

Hölzel et al. (mindfulness and brain scans)

AS

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What you need to know

The syllabus asks the same things of every core study. For Hölzel et al. (2011) you should be able to:

1. **Explain the psychology being investigated:** mindfulness and localisation of function (the idea that particular areas of the brain do particular jobs).
2. **Give the background:** why earlier comparisons of meditators with non-meditators could not show that meditation *causes* brain changes, and why a before-and-after study was needed.
3. **State the aim** of the study.
4. **Describe the procedure and its methodology:** an experiment with a **longitudinal** design, using **MRI scans** and a **self-report** questionnaire (the FFMQ), plus **correlations**; the sample and its inclusion criteria, the control group, the experimental design, the Mindfulness-Based Stress Reduction (MBSR) course, and the variables changed and measured.
5. **Discuss the ethical issues**, such as informed consent, the right to withdraw, protection from harm and the control group going without help.
6. **Give the results:** the changes in grey matter concentration (which brain areas, in which group), the questionnaire changes, the correlations that were *not* found, and how the results could be shown.
7. **State the conclusions** that were or could be drawn.
8. **Evaluate every part of the study:** its methods, sample, data, validity, reliability, generalisability, ethics and usefulness.
9. **Relate it to the AS issues and debates:** the application of psychology to everyday life, nature versus nurture, and individual and situational explanations. Children and animals were not used, so those two debates only apply as contrasts (for example, problems that could arise with children).
10. **Explain why it belongs to the biological approach**, using its assumptions, and compare it with the other biological core studies, Dement and Kleitman and Hassett et al.

Understand it

The psychology: mindfulness and localisation of function

Mindfulness means paying attention, on purpose, to what is happening right now (your breathing, body sensations, sounds, thoughts and feelings) while accepting it without judging it as good or bad. It is the opposite of running on "autopilot".

Localisation of function is the idea that different areas of the brain carry out different functions. If practising mindfulness changes how people attend, remember and handle emotion, the areas that do those jobs might change physically.

Grey matter is the brain tissue made mostly of the cell bodies of neurons. Its **concentration** (how densely packed it is in an area) can be measured from an MRI scan. Hölzel et al. measured **grey matter concentration (GMC)**. Earlier research had shown that the adult brain can change its structure with experience, for example when people learn a new skill.

Background: why a before-and-after study?

Earlier studies had compared the brains of experienced meditators with the brains of people who did not meditate, and found differences in areas such as the **hippocampus** and the **insula**. But a one-off comparison like this can't show cause and effect: perhaps people whose brains were already different were the ones who chose to meditate. To test whether mindfulness **causes** brain change, the same people have to be scanned **before and after** they learn it, and compared with a **control group** who don't.

The aim

To investigate whether taking part in an 8-week **Mindfulness-Based Stress Reduction (MBSR)** course leads to **changes in grey matter concentration** in the brain. The researchers predicted increases in two areas chosen in advance (the hippocampus and the insula), and also looked across the whole brain for any other changes.

The sample and the inclusion criteria

- **MBSR group: 16 participants, 6 men and 10 women**, all **right-handed** adults. Two more people (both men) started but **withdrew** because they found the MRI scan uncomfortable.
- **Control group**: people who did not take a course during the study, scanned about the same time apart. Similar criteria were applied, so the two groups were alike.
- Participants were recruited from people already enrolled on **four MBSR courses in New England, USA**. They had signed up themselves, or been sent by their doctor, to **reduce their stress**, so the sample was self-selected (a volunteer sample).

To join the MBSR group, a person had to meet **inclusion criteria**. Learn them with the reason each one mattered:

Inclusion criterion	Why it mattered
Physically and psychologically healthy (by self-report)	Illness, or its treatment, could change the brain or stress levels whatever the course did
Not taking any medication	Medication might reduce stress or alter the brain, so any change could not be put down to MBSR
No meditation classes in the last six months	Recent practice could already have changed the brain, hiding the effect of this course
No more than four meditation classes in the past five years, or ten in their lifetime	Experienced meditators might have changed already, so there would be less left to change
Aged 25 to 55	Younger or older brains may still be developing or be declining, which could look like a change caused by MBSR
No reason they could not have an MRI scan, such as metal implants or claustrophobia	A strong magnet can move metal in the body, and the scanner's tight tube can distress some people, so this protected them from harm
Committed to attending all eight classes and doing all the homework	Otherwise it would be hard to tell whether MBSR caused any change, because people would have had different amounts of it

All participants were also right-handed. One mark scheme accepted this as a criterion and another did not, so use the criteria in the table first. The reason it can matter: left- and right-handed people can differ in how jobs are divided between the two halves of the brain (lateralisation).

