

Cambridge AS & A Level · Psychology 9990 · Notes

Aims, hypotheses and variables AS

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What you need to know

These ideas run through every Paper 2, in short questions about the core studies and in questions about studies you have never seen before. By the end of this topic you should be able to:

1. **Aims.** Say what an aim is and write one for a study, including the aims of the core studies.
2. **Hypotheses.** Describe and recognise the **null hypothesis** and the **alternative hypothesis** (called the experimental hypothesis in an experiment), and tell **directional** (one-tailed) from **non-directional** (two-tailed) ones. Write each kind for a given study.
3. **Independent and dependent variables.** Say what an **IV** and a **DV** are, pick them out in any study, and describe the different ways a DV can be measured.
4. **Operational definitions.** Understand what it means to **operationalise** a variable, and operationalise both an IV and a DV.
5. **Controls.** Describe how psychologists **control** variables, and what it means to **standardise** a procedure.
6. **Uncontrolled variables.** Understand **uncontrolled**, **participant** and **situational** variables, and how each can spoil a result.
7. **Apply** all of this to a new research scenario: name the variables in it, operationalise them, spot what could go wrong and suggest how to control it.

Experimental designs, correlations, counterbalancing and control groups are described in the research methods note; questions on this topic often use them, so the parts you need are repeated here.

Understand it

Aims and hypotheses

An **aim** is a general statement of **what a study sets out to investigate**: its purpose. It usually starts "To investigate..." or "To find out whether...", for example "To investigate whether listening to music while revising affects memory." An aim doesn't predict anything.

A **hypothesis** is a **testable prediction** about the result: what you expect to find, stated precisely enough that the data can show whether it is right. It names the variables. A hypothesis is a statement, not a question, and it is written before the data is collected, so it is never a result or a conclusion.

Every study has two hypotheses that go together:

- The **alternative hypothesis** predicts a **difference** between conditions (in an experiment) or a **relationship** between two variables (in a correlation). In an experiment it is also called the **experimental hypothesis**.
- The **null hypothesis** predicts **no** difference or **no** relationship. It can add "any difference is due to chance".

The data decides between them. If a clear difference appears, the null hypothesis is rejected and the alternative is supported; if not, the null is retained and the alternative is rejected.

An alternative hypothesis is one of two kinds:

	Directional (one-tailed)	Non-directional (two-tailed)
What it predicts	Which way the difference or relationship goes	That there is a difference or relationship, but not which way
Experiment example	"People who revise in silence will recall more words than people who revise with music playing."	"There will be a difference in the number of words recalled between people who revise in silence and people who revise with music playing."
Correlation example	"There will be a negative correlation between hours of screen time before bed and hours of sleep."	"There will be a correlation between hours of screen time before bed and hours of sleep."
When to use it	Earlier research or a theory points one way	There is no earlier research, or findings so far disagree, or either direction is possible

The matching null for the experiment is "There will be no difference in the number of words recalled between people who revise in silence and people who revise with music playing", and for the correlation "There will be no correlation between hours of screen time before bed and hours of sleep."

A useful test: if you could swap the two groups round and the hypothesis would then predict the **opposite** result, it is directional. "People who exercise daily sleep longer than people who don't exercise" changes meaning when swapped; "people who exercise daily and people who don't differ in how long they sleep" doesn't.

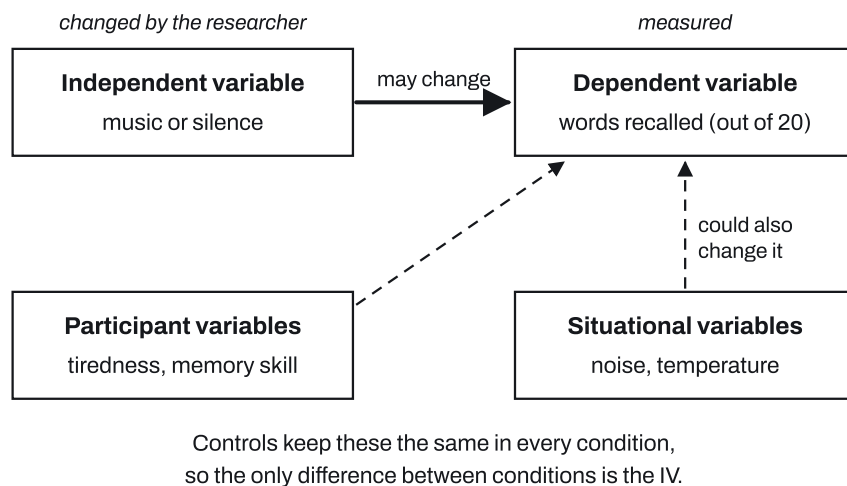
Two traps. A hypothesis that just names a cause, such as "sleep affects mood" or "noise affects concentration", is **non-directional**: it says the DV will change with the IV but not whether it goes up or down. And a word like "better", "more", "faster" or "worse" comparing the groups makes it **directional**.

