Course Companion

GRE Subject Test · GRE Psychology

Every topic handout in one volume

全部专题讲义合集

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Biological psychology

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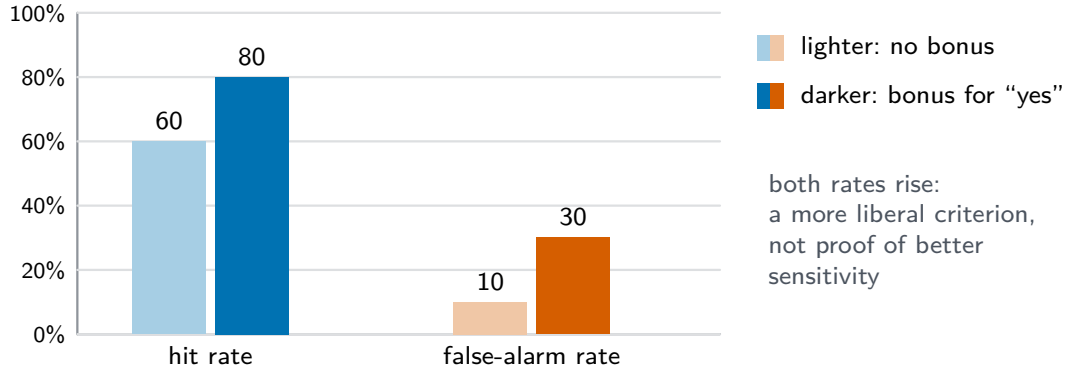
On 13 September 1848 Phineas Gage, a railway foreman in Vermont, was packing explosive into a rock with an iron rod over a metre long when the charge went off. The rod passed up through his left cheek and out of the top of his head, damaging much of the front of his brain. He survived, and could walk and talk within minutes. But his doctor reported that Gage, once careful and reliable, became impulsive and hard to work with: "no longer Gage". Historians now think the change was smaller and less permanent than the legend says. The case still shows the central claim of biological psychology: behaviour depends on the brain.

GRE Psychology biological questions ask you to:

- Separate **sensation** 感觉 from perception, and sensitivity from the **response criterion** 反应标准.
- Describe how neurons signal and how brain systems divide the work.
- Compare methods for studying the brain.
- Explain sleep, motivation and emotion with biological mechanisms.

Sensation and perception

- Sensation is the reception of stimulation: receptors convert energy into neural signals.
- Perception is the interpretation of those signals, using context and expectation.
- Signal detection theory separates how well a person can detect a signal (sensitivity, d') from how willing they are to say "yes" (the criterion). Rewards and expectations move the criterion.



Both rates rise together: a shifted criterion, not proof of better sensitivity.

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Neurons and brain systems

- A neuron fires an all-or-none action potential when its summed inputs reach threshold; at synapses, neurotransmitters carry the signal to the next cell.
- The brain divides work but uses networks: the hippocampus forms new memories, the amygdala supports fear learning, the hypothalamus controls drives, and the prefrontal cortex supports planning and control.
- One region's activity during a task does not show that it acts alone.

Studying the brain

- Lesion studies: damage, by accident or illness, shows what a region is needed for.
- EEG records electrical activity with millisecond timing but blurry location.
- fMRI shows where blood flow rises, with good location but a delay of seconds.
- Stimulation (such as TMS) changes activity briefly, so it can test causes.
- Imaging alone shows association: activity may cause, follow or merely accompany a task.

Sleep

- Sleep is timed by two processes: a roughly 24-hour **circadian rhythm** 昼夜节律, set by the suprachiasmatic nucleus and light, and sleep pressure that builds while we are awake.
- A night has cycles of about 90 minutes, through stages of non-REM sleep and REM sleep. Deep slow-wave sleep is greatest early in the night, REM later.
- REM sleep brings vivid dreams, rapid eye movements and paralysed muscles.

Motivation and emotion

- Hunger: the hypothalamus integrates signals such as blood glucose and hormones from fat and the gut. In rats, damage to the lateral hypothalamus reduces eating; damage to the ventromedial area leads to overeating.
- James–Lange theory: emotion follows awareness of the body's response. Cannon–Bard: body response and emotion happen together. Schachter–Singer two-factor theory: arousal plus a cognitive label produces emotion.
- Hormones and nerves interact with the environment; one hormone or one area rarely explains a behaviour fully.

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Worked example: an alarm bonus

In a fictional alarm task, a bonus for reporting alarms raises hits from 60% to 80% and false alarms from 10% to 30%.

- Before: $d' = z(0.60) - z(0.10) = 0.25 - (-1.28) = 1.53$.
- After: $d' = z(0.80) - z(0.30) = 0.84 - (-0.52) = 1.37$.
- Sensitivity did not improve; the criterion became more liberal. Hit rate alone would have misled.

Signal detection: four outcomes separate sensitivity from bias

	Signal present	Signal absent
Respond yes	Hit	False alarm
Respond no	Miss	Correct rejection

Four outcomes let sensitivity be measured separately from the bias towards saying yes

Worked example: a brain scan

A participant who slept little before a memory scan recalls less, and one region is less active.

- Explanation 1: lack of sleep reduced that region's activity, which reduced recall.
- Explanation 2: poor recall, from tiredness or lower effort, led to less activity in that region.
- Better design: randomly assign participants to normal sleep or sleep restriction, and compare recall and activity with effort measured.

Common errors

- Treating sensation and perception as the same thing.
- Reading a higher hit rate as better sensitivity.
- Treating an fMRI image as proof of a cause.
- Naming one brain area as the whole basis of a behaviour.
- Mixing up the James–Lange and Cannon–Bard theories.

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Key terms

sensation: The reception of stimulation by the sense organs.

response criterion: The level of evidence a person needs before reporting that a signal is present.

circadian rhythm: A roughly 24-hour cycle in body processes such as sleep and temperature.

Check yourself

- Which method gives the best timing of brain activity: EEG or fMRI?
- According to two-factor theory, what turns arousal into a specific emotion?
- When in the night is deep slow-wave sleep greatest?

Answers: EEG. A cognitive label for the arousal. Early in the night.

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Cognition, language and learning

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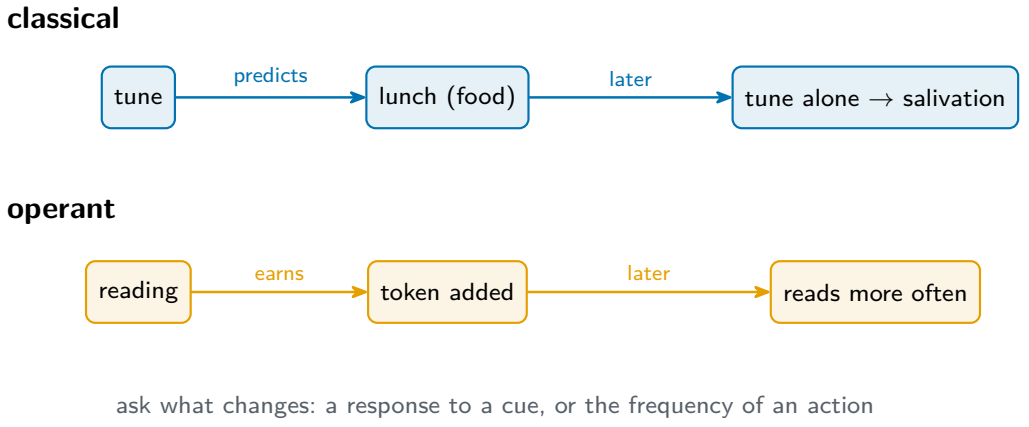
In the 1880s Hermann Ebbinghaus, in Berlin, memorised hundreds of lists of nonsense syllables such as “DAX” and “BOK”, chosen so that meaning could not help. He then measured how much faster he could relearn each list after delays from 20 minutes to a month. The time saved showed how much was still stored. Forgetting was fast at first and then slowed: most of the loss came within the first day. His 1885 book *On Memory* showed that higher mental processes could be studied by experiment.

GRE Psychology cognitive questions ask you to:

- Separate classical from operant conditioning, and reinforcement from punishment, including **negative reinforcement** 负强化.
- Describe working memory and long-term memory, and compare recall with **recognition** 再认.
- Name the levels of language, such as the phoneme and the **morpheme** 语素.
- Recognise heuristics and obstacles in problem solving.

Learning

- Classical conditioning: a cue comes to predict an event and produces a response. A tune that always comes before lunch comes to cause salivation.
- Operant conditioning: a consequence changes how often an action happens.
- Positive means adding, negative means removing. Reinforcement increases behaviour; punishment decreases it.
- Negative reinforcement removes something unpleasant and increases behaviour. It is not punishment.

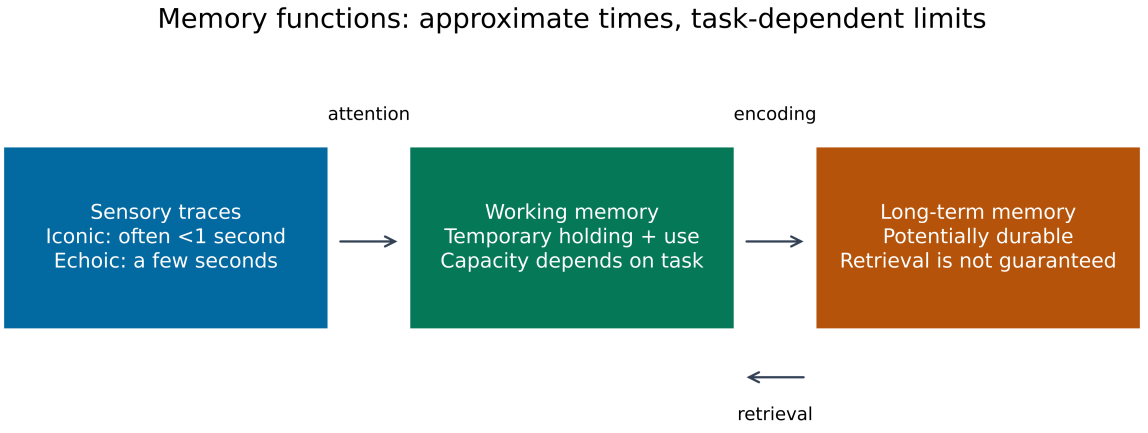


Classical: a cue predicts an event. Operant: a consequence changes an action’s frequency.

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Memory

- Sensory memory holds input for under a second to a few seconds; working memory holds a few items while we use them; long-term memory is lasting.
- Explicit memory is deliberate recall of events and facts; implicit memory appears in skills and priming.
- Recognition gives the answer as a cue, so it is usually easier than free recall. A failure to recall does not show that the memory is gone.



Attention moves information into working memory, encoding into long-term memory; retrieval is never guaranteed

Language

- Phonemes are sound units that change meaning (/b/ versus /p/); morphemes are the smallest units of meaning ("un-", "happy", "-ness").
- Syntax is word order and structure; semantics is meaning; pragmatics is meaning in context.
- Identify which level a task uses, rather than treating language as one ability.

Thinking

- Algorithms guarantee a solution; heuristics are fast shortcuts that can fail.
- Availability judges by ease of recall; representativeness judges by similarity and ignores base rates.
- Functional fixedness and mental set block new solutions.

Worked example: classifying learning

- A seat-belt alarm stops when the belt is fastened, and fastening becomes more frequent: negative reinforcement.
- A fine reduces speeding: positive punishment (something is added, behaviour falls).
- A child salivates when the lunch tune plays: classical conditioning.
- A child earns a token for reading and reads more: positive reinforcement. A pleasant event counts as reinforcement only if the behaviour increases.

Worked example: recall and recognition

Students cannot state a definition from memory, but give it at once when shown its first letter.

- The memory was stored; the problem was retrieval without a cue.
- The first letter acted as a retrieval cue.
- Compare free recall, cued recall and recognition for the same items to separate storage from retrieval.

Common errors

- Calling negative reinforcement punishment.
- Treating recognition and recall as the same measure.
- Confusing phonemes with morphemes.
- Calling every heuristic an error.
- Naming a learning process before identifying what changed.

Key terms

negative reinforcement: Increasing a behaviour by removing something unpleasant.

recognition: Identifying a previously learned item when it is presented again.

morpheme: The smallest unit of language that carries meaning.

Check yourself

- A child stops whining after losing screen time for it. What kind of consequence is this?
- Why is a multiple-choice test usually easier than a short-answer test on the same material?
- How many morphemes are in "teachers"?

Answers: negative punishment. Recognition supplies cues that free recall lacks. Three (teach, -er, -s).

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Social psychology

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In the early 1930s Richard LaPiere drove around the United States with a young Chinese couple, at a time of strong prejudice against Chinese people. They were refused service at only one of 251 hotels, restaurants and cafés. Six months later LaPiere wrote to the same places asking whether they would accept Chinese guests. Of those that replied, 92% said they would not. What people said and what they did were very different. His 1934 paper started a long debate about when attitudes predict behaviour.

GRE Psychology social questions ask you to:

- Use **attribution** 归因 to separate situational from dispositional causes.
- Separate **conformity** 从众 from obedience, and normative from informational influence.
- Explain when attitudes predict behaviour.
- Judge evidence about groups, with attention to selection and ethics.

Attribution

- A dispositional explanation points to the person ("she is careless"); a situational one points to the circumstances ("the road was icy").
- The fundamental attribution error over-uses dispositional explanations for other people.
- One action under strong pressure says little about a person's stable traits.

Social influence

- Normative influence: agreeing in public to be accepted, while privately doubting.
- Informational influence: agreeing because others seem to know, and coming to believe it.
- Obedience: following an instruction from an authority.
- The same public act can come from any of the three; private belief and the presence of an authority tell them apart.

	public act	private belief	source
normative	agrees	still doubts	peers (acceptance)
informational	agrees	now believes	peers (evidence)
obedience	complies	either	an authority's instruction

The same public act, three different routes.

Attitudes and behaviour

- Attitudes predict behaviour better when they are specific to the behaviour, strong, and measured close in time to it.
- General attitudes ("I care about the environment") predict specific acts (taking the bus today) weakly.
- Situational pressures, such as a customer standing in front of you, can override an attitude.
- Cognitive dissonance works the other way: behaviour can change attitudes.