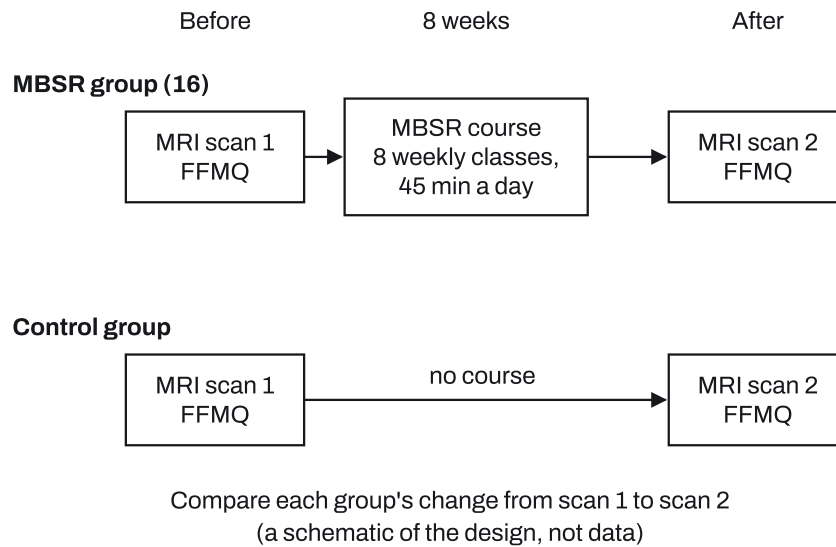
The procedure

Scan 1 (before). Each participant had a **structural MRI scan** of the brain and completed the **Five Facet Mindfulness Questionnaire (FFMQ)**.

The 8-week MBSR course (MBSR group only):

- **Eight weekly group meetings**, one a week for the 8 weeks.
- **Formal practice** in the classes, then at home for **45 minutes a day** using audio recordings:
 - **Body scan**: attention is guided **step by step through the whole body**, noticing the sensations in each region with **non-judgemental awareness**, and ending with awareness of the **body as a whole**. (It is the *body* that is scanned with attention: only the *brain* went in the MRI scanner.)
 - **Mindful yoga**: slow stretching movements and postures, combined with paying attention to breathing and body sensations.
 - **Sitting meditation**: attention on the sensations of breathing, then widening to sounds, sights, thoughts and emotions, noticing them without judging them.
- **Informal practice**: being mindful during everyday activities such as eating, walking, washing up or showering.
- Participants **recorded how long** they spent on their homework.

Scan 2 (after). Within a few weeks of the course ending, each participant was scanned again and completed the FFMQ again. The control group had the same two scans and questionnaires about the same time apart, with no course in between.



The FFMQ

The **Five Facet Mindfulness Questionnaire** is a self-report questionnaire of **39 items**. Each item is a statement rated on a **5-point scale**, from **1 = never or very rarely true** to **5 = very often or always true**. It measures **five facets** of mindfulness:

Facet	What it means
Observing	Noticing and attending to experiences inside and outside you: sensations, sounds, sights, thoughts, feelings
Describing	Putting experiences and feelings into words, labelling them
Acting with awareness	Paying conscious attention to what you are doing now, instead of acting automatically, on autopilot
Non-judging of inner experience	Not criticising or evaluating your own thoughts and feelings as good or bad
Non-reactivity to inner experience	Letting thoughts and feelings come and go without getting caught up in them or reacting

Methods, variables and design

- **Research method:** an **experiment** with a **longitudinal** design (the same people measured at two points in time, before and after 8 weeks). It is **not** a laboratory experiment: the scans had to happen in a controlled laboratory, but the course took place in the participants' normal lives.
- **Independent variable:** whether the participant took the MBSR course (MBSR group or control group). Time (before or after) is also compared.

- **Dependent variables:** **grey matter concentration** in the brain, measured from the MRI scans, and **FFMQ scores**.
- **Experimental design:** **independent measures** for the two groups (MBSR versus control) and **repeated measures** for before versus after, since each person was scanned twice.
- **Controls:** the inclusion criteria; a control group scanned over the same time span; the same scanner and the same questionnaire before and after.
- **Correlations:** the researchers tested whether the **amount of home practice** was related to the change in grey matter, and whether the **change in FFMQ scores** was related to the change in grey matter.
- **Data:** **quantitative** (grey matter concentration, FFMQ scores, hours of practice).