Independent and dependent variables

In an experiment the researcher sets up two or more **conditions** (also called **levels** of the IV) and compares them.

- The **independent variable (IV)** is the variable the researcher **manipulates** (changes) to create the conditions. Name it by its levels: "music or silence", not just "music".
- The **dependent variable (DV)** is the variable that is **measured** to see whether the IV has had an effect. It "depends" on the IV.

Sometimes the IV is a difference that already exists between people, such as age or having a diagnosis, rather than one the researcher creates. It is still the IV, because it is what defines the groups being compared. In a correlation there is no IV or DV: both variables are measured and are called **co-variables**.



Operationalisation

Many things psychologists study are ideas you can't see: memory, stress, happiness, helping, learning. To **operationalise** a variable is to define it in a way that can be **observed and measured** (or, for an IV, set up exactly). The **operational definition** says precisely what will be done or counted, so that anyone could repeat the study and get comparable numbers.

Operationalising the DV means saying exactly how it will be measured:

- "memory" → "the number of words correctly written down, out of 20, in 2 minutes";
- "helping" → "whether a passer-by picks up a dropped glove within 10 seconds";
- "learning" (for a dog learning to sit) → "the number of trials until it sits on command 5 times in a row".

Operationalising the IV means saying exactly what is different between the conditions:

- "music" → "a 10-minute pop playlist at a fixed volume" versus "10 minutes of silence";
- "tired" → "after a normal night's sleep" versus "after being kept awake until 3 a.m.".

There are three ways an IV can be set up, and each can be operationalised:

1. **The researcher manipulates it**, by giving people different experiences. Example: one group chews gum while learning a list, the other doesn't. Andrade's participants either had a sheet to doodle on while listening to a phone message, or did not.

2. **Using differences that already exist between people.** Example: comparing people aged 18–25 with people aged 60–70. Operationalising means giving the exact groups (age ranges, a diagnosis), not just "age". Baron-Cohen et al. compared adults with autism or Asperger syndrome with adults who had neither.
3. **Using differences that already exist between situations.** Example: comparing behaviour in a quiet library with a busy canteen, or in summer with winter. In Hassett et al., monkeys were offered two different kinds of toy, plush toys and wheeled toys.

Ways of measuring a DV

Way	What is recorded	Examples
Counting (frequency)	How many times something happens, or how many correct	Words recalled; acts of aggression tallied in an observation (Bandura et al.)
Timing	How long something takes or lasts	Reaction time in milliseconds; seconds spent playing with a toy (Hassett et al.)
Test score	Marks on a task with right and wrong answers	Score out of 36 on the Eyes Test (Baron-Cohen et al.)
Self-report rating	A number the participant gives	"How stressed do you feel, 1–10?"
Behavioural choice or level	How far someone goes, or which option they pick	The highest shock level given (Milgram)
Scientific equipment	A physical measure from a machine	Heart rate; EEG brain activity to detect REM sleep (Dement and Kleitman); brain scans

Evaluating a measure. Ask whether it is **objective** (a count, a time or a machine reading doesn't depend on the researcher's opinion), whether it really captures the idea (**valid**), and whether it would give the same answer again (**reliable**). Self-report ratings are quick and get at feelings directly, but people may give the answer that makes them look good. Scientific equipment is precise and hard to fake, but it is expensive, the setting is unfamiliar (a scanner is noisy and enclosed), so people may feel anxious and behave unnaturally, and a fault in the machine may go unnoticed. A count is only as good as its definition: if "jump" and "hop" look alike, two observers may score the same movement differently.

Controls and standardisation

If the DV differs between conditions, you want to be able to say the **IV** caused it. That's only safe if nothing else differed between the conditions. A **control** is any step that keeps another variable the same in every condition, or removes it.

- **Situational controls:** same room, same time of day, same lighting and temperature, same task materials, same length of time.
- **Standardisation of the procedure:** every participant gets the **same instructions** (often read from a script), in the same order, from the same researcher, and their answers are scored the same way. A standardised procedure can be repeated exactly, which makes the study more **reliable**.

- **Controls on materials:** if conditions use different stimuli (two sets of faces, two word lists), they must be matched on everything except what the IV is about: same size and colour of photo, same age and gender of faces, words of the same length.
- **Controls on participants: inclusion criteria** (only people of a certain age, not taking medication, with no earlier experience of the task), **random allocation** to conditions, or **matched pairs** (see below).