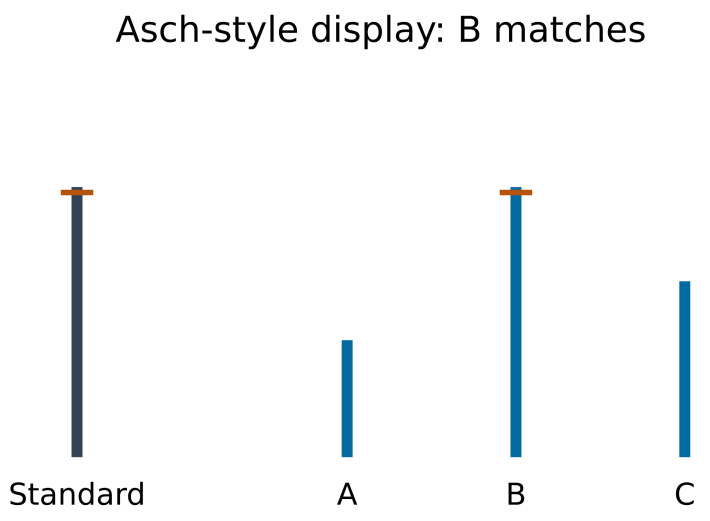
Groups

- Others' presence helps easy tasks and hurts hard ones (social facilitation); pooled effort falls (social loafing).
- Bystanders help less when there are more of them.
- Stereotypes (beliefs), prejudice (feelings) and discrimination (actions) are different.
- Group differences need careful evidence: who was sampled, what norms applied, and what opportunities people had.

Worked example: public and private answers

In an Asch-style task, a pupil gives the group's wrong answer aloud but writes the correct answer privately. No adult gave an instruction.

- The public–private difference fits normative influence.
- It is not obedience, because no authority gave an order.
- The motive (fear of rejection) is still an inference. Asking the pupil afterwards, or making answers anonymous, would test it.



Stimulus schematic; the drawing does not measure conformity.

The correct answer is unambiguous, so any conforming errors come from social pressure

Worked example: a generous club

Members of a volunteering club help more than non-members.

- This does not show that joining causes generosity. Generous people may choose to join (selection).
- A better design measures helping before and after joining, or compares people randomly offered membership with others not yet offered it.
- Any such study must obtain informed consent and avoid harm.

Common errors

- Inferring a stable trait from one action under pressure.
- Calling any group pressure obedience.
- Expecting general attitudes to predict specific actions well.
- Treating a correlation between group membership and behaviour as a cause.
- Using stereotype, prejudice and discrimination as synonyms.

Key terms

attribution: An explanation of the cause of behaviour, by the person or by the situation.

conformity: Changing behaviour or judgement to match a group.

Check yourself

- A soldier fires because an officer orders it. Conformity or obedience?
- Which attitude better predicts recycling next week: “I care about nature” or “I intend to recycle my bottles”?
- A student agrees with friends in public and changes her private view too. Which influence is this?

Answers: obedience. The specific intention. Informational influence.

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Developmental psychology

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In 1956 K. Warner Schaie began testing the mental abilities of adults in Seattle, from their twenties to their seventies. Comparing age groups at one time suggested that abilities fell steadily from early adulthood. But Schaie kept testing the same people every seven years. Followed individually, most people held their abilities until about 60 and declined only modestly before their mid-70s. The older groups had simply had less schooling when young. The Seattle Longitudinal Study became a classic lesson in how the design of a study can change its answer.

GRE Psychology developmental questions ask you to:

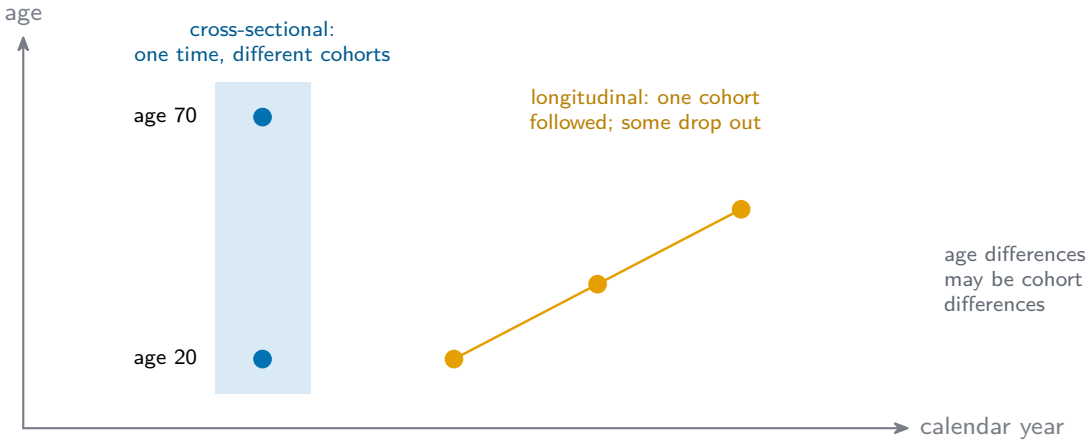
- Compare cross-sectional, longitudinal and sequential designs.
- Explain **cohort** 同龄群体 effects and **attrition** 样本流失.
- Apply the main developmental theories by their mechanisms.
- Interpret twin and adoption evidence on nature and nurture.

Development across the lifespan

- Development covers physical, cognitive, social and emotional change from conception to old age.
- Different domains change at different rates: vocabulary can grow in old age while processing speed declines.
- Averages describe groups; they are not deadlines for each child.

Research designs

- Cross-sectional: different age groups tested at one time. Quick, but age is confounded with cohort.
- Longitudinal: the same people followed over time. Shows real change, but loses participants and suffers practice effects.
- Sequential: several cohorts followed over time, which separates age from cohort.



Cross-sectional risks cohort effects; longitudinal risks attrition.

Theories

- Piaget: children actively build understanding, through stages of reasoning.
- Vygotsky: learning is social. The zone of proximal development is what a child can do with help but not yet alone; scaffolding is that help.
- Attachment theory (Bowlby, Ainsworth): the security of the caregiver relationship shapes exploration and later relationships.
- Erikson: eight psychosocial crises from infancy to old age.
- A stage label describes; the mechanism explains.

Piaget's proposed sequence: examples

1 Sensorimotor	2 Preoperational
Roughly birth to 2 years Action and perception Object permanence	Roughly 2 to 7 years Symbols and pretend play Focus on one feature
3 Concrete operations	**4 Formal operations**
Roughly 7 to 11/12 years Conservation Reversibility	From about 11/12 years Hypotheses Controlled comparisons

Approximate ages; one task does not establish a complete profile.

Piaget defined each stage by how the child reasons, with approximate ages

Nature and nurture

- Identical twins share all their genes, fraternal twins about half. If identical twins are more alike, genes contribute.
- Adopted children can be compared with biological and adoptive parents.
- **Heritability** 遗传力 is the share of variation in a trait within a population linked to genetic differences. It says nothing about an individual, and it can change when environments change.

Worked example: computers and age

A survey finds 20-year-olds use computers far more confidently than 70-year-olds.

- This is cross-sectional, so age is confounded with cohort: the older group grew up without computers.
- A longitudinal study of one cohort would separate ageing from experience, but people who find the tests hard may drop out, making the remaining group look better.
- A sequential design follows several cohorts and compares them at the same ages.

Worked example: hints

Children sort cards correctly with an adult's hints but not alone.

- In Vygotsky's terms, the task lies in their zone of proximal development; the hints are scaffolding.
- Record exactly which hints were given, and later test without them.
- Success with help does not yet show independent mastery.

Common errors

- Treating a cross-sectional age difference as change in individuals.
- Ignoring attrition in longitudinal studies.
- Using a stage name as an explanation.
- Applying heritability to one person.
- Treating average milestones as fixed deadlines.

Key terms

cohort: A group of people born in the same period, who share historical experiences.

attrition: The loss of participants during a study.

heritability: The proportion of variation in a trait, within a population, linked to genetic differences.

Check yourself

- Which design best separates age effects from cohort effects?
- Why might a longitudinal study overestimate how well older people do?
- Identical twins are more alike in a trait than fraternal twins. What does this suggest?

Answers: a sequential design. The people who drop out often score lower. Genes contribute to variation in the trait.

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Personality, clinical and abnormal psychology

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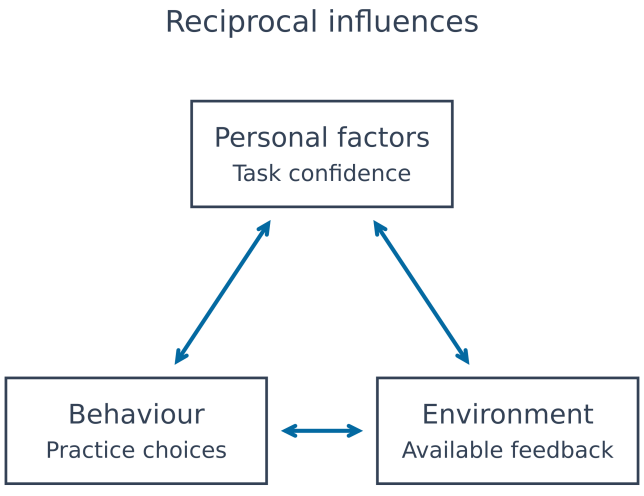
In 1968 Walter Mischel, at Stanford, reviewed decades of personality research and reached an uncomfortable conclusion. A person's score on a **trait** 人格特质 test rarely correlated with their behaviour in a particular situation at more than about 0.30. Someone honest in one setting might cheat in another. His book started the "person–situation debate". It ended with a compromise most researchers accept: traits predict well when behaviour is averaged over many situations, and situations matter a great deal for any single act.

GRE Psychology personality and clinical questions ask you to:

- Compare trait, psychodynamic, behavioural, cognitive and humanistic accounts of personality.
- Evaluate personality assessments.
- Use **differential diagnosis** 鉴别诊断: compare possible explanations of a presentation.
- Judge treatment evidence, which needs comparison groups.

Theories of personality

- Trait theories describe stable dimensions. The Big Five are openness, conscientiousness, extraversion, agreeableness and neuroticism.
- Psychodynamic theories (Freud and later analysts) stress unconscious processes and early experience.
- Behavioural accounts explain personality by learning histories.
- Social-cognitive accounts: Bandura's **reciprocal determinism** 交互决定论 says person, behaviour and environment influence one another. Self-efficacy is belief in one's ability to succeed at a task.
- Humanistic theories (Rogers, Maslow) stress growth and the self.



Bandura's reciprocal determinism: person, behaviour and environment influence one another

Assessment

- Self-report inventories (such as the MMPI) are standardised and reliable, but answers can be distorted by social desirability.
- Projective tests (such as the Rorschach inkblots) have weaker reliability and validity.
- Consistency across weeks shows reliability, not that the trait interpretation is valid.

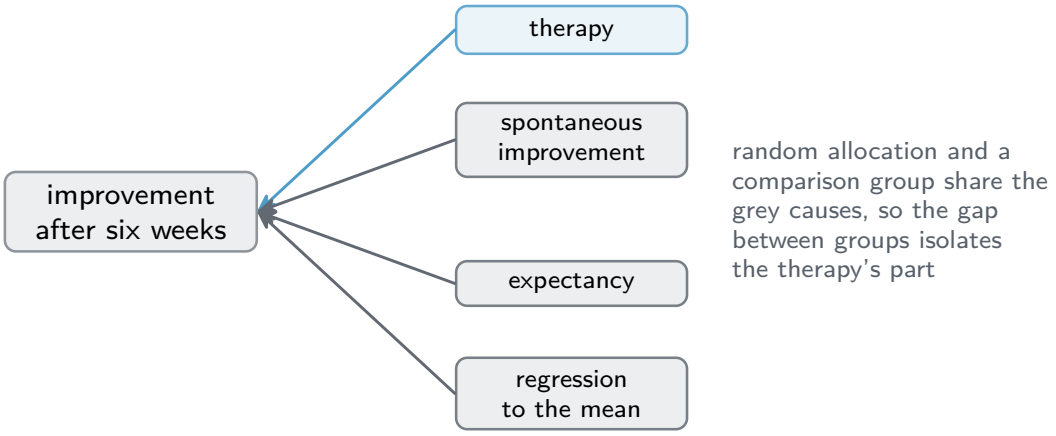
Clinical classification

- Diagnosis looks at a pattern: symptoms, duration, distress or impairment, context and exclusions.
- Differential diagnosis compares explanations that fit the same signs, such as a medical condition, a substance or another disorder.
- Categories describe patterns; they do not by themselves give causes.
- These lessons teach concepts. They are not for diagnosing yourself or others.

Treatment evidence

- Different therapies propose different mechanisms: cognitive approaches change thoughts, behavioural approaches change learning contingencies.
- A gain after treatment can come from the treatment, spontaneous improvement, expectation or regression to the mean.

- Random allocation to treatment or a suitable comparison separates these.



A pre-post gain bundles several causes.

Worked example: an uncontrolled programme

A support programme selects people with unusually high stress scores and reports a large fall after six weeks.

- Regression to the mean: people chosen for extreme scores tend to score less extremely next time.
- Spontaneous improvement: stress often falls with time.
- A useful comparison: randomly assign similar high scorers to the programme or to a waitlist.

Worked example: a self-report scale

A pupil's self-report scores are stable across weeks but change when a teacher is in the room.

- Stability shows reliability under similar conditions.
- The teacher's presence may raise social desirability: the pupil reports what seems acceptable.
- Use several methods and settings. Consistency alone neither validates a trait interpretation nor supports a diagnosis.

Common errors

- Treating one situation's behaviour as a full measure of a trait.
- Treating projective tests as equal in evidence to standardised inventories.
- Inferring a treatment effect from a before-and-after change alone.
- Treating a diagnostic label as an explanation.

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- Using classroom descriptions to diagnose real people.

Key terms

trait: A relatively stable dimension on which people differ.

reciprocal determinism: Bandura's idea that personal factors, behaviour and environment influence one another.

differential diagnosis: Comparing possible explanations for a clinical presentation.

Check yourself

- Name the five Big Five traits.
- Why do people selected for very high scores often score lower later, without treatment?
- Which has weaker reliability: the MMPI or the Rorschach?