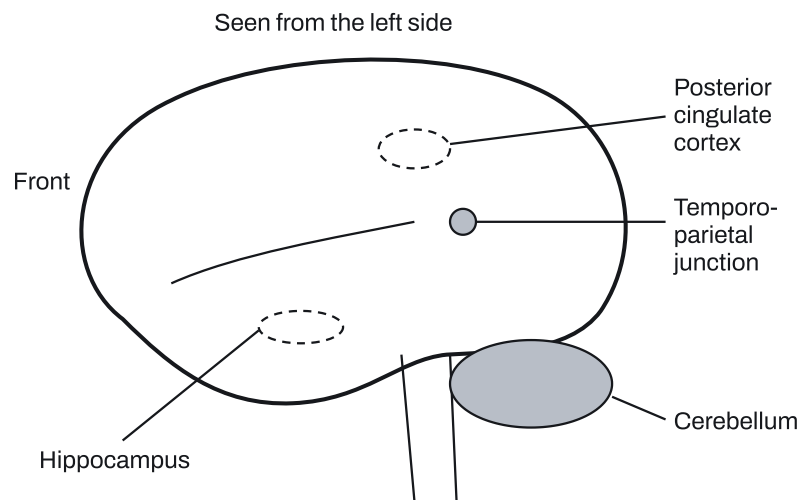
The results

Grey matter (MBSR group, before versus after):

- An **increase** in grey matter concentration in the **left hippocampus**, one of the two areas chosen in advance.
- **No change** in the **insula**, the other area chosen in advance.
- Looking across the whole brain, increases in the **posterior cingulate cortex**, the **left temporo-parietal junction (TPJ)** and two areas of the **cerebellum**.
- The **control group** showed **no** such increases.

Localisation of function: each of these areas is linked with jobs that mindfulness trains.

Brain area	Functions it is linked with
Hippocampus	Learning and memory, and regulating emotion
Posterior cingulate cortex	Thinking about yourself, and mind-wandering
Temporo-parietal junction	Taking another person's perspective, empathy and compassion, and the sense of your own body
Cerebellum	Balance and coordinating movement, and also regulating emotion and thinking



Schematic, not to scale. Dashed shapes lie deep inside the brain.

The FFMQ (MBSR group): scores increased significantly on **three** of the five facets: **acting with awareness**, **observing** and **non-judging**. There was no significant change in the control group.

Correlations: there was **no** significant correlation between the **amount of homework** done and the change in grey matter, and **no** significant correlation between the change in **FFMQ scores** and the change in grey matter. So doing more homework did not go with bigger brain changes.

Showing the results: a **bar chart** with the two groups (MBSR, control) as separate categories on the horizontal axis and the **change** in grey matter concentration (or in an FFMQ facet score) on the vertical axis.

The conclusions

- Taking part in an 8-week MBSR course is linked with **increases in grey matter** in brain areas involved in **learning and memory, emotion regulation, thinking about the self and taking other people's perspectives**.
- The adult brain's **structure can change** with mental practice (mindfulness), not just with physical practice.
- The benefits people report from mindfulness may be explained by these changes in the brain.

Why it is biological

The biological approach has two assumptions:

- Behaviour, cognitions and emotions can be explained by the **working of the brain** and the effect of **hormones, genetics and evolution**.
- **Similarities and differences** between people can be understood through **biological factors** and how they **interact** with other factors.

Hölzel et al. explains a change in thinking and feeling (becoming more mindful and less stressed) through a measurable change in the **brain** (grey matter, seen on MRI). It also shows an **interaction**: an external experience (the MBSR course) changed an internal, biological factor (brain structure).

Key facts and formulas

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

Fact	Status
Hölzel et al. sample: MBSR group of 16 right-handed adults (6 men, 10 women), 2 men withdrew because of the MRI; a control group with no course	Learn it
Hölzel et al. inclusion criteria: healthy, no medication, no meditation class in 6 months, at most 4 classes in 5 years or 10 in a lifetime, aged 25–55, safe to have an MRI, committed to all 8 classes and the homework	Learn it
Hölzel et al. MBSR course: 8 weekly classes, 45 minutes of home practice a day (body scan, mindful yoga, sitting meditation), informal mindfulness in daily life	Learn it
FFMQ: 39 items rated 1 (never or very rarely true) to 5 (very often or always true); facets observing, describing, acting with awareness, non-judging, non-reactivity	Learn it
Hölzel et al. grey matter results: increases in the left hippocampus, posterior cingulate cortex, left temporo-parietal junction and cerebellum in the MBSR group; no change in the insula; no increases in the control group	Learn it
Hölzel et al. FFMQ results: MBSR group rose on acting with awareness, observing and non-judging; no correlation of homework or FFMQ change with grey matter change	Learn it
Percentage = $\frac{\text{part}}{\text{whole}} \times 100$	Learn it

How to do it

We have tagged 20 questions on this study, from 2024 to 2026 (Papers 1 and 2). 6 of them have parts of two types, so the counts add up to 26.