Each control has a reason, and the reason always comes back to the DV: "if one set of faces were in colour and the other in black and white, colour might make faces look friendlier, so a difference in ratings could be caused by the colour, not by the IV".

Uncontrolled variables

An **uncontrolled variable** (also called an **extraneous variable**) is any variable other than the IV that could affect the DV and hasn't been kept the same. If it differs between conditions it becomes a **confounding variable**: it can **hide** a real effect of the IV or **create** a difference that isn't really caused by the IV, so the results lose **validity**.

There are two kinds:

- A **participant variable** is something **inside the person**: a characteristic, state or individual difference, such as age, personality, intelligence, mood, hunger, tiredness, illness, experience or skill.
- A **situational variable** is something **outside the person**, in the environment or the procedure: noise, temperature, lighting, time of day, how crowded a place is, who else is present.

If the study is *about* a characteristic (it compares men and women, say), that characteristic is the IV, so it can't also be called a participant variable in that study.

Controlling participant variables. In an **independent measures** design, the two groups are different people, so they might differ in ability, mood or experience. Two fixes:

- **Random allocation:** decide by chance which condition each person goes into (a random number generator, names drawn from a hat), so every participant is equally likely to end up in either condition. Differences between people are then spread by luck, not by the researcher's choices.
- **Matched pairs:** first test or question everyone on the variable that worries you (a timing test, a questionnaire about how much they like films), pair up people with similar scores, and put one of each pair in each condition.

A **repeated measures** design removes participant variables between conditions altogether, because the same people do both.

Limiting an uncontrolled variable in an observation or a study you can't fully control: remove it (only observe when the playground is busy), measure it and exclude people (ask about health and leave out anyone who is ill), or observe each person several times so one unusual day doesn't decide their score. Every fix has a cost: excluding people makes the sample smaller and less representative; testing everyone at one time of day means the results only apply to that time.

Participants' own reactions are another uncontrolled variable. **Demand characteristics** are clues that let participants guess the aim, so they change what they do (to help or spoil the study). **Social desirability** is acting or answering in a way that makes you look good, such as being friendlier or more helpful than usual when watched. Both make behaviour less natural. They are reduced by **hiding the aim** (a cover story that the study is about something else), by **covert observation** (people don't know they are being watched), or by not telling participants which condition they are in (**single-blind**).

Order effects

In a **repeated measures** design each person does every condition, so the **order** of the conditions becomes an uncontrolled variable:

- a **practice effect**: people do **better** later because they have learned the task or got used to the setting;
- a **fatigue effect**: people do **worse** later because they are tired or bored.

Counterbalancing controls this: half the participants do condition A then B, and the other half do B then A, so any practice or fatigue affects both conditions equally. Order effects also happen in longitudinal studies, where people repeat the same test over the years.

Control conditions and control groups

A **control condition** (or **control group**) is one in which participants do **not** get the thing being tested, so it gives a **baseline** to compare the experimental condition with. A good control is the same as the experimental condition in every way **except** the IV: a **placebo** (a pill or injection with no active ingredient) controls for the effect of simply expecting a drug to work. In Baron-Cohen et al., a gender-recognition task from photos of eyes checked that the participants with autism could do an eyes task at all, so a lower Eyes Test score couldn't just be put down to trouble with the task itself.

When you suggest a control group, explain what it rules out: "a group who watch a calm nature film rules out the possibility that any film changes time estimates, so a difference must be due to boredom".

Correlations

In a correlation the two **co-variables** are both **measured**. Each needs its own operational definition on a numerical scale ("number of hours of sleep, from a sleep app", "score on a 1–10 tiredness scale"). The hypothesis talks about a **relationship** or **correlation**, never a difference: "There will be a positive correlation between hours spent reading per week and score on a vocabulary test." Use a non-directional hypothesis when the relationship could be either positive or negative. A correlation can't show which variable affects which.

Key facts and formulas

There is no formula list in the 9990 exam. "Learn it" means you must remember it.