Answers: openness, conscientiousness, extraversion, agreeableness, neuroticism. Regression to the mean. The Rorschach.

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Measurement, methods, statistics and history

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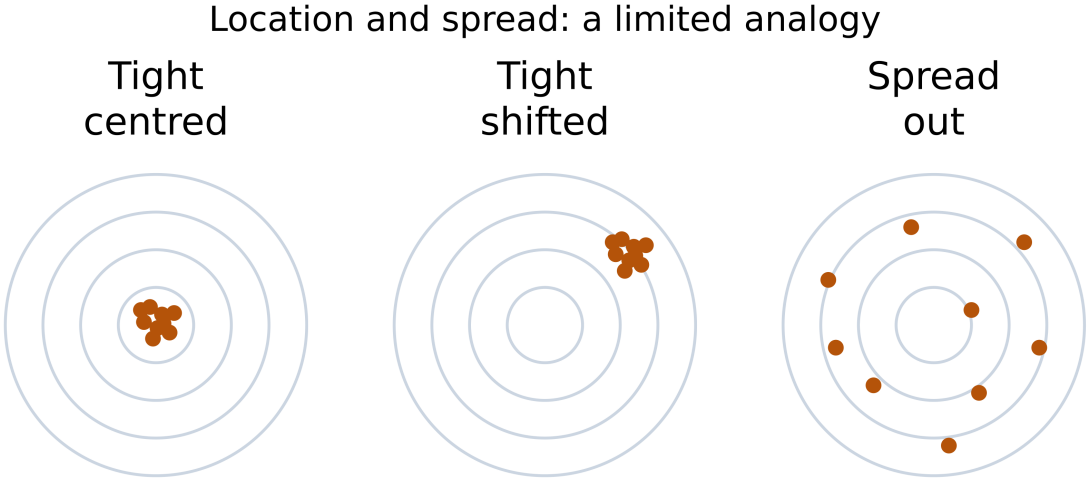
In 2015 a team of 270 researchers, the Open Science Collaboration, repeated 100 studies from three leading psychology journals as closely as they could. In the original papers, 97 of the studies had reported significant results. In the repeats, only about 36 did, and the effects were on average about half as large. The project did not show that the original researchers had cheated. It showed that small samples, flexible analysis and a habit of publishing only "positive" results can make findings look stronger than they are. Careful measurement and design are how psychology protects itself.

GRE Psychology methods questions ask you to:

- Write operational definitions and judge **reliability** 信度 and **validity** 效度.
- Separate random sampling from random assignment.
- Describe data with averages and spreads.
- Interpret p-values, effect sizes and **statistical power** 统计检验力.
- Apply research ethics.

Measurement

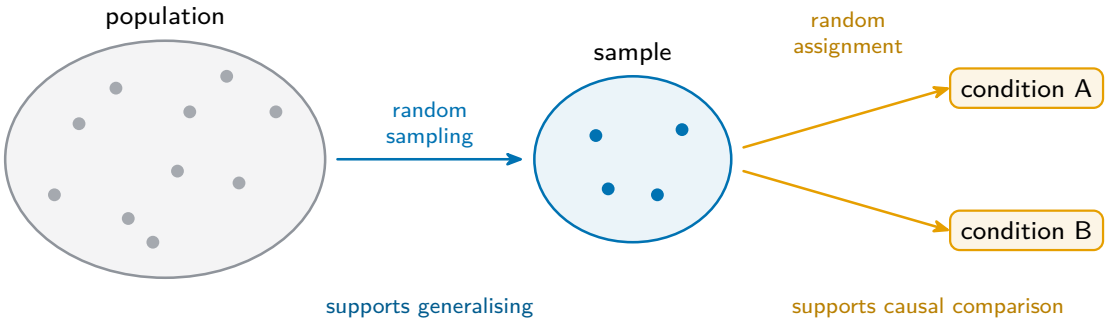
- An operational definition says exactly how a construct is measured: "anxiety" as a score on a named scale, or as heart rate during a speech.
- Reliability is consistency; validity is evidence that the scores mean what is claimed.
- Naming a questionnaire "memory test" does not make it one.



Tight grouping is like reliability, being on target like validity: a test can be reliable but not valid

Sampling and assignment

- Random sampling decides who enters the study. It supports generalising to the population.
- Random assignment decides which condition each participant gets. It supports causal conclusions.
- Volunteers randomly assigned to conditions give a fair comparison, but only for people like the volunteers.



Two different random steps answer two different questions.

Describing data

- Mean, median and mode describe the centre. With a long right tail (such as income), the mean is pulled above the median.
- Standard deviation describes spread. In a normal distribution about 68% of scores lie within 1 SD of the mean.
- A correlation runs from -1 to $+1$; it describes a linear association, not a cause.

Inference

- A p-value is the probability of data at least this extreme if the null hypothesis were true. It is not the probability that the null hypothesis, or a theory, is true.
- An effect size, such as Cohen's d (the difference in means divided by the SD), describes how large an effect is. Significance does not.
- Power is the probability of detecting a real effect. Small samples have low power, and their significant results tend to overestimate effects.

Ethics and history

- Ethics requires informed consent, the right to withdraw, minimal risk, confidentiality and debriefing; review boards approve studies first. Deception must be justified and explained afterwards.
- History questions match schools to their questions and methods: structuralism (elements of experience), functionalism (purposes), behaviourism (observable behaviour), Gestalt (organised wholes), cognitive psychology (information processing).

Worked example: a reliable test

A "memory test" gives very similar scores when repeated, but scores depend mostly on reading skill.

- It has test–retest reliability.
- It lacks validity evidence for the memory interpretation.
- Validity needs more: correlations with other memory measures, and weak correlations with reading once memory is controlled.

Worked example: misreading p

A report finds $p = 0.03$ and claims its theory has a 97% chance of being true and a large effect.

- Wrong: p is the probability of such data if the null were true, not the probability that the theory is true.
- Wrong: p does not measure size. Report an effect size with a confidence interval.
- With a small sample and many analyses tried, the result may not replicate.

Common errors

- Treating random assignment as random sampling.
- Treating reliability as validity.
- Reading p as the probability that a hypothesis is true.
- Calling a significant result large or important without an effect size.
- Using the mean to describe a strongly skewed distribution.

Key terms

reliability: The consistency of a measure.

validity: Evidence that a measure supports its intended interpretation.

statistical power: The probability that a study detects an effect that really exists.

Check yourself

- Most students are aged 18–20, but a few are over 50. Which is larger, the mean age or the median?
- Which random step supports causal conclusions?
- A huge study finds a significant but tiny effect. What should be reported as well as p?

Answers: the mean. Random assignment. The effect size, with its confidence interval.

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Historical perspectives and psychometric interpretation

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In 1904 the French Ministry of Education asked Alfred Binet to find a way to identify children who needed extra help at school. With Théodore Simon he built a set of tasks of rising difficulty, from following a lit match with the eyes to explaining abstract words, and in 1905 published the first practical intelligence test. Binet warned that the score described present performance, not a fixed quantity, and that it should be used to help children. Much of psychological testing since then has turned on the questions he raised: what does a score mean, and for what use?

GRE Psychology questions on perspectives and test interpretation ask you to:

- Compare the explanations offered by the main perspectives in psychology.
- Separate **reliability** 信度 from **validity** 效度.
- Tell a **percentile** 百分位数 from a percentage correct, and norm-referenced from criterion-referenced scores.
- Find the **positive predictive value** 阳性预测值 of a screening test from base rates.

Perspectives

Each perspective asks a different question about the same behaviour.

- Biological: which brain systems, genes and hormones are involved?
- Behavioural: what learning history and consequences shape it?
- Cognitive: what information processing produces it?
- Psychodynamic: what unconscious conflicts drive it? Humanistic: how does it relate to growth and choice?
- These are complementary emphases, not rival labels for the same claim. One observation rarely settles which is “right”.

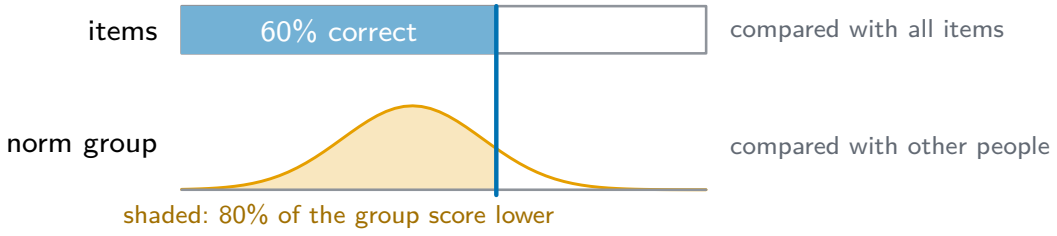
Reliability and validity

- Reliability is consistency: the same person gets similar scores on retesting, on another form, or from another scorer.
- Validity is evidence that scores support a particular interpretation and use.
- A test can be reliable without being valid: a consistent scale that measures something else. It cannot be valid for a use without being reliable.

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Norms and standards

- Standardisation means the same instructions, timing and scoring for everyone, and a reference (norm) group.
- A norm-referenced score compares a person with the norm group. A criterion-referenced score compares performance with a fixed standard, such as "can solve linear equations".
- A percentile is the percentage of the norm group scoring lower. A percentage correct is the share of items answered correctly. They can differ widely.
- The norm group must fit the people tested: norms from one country or age group may mislead for another.



Percent correct compares with items; percentile compares with people.

Screening and base rates

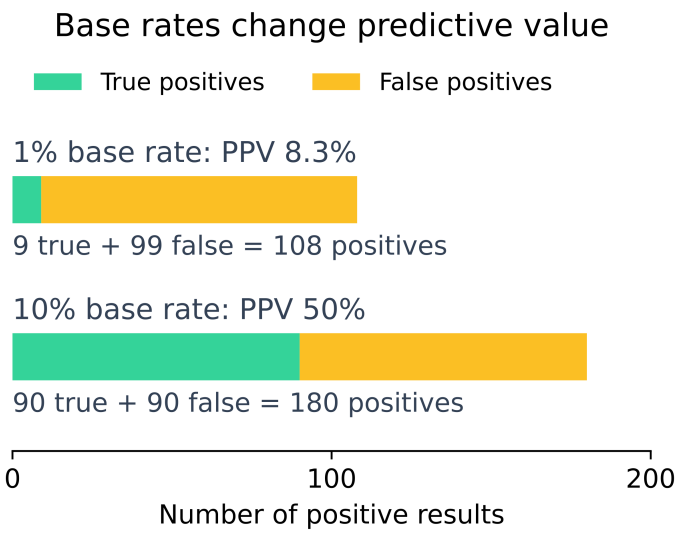
- Sensitivity: the share of people with the condition who test positive.
- Specificity: the share of people without it who test negative.
- Positive predictive value: the share of positive results that are correct. It depends strongly on how common the condition is.

Worked example: a rare condition

In 1,000 people, 10 have a condition. A screen detects 9 of them and wrongly flags 99 of the other 990.

- Sensitivity is $9/10 = 90\%$, and specificity is $891/990 = 90\%$.
- There are $9 + 99 = 108$ positive results, of which only $9/108 = 8.3\%$ are correct.
- If 100 of the 1,000 had the condition, the same test would give 90 true and 90 false positives: a predictive value of 50%.

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1,000 people; sensitivity = specificity = 90%.

The same test means far more when the condition is common: base rates set the predictive value

Worked example: two numbers for one score

A student answers 60% of a hard test correctly and is at the 80th percentile.

- These are not contradictory: 60% compares the score with the items, and the 80th percentile compares it with other students.
- On a hard test, many students score below 60%.
- Report which comparison is meant, and which norm group.

Common errors

- Equating sensitivity with the chance that a positive result is correct.
- Treating high reliability as proof of validity.
- Confusing a percentile with a percentage correct.
- Using norms from a group that does not match the people tested.
- Treating perspectives as competing answers to the same question.

Key terms

reliability: The consistency of scores across repeated measurement.

validity: Evidence that test scores support a particular interpretation and use.

percentile: The percentage of a norm group that scores below a given score.

positive predictive value: The share of positive test results that are correct.

Check yourself

- A scale always reads 2 kg too heavy. Is it reliable, valid, both or neither?
- A screen flags 18 of 20 true cases and 198 of 1,980 others. What fraction of positives are true cases?
- Which kind of score says whether a student can drive safely: norm-referenced or criterion-referenced?

Answers: reliable but not valid. $18/216 = 8.3\%$. Criterion-referenced.

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Diagnostic systems and disorder classification

GRE Subject Test · GRE Psychology

In the late 1960s the US–UK Diagnostic Project showed the same videotaped patient interviews to psychiatrists in New York and London. The New York psychiatrists diagnosed schizophrenia far more often; the London psychiatrists more often diagnosed mood disorders. The patients were the same, so the difference lay in how the psychiatrists classified. Findings like this led the American Psychiatric Association to publish DSM-III in 1980, with explicit lists of **diagnostic criteria** 诊断标准 for each disorder. The aim was that two clinicians seeing the same person would reach the same diagnosis.

GRE Psychology questions on classification ask you to:

- Describe how DSM classification works and what it does not claim.
- Use all the parts of a diagnostic description: symptoms, duration, impairment and exclusions.
- Apply the **diathesis–stress model** 素质-应激模型.
- Separate positive and negative symptoms, and episodic from lasting patterns.

How classification works

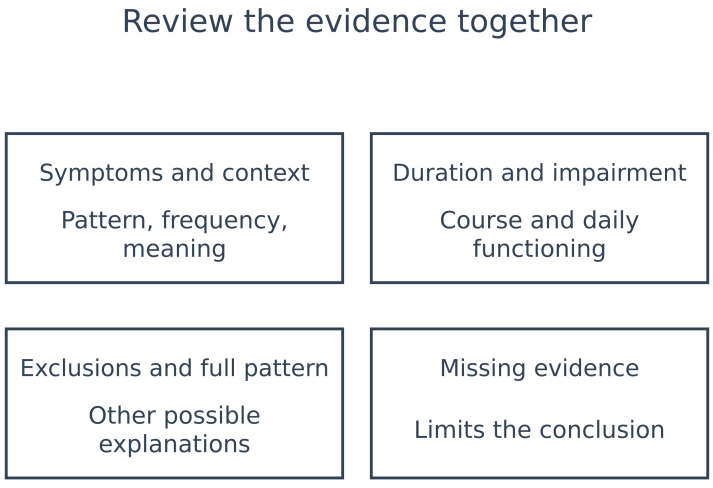
- The current US system is DSM-5-TR (2022). The World Health Organization's ICD-11 is used in much of the world.
- A diagnosis describes a pattern. It does not by itself explain the cause.
- Explicit criteria improve **diagnostic reliability** 诊断信度, the agreement between clinicians. Reliable classification is not automatically valid.
- GRE practice items were written for an earlier edition, so check which version a question assumes.