Question type	Questions
Evaluation: validity, sample, self-reports and ethics	6
Aim, procedure, sample and inclusion criteria	5
The FFMQ	4
Applications and advice	4
The biological approach, issues and debates	3
Comparing with another study	2
Research methods applied to the study	2

1. Evaluation: validity, sample, self-reports and ethics (6 questions)

Short questions (2–4 marks). Identify the strength or weakness (1 mark), then explain it with a detail from this study (1 mark). Use these:

Point	Strength or weakness	Example from the study
MRI is objective	Strength	The scan measures grey matter concentration directly; it does not depend on what participants say or on a researcher's opinion
Controls (internal validity)	Strength	Inclusion criteria (no medication, no recent meditation, aged 25–55) and a control group scanned over the same period, so the change can be put down to MBSR
Longitudinal, before-and-after design	Strength	The same people were scanned before and after, so the brain change followed the course; earlier one-off comparisons of meditators could not show this
Standardised procedure (reliability)	Strength	The same MBSR course, the same scanner and the same 39-item FFMQ at both times, so the study can be repeated and checked
Ecological validity	Strength	The MBSR course was a real course people chose to attend to reduce stress, practised in their everyday lives
Self-report: social desirability	Weakness	Participants who had committed to the course might rate themselves as more mindful on the FFMQ afterwards to look as if the course had worked
Self-report: homework records	Weakness	Practice time was self-recorded, so people could over-report how much they did; the homework could not be checked
Small, narrow sample (generalisability)	Weakness	Only 16 in the MBSR group, all right-handed, aged 25–55, mostly women, all wanting to reduce stress; the results may not apply to left-handed people, children or older adults
Uncontrolled variables at home	Weakness	Home practice (where, when, how) was not controlled, and meeting people in the classes could itself have changed the brain, not mindfulness
No correlations found	Weakness	More homework did not go with more grey matter, and FFMQ change did not match grey matter change, so the link between practice and brain change is not clear
Ethics	Mixed	Consent and the right to withdraw (two men did withdraw), MRI safety screening; but the scan was uncomfortable for some, and the control group got no help with stress during the study

Variations you will meet:

- **One weakness of the study:** use self-report, the sample, extraneous variables at home or ethics. Don't call it a "laboratory experiment": it wasn't one. Don't say the study can't be replicated because people did different things at home: that affects **reliability**, not replicability.
- **Why it has validity** (with evidence): define the type first (validity is whether a study measures what it claims to; internal validity is whether the IV really caused the change in the DV), then give several pieces of evidence: MRI is an objective measure of grey matter; inclusion criteria controlled medication and past meditation; a control group; the FFMQ is an established measure of mindfulness; a real-life course (ecological validity).
- **Why the sample may not be representative:** two **different** reasons, each with what follows: 10 women and 6 men, so less representative of men; all right-handed, so not of left-handed people; all adults aged 25–55, so not of children or older people; only 16, so little variety; all wanted to reduce stress, so not of people who are not stressed.
- **Why the two withdrawals could reduce validity:** the sample became smaller (1 mark) **and** say what that did here (1 mark): both who left were men, adding a sex bias if men respond differently to MBSR; or the people who left might have been more anxious or stressed, so those who stayed were less typical.

The 10-mark evaluation ("two strengths and two weaknesses, at least one about ..."):

1. Plan four points of **equal depth**, one of which is the **named issue** (self-reports, generalisations, reliability and so on). Without it the answer is capped at Level 3 (6 marks).
2. For each point: say what the issue is, whether it is a strength or a weakness of **this** study, give **two** specific details from the study, and explain **why** it matters for the conclusions.
3. **Self-reports can be either side:** a strength (the FFMQ gave quantitative scores before and after, so the change in all five facets could be compared between groups) or a weakness (social desirability; 39 items could cause boredom and careless answers).
4. Don't describe the study for its own sake: description earns nothing here.

2. Aim, procedure, sample and inclusion criteria (5 questions)

Mostly recall, one mark per correct point.

1. **Find which part is asked for:** the **inclusion criteria**, the **sample**, the **MBSR course** or one of its parts (such as the body scan), or the **aim**.
2. **Give separate, specific points**, one per mark, with exact numbers (25–55; six months; four classes in five years or ten in a lifetime; eight classes).
3. **Don't repeat what the question gives you:** if it already says they wanted to reduce stress and could have an MRI, give two **other** criteria.