Fact	Status
Aim: a general statement of what a study sets out to investigate	Learn it
Hypothesis: a testable prediction of the result, naming the variables	Learn it
Directional (one-tailed): predicts which way the difference or relationship goes	Learn it
Non-directional (two-tailed): predicts a difference or relationship, not its direction	Learn it
Null hypothesis: no difference (or no relationship); any difference is due to chance	Learn it
IV: manipulated by the researcher to create the conditions (levels). DV: measured to see the effect of the IV	Learn it
Operationalise: define a variable so it can be observed and measured (or, for an IV, set exactly)	Learn it
Three ways to set up an IV: manipulate it; use existing differences between people; use existing differences between situations	Learn it
Participant variable: inside the person (individual differences, state). Situational variable: outside the person (environment)	Learn it
Uncontrolled (extraneous) variable: anything other than the IV that could affect the DV and isn't kept the same	Learn it
Standardisation: same instructions, procedure, materials and scoring for everyone	Learn it
Random allocation: chance decides each participant's condition. Matched pairs: pair on a relevant variable, one of each pair per condition	Learn it
Practice effect: better with repetition. Fatigue effect: worse through tiredness or boredom. Counterbalancing with n participants: $\frac{n}{2}$ do A then B and $\frac{n}{2}$ do B then A	Learn it
Control condition: the condition without the IV, giving a baseline for comparison	Learn it

How to do it

We have tagged 88 questions on this topic, all from Paper 2, from 2021 to March 2026. 25 of them have parts of more than one type, so the counts add up to 122.

Question type	Questions
Operationalise or measure a variable	19

Question type	Questions
Suggest controls and explain why	15
Identify a hypothesis type and justify it	11
Identify or define the IV and DV	10
Suggest an uncontrolled variable and explain its effect	10
Write a hypothesis	9
Strength or weakness of a way of measuring a variable	9
Participant and situational variables	8
Correlations: co-variables and hypotheses	8
Control conditions and control groups	7
Random allocation and matching	6
State or define an aim	5
Order effects and counterbalancing	5

1. Operationalise or measure a variable (19 questions)

Short questions (1–2 marks): "Suggest how 'learning' could be operationalised in this study."

1. Pick something you can **count, time or score** in this exact scenario.
2. Say **exactly** what is counted and over what: a number, a unit, a time limit. "How many of 10 balls the child throws through the hoop" beats "how good they are at throwing".
3. For 2 marks, add a detail linked to the scenario (the time allowed, what counts as correct).

Variations you will meet:

- **A core study:** "Explain how the IV was operationalised in Andrade's study." Name the IV with both levels (doodling or not) **and** the detail of how each was set up (one group had a sheet of shapes to shade in while listening; the other didn't). "Doodling and control" alone gets nothing. For Milgram's DV, give the measure: the highest voltage on the shock generator that each participant went up to, from 15 V to 450 V.
- **Behaviour categories:** define a category so it can't be confused with another ("nod: moves head down and up once"). Two categories that look alike ("hop" and "jump") make scoring unreliable; recording on video lets each response be scored twice, or by two people, to check agreement.
- **A choice of manipulation:** which version of an IV makes a fair test (a reward that is the same size each time, a noise at a set loudness).
- **6 marks: "Describe how IVs can be operationalised, using any example(s)."** Give the definition (making an abstract idea measurable, or setting each level exactly), then the **three ways**: manipulating the IV, using existing differences between people, using existing differences between situations. For each way, a point of detail and an example (your own, or a core study: Andrade, Baron-Cohen et al., Hassett et al.). Up to 2 marks per way and up to 4 for examples; with no examples, or only one way, the most is 4.

- **6 marks: "Describe how variables in correlations can be measured."** Use the "Ways of measuring a DV" table: give two or three ways (self-report rating, counting, equipment), each with a detail and an example of a co-variable.

2. Suggest controls and explain why (15 questions)

1. **Suggest the control** for this scenario: a specific thing to keep the same (the gender, age and size of the faces in two photo sets; the temperature in two parts of a factory). One mark each.
2. **Explain why** it matters: a generic reason (so any difference in the DV is due only to the IV; to standardise) **plus** a link showing how this feature could change **this** DV ("a hotter room might make people want more space between them").

Variations you will meet:

- **Inclusion criteria** in a core study (Hölzel et al.: no recent meditation classes, not taking medication, safe to go in a scanner): for each, explain what it rules out ("earlier meditation could have changed the brain already, so changes couldn't be put down to the course").
- **Standardising** an interview or questionnaire: same script, same order, same interviewer, same setting.
- **Why a random order** of questions or trials: so the participant (or animal) can't learn a pattern and the order can't affect the DV.
- **6 marks: "Describe the use of controls in laboratory and field experiments."** Define controls, give two kinds (situational, standardised procedure, participant), say that labs can control more than field settings, and give examples of each.

3. Identify a hypothesis type and justify it (11 questions)

1. **Look for a direction word:** "more", "less", "better", "faster", "worse", "higher" → **directional**. "Differ", "a difference", "affects", "a relationship", "a correlation" → **non-directional**. "No difference", "no relationship", "due to chance" → **null**.
2. **Justify**, when asked, in two steps: the generic reason ("it predicts which group will score higher" / "it only predicts that the DV will be different in the two conditions") **and** the link, naming the IV and DV from the hypothesis.