The parts of a criterion

A diagnosis needs the whole pattern, not one feature.

- Symptoms: what is experienced and observed.
- Duration: how long it has lasted. For example, a major depressive episode needs at least two weeks; acute stress disorder covers three days to one month after a trauma, and PTSD lasts more than a month.
- Clinically significant distress or impairment in daily life.
- Exclusions: the pattern is not better explained by a substance, a medical condition or another disorder.

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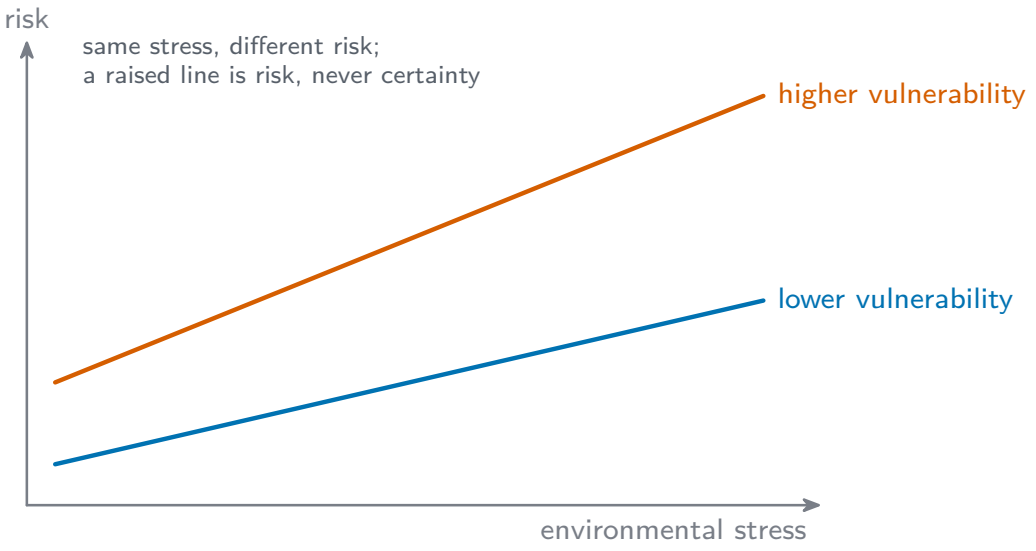
Educational evidence domains: an incomplete vignette does not establish a diagnosis.

Diathesis and stress

The diathesis–stress model says risk depends on a vulnerability (the diathesis) and on stress, together.

- A vulnerability can be genetic, biological or psychological, such as a family history or a pessimistic style of thinking.
- Stress can be a loss, illness or long-term pressure.
- Neither makes an outcome inevitable. People with high vulnerability need less stress to be affected; people with low vulnerability may stay well under heavy stress.

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Vulnerability and stress combine to shape risk; neither makes an outcome inevitable.

Useful distinctions

- Positive symptoms add experiences, such as hallucinations and delusions in schizophrenia. Negative symptoms reduce functions, such as flat emotion and loss of motivation.
- Episodic conditions come and go (many mood disorders); personality disorders describe lasting patterns from early adulthood.
- Anxiety disorders centre on fear and worry; mood disorders on depression or mania.

Worked example: an incomplete vignette

A fictional student had a frightening accident last week and now sleeps badly and avoids the road where it happened.

- The vignette gives an event and two symptoms.
- It does not give impairment, the full symptom pattern or exclusions, and one week is short.
- The correct response is to name what is missing. A classroom vignette cannot establish a diagnosis, and real people should be assessed by a qualified clinician.

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Worked example: two siblings

Two fictional siblings share a family history of depression. One loses a parent and a job in the same year and develops depression; the other does not.

- The diathesis–stress model explains the difference: same vulnerability, different stress.
- It does not predict that the second sibling is protected for ever, or that the first was certain to become ill.
- Protective factors, such as social support, also matter.

Common errors

- Treating a diagnosis as an explanation of its own cause.
- Deciding on duration or a few symptoms alone.
- Confusing reliability (agreement) with validity (meaning).
- Reading a family history as destiny.
- Calling hallucinations negative symptoms.

Key terms

diagnostic criteria: The required symptoms, duration, impairment and exclusions for a classification.

diagnostic reliability: The degree to which different clinicians give the same diagnosis to the same person.

diathesis–stress model: The idea that a vulnerability and stress together shape the risk of a disorder.

Check yourself

- Are delusions positive or negative symptoms?
- What did DSM-III change in 1980, and why?
- Does a vulnerability alone cause a disorder, in the diathesis–stress model?

Answers: positive. It introduced explicit criteria, to improve agreement between clinicians. No: stress is also needed.

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Treatment models and outcome evidence

GRE Subject Test · GRE Psychology

In 1952 Hans Eysenck, in London, reviewed reports on psychotherapy and claimed that about two thirds of people with neurotic problems improved within two years whether or not they received therapy. If so, therapy added nothing. His paper provoked a generation of controlled studies. In 1977 Mary Lee Smith and Gene Glass combined the results of 375 of them in one of the first meta-analyses: the average treated person ended up better off than about 75% of untreated people. Eysenck's challenge made the field ask the right question: better than what?

GRE Psychology treatment questions ask you to:

- Match each therapy to its proposed mechanism.
- Choose techniques that fit common problems.
- Explain why outcome studies need control groups.
- Separate efficacy from effectiveness, and evaluate the **common factors** 共同因素 view.

Therapy families

- Psychodynamic: uncover unconscious conflict and early relationships, often through transference (feelings toward the therapist that echo earlier relationships). Object-relations approaches focus on early relationships in particular.
- Behavioural: apply learning principles. Systematic desensitisation pairs a graded list of feared situations with relaxation: **counterconditioning** 对抗性条件作用. Exposure therapy uses repeated contact without needing relaxation.
- Cognitive-behavioural (Beck, Ellis): identify and test distorted thoughts, and plan rewarding activities.
- Humanistic: Rogers's person-centred therapy offers empathy, unconditional positive regard and genuineness. Gestalt therapy focuses on the here and now.
- Biological: medication, and for severe depression that has not responded to other treatment, electroconvulsive therapy.

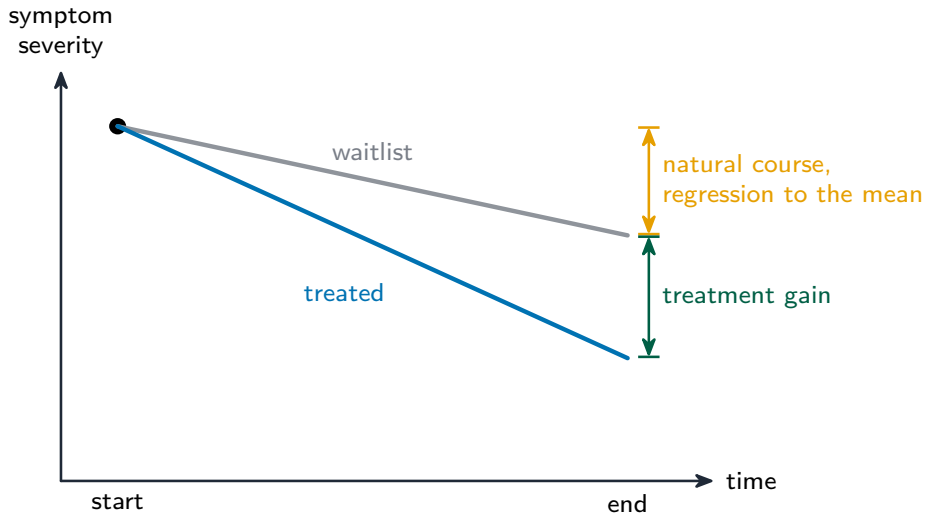
Matching technique to problem

- Specific phobia: graded exposure.
- Obsessive-compulsive disorder: exposure with response prevention (facing the trigger without performing the ritual).
- Depression: cognitive restructuring together with behavioural activation; medication for some.
- A question naming a therapist's theory usually expects its matching method: an object-relations therapist focuses on early relationships, not on medication.

Why controls are needed

People seek help when they feel worst, so many improve anyway.

- **Spontaneous remission** 自发缓解: problems ease without treatment.
- **Regression to the mean** 均值回归: extreme scores tend to be followed by less extreme ones.
- A randomised controlled trial compares treatment with a waitlist, a placebo or another treatment. Only the difference between groups is the treatment's effect.



schematic: people enrol at their worst and improve anyway

Only the gap between the groups is the treatment's effect.

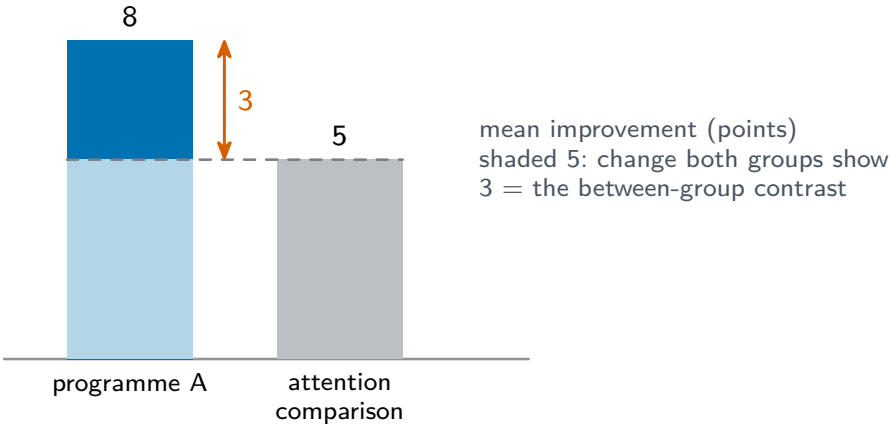
Efficacy, effectiveness and common factors

- Efficacy: how well a treatment works under controlled trial conditions.
- Effectiveness: how well it works in everyday practice, with ordinary patients and therapists.
- Meta-analysis combines many trials for a more stable estimate, but cannot fix weak trials.
- When different genuine therapies give similar average results, the common-factors view credits shared ingredients: the working alliance between therapist and client, hope and empathy. Similar averages do not prove that the mechanisms are identical.

Worked example: a between-group contrast

In a fictional randomised study, mean improvement is 8 points with programme A and 5 points with an attention-only comparison.

- The effect is the difference: $8 - 5 = 3$ points.
- The 8-point gain includes the 5 points that also happened in the comparison group.
- The result supports a relative benefit under these conditions. It does not show the mechanism, or that A is better everywhere.



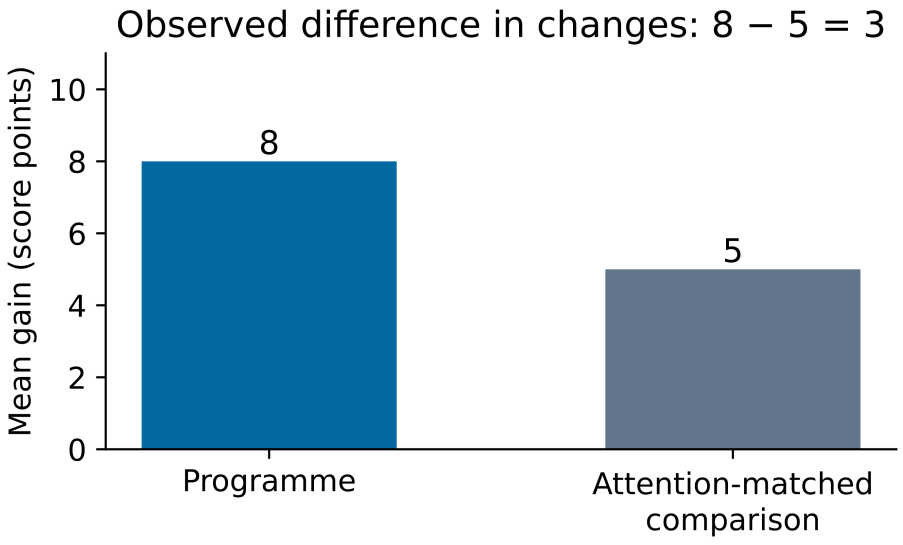
The contrast is the gap between groups, not the 8-point gain.

Worked example: reading a claim

A clinic reports that clients' anxiety scores fell by 40% from the first to the last session.

- Without a control group, spontaneous remission and regression to the mean could explain much of the fall.
- People who dropped out may have done worse, so the remaining clients may not be typical.
- A randomised comparison with similar attention and expectations is needed before crediting the technique.

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Fictional classroom example; no causal design or uncertainty supplied.

Original fictional programme contrast: eight minus five equals three improvement points.

Common errors

- Inferring that a treatment works from before-and-after change alone.
- Treating similar averages as proof of identical mechanisms.
- Confusing efficacy with effectiveness.
- Saying systematic desensitisation needs no relaxation; that describes exposure therapy.
- Matching a therapy to the wrong mechanism.

Key terms

counterconditioning: Replacing a conditioned response by pairing the stimulus with an incompatible response, such as relaxation.

spontaneous remission: Improvement without treatment.

regression to the mean: The tendency of extreme scores to be followed by scores closer to the average.

common factors: Ingredients shared by many therapies, such as the working alliance and hope, proposed to explain similar outcomes.

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Check yourself

- A therapist asks a client to touch a "contaminated" doorknob and not wash. What is the technique?
- Why does a waitlist group improve at all?
- What is the difference between efficacy and effectiveness?

Answers: exposure with response prevention. Spontaneous remission and regression to the mean. Efficacy is under trial conditions; effectiveness is in everyday practice.