Variations you will meet:

- **Describe the inclusion criteria:** seeking stress reduction (self-enrolled or sent by a doctor); healthy; no medication; no meditation class in the last six months; at most four classes in five years or ten in a lifetime; aged 25–55; no claustrophobia or metal implants; committed to all eight classes and the homework;

recruited from four MBSR courses in New England. Be careful to write **medication** (drugs) and **meditation** (classes) correctly. Leave out what they did on the course.

- **Why a criterion mattered:** give a reason specific to this study, other than making the groups similar (see the table under "The sample and the inclusion criteria"). For example, no recent meditation classes, so any brain change could be put down to this MBSR course and not to earlier practice.
- **The body scan:** guided step by step through the whole body; aware of the sensations in each region; observing them non-judgementally; ending with awareness of the body as a whole. It is **not** the brain scan.
- **The sample:** 16 in the MBSR group, 6 men and 10 women, all right-handed adults; 2 men withdrew; a control group who did no course.
- **One aim:** name what changed and what caused it for 2 marks: "to investigate the effect of an MBSR course on grey matter concentration in the brain". "To investigate the benefits of mindfulness" or "changes in brain density" is brief (1 mark); "to investigate mindfulness" repeats the question (0).

3. The FFMQ (4 questions)

- **Describe the FFMQ** (one mark per point): a questionnaire of **39 items**; measures **five facets** of mindfulness (naming one facet earns a mark, but only one); rated on a **5-point scale**; **1 = never or very rarely true**; **5 = very often or always true**. Describing the facets in detail earns nothing here.
- **Outline a facet** (name 1, outline 1): observing is attending to things inside and outside you; describing is labelling experiences with words; acting with awareness is focusing consciously on what you are doing now instead of acting automatically; non-judging is not evaluating your own thoughts and feelings; non-reactivity is letting thoughts come and go. "Being aware of..." on its own doesn't earn the outline mark for acting with awareness.
- **A strength of the FFMQ** (about the questionnaire, not the whole study): it gave **quantitative** scores (1), so scores before and after the course could be compared to see whether mindfulness rose (1). Or: it is a **standardised**, established measure with good internal reliability, so the five facet scores are consistent and the same measure could be used as a baseline before the course. Don't say it was "easier".
- **A weakness of the FFMQ:** it is a self-report, so participants could give **socially desirable** answers (1), so scores may not show their real mindfulness, lowering validity (1). Or: **39 items is a lot**, so participants could get bored (a **fatigue effect**) and stop answering carefully towards the end. Or: a **practice effect**, since they answered the same items twice and might repeat their first answers.

4. Applications and advice (4 questions)

Applications to everyday life (usually 2 marks each, or a 5-mark band):

1. Say **what** the application is and **who** it is for, based on a finding of the study (1).
2. Say **how** it would be done (1). "Do mindfulness" or "MBSR" alone is not a "how": say what would happen (yoga sessions, body scans, meditation, how often).
3. Two applications must use **different** findings or ideas, and both must be **ethical** and forward-looking (something you would do, not an explanation of behaviour). Name the population: "stressed people" alone is too vague.

4. Any application that uses **brain scans** must say **MRI**.

What (based on the study)	How
Mindfulness reduces stress at work	Employers run weekly mindful yoga or meditation sessions during working hours
Students are stressed around exams	Schools put short body-scan or breathing practice into the timetable before exams
Grey matter rose in the hippocampus, linked to memory	Offer daily meditation programmes to older people whose memory is declining
Hölzel showed brain change can be measured	Use MRI before and after a therapy to check whether it changes brain structure
Homework time did not predict brain change	Schools could give less homework and use more active class time

Advice to a friend who is stressed (4 marks, one per piece of advice based on the study):

- Name **one** task, such as joining an MBSR course or doing yoga (only one mark for naming a task), then add marks by **describing** what to do: in the body scan, move your attention slowly through every part of your body and notice what you feel without judging it; in mindful yoga, do slow stretches while paying attention to your breathing; in meditation, notice sounds, feelings and thoughts and let them pass; practise mindfully while eating or walking.
- A **time frame** earns one mark, once: 45 minutes a day, or for 8 weeks.
- "Do mindfulness" alone, or "do it in your daily life" alone, earns nothing. Don't justify the advice unless the question asks for a reason.
- **"Explain one reason for one piece of advice"** (2 marks): link it to a finding (observing scores rose, so he could notice what stresses him at work and handle it) or to how the technique works (meditation focuses attention on one thing, so work worries take up less of the mind). "Grey matter increased" alone is brief (1).