For example, "Sleep affects mood" is non-directional: it only predicts that mood will be different depending on how much people sleep, not whether more sleep makes mood better or worse.

Variations you will meet:

- **Pick one of three** (directional, non-directional, null): 1 mark, just the name.
- **"Explain what makes this directional":** "it shows the direction" repeats the question and scores nothing. Say what it predicts and which way, using the variables.
- **Choose a type for a planned study, with a reason:** directional if earlier research points one way; non-directional if there is none, or "the correlation could be positive or negative".

4. Identify or define the IV and DV (10 questions)

1. **IV:** what is changed or what differs between the conditions. Give **both levels** ("noise or no noise").
2. **DV:** what is measured. "Outline the DV" usually has a second mark for **how** it is measured ("each participant's estimate, in minutes, of how long the task lasted").
3. **Define** them **generically** when asked: the IV is manipulated by the researcher to create two or more conditions; the DV is measured to see the effect of the IV. Examples alone don't earn the definition marks.
4. **"Identify the DV and justify":** name it, then "because it is what is being measured" or "because it is what changes as a result of the IV".

Variations you will meet: naming the IV and DV of a core study (Milgram had no IV in the main study, only a DV, obedience); spotting **two IVs** in one study (for example, the time of day *and* the type of task), and listing every combination of their levels as the conditions.

5. Suggest an uncontrolled variable and explain its effect (10 questions)

1. **Name a plausible variable** other than the IV, specific to the scenario (interest in films, being a shelf-stacker, culture, number of siblings, how crowded the street is). If the question rules out some (such as age and gender), don't use them.
2. **Explain its effect:** which way it would push the DV, in this study, and why that lowers validity ("a person who works stacking shelves is used to that kind of task, so they might find the box-moving less boring, and their estimate of the time would be shorter for a reason other than the IV").

Variations you will meet: define "uncontrolled variable" (a variable other than the IV that could affect the DV but isn't kept the same, so it may hide or exaggerate the IV's effect); explain why a named one was a problem in a core study (in Andrade's study, people who daydream more might have missed more of the message whatever their condition); suggest how to find out whether it caused the result (measure it and compare people high and low on it).

6. Write a hypothesis (9 questions)

1. **Decide the type** the question asks for.
2. **Name the IV with both levels, and the DV** (operationalised, unless told not to).
3. **Use the right wording:**
 - directional: "[group 1] will [more/less] [DV] than [group 2]";
 - non-directional: "there will be a difference in [DV] between [group 1] and [group 2]";
 - null: "there will be no difference in [DV] between [group 1] and [group 2]", or "any difference ... is due to chance";
 - for a correlation, "relationship" or "correlation" instead of "difference", and "positive" or "negative" for a directional one.

Variations you will meet:

- **Turn a non-directional hypothesis into a directional one** (or back). Keep both groups in the sentence: "Teenagers will take more risks" alone is incomplete; "teenagers will take more risks than adults" is complete.
- **A null hypothesis for a core study**, such as Dement and Kleitman's comparison of dreamers' estimates after 5 and 15 minutes of REM sleep: "there will be no difference in estimated dream length between dreamers woken after 5 minutes of REM and after 15 minutes".
- **"Explain why the non-directional hypothesis must be rejected"** when the results in both conditions were the same: it predicted a difference in the DV between the conditions, and none was found, so the null is retained.

7. Strength or weakness of a way of measuring a variable (9 questions)

1. **Name the strength or weakness** (1 mark): accurate, objective, hard to fake; or easy to misreport, frightening, may be faulty, affected by something else.
2. **Explain it with detail about this measure** (1 mark). Just writing "valid", "reliable" or "demand characteristics" earns nothing; say why.

Examples: a step-counting watch is accurate and needs no effort from the participant, so the count is valid (strength); but a fast walker may take fewer steps for the same exercise, so steps don't fully capture exercise (weakness). A brain scanner is noisy and enclosed, so people may be anxious and their brain activity unlike everyday life; a machine fault might go unnoticed, so it records the wrong thing or gives different readings for the same person.

Variations you will meet: a practical strength and a practical limitation of how you measured one co-variable in your own correlational study (both about the **same** variable); why a measure suits or doesn't suit certain participants (babies can't fill in a questionnaire; some measures are too invasive).

