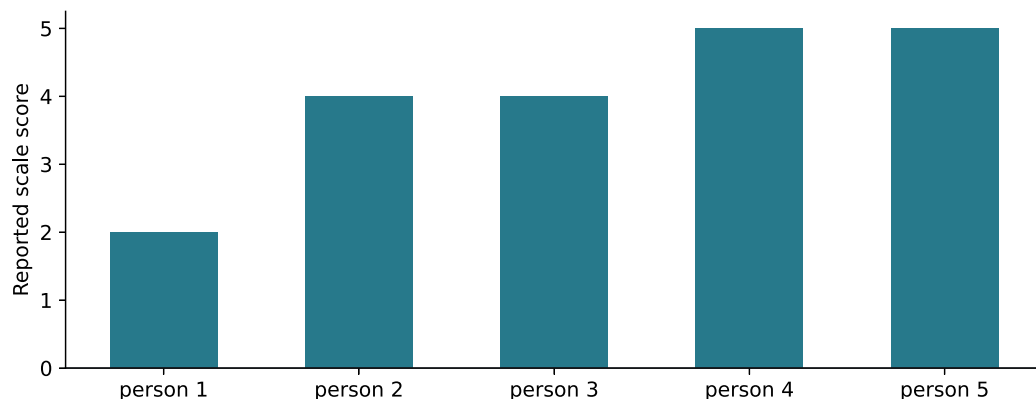
Motivation, stress and evidence in sport

■ What would explain this observation?

- Two athletes can react differently to the same competition. Their appraisal, experience and **coping** strategies affect the response.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Motivation** concerns initiation, direction and persistence of behaviour. Stress depends partly on the relationship between perceived demands and perceived resources. Arousal and anxiety are related but distinct constructs.
- motivation: Processes influencing initiation and persistence; coping: Strategies used to manage demands.



■ Choose evidence that can test it

- A self-report scale measures reported experience under its design. It does not diagnose a disorder or establish a universal relationship between arousal and performance. Analyse within-person and between-person variation separately.
- Use anonymous voluntary questionnaires approved by the school, avoid sensitive personal disclosure, and allow withdrawal. Compare the same task and time point, define the scale and explain its limitations.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: reported scores are 2, 4, 4, 5 and 5. Mean = $\text{sum}/\text{count} = 20/5 = 4$. Range = maximum-minimum = $5-2 = 3$. The mean summarizes this sample and scale, without proving why the participants differ.

Example:

Scores are 3, 5, 5 and 7. Find the mean. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- Correlation does not prove that stress caused a performance result. Students should not induce distress to investigate coping.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A self-report stress score is a medical diagnosis. This claim is false: Correlation does not prove that stress caused a performance result. Students should not induce distress to investigate coping.

Key:

Motivation, stress and evidence in sport: A self-report scale measures reported experience under its design. It does not diagnose a disorder or establish a universal relationship between arousal and performance. Analyse within-person and between-person variation separately.

Motor learning · supported focus

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

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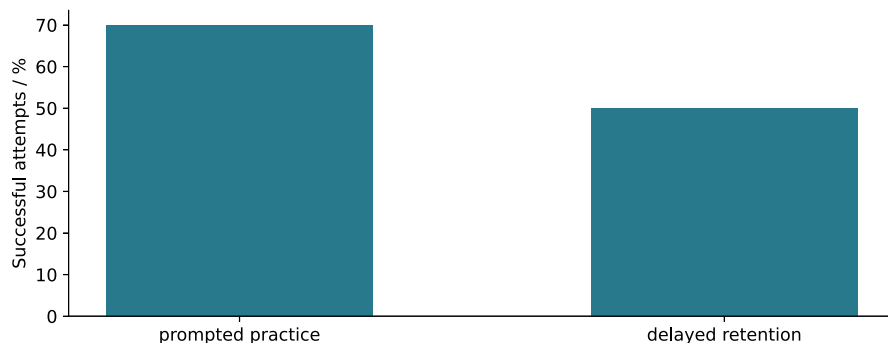
Motor control: feedback, timing and evidence

■ 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.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ 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.



■ 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.
- 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

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- 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.

Example:

Success rate changes from 80% in practice to 55% in retention. Find the decrease in percentage points. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ 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.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A strong score with continuous prompts proves lasting motor learning. This claim is false: 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.

Key:

Motor control: feedback, timing and evidence: 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.