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Psychometrics and test construction

GRE Subject Test · GRE Psychology

In 1917, when the United States entered the First World War, Robert Yerkes and a team of psychologists tested about 1.75 million army recruits in groups. Recruits who could read took the written Army Alpha; those who could not took the picture-based Army Beta. It was the first mass testing in history. It also showed what can go wrong: questions assumed knowledge of American culture, and the results were later misused in arguments for restricting immigration. Good test construction asks not only whether a test is consistent, but whether it measures what it claims for the people who take it.

GRE Psychology psychometrics questions ask you to:

- Name the kind of reliability from the design that produced it.
- Use the Spearman–Brown formula and the **standard error of measurement** 测量标准误.
- Separate content, criterion and **construct validity** 构想效度.
- Convert between z-scores, T-scores and deviation IQ, and read item statistics.

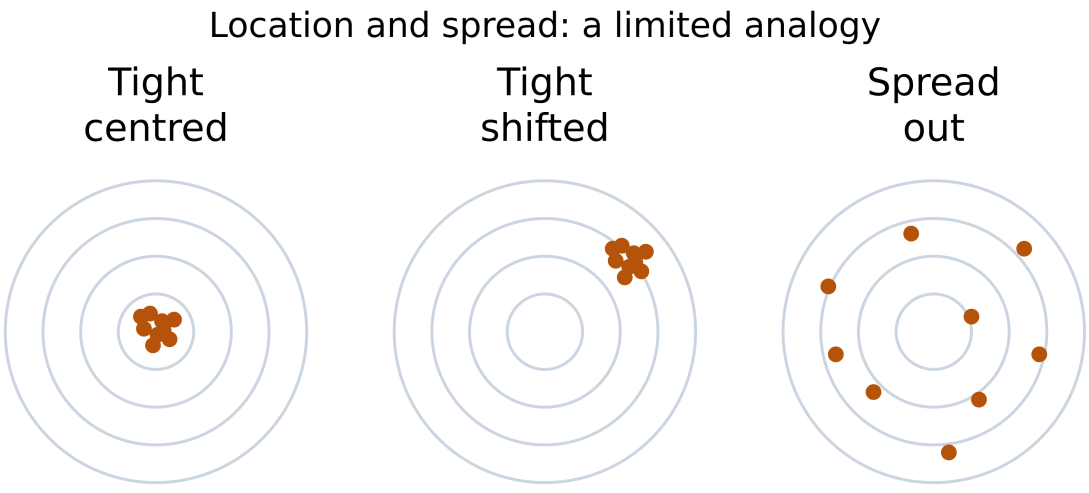
Reliability

The type of reliability is named by the source of variation it studies.

- Test–retest: the same test given twice.
- Alternate forms: two similar versions of the test.
- Internal consistency: agreement among items in one sitting (split-half, Cronbach's alpha).
- Inter-rater: agreement between scorers. A high correlation shows that raters rank people the same way, not that they give the same scores.
- Spearman–Brown: a half-test correlation r predicts a full-test reliability $\dfrac{2r}{1+r}$.

Validity

- Content validity: the items cover the domain fairly.
- Criterion validity: scores predict an outcome, now (concurrent) or later (predictive).
- Construct validity: convergent evidence (correlates with related measures) and discriminant evidence (does not correlate with unrelated ones).
- Reliability limits validity, but never establishes it.

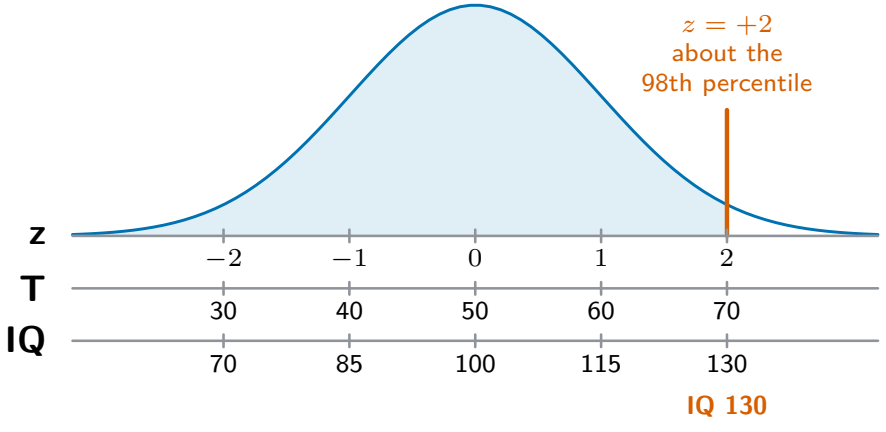


Tight grouping is like reliability, being on target like validity: a test can be reliable but not valid

Standard scores

$$z = \frac{X - \bar{X}}{SD}, \qquad T = 50 + 10z, \qquad IQ = 100 + 15z$$

- $z = +2$ gives $T = 70$ and IQ 130, about the 98th percentile.
- About 68% of scores lie within 1 SD of the mean, and 95% within 2 SD.
- Standard scores describe relative position. They do not show that a test is fair across groups.



One curve, three scales: $T = 50 + 10z$ and $IQ = 100 + 15z$.

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Measurement error

$$SEM = SD\sqrt{1 - r}$$

- The standard error of measurement describes how far observed scores spread around a person's true score.
- A band of ±1 SEM around a score covers the true score about 68% of the time; ±2 SEM about 95%.
- It is not the standard error of a sample mean.

Item analysis

- Item difficulty p: the proportion who answer correctly. Items with p near 0 or 1 tell you little.
- Item discrimination: the correlation between the item and the total score. A negative value suggests a wrong key or a misleading item.

Worked example: reliability

- Two similar vocabulary tests a week apart correlate at 0.90: alternate-forms reliability, because the form changed.
- A split-half correlation of 0.80 predicts a full-length reliability of $2(0.80)/1.80 = 0.89$.
- With SD = 15 and $r = 0.91$: $SEM = 15\sqrt{0.09} = 4.5$ points.

Worked example: a score

A fictional scale has mean 50, SD 10 and reliability 0.84. A student scores 65.

- $z = (65 - 50)/10 = 1.5$; $T = 50 + 10(1.5) = 65$.
- $SEM = 10\sqrt{0.16} = 4$ points, so a 95% band is about 57 to 73.
- The band describes measurement uncertainty, not validity.

Common errors

- Calling a two-form correlation test–retest reliability.
- Citing high reliability as validity evidence.
- Reading a high inter-rater correlation as exact agreement.
- Confusing the SEM with the standard error of a mean.
- Keeping items with negative discrimination.

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Key terms

standard error of measurement: The expected spread of observed scores around the true score, $SD\sqrt{1-r}$.

construct validity: Convergent and discriminant evidence that scores reflect the intended trait.

Check yourself

- What IQ corresponds to $z = -1$?
- A test has SD 20 and reliability 0.75. What is its SEM?
- A new anxiety scale correlates 0.7 with an older anxiety scale and 0.05 with height. What kind of evidence is this?

Answers: 85. $20\sqrt{0.25} = 10$. Construct validity (convergent and discriminant).

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Research designs and statistical interpretation

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At a summer tea party in Cambridge in the 1920s, the biologist Muriel Bristol said she could taste whether the milk had been poured into the cup before or after the tea. The statistician Ronald Fisher proposed a test: eight cups, four of each kind, in a random order. If she was only guessing, the chance of sorting all eight correctly is 1 in 70. She is said to have got them all right. Fisher used the story to open his 1935 book *The Design of Experiments*, where he argued that **random assignment** 随机分配 is what makes a fair test possible.

GRE Psychology methods questions ask you to:

- Tell experiments from quasi-experiments and correlational studies.
- Separate internal validity from external validity.
- Choose an analysis that fits the design.
- Read main effects and the **interaction effect** 交互作用.
- Interpret p-values, effect sizes and errors correctly.

Designs

- A true experiment manipulates an independent variable and assigns participants to conditions at random.
- Between-subjects: different people in each condition. Within-subjects: the same people in every condition, which needs **counterbalancing** 平衡抵消 of the order.
- A quasi-experiment compares groups that were not randomly assigned, such as two existing classes.
- A correlational study measures without manipulating. Correlation does not show causation or which came first.

Two kinds of randomness

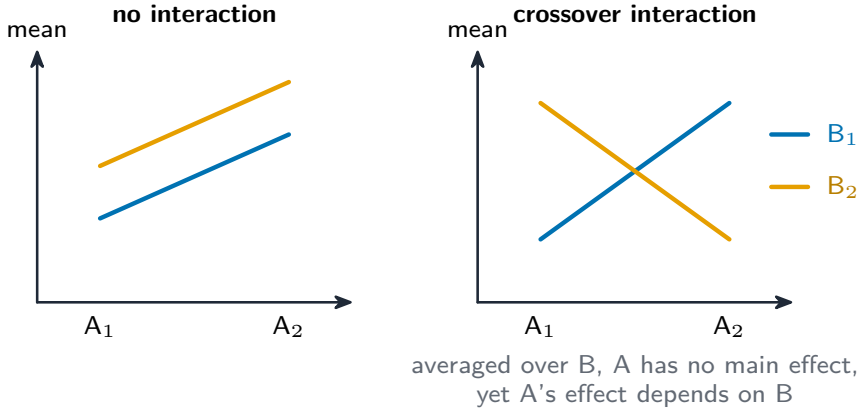
- Random assignment supports **internal validity** 内部效度: confidence that the manipulation caused the difference.
- Random sampling supports **external validity** 外部效度: confidence that results apply to the wider population.
- A study can have one without the other.

Matching the analysis

- Two independent groups, quantitative scores: an independent-samples t-test.
- The same people measured twice: a paired t-test.
- Several factors: analysis of variance (ANOVA).
- Counts in categories: chi-square, if expected counts are large enough.
- Associations: correlation or regression, which still do not show causation.

Main effects and interactions

- A main effect is the effect of one factor averaged over the other.
- An interaction means the effect of one factor depends on the level of the other. On a graph of means, the lines are not parallel.
- An interaction can exist even when every main effect is zero.



Crossing lines can hide an interaction behind cancelled main effects.

Reading statistics

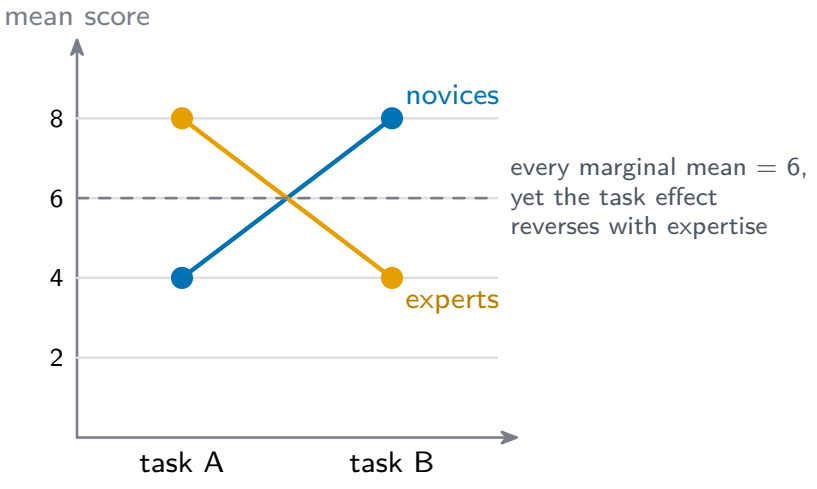
- A p-value is the probability of results at least this extreme if the null hypothesis and the model's assumptions were true. It is not the probability that the null hypothesis is true.
- Statistical significance is not effect size. A tiny effect can be significant in a huge sample.
- Type I error: rejecting a true null hypothesis. Type II error: failing to reject a false one.
- A mean of 26 with most students aged 25 or younger suggests right skew, but does not prove the shape.

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Worked example: a crossover

Fictional mean scores: on task A, novices score 4 and experts 8; on task B, novices 8 and experts 4.

- Novices average $(4 + 8)/2 = 6$; experts average 6. Each task also averages 6.
- So there is no main effect of expertise or of task.
- Yet the task effect reverses with expertise: a complete interaction.

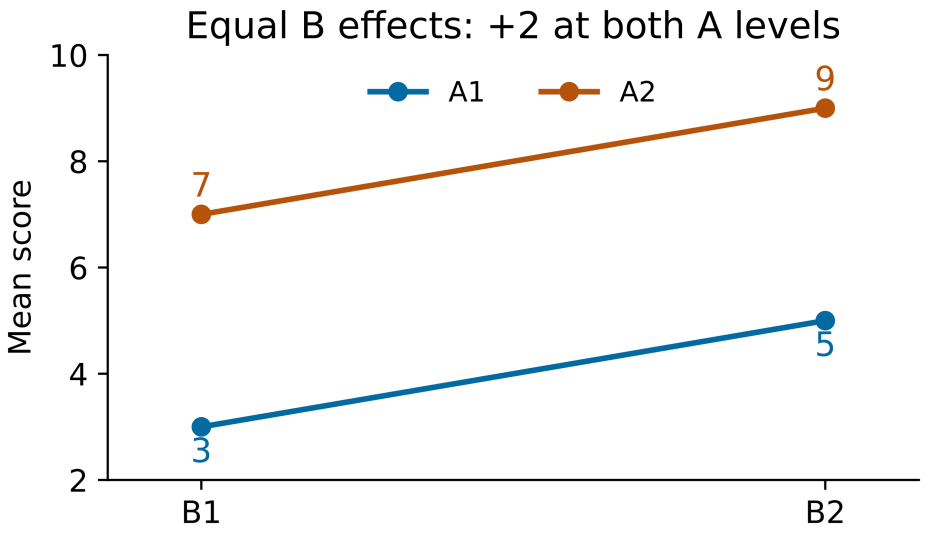


Equal marginal means can hide a full interaction.

Worked example: parallel lines

Means of 3 and 5 at level A1, and 7 and 9 at A2, across B1 and B2.

- B adds 2 points at both levels of A, and A adds 4 points at both levels of B.
- The lines are parallel: two main effects and no interaction.
- If the same 24 people gave all the scores, the 48 scores are not independent. A repeated-measures analysis is needed.



Invented balanced examples; no significance test is shown.

Parallel lines mean B adds +2 at both levels of A: main effects and no interaction

Common errors

- Drawing causal conclusions from a correlational study.
- Confusing random assignment with random sampling.
- Treating paired scores as independent.
- Reporting an interaction as a main effect of one factor.
- Reading p as the probability that the null hypothesis is true.