8. Participant and situational variables (8 questions)

1. **Define** each: participant = an internal characteristic, state or individual difference of the participants; situational = an external, environmental factor. Add that either could affect the DV, hiding or exaggerating a difference between the levels of the IV.
2. **"Explain which one is a participant variable"**: no mark for picking; the mark is for **why** ("because a headache is an internal state of that individual"). Same for situational ("because the number of people nearby is part of the environment").
3. **Example from the stem**: take it straight from the scenario (the hunger, the building noise).
4. **"Suggest how to limit it"**: a suggestion plus a detail. Participant: observe each person more than once; ask about health and exclude anyone unwell; match or randomly allocate. Situational: only collect data when the condition is the same (always when the playground is crowded); test everyone in the same room.
5. **"One problem your fix could create"**: fewer participants or a less representative sample; results only apply to that time or place; asking questions may reveal the aim.

9. Correlations: co-variables and hypotheses (8 questions)

- **Name the relationship:** as one goes up and the other goes down, it's a **negative** correlation; both rise together, **positive**. Say it in terms of the two variables.
- **Why a correlation and not an experiment:** the relationship might not be causal, or changing one variable (happiness, loneliness) would be impossible or unethical, so it can't be an IV.
- **Hypotheses:** use "correlation" or "relationship"; non-directional when either direction is possible.
- **A core-study example:** in Baron-Cohen et al., scores on the Autism Spectrum Quotient (AQ) were negatively correlated with Eyes Test scores: the more autistic traits a person reported, the lower their Eyes Test score tended to be.
- **Planning one (10 marks):** two co-variables, how each is measured (a decibel meter for noise; a sleep-quality rating or EEG), the expected relationship, and a scatter graph. Don't call them IV and DV.
- **Cause:** even a strong correlation doesn't show that one variable causes the other; a third variable may affect both.

10. Control conditions and control groups (7 questions)

1. **Define:** the condition where participants don't receive the IV (or get a neutral version), which gives a baseline to compare against.
2. **Suggest one** for the scenario: no activity, a neutral version of the task, a placebo.
3. **Explain why it is suitable:** what difference it rules out, linked to the study ("compared with no activity, we can see whether boredom changes time estimates, or whether excitement does").

Core-study variants: the placebo condition in a drug study controls for expecting a drug to work; Baron-Cohen et al.'s gender task controlled for basic difficulty with eye photos; a control group that does nothing different shows what changes over time anyway.

11. Random allocation and matching (6 questions)

1. **Suggest the method:** random allocation (each person given a number, numbers drawn from a hat, odd numbers in one condition), or matched pairs on a pre-test.
2. **Say how it helps here:** "so that the people who are good at timing aren't all in one group, and a difference in time estimates is due to the activity, not timing ability".
3. **For matching,** name variables that would affect **this** DV (for a memory test: earlier memory scores, age), and how you'd measure them before the study.

12. State or define an aim (5 questions)

1. **Define:** a general statement of what the study sets out to investigate.
2. **Write one:** "To investigate whether/how [IV] affects [DV]" or "To investigate the relationship between [X] and [Y]". Don't write a result, part of the procedure, or the aim the question already gave you.

3. **Aim vs hypothesis:** an aim states the purpose; a hypothesis is a precise, testable prediction of the outcome.
4. **Core studies:** learn one aim for each (Piliavin et al.: to see whether the type of victim, ill or drunk, affected helping on a subway train; Andrade: whether doodling helps people pay attention to a dull message).

13. Order effects and counterbalancing (5 questions)

- **Counterbalancing:** half the participants do condition A then B, the other half B then A (ABBA), to spread order effects equally across the conditions.
- **6 marks: "Describe practice effects and fatigue effects, using any example(s)." For each:** what it is (performance improves with repetition / gets worse through tiredness or boredom), a detail (it happens in repeated measures designs and longitudinal studies; counterbalancing controls it), and an example ("doing the same puzzle twice, people remember the answers"; "after an hour of reaction-time trials, people slow down"). Core-study examples: Dement and Kleitman woke one participant from REM and non-REM sleep in a random order, so he couldn't learn to predict which kind of waking was coming; Hölzel et al. gave the same questionnaire before and after the course.

Worked examples

Example 1

Ines is investigating whether chewing gum affects memory. Participants learn a list of 20 words. Half chew gum while learning and half do not. Earlier studies have found that chewing gum improves recall.