5. The biological approach, issues and debates (3 questions)

Assumptions (2 marks each for a full one): behaviour, cognitions and emotions can be explained by the working of the **brain** and the effect of **hormones, genetics and evolution** (name at least two of these); similarities and differences between people can be understood through **biological factors** and their **interaction** with other factors. Just "behaviour is caused by the brain" is brief (1 mark).

How Hölzel et al. supports an assumption (2 marks): a **finding** (1), then an explicit **link** to the assumption, naming a concept from it (1). For example: grey matter increased in the hippocampus after the MBSR course (1), which shows an **interaction** between an external factor (mindfulness training) and an internal, biological factor (brain structure) (1). Or: FFMQ scores rose as grey matter rose, consistent with emotions and thinking being explained by the working of the brain. The link must be to the assumption you gave in part (a). Using the aim ("they measured grey matter") instead of a finding earns at most 1.

The use of children (problems if children were participants), each a problem (1) and a link to Hölzel et al. (1):

- Children find it hard to **keep still**, and an MRI scan needs the person to stay still for a long time, so the scans might be unusable and grey matter could not be measured.
- Children may **not understand** the mindfulness exercises and might treat yoga as a game, so the course might not be done as intended.
- Children's brains are **still developing**, so grey matter might increase anyway, and the change could not be put down to MBSR.
- Children might misreport their homework, and they can't give full informed consent themselves.

Nature versus nurture: the study supports **nurture** changing **nature**: an experience (the course) changed the physical brain. **Individual and situational:** the course is situational, but not everyone changed equally, which points to individual differences.

6. Comparing with another study (2 questions)

The 8-mark part of Paper 1 Question 9 or 10: two similarities or differences (or one of each), **4 marks each**, marked in levels:

Level	What it needs
4	The point is well explained, with an example from both studies
3	Well explained with one study's example, or both studies used briefly
2	Brief, with an attempt at one example; or well explained with no example
1	Brief, with no examples

1. **Choose a point you can develop:** technique for studying the brain, experimental design, sample, type of data, ethics. "Different aims", "different species", "same species" or "both have applications" stays in Level 1; "both study biology" earns nothing.
2. **State the point, give each study's detail, then explain** what follows from it.
3. **Obey the question's conditions:** if one point must be about the brain technique, make it so; if questionnaires are banned, don't use the FFMQ.

Useful points:

- **Brain technique** (difference with Dement and Kleitman): Hölzel et al. used **MRI** to measure grey matter concentration before and after the course, showing the brain's **structure**; Dement and Kleitman used an **EEG** to record brain-wave activity and eye movements through the night, showing the brain's **function** in real time. Say what each technique measured: naming MRI and EEG alone stays low, and a wrong technique caps the answer at Level 1.
- **Experimental design** (difference with Dement and Kleitman): Hölzel et al. compared an MBSR group with a different control group (independent measures); every Dement and Kleitman participant was woken in both REM and NREM sleep (repeated measures).
- **Both measured the brain with equipment** (similarity with Dement and Kleitman): objective physical measures (MRI, EEG) instead of relying only on what people said.

- **Small samples** (similarity with Dement and Kleitman): 16 in Hölzel's MBSR group, 9 in Dement and Kleitman's study, so both are hard to generalise.
- **Quantitative data** (similarity with Hassett et al. or Dement and Kleitman): Hölzel et al. measured grey matter concentration and FFMQ scores; Hassett et al. recorded how often and how long monkeys played with each toy. Numbers allow direct comparison between groups or conditions.
- **Technique** (difference with Hassett et al.): Hölzel et al. used MRI scans of brain structure; Hassett et al. measured no physiology, only behaviour coded from video.
- **Ethics** (similarity with Hassett et al.): both followed the rules relevant to them: Hölzel et al. had approval from a hospital and medical school and gained informed consent from its human participants; Hassett et al. followed NIH guidance on housing and enrichment for animals.

7. Research methods applied to the study (2 questions)

- **Fatigue effect:** performance gets worse because a task is repeated or long, through boredom or tiredness (1). In Hölzel et al.: participants might get bored with the daily exercises and stop trying, or stop doing the homework before the end of the 8 weeks (1). Answering 39 FFMQ items twice is another example.
- **Withdrawal and validity:** see "Why the two withdrawals could reduce validity" above. Most students get the first mark (a smaller sample); the second needs what the loss did **in this study** (both were men; those who left might have been more stressed).