Key terms

random assignment: Allocating participants to conditions by chance.

counterbalancing: Varying the order of conditions across participants so that order effects cancel.

internal validity: Confidence that the manipulated variable caused the observed difference.

external validity: Confidence that results generalise beyond the study.

interaction effect: A pattern in which the effect of one factor depends on the level of another.

Check yourself

- A study compares two existing schools. Is it a true experiment?
- Which kind of randomness supports causal conclusions?
- On a graph of means the lines cross. What does this suggest?

Answers: no, a quasi-experiment. Random assignment. An interaction.

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Sensation, perception and psychophysics

GRE Subject Test · GRE Psychology

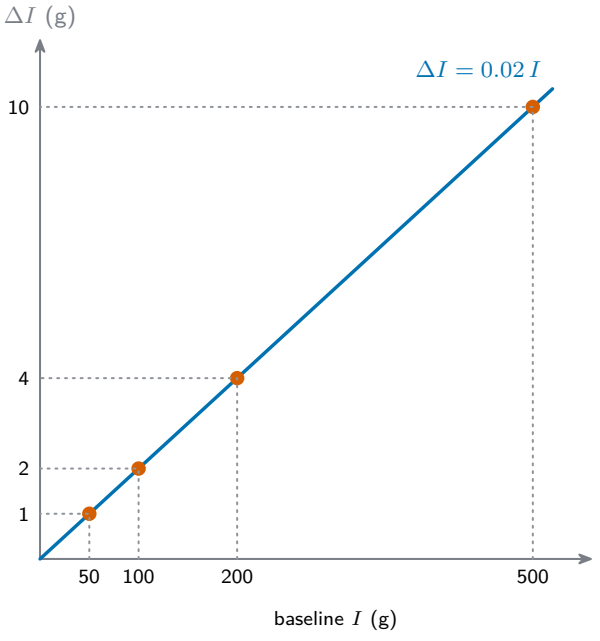
On the morning of 22 October 1850, Gustav Fechner, a physicist in Leipzig, lay in bed thinking about how the mind and the physical world are related. He realised that it might be possible to measure the link: not by asking how bright a light *feels*, but by finding the smallest change in brightness that a person can notice. Ten years later his *Elements of Psychophysics* turned this idea into methods still used in laboratories. Psychologists sometimes still mark 22 October as "Fechner Day".

GRE Psychology perception questions ask you to:

- Define the absolute threshold and the **difference threshold** 差别阈限, and use Weber's law.
- Separate sensitivity from response bias with **signal detection theory** 信号检测论.
- Describe **transduction** 换能 and **sensory adaptation** 感觉适应.
- Use Gestalt grouping and top-down processing.

Thresholds

- The absolute threshold is the weakest stimulus detected on a stated share of trials, usually 50%. It is not a sharp line between "always seen" and "never seen".
- The difference threshold, or just noticeable difference (JND), is the smallest change detected on 50% of trials.
- Weber's law: the JND is a constant fraction of the starting level, $\Delta I / I = k$. With $k = 0.02$, 100 g needs a 2 g change and 500 g needs 10 g.
- Fechner's law: felt intensity grows with the logarithm of physical intensity. Stevens's power law, $S = kI^n$, fits more senses: brightness grows slowly ($n < 1$), electric shock fast ($n > 1$).

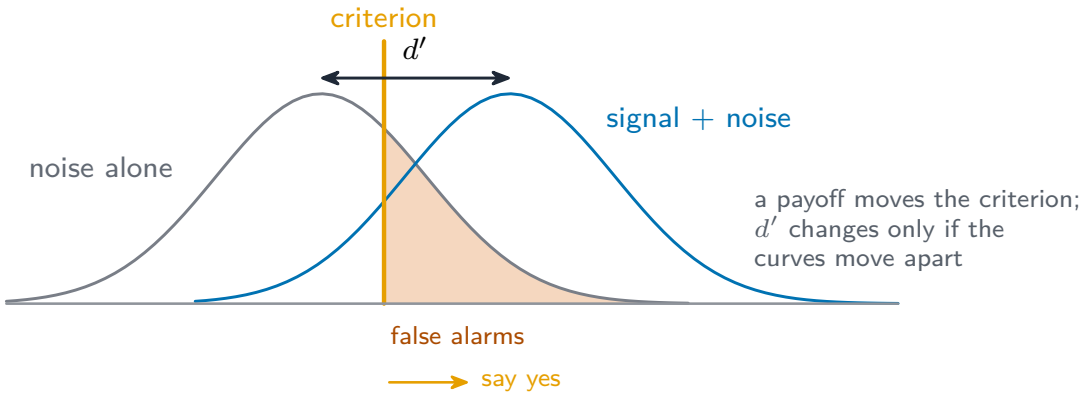


Weber's law: the noticeable change is a fixed fraction of the baseline.

Signal detection theory

Detection is noisy, and observers also decide how readily to say "yes". Signal detection theory, first developed for radar operators, separates the two.

- On each trial a signal is present or absent, and the observer says yes or no. The four outcomes are hits, misses, false alarms and correct rejections.
- Sensitivity, d', is how far apart the signal and noise distributions are: $d' = z(\text{hit rate}) - z(\text{false-alarm rate})$.
- The criterion is how willing the observer is to say yes. Rewards for hits move it; they do not change d'.
- A higher hit rate alone does not show better sensitivity, if false alarms rose too.



d prime is separation; the criterion is willingness to say yes.

From energy to experience

- Transduction: receptors convert physical energy into neural signals. Rods and cones respond to light; hair cells in the cochlea respond to sound vibrations.
- Sensory adaptation: the response to a constant stimulus weakens, as with the feeling of a watch on your wrist.
- Dark adaptation: in dim light, sensitivity recovers over about 30 minutes, first through the cones and then, more slowly, the rods.

Organising perception

- Gestalt grouping: we group by proximity, similarity, closure and good continuation. The whole is seen before the parts.
- Bottom-up processing builds a percept from features; top-down processing uses context and expectation. The same smudge reads as "H" in "THE" and "A" in "CAT".
- Perceptual constancy: we see a door as rectangular and a friend as the same size, though the image on the eye changes.

Worked example: Weber's law

With $k = 0.03$:

- From 100 g, the JND is $0.03 \times 100 = 3$ g.
- From 300 g, it is $0.03 \times 300 = 9$ g.
- A constant 3 g change at both levels would ignore the law: equal ratios, not equal amounts, are noticed equally.

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Worked example: a radiologist

A radiologist has a hit rate of 0.84 and a false-alarm rate of 0.16. After a bonus for each detected tumour, the rates become 0.93 and 0.31.

- Before: $d' = z(0.84) - z(0.16) = 0.99 - (-0.99) = 2.0$.
- After: $d' = z(0.93) - z(0.31) = 1.48 - (-0.50) = 2.0$.
- Sensitivity is unchanged. The criterion moved: the radiologist now says yes more readily.

Signal detection: four outcomes separate sensitivity from bias

	Signal present	Signal absent
Respond yes	Hit	False alarm
Respond no	Miss	Correct rejection

Four outcomes let sensitivity be measured separately from the bias towards saying yes

Common errors

- Treating the JND as a fixed amount rather than a fraction.
- Reading a higher hit rate as better sensitivity.
- Confusing sensory adaptation (receptors) with habituation (learning).
- Treating thresholds as sharp boundaries.
- Thinking perception copies the input without interpretation.

Key terms

difference threshold: The smallest change in a stimulus that is detected on half of the trials.

signal detection theory: A model that separates an observer's sensitivity from their willingness to report a signal.

transduction: The conversion of physical energy into neural signals by receptors.

sensory adaptation: A weakening response of the senses to an unchanging stimulus.

Check yourself

- The JND for a 200 g weight is 4 g. What is it for 600 g?
- An observer's hits and false alarms both rise. What has probably changed?
- Which receptors respond to sound vibrations?

Answers: 12 g. The criterion. Hair cells in the cochlea.

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Neurons, synapses and brain systems

GRE Subject Test · GRE Psychology

On the night before Easter Sunday in 1921, the pharmacologist Otto Loewi woke from a dream with an experiment in mind, scribbled it on paper, and in the morning could not read his notes. The next night the dream came back, and he went straight to his laboratory in Graz. He stimulated the vagus nerve of a frog's heart, which slowed it, then moved the fluid around that heart to a second heart. The second heart slowed too. A chemical, not electricity alone, carried the message across. Loewi shared the 1936 Nobel Prize for showing that nerves signal with chemicals.

GRE Psychology biological questions ask you to:

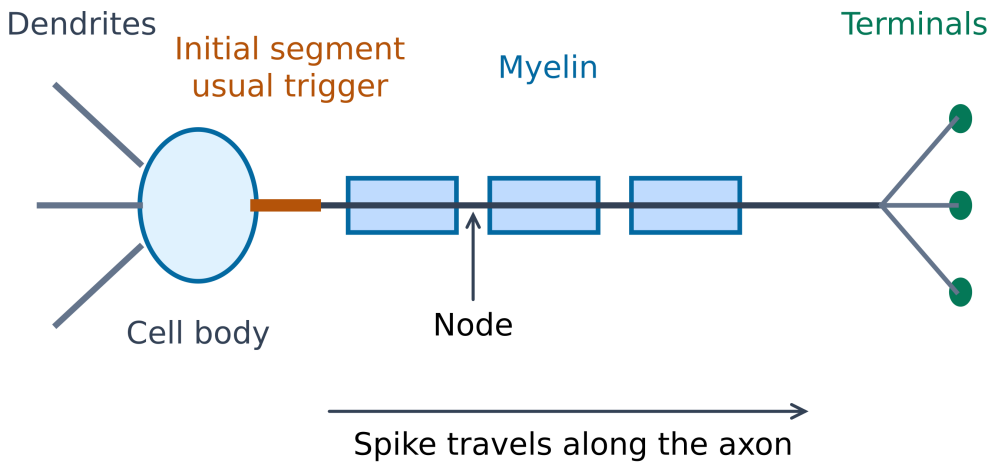
- Explain the **action potential** 动作电位 and the **all-or-none principle** 全或无定律.
- Describe the steps of chemical transmission at a **synapse** 突触, including **reuptake** 再摄取.
- Classify drugs as **agonists** 激动剂 or **antagonists** 拮抗剂.
- Link major brain structures and transmitters to functions.

The action potential

- At rest, the inside of a neuron is about −70 mV compared with the outside.
- Inputs from other cells cause small graded potentials that add up at the axon hillock. If the total reaches threshold (about −55 mV), sodium channels open and the neuron fires.
- All or none: every spike has the same size. A stronger stimulus raises the firing rate and the number of neurons that fire, not the spike height.
- After a spike, the absolute refractory period stops the neuron firing again for about a millisecond.
- Myelin speeds conduction: the signal jumps between gaps (nodes of Ranvier). Myelinated axons conduct at up to about 100 m/s, thin unmyelinated ones at about 1 m/s. Multiple sclerosis damages myelin.

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A typical input-to-output pathway

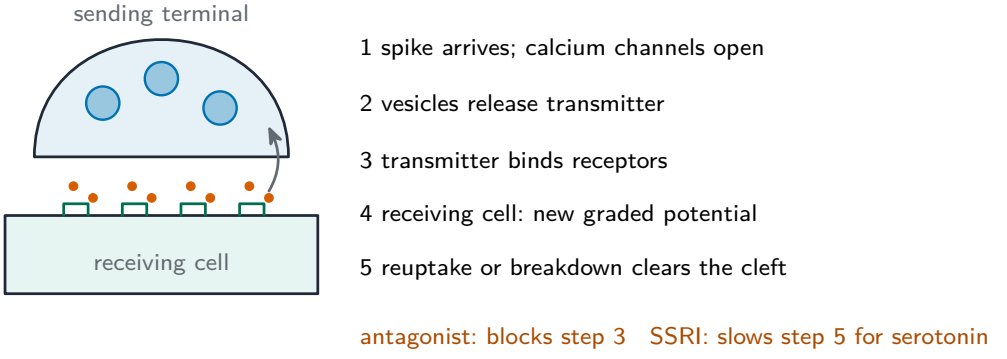


A spike starts at the initial segment and travels along the axon to the terminals

The synapse

1. The spike reaches the terminal and calcium channels open.
2. Vesicles release neurotransmitter into the gap.
3. The transmitter binds to receptors on the receiving cell.
4. The receiving cell gets a graded potential: excitatory or inhibitory.
5. Reuptake into the sending cell, or breakdown by enzymes, clears the transmitter.

- An agonist mimics or strengthens a transmitter's action; an antagonist blocks it.
- SSRIs (such as fluoxetine) block the reuptake of serotonin, so more stays in the gap.



Each drug action targets one step.

Transmitters

- Acetylcholine: muscle movement and memory; it is lost early in Alzheimer's disease.
- Dopamine: movement and reward. Loss of dopamine neurons causes Parkinson's disease; too much dopamine activity is linked to the hallucinations and delusions of schizophrenia, and many antipsychotic drugs block D2 dopamine receptors.
- Serotonin: mood, sleep and appetite. GABA is the main inhibitory transmitter, glutamate the main excitatory one.
- One transmitter serves many systems, so a drug's effect depends on the pathway and receptor type.

Brain structures

- Amygdala: emotion and fear learning. Hippocampus: forming new episodic memories.
- Hypothalamus: hunger, thirst, temperature and hormones. Cerebellum: coordination and timing of movement.
- Broca's area (left frontal): producing speech. Wernicke's area (left temporal): understanding speech.
- Prefrontal cortex: planning and self-control. Most behaviour depends on networks, not one centre.

Worked example: a stronger stimulus

A light touch produces 10 spikes per second in a sensory neuron; a firm press produces 80. All the spikes are the same height.

- This supports the all-or-none principle: intensity is coded by rate, not size.
- More neurons also fire for the firm press: recruitment.
- A student who calls this evidence against all-or-none firing has confused spike rate with spike size.

Worked example: drug actions

- A drug binds dopamine receptors without activating them: an antagonist. It would be expected to reduce dopamine-driven symptoms.
- A drug slows serotonin reuptake: an agonist-like effect, keeping serotonin in the gap longer.
- Neither description predicts the whole behavioural effect. Receptor subtypes and feedback matter.