- (a) Write a directional hypothesis for Ines's study. [2]
 - (b) Write a null hypothesis for Ines's study. [1]
 - (c) A different study has the hypothesis "Hunger affects reaction time". State whether this is directional or non-directional, and justify your answer. [2]
- (a) "Participants who chew gum while learning a list of 20 words will recall more words in 2 minutes than participants who do not chew gum." (1) for a correct direction comparing the two levels of the IV, (1) for operationalising the DV (words recalled out of 20, in 2 minutes).
- (b) "There will be no difference in the number of words recalled between participants who chew gum and participants who do not chew gum." (1)
- (c) Non-directional (no mark on its own). It only predicts that reaction time will be different depending on hunger (1), without saying whether hungry people will react faster or slower than people who have just eaten (1).

Example 2

Mateo is testing whether background music affects how many maths problems teenagers solve. Each participant works for 10 minutes either while listening to songs with lyrics or while listening to instrumental music. Mateo uses a sample of 30 participants.

- (a) Identify the independent variable and the dependent variable in Mateo's study. **[2]**
- (b) Outline how the dependent variable could be operationalised. **[1]**
- (c) (i) Suggest two situational variables that Mateo should control. **[2]** (ii) For one of the variables you suggested in (c)(i), explain why it is important to control it. **[2]**
- (d) Mateo decides to use a repeated measures design. Explain why he should counterbalance the conditions, and how he could do this with his sample. **[2]**
- (a)** IV: whether the background music has lyrics or is instrumental **(1)**. DV: how many maths problems are solved **(1)**.
- (b)** The number of problems answered correctly in the 10 minutes, out of a sheet of 40 problems of equal difficulty **(1)**.
- (c)(i)** The volume of the music **(1)**; the temperature of the room **(1)**.
- (ii)** So that any difference in the number of problems solved is due only to the lyrics, not something else **(1)**. Louder music might be more distracting whatever its type, so if the songs with lyrics were played louder, fewer problems might be solved for that reason **(1)**.
- (d)** The second time each teenager does a sheet, they may be faster because they are used to the type of problem (a practice effect), which would make whichever condition comes second look better **(1)**. So 15 participants do the lyrics condition first and the other 15 do the instrumental condition first **(1)**.

Example 3

Dr Achieng is investigating whether a 20-minute nap improves reaction time in nurses working night shifts. One group of nurses naps at 2 a.m.; the other group stays awake. Reaction time is measured at 3 a.m. on a computer task. She notices two problems:

- some nurses had a busy shift with many emergencies, and others had a quiet one;
- some nurses drink a lot of coffee every night.

- (a) Explain which one of these is a participant variable. **[1]**
- (b) Explain which one of these is a situational variable. **[1]**
- (c) (i) Suggest how Dr Achieng could limit the effect of the participant variable. **[2]** (ii) Suggest one problem your answer to (c)(i) could create. **[2]**
- (d) Suggest a suitable control for the nap group, other than staying awake, and explain why it is suitable. **[2]**

(a) Drinking a lot of coffee, because it is a habit and a state of the individual nurse, something inside the person (1).

(b) How busy the shift was, because it is part of the nurses' working environment, outside the person (1).

(c)(i) Ask each nurse how many cups of coffee they usually drink in a night shift and match the groups on this (1), so that each group has the same number of heavy, moderate and light coffee drinkers, and coffee can't explain a difference in reaction time (1).

(ii) Asking about coffee might tell the nurses that the study is about alertness (1), so they might try harder on the reaction-time task, and their speed would reflect effort, not the nap (1).

(d) A group who rest quietly in the same room for 20 minutes with their eyes open but don't sleep (1). This is the same as the nap condition in every way except sleep, so if the nap group reacts faster, it is due to sleeping, not just to a 20-minute break from work (1).

Example 4

Describe how dependent variables can be measured, using any example(s). [6]

Counting (frequency). The DV is the number of times a behaviour happens, or the number of correct answers (1). Counts are objective, so different researchers get the same number if the behaviour is clearly defined (1). Example: Bandura et al. counted the children's imitative aggressive acts, such as hitting the doll with a mallet (1).

Scientific equipment. A machine records a physical response, such as heart rate or brain activity (1). The reading can't be faked by the participant, but the equipment can make people anxious (1). Example: Dement and Kleitman used EEG to find out when participants were in REM sleep (1).

(Other ways that could earn the marks: timing, such as reaction time in milliseconds; a test score, such as the Eyes Test out of 36; a self-report rating from 1 to 10.)

Common mistakes

- **Defining "directional" as "it shows the direction".** That repeats the question. Say what it predicts: which group will score higher, or whether the correlation is positive or negative, using the variables.
- **Calling a "this affects that" hypothesis directional.** "Sleep affects mood" doesn't say better or worse, so it is non-directional.
- **Leaving a group out of a hypothesis.** "Night-shift workers will make more errors" is incomplete; say who they make more errors than (day-shift workers). Name both levels of the IV and the DV.
- **Writing a correlation hypothesis about a difference**, or an experimental hypothesis about a correlation. Experiments predict differences; correlations predict relationships.
- **Writing a hypothesis as a result or conclusion** ("the results showed..."). A hypothesis comes before the data.
- **Calling a hypothesis "an educated guess".** It is a precise, testable prediction.