Worked examples

Example 1

From the study by Hölzel et al. (mindfulness and brain scans):

(a) Describe what participants in the MBSR group were asked to do during the 8 weeks of the course. [4]

(b) Outline one result about the FFMQ scores. [2]

(a) They took part in an MBSR course lasting 8 weeks, with a group class each week (1). They practised at home for 45 minutes a day (1). One exercise was the body scan, in which attention is moved through each part of the body in turn, noticing sensations without judging them (1). Another was mindful yoga, slow stretches done while paying attention to breathing (1). They also did sitting meditation and practised mindfulness informally in daily life, for example while eating or walking (further creditworthy points).

(b) After the course, the MBSR group's scores rose significantly on observing, acting with awareness and non-judging (1: **result**), whereas the control group's scores showed no significant change (1: **meaningful comparison**).

Example 2

From the study by Hölzel et al. (mindfulness and brain scans):

(a) Explain one strength of using MRI scans in this study. [2]

(b) Explain one ethical issue raised by the use of a control group in this study. [2]

(a) MRI gives an objective, quantitative measure of the brain that does not depend on what participants say **(1: strength identified)**. Scanning each person before and after the course showed the change in their grey matter concentration, such as the increase in the left hippocampus, which could not have been seen from questionnaire answers **(1: example from the study)**.

(b) Participants should be protected from psychological harm **(1: issue identified)**. The control group were given no course or help during the 8 weeks, so they went without what the MBSR group received, while still having to give up time for two MRI scans **(1: example from the study)**.

Example 3

(a) Outline one finding about grey matter from the study by Hölzel et al. (mindfulness and brain scans), and explain how it shows localisation of function. [3]

(b) Explain one similarity and one difference between the study by Hölzel et al. (mindfulness and brain scans) and the study by Hassett et al. (monkey toy preferences). Do not refer to the sample. [8]

(a) After the MBSR course, grey matter concentration increased in the left hippocampus, but not in the control group **(1: finding)**. The hippocampus is an area linked with learning, memory and controlling emotion **(1)**, skills that mindfulness practice trains, so the change happened in the specific area that does the job being practised, which supports the idea that functions are localised in the brain **(1)**.

(b) Similarity. Both studies collected quantitative data. Hölzel et al. measured grey matter concentration from MRI scans and scored the 39-item FFMQ before and after the course, and Hassett et al. recorded how often and for how long each monkey played with wheeled and plush toys. Because both produced numbers, the groups or conditions could be compared directly and objectively, for example MBSR against control, or males against females. **(Level 4: well explained, with an example from both studies.)**

Difference. The studies used different techniques. Hölzel et al. measured the brain itself, using MRI to see changes in its structure after mindfulness training. Hassett et al. measured no physiology at all: they filmed the monkeys' play and coded it afterwards with a behavioural checklist. So Hölzel et al. could show a physical change in the brain directly, while Hassett et al. could only infer the role of hormones from behaviour. **(Level 4.)**

Each point is worth 4 marks, so 8 in total. "They had different aims" would stay in Level 1, and "one used humans and one used monkeys" would score nothing, because the sample is banned.

Example 4

Evaluate the study by Hölzel et al. (mindfulness and brain scans) in terms of two strengths and two weaknesses. At least one of your evaluation points must be about reliability. [10]

Plan: strengths are reliability (the named issue) and the objective MRI data; weaknesses are generalisability and self-reports. Each paragraph has the point, two details from the study and why it matters.

Strength 1: reliability (the named issue). The procedure was standardised, so the study could be repeated and its results checked. Every MBSR participant followed the same 8-week course with the same exercises (body scan, mindful yoga, sitting meditation) and the same 45 minutes a day of home practice using audio recordings. Every participant, in both groups, had the same MRI scan and filled in the same 39-item FFMQ before and after. Because the measures were identical at both times, the before-and-after change in grey matter can be compared fairly, and another researcher could run the same course and scans to see whether the hippocampus increase appears again. (One limit: home practice was not supervised, so the amount and quality of practice varied between people.)

Strength 2: objective measurement with MRI. Grey matter concentration was measured by MRI scans before and after the course. The scan does not depend on participants' honesty or on a researcher's judgement, so the increases found in the left hippocampus, posterior cingulate cortex, temporo-parietal junction and cerebellum are objective, quantitative evidence that the brain's structure changed.

Weakness 1: generalisability. The MBSR group was only 16 people, all right-handed adults aged 25 to 55, with more women (10) than men (6), and all had chosen to join a course to reduce stress. Left-handed people may divide jobs between the halves of the brain differently, and children's brains are still developing, so the brain changes may not happen in the same way for them. The conclusions may therefore apply only to stressed, right-handed adults like these.