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Common errors

- Saying a stronger stimulus makes a bigger spike.
- Placing the start of the spike in the dendrites.
- Mixing up Broca's area (production) and Wernicke's area (comprehension).
- Saying one transmitter has one function.
- Naming one structure as the whole basis of a complex behaviour.

Key terms

action potential: A brief, all-or-none electrical impulse that travels along an axon.

all-or-none principle: Once threshold is reached, a neuron fires a complete spike of fixed size.

synapse: The junction where a neuron passes a signal to another cell.

reuptake: The return of a released neurotransmitter into the sending neuron.

agonists: Drugs that mimic or strengthen the action of a neurotransmitter.

antagonists: Drugs that block the action of a neurotransmitter.

Check yourself

- Which part of the neuron usually starts the action potential?
- A patient speaks fluently but makes little sense and understands poorly. Which area is damaged?
- How do SSRIs act?

Answers: the axon hillock (initial segment). Wernicke's area. They block serotonin reuptake.

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Developmental theories and milestones

GRE Subject Test · GRE Psychology

In 1983 Heinz Wimmer and Josef Perner, in Salzburg, acted out a short story for children with puppets. Maxi puts his chocolate in a blue cupboard and goes out to play. While he is away, his mother moves it to a green cupboard. Where will Maxi look when he comes back? Most three-year-olds said the green cupboard, where the chocolate really is. Most six-year-olds said the blue one, where Maxi *thinks* it is. Between about four and five, children come to understand that other people can hold beliefs that are false.

GRE Psychology developmental questions ask you to:

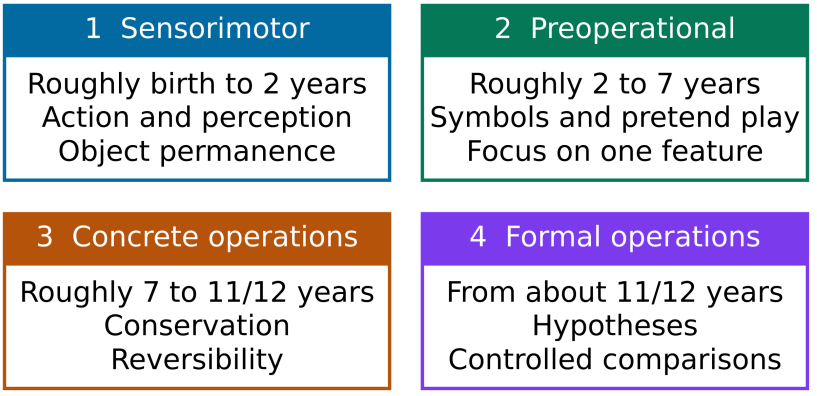
- Describe Piaget's stages by what children can do, including **object permanence** 客体永久性 and **conservation** 守恒.
- Explain **assimilation** 同化 and **accommodation** 顺应.
- Compare Kohlberg's and Erikson's stage theories.
- Interpret **attachment** 依恋 patterns and tests of **theory of mind** 心理理论.

Piaget's stages

Each stage is defined by how the child reasons. The ages are approximate.

- Sensorimotor (birth to about 2): learning through action. Object permanence, knowing that hidden objects still exist, develops during this stage.
- Preoperational (about 2 to 7): symbols and pretend play, but egocentrism and no conservation. A child thinks a tall, thin glass holds more than a short, wide one.
- Concrete operational (about 7 to 11): conservation and logical operations on real objects.
- Formal operational (from about 11 or 12): abstract and hypothetical reasoning. In the pendulum task, the child tests one factor at a time while holding the others constant.

Piaget's proposed sequence: examples



Approximate ages; one task does not establish a complete profile.

Piaget defined each stage by how the child reasons, with approximate ages

How schemes change

- Assimilation: fitting new experience into an existing scheme. A child calls a cat "doggie".
- Accommodation: changing the scheme when it does not fit. The child forms a separate category for cats.
- Vygotsky added the zone of proximal development: what a child can do with help but not yet alone. Scaffolding is help that organises the child's thinking without giving the answer.

Moral and psychosocial stages

- Kohlberg: preconventional reasoning (avoid punishment, gain rewards), conventional (approval, rules and law), postconventional (universal principles). He scored the reasoning, not the decision.
- Erikson: eight psychosocial crises across life. Trust versus mistrust in infancy; identity versus role confusion in adolescence; intimacy versus isolation in young adulthood; integrity versus despair in old age.
- Stage theories describe a common order, not a fixed timetable.

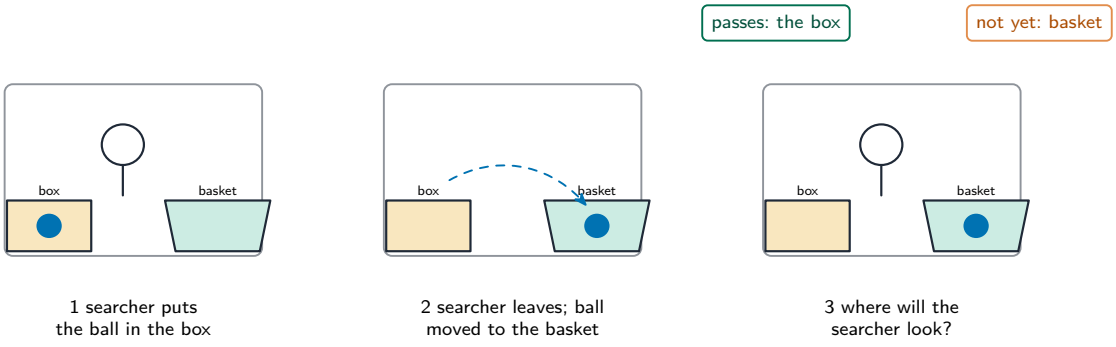
Attachment

Mary Ainsworth's strange situation separates a one-year-old from the caregiver briefly and watches the reunion.

- Secure: the infant explores, is upset at separation and is comforted at reunion. This is the most common pattern, about two thirds of infants in the original samples.
- Avoidant: little distress, and the infant ignores the caregiver at reunion.
- Resistant (ambivalent): great distress, and the infant clings yet is hard to comfort.
- Disorganised: confused or contradictory behaviour (added by Main and Solomon).
- Sensitive caregiving predicts security. Early patterns relate to later relationships but do not fix them.

Theory of mind

- Passing a false-belief task means predicting from the other person's belief, not from reality.
- Deliberate lying needs the same skill: you must model what the listener will believe.



Passing means predicting from the searcher's belief, not from reality.

Worked example: identifying the stage

- A child pours water from a short glass into a tall one and says the amount is the same "because you could pour it back": concrete operational (conservation, reversibility).
- A child searches under a blanket for a toy she saw hidden there: object permanence (sensorimotor).
- A teenager tests whether string length or weight changes a pendulum's period, one at a time: formal operational.

Worked example: a conservation question

A child says the tall glass "has more" after the water is poured.

- A leading question ("It's still the same, isn't it?") gives away the answer.
- A better question: "Is there more, less or the same? How do you know?" Then pour the water back.
- The child's reason, not the word "same", shows the stage.

Common errors

- Assigning a stage by age alone.
- Treating stage ages as fixed.
- Mixing up assimilation and accommodation.
- Placing identity versus role confusion in childhood; it belongs to adolescence.
- Treating an infant's attachment pattern as a personality diagnosis.

Key terms

object permanence: Knowing that objects continue to exist when they cannot be seen.

conservation: Understanding that a quantity stays the same when its shape or arrangement changes.

assimilation: Fitting new experience into an existing scheme.

accommodation: Changing a scheme to fit new experience.

attachment: The emotional bond between an infant and a caregiver.

theory of mind: Understanding that others have beliefs, desires and knowledge, which can differ from one's own and from reality.

Check yourself

- In which Piaget stage does conservation first appear?
- An infant shows little distress at separation and ignores the caregiver at reunion. Which pattern is this?
- Which Erikson crisis belongs to old age?

Answers: concrete operational. Avoidant. Integrity versus despair.

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Theorists, schools and their claims

GRE Subject Test · GRE Psychology

In 1879 Wilhelm Wundt set aside a room at the University of Leipzig for psychological experiments: measuring reaction times and asking trained observers to report their sensations under controlled conditions. It is usually counted as the first psychology laboratory. Students came from across Europe and America, and many went home to found laboratories of their own: G. Stanley Hall opened the first American one at Johns Hopkins in 1883 and helped found the American Psychological Association in 1892. Each later school of psychology defined itself partly against the ones before it.

GRE Psychology history questions ask you to:

- Match each school to its main claim and method.
- Explain what each school reacted against.
- Link major theorists to their ideas.
- Tell the kinds of evidence apart: introspection, clinical case, experiment.

The first schools

- **Structuralism** 结构主义 (Titchener, Wundt's student): break conscious experience into basic elements by trained introspection.
- **Functionalism** 机能主义 (William James, *Principles of Psychology*, 1890): ask what mental processes are for, how they help us adapt. Influenced by Darwin.
- **Gestalt psychology** 格式塔心理学 (Wertheimer, Köhler, Koffka): the whole is seen before its parts, so experience cannot be built from elements. Wertheimer's 1912 study of apparent motion is the starting point.

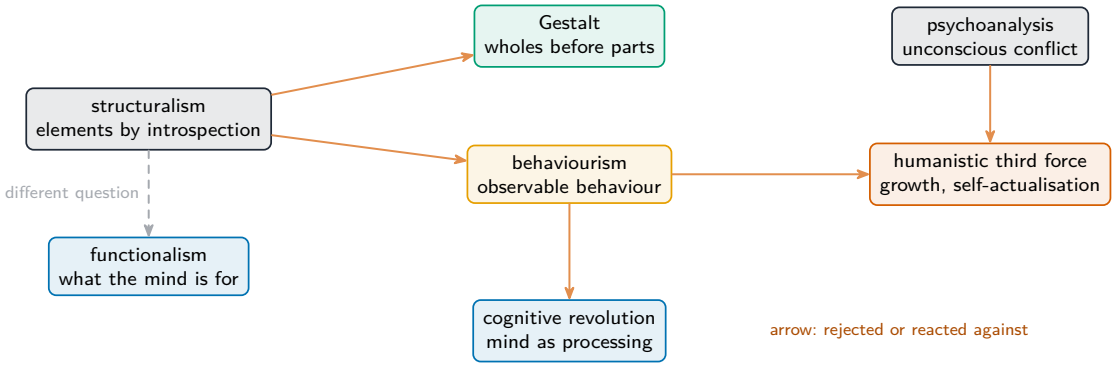
Psychoanalysis and behaviourism

- Freud's psychoanalysis: unconscious conflict, early experience, defence mechanisms and psychosexual stages. Its evidence was clinical cases, and many of its claims are hard to test.
- Later analysts changed the emphasis: Horney stressed social relationships and coping by moving toward, against or away from people; Adler stressed striving to overcome inferiority.
- **Behaviourism** 行为主义 (Watson, 1913): psychology should study only observable behaviour, not consciousness. Skinner's radical behaviourism explained behaviour by its consequences.

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The third force and the cognitive revolution

- Humanistic psychology (Maslow, Rogers): growth, free will and self-actualisation, against both psychoanalysis and behaviourism. Maslow's hierarchy of needs; Rogers's unconditional positive regard.
- The **cognitive revolution** 认知革命 of the 1950s brought mental processes back as objects of science: Miller's 1956 limits of short-term memory, Chomsky's 1959 review of Skinner's *Verbal Behavior*, and Neisser's 1967 *Cognitive Psychology*.
- Later traditions combined approaches: Bandura's social learning, Beck's cognitive therapy for depression, Eysenck's personality dimensions.



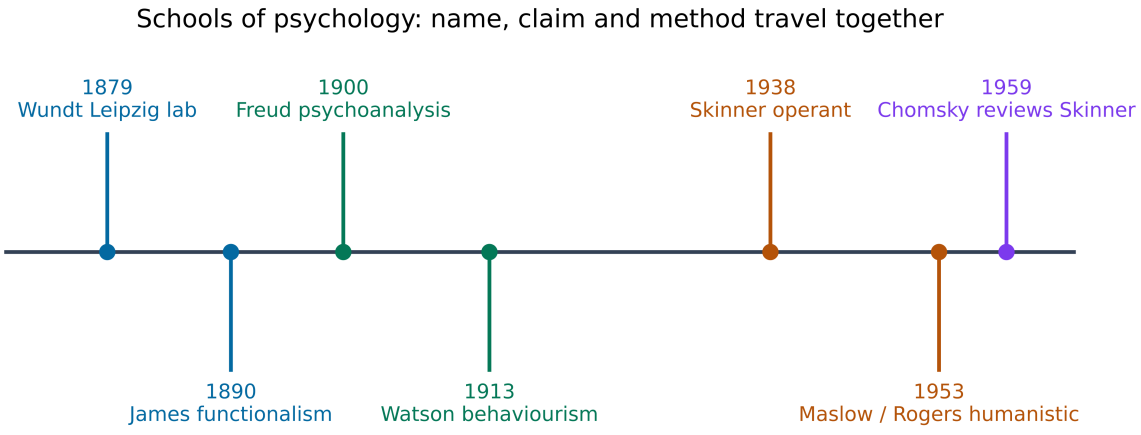
Each school defined itself against an earlier one.

Kinds of evidence

- Introspection: trained self-report. Observers often disagreed, and there was no way to settle disputes.
- Clinical case: rich detail about individuals, but no control group.
- Experiment: manipulates a variable and controls others, which allows causal claims.
- When classifying a theory, ask what mechanism it proposes and what evidence could test it.

Worked example: matching emphases

- A researcher maps how reinforcement schedules shape lever pressing: behaviourism.
- A researcher models a temporary store that holds about four chunks: the cognitive approach.
- A researcher asks how a habit helps an animal survive in its environment: functionalism.



Link each school's name to its claim, its method and its date

Worked example: naming the theorist

- "The perception of a melody does not depend on its individual notes; transpose it and it stays the same": Gestalt.
- "Give me a dozen healthy infants, and I'll guarantee to train any one of them to become any type of specialist": Watson.
- A therapist challenges a client's automatic thought "I always fail": Beck's cognitive therapy.