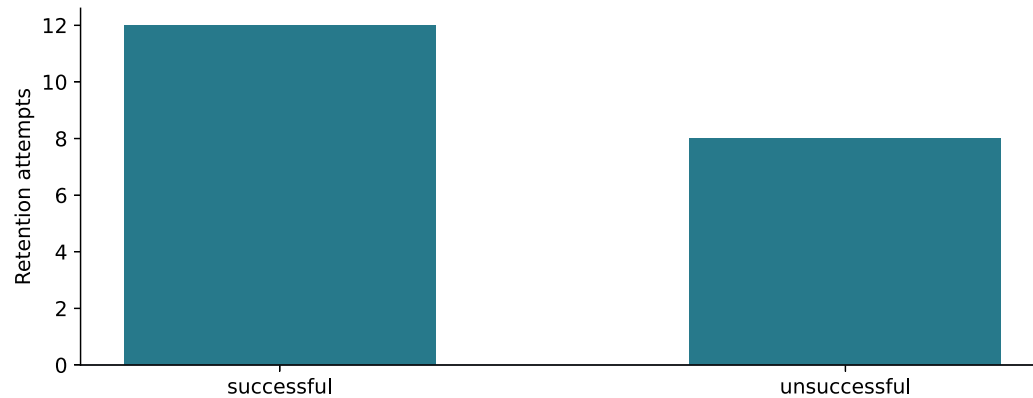
Motor learning, feedback and retention

■ 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.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ 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.



■ 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.
- 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

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 12 of 20 throws hit a target during retention. $\text{Accuracy} = \frac{\text{successful attempts}}{\text{total attempts}} \times 100 = \frac{12}{20} \times 100 = 60\%$. Another group at 70% is not automatically superior without sample variability and comparable starting performance.

Example:

15 of 25 retention attempts succeed. Find success percentage. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ 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.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

High performance during guided practice always proves lasting motor learning. This claim is false: More feedback is not always better for independent performance. A short-term improvement alone does not demonstrate a lasting learning change.

Key:

Motor learning, feedback and retention: 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.

Experimental programme · supported focus

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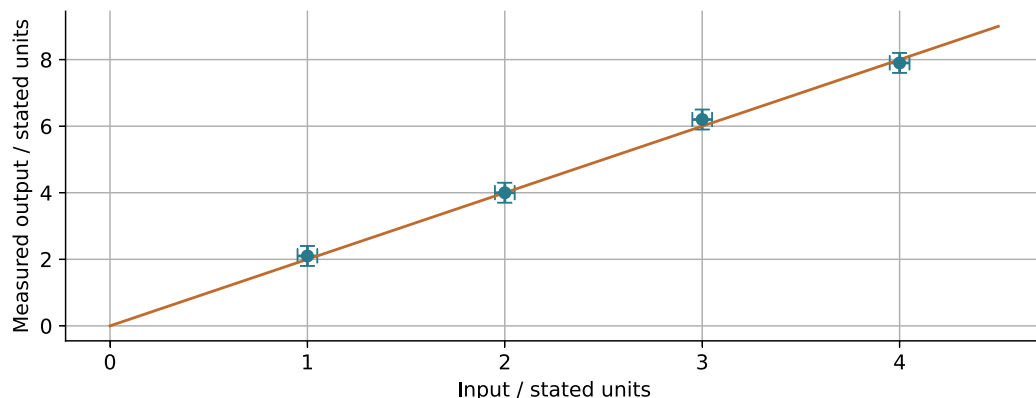
Uncertainty, gradients and model testing

■ What would explain this observation?

- A line passing near every data point is useful, but its gradient can still be uncertain. A graph is evidence for a model within the measurement range.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Random variation makes repeated readings differ. **Systematic error** shifts results consistently. Absolute **uncertainty** has the measured unit; relative or percentage uncertainty compares uncertainty with the measured value.
- uncertainty: A quantified limitation on a measured result; systematic error: A consistent measurement bias.



■ Choose evidence that can test it

- For a product or quotient, adding fractional uncertainties is a common maximum-uncertainty approximation. For a difference, add absolute uncertainties. A nonzero intercept can reveal an offset or an incomplete model.
- Show units on axes and choose a sensible scale. Plot uncertainty bars where justified, draw a best-fit line rather than joining every point, and estimate steepest and shallowest plausible gradients when the course method calls for them.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: length = 50.0 mm with uncertainty 1.0 mm. Percentage uncertainty = absolute uncertainty/value $\times 100 = 1.0/50.0 \times 100 = 2.0\%$. For a quotient of two independently measured quantities with maximum percentage uncertainties 2% and 3%, the summed maximum estimate is 5%.

Example:

A 40 cm reading has an absolute uncertainty of 1 cm. Find percentage uncertainty. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Repeating readings reduces random uncertainty in a mean but does not automatically remove a zero error. Do not quote more decimal places than your measurement can support.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Repeating a measurement always removes a calibration offset. This claim is false: Repeating readings reduces random uncertainty in a mean but does not automatically remove a zero error. Do not quote more decimal places than your measurement can support.

Key:

Uncertainty, gradients and model testing: For a product or quotient, adding fractional uncertainties is a common maximum-uncertainty approximation. For a difference, add absolute uncertainties. A nonzero intercept can reveal an offset or an incomplete model.