Weakness 2: self-reports. Mindfulness was measured with the FFMQ, and home practice was recorded by the participants themselves. People who had committed to an 8-week course might rate themselves as more mindful afterwards, or claim more practice than they did, to seem to have done well. This may be one reason no correlation was found between homework and grey matter change, and it means the FFMQ results may not show real changes in mindfulness.

How it would be marked: four points of equal depth, each with specific evidence from the study and an explanation of why it matters, including the named issue: Level 5 (9–10 marks). Leaving out reliability would cap it at 6.

Common mistakes

- **Confusing the body scan with the brain scan.** The body scan is a mindfulness exercise, attention moving through the body; only the brain went in the MRI scanner. The March 2025 report says most students made this mistake.
- **Calling it a laboratory experiment.** The scans were in a laboratory, but the course happened in people's normal lives. It was an experiment with a longitudinal design.
- **Mixing up medication and meditation** in the inclusion criteria: no **medication** at all; no **meditation** classes in six months.
- **Describing the facets when asked to describe the FFMQ.** That question wants 39 items, five facets (one named), the 1–5 scale and what 1 and 5 mean.
- **Generic applications.** "Use mindfulness with stressed people" names no one and says no "how". Say who, what finding and exactly how; mention MRI if scans are part of it.

- **Advice with no detail.** "Do mindfulness" earns nothing; say what the body scan, yoga or meditation involves, and give a time frame once.
- **Half an answer on the withdrawals.** "The sample is smaller" earns 1; add what it did here (both were men; those who left might have been more stressed).
- **Linking to the aim instead of a finding** when showing how the study supports an assumption, or linking to an assumption you didn't give in part (a).
- **Saying the study can't be replicated** because people practised differently at home. It could easily be run again; uncontrolled home practice is a **reliability** issue.
- **Comparing aims or species** in a comparison question, or naming MRI and EEG without saying what each measured.
- **Inventing results.** The insula did **not** change, and more homework did **not** go with more grey matter.

How to get the marks

- **"Identify" and "state"** need a short exact answer: a number, a criterion, a facet. Only the first answer is marked when one is asked for.
- **"Outline"** needs the point with a little detail: a 2-mark facet names it and says what it means; a 2-mark aim names the cause (MBSR) and the effect (grey matter).
- **"Describe"** needs several separate points, one mark each, with exact numbers (no tolerance on the inclusion criteria).
- **"Explain"** needs a reason and a link to this study: the strength or weakness (1 mark) and the example from Hölzel et al. (1 mark).
- **"Suggest"** wants something sensible that fits the study, not one fixed answer; read whether the question wants a reason "other than" something.
- **Applications:** what (from a finding) and how, for a named population, ethical; MRI named if scans are used.
- **Advice:** one mark per piece of advice based on the study; only one for naming a task, one for a time frame.
- **Comparisons** (8 marks): two points, each with an example from **both** studies and an explanation, obeying what is banned or required.
- **"Evaluate ... two strengths and two weaknesses"** (10 marks): four equal points, the named issue included, specific evidence in each, no description.

Quick check

1. State the number of men and women in the final MBSR group, and its total.
2. Calculate the percentage of the final MBSR group who were women.
3. Each FFMQ item is scored from 1 to 5. Calculate the lowest and highest total score a participant could get on the whole questionnaire.

4. Participants were asked to practise at home for 45 minutes a day for 8 weeks. Calculate how many hours of home practice this would be. Suggest one reason why participants may not all have done this amount, and what that means for the study.
5. Name two brain areas where grey matter increased in the MBSR group, and give one function of each.

Answers

1. 6 men and 10 women: **16** in the MBSR group.
2. $\frac{10}{16} \times 100 = \mathbf{62.5\%}$.
3. Lowest = $39 \times 1 = \mathbf{39}$; highest = $39 \times 5 = \mathbf{195}$.
4. $45 \times 7 \times 8 = 2520$ minutes = **42 hours**. Home practice was unsupervised and self-recorded, so some people may have been too busy to do it all, or may have over-reported it. The amount of mindfulness each person got was therefore not standardised, which fits the finding that the amount of homework did not correlate with the change in grey matter.
5. Any two of: the hippocampus (learning, memory and emotion regulation); the posterior cingulate cortex (thinking about yourself, mind-wandering); the temporo-parietal junction (perspective taking, empathy and compassion); the cerebellum (balance and coordination, and regulating emotion).

Past questions to try

- 9990/11/O/N/25 Q8: advice to a stressed friend, then a reason for one piece of advice.
- 9990/11/M/J/25 Q5: an assumption of the biological approach, and how a finding supports it.
- 9990/22/F/M/25 Q3: why two participants withdrawing could reduce validity.
- 9990/13/M/J/24 Q7: two problems if children had been the participants.