- **Giving a finding or part of the procedure as an aim.** An aim says what the study set out to investigate.
- **Naming a technique instead of operationalising.** "By a questionnaire" or "by observation" doesn't say what is counted. Give the measure itself: "score out of 20", "time in seconds".
- **Naming the IV as one word.** "Age" is not operationalised; "aged 4 compared with aged 8" is. Give both levels.
- **Calling the IV a participant variable.** If the study compares men and women, gender is the IV, not an uncontrolled participant variable.
- **Mixing up participant and situational variables.** Participant = inside the person (tiredness, mood, skill); situational = outside (noise, crowding, time of day).
- **Saying "valid", "reliable" or "demand characteristics" with no explanation.** The second mark is for saying why, in this study.
- **Giving the same control for two different variables,** or a control that isn't specific ("keep everything the same"). Name the exact thing and why it matters for this DV.
- **Explaining how counterbalancing works when asked why it is needed.** Say which order effect it removes in this study.

How to get the marks

- **"State" or "identify":** a word or phrase ("non-directional", "the number of words recalled"). For a hypothesis type, the label alone often gets no mark when the question also says "justify": the marks are in the reason.
- **"Define" or "outline what is meant by":** a generic definition in your own words; examples don't replace it.
- **"Describe ... including an example from X's study":** one mark for the definition, one for the example taken from the stem.
- **"Explain which one is...":** no mark for choosing; the mark is for the reason (internal or external).
- **"Suggest":** apply it to the scenario. A point that would fit any study usually gets only half the marks; tie it to this study's IV, DV and participants.
- **"Explain why it is important":** a generic reason (so only the IV affects the DV) plus how this particular variable could change this DV.
- **Write hypotheses** with both levels of the IV and an operationalised DV, unless the question says you needn't operationalise.
- **6-mark "Describe X, using any example(s)":** up to 2 marks for points about each part and up to 2 for examples of each; with no example, or only one part, the most is 4. One example is enough to reach 6 if the other points are there.
- **Two-part answers ("suggest" then "explain why")** must be about the same thing: if (ii) says "for one of these", pick one you can explain well.

Quick check

1. State whether each hypothesis is directional, non-directional or null: (a) "Students who revise with flashcards will score higher on a vocabulary test than students who reread their notes." (b) "Temperature affects aggression." (c) "There will be no relationship between age and hours of sleep."
2. Write a non-directional hypothesis and a null hypothesis for a study comparing the reaction times, in milliseconds, of people who have drunk a cup of coffee and people who have drunk a cup of water.
3. Suggest how "helpfulness" could be operationalised in a field study of shoppers.
4. Kai is studying whether a classroom painted blue helps pupils concentrate. Two problems are that some pupils slept badly the night before, and a lawnmower was running outside during one lesson. Which is the participant variable and which is the situational variable? Explain each.
5. A researcher has 24 participants in a repeated measures design with two conditions. Describe how she could counterbalance them, and say how many participants do each order.

Answers

1. (a) Directional: it predicts which group will score higher. (b) Non-directional: it predicts that aggression changes with temperature, but not whether it goes up or down. (c) Null: it predicts no relationship.
2. Non-directional: "There will be a difference in reaction time, in milliseconds, between people who have drunk a cup of coffee and people who have drunk a cup of water." Null: "There will be no difference in reaction time between people who have drunk a cup of coffee and people who have drunk a cup of water."
3. For example: whether a shopper holds the door open for a researcher carrying a heavy box, recorded as yes or no for each shopper, and counted as the number of shoppers out of 50 who help. Or the number of seconds before someone picks up items the researcher drops.
4. Sleeping badly is the participant variable, because it is a state inside each pupil (how tired they are). The lawnmower is the situational variable, because it is part of the environment outside the pupils.
5. Split them into two halves: 12 do condition A then condition B, and the other 12 do condition B then condition A. Any practice or fatigue effect then affects both conditions equally.

Past questions to try

- [9990/23/O/N/25 Q2](#): choose directional, non-directional or null.
- [9990/22/M/J/25 Q4](#): operationalise "learning" in an animal study.
- [9990/21/M/J/24 Q9](#): participant and situational variables, limiting one, and the problem it creates.
- [9990/22/F/M/23 Q9](#): operationalising behaviour categories and scoring them reliably.