Common errors

- Mixing up structuralism (elements of experience) and functionalism (purposes of the mind).
- Crediting Wundt's student Titchener's structuralism to James.
- Placing the cognitive revolution before behaviourism.
- Treating psychoanalytic claims and controlled experiments as the same kind of evidence.
- Matching a name to a slogan without knowing the claim.

Key terms

structuralism: Titchener's school, which analysed conscious experience into basic elements by introspection.

functionalism: James's school, which asked what mental processes are for.

Gestalt psychology: The school holding that organised wholes are perceived before their parts.

behaviourism: The school that studies only observable behaviour and its relation to

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the environment.

cognitive revolution: The return, from the 1950s, of mental processes as a central object of scientific study.

Check yourself

- Which school would study how attention helps an animal survive?
- What did Chomsky argue in his 1959 review?
- Name the two schools humanistic psychology reacted against.

Answers: functionalism. That reinforcement cannot explain how children learn language. Psychoanalysis and behaviourism.

Conditioning, reinforcement and observational learning

GRE Subject Test · GRE Psychology

Ivan Pavlov won the 1904 Nobel Prize for his work on digestion, not for the discovery he is now famous for. While measuring the saliva of dogs in his St Petersburg laboratory, his team noticed that the dogs began to salivate before the food arrived: at the sight of the assistant who fed them, or at the sound of his footsteps. Pavlov turned this "psychic secretion" into a precise experiment, pairing a sound with food. His method, **classical conditioning** 经典条件作用, became one of psychology's first laboratory models of learning.

GRE Psychology questions on learning ask you to:

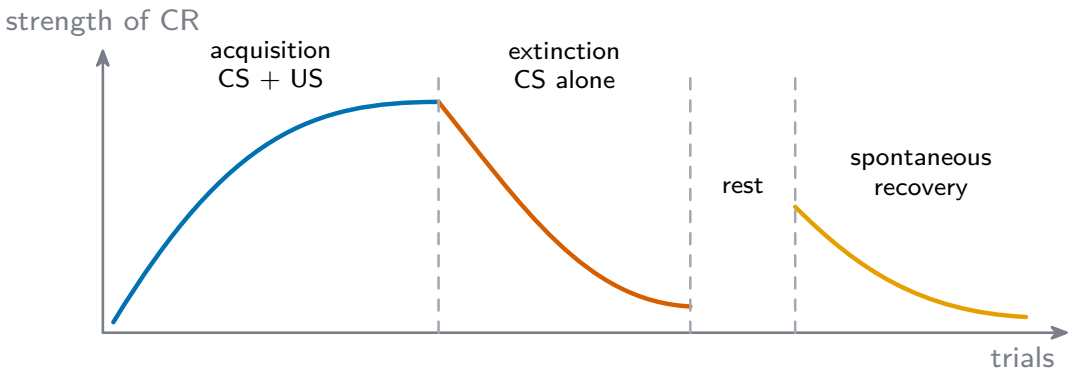
- Name the parts of classical conditioning and its main effects.
- Classify reinforcement and punishment in **operant conditioning** 操作性条件作用.
- Recognise the four **reinforcement schedules** 强化程序 by the patterns they produce.
- Explain **observational learning** 观察学习 and its conditions.

Classical conditioning

A neutral stimulus is paired with an unconditioned stimulus (US), such as food, which already produces an unconditioned response (salivation). After pairing, the neutral stimulus becomes a conditioned stimulus (CS) that produces a conditioned response (CR) by itself.

- Acquisition works best when the CS comes just before the US and reliably predicts it. Pairing alone, without prediction, is weak.
- **Extinction** 消退: the CS appears without the US, and the CR weakens.
- **Spontaneous recovery** 自发恢复: after a rest, an extinguished CR returns, partly. Extinction is new learning, not erasure.
- Generalisation: similar stimuli also produce the CR. Discrimination: the learner responds only to the CS that predicts the US.

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Extinction is not erasure: the response can return after a rest.

Operant conditioning

Operant behaviour changes because of its consequences. Two questions classify any case:

- Is something added (positive) or removed (negative)?
- Does the behaviour increase (reinforcement) or decrease (punishment)?
- **Negative reinforcement** 负强化 removes something unpleasant, so the behaviour increases. It is not punishment. Escape (ending a headache with aspirin) and avoidance (leaving early to miss traffic) are both negative reinforcement.
- Shaping reinforces closer and closer approximations to a target behaviour.

	behaviour increases	**behaviour decreases**
add (positive)	positive reinforcement token after reading	positive punishment a fine added
remove (negative)	negative reinforcement aspirin ends a headache	negative punishment game access removed

Positive and negative mean add and remove; the behaviour's direction decides the rest.

Reinforcement schedules

Ratio schedules count responses; interval schedules count time before a response can earn a reward.

- Fixed ratio (every 5th response): high rate, with a pause after each reward.
- Variable ratio (on average every 5th): the highest, steadiest rate and the strongest resistance to extinction, as in gambling.
- Fixed interval (first response after 60 s): scalloped responding that speeds up near the end of each interval.
- Variable interval (first response after a varying time): a steady, moderate rate.
- Partial reinforcement makes behaviour harder to extinguish than reinforcing every response.

Observational learning

In 1961 Albert Bandura showed that children who watched an adult hit an inflatable Bobo doll were more likely to hit it themselves. Learning can happen without any direct reward.

- Four conditions: attention to the model, retention, the ability to reproduce the action, and motivation.
- Vicarious reinforcement: seeing the model rewarded raises imitation; seeing the model punished lowers it.
- Children who saw the model punished still learned the action: they reproduced it when offered a reward. Learning and performance are different.

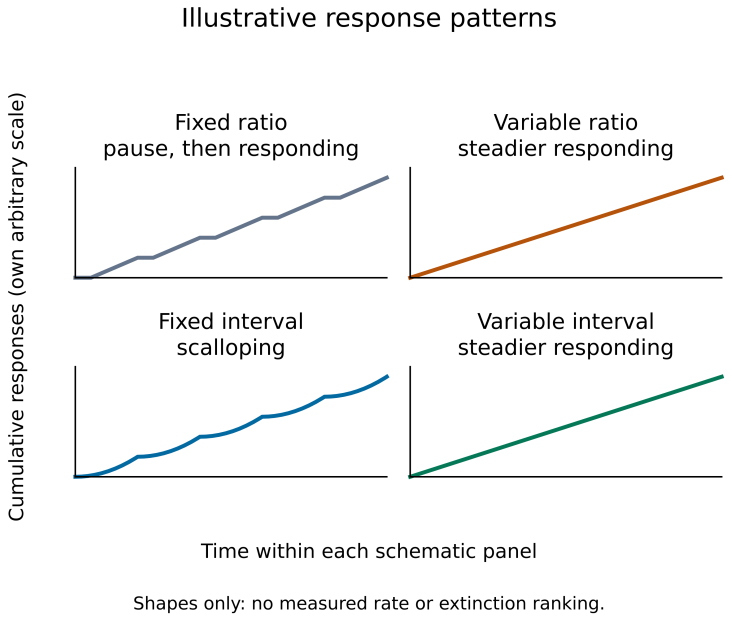
Worked example: classifying consequences

- A teenager loses phone access after rude remarks, and the remarks decrease: something wanted is removed and the behaviour falls, so negative punishment.
- An alarm stops when homework begins, and starting homework increases: something unpleasant is removed and the behaviour rises, so negative reinforcement.
- The word "removed" appears in both. The direction of the behaviour decides the label.

Worked example: schedules

- A factory pays for every 10 shirts sewn: fixed ratio. Expect a short pause after each payment.
- A slot machine pays after an unpredictable number of plays: variable ratio, with fast play that is hard to extinguish.
- Checking email that arrives at random times: variable interval. Checking more often does not make mail arrive sooner, so the rate is moderate.

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Each reinforcement schedule leaves its own shape in the cumulative record

Common errors

- Calling negative reinforcement punishment.
- Calling every unpredictable reward variable ratio; if time decides, it is variable interval.
- Treating extinction as forgetting.
- Classifying by the intention of the person giving the consequence, not by what happens to the behaviour.
- Assuming a child who does not imitate has not learned.

Key terms

classical conditioning: Learning in which a neutral stimulus comes to predict an unconditioned stimulus and produce a response.

operant conditioning: Learning in which behaviour changes because of its consequences.

extinction: The weakening of a learned response when the CS no longer predicts the US, or the behaviour is no longer reinforced.

spontaneous recovery: The partial return of an extinguished response after a rest.

negative reinforcement: Strengthening a behaviour by removing something unpleasant.

reinforcement schedules: Rules for which responses are reinforced, by count (ratio) or by time (interval).

observational learning: Learning by watching a model and the consequences of the model's behaviour.

Check yourself

- A dog salivates to a bell after many pairings with food. What is the bell now?
- A driver fastens a seat belt to stop a buzzer. What kind of consequence is this?
- Which schedule produces scalloped responding?

Answers: a conditioned stimulus. Negative reinforcement. Fixed interval.

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Memory systems, processes and forgetting

GRE Subject Test · GRE Psychology

In 1953 the surgeon William Scoville removed parts of both temporal lobes, including most of the hippocampus, from a 27-year-old man with severe epilepsy, Henry Molaison. The seizures improved, but Molaison could no longer form new memories of events or facts. He could hold a number in mind while he rehearsed it, and he remembered his childhood. Yet the psychologist Brenda Milner found something more surprising: practising mirror drawing over three days, he improved steadily while saying each time that he had never done the task before. Memory is not one system.

GRE Psychology memory questions ask you to:

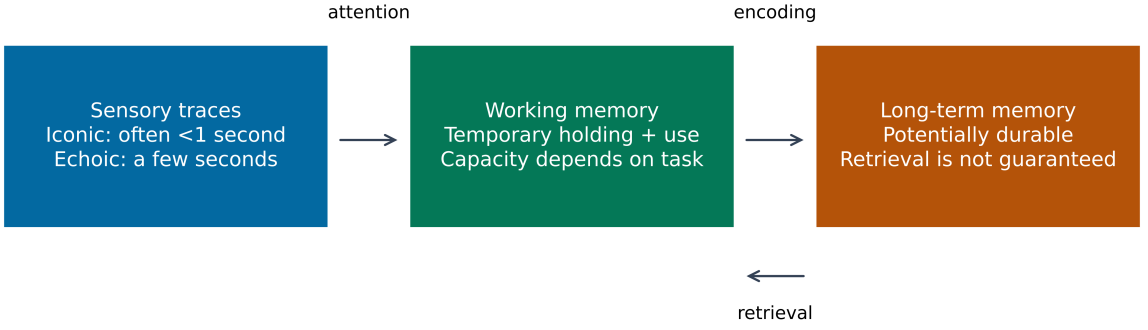
- Describe the stores of the modal model and **working memory** 工作记忆.
- Separate explicit memory (episodic and semantic) from **implicit memory** 内隐记忆.
- Explain forgetting by interference and retrieval failure.
- Read the **serial position curve** 系列位置曲线.

The modal model

Atkinson and Shiffrin (1968) described three stores that differ in how long they hold information.

- Sensory memory: a brief, almost complete copy of the input. Sperling (1960) showed that a visual (iconic) image fades in under a second; the sound (echoic) trace lasts a few seconds.
- Short-term memory: a few items for about 20 seconds without rehearsal. Miller's 1956 estimate was 7 ± 2 items; later work suggests about 4 chunks.
- Long-term memory: lasting and practically unlimited.
- Chunking recodes items into familiar units ("FBI", "CIA") so that more information fits.

Memory functions: approximate times, task-dependent limits



Attention moves information into working memory, encoding into long-term memory; retrieval is never guaranteed

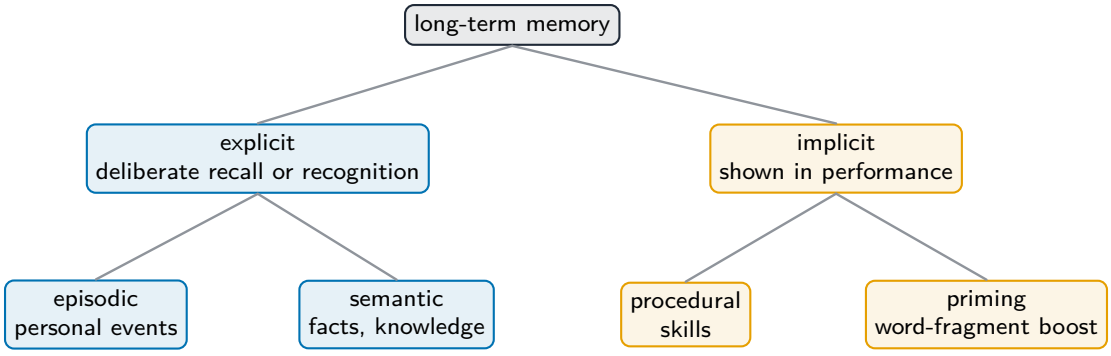
Working memory

Baddeley and Hitch (1974) argued that short-term memory is a workspace, not one box.

- The central executive directs attention and coordinates the other parts.
- The phonological loop holds speech-like material; the visuospatial sketchpad holds images and locations.
- Two tasks that use the same part interfere more than tasks that use different parts.

Kinds of long-term memory

- Explicit (declarative) memory is deliberate recall or recognition. Episodic memory holds personal events; semantic memory holds facts.
- Implicit memory shows in performance without conscious recollection: skills (**procedural memory** 程序性记忆) and **priming** 启动效应, where earlier exposure makes later processing easier.
- Molaison lost new explicit memory but kept implicit learning, so the two can be separated.



Long-term memory by awareness and content.

Forgetting

- **Proactive interference** 前摄干扰: old learning disrupts new learning.
- **Retroactive interference** 倒摄干扰: new learning disrupts old learning.
- Retrieval failure: the memory is stored but the cue does not reach it. Encoding specificity says recall is best when the cues at retrieval match those at learning. Divers who learned words underwater recalled them better underwater (Godden and Baddeley, 1975).
- Decay alone explains little; most exam cases are interference or retrieval failure.

The serial position curve

When people recall a list in any order, they remember the first items (primacy) and the last items (recency) best.

- Primacy reflects extra rehearsal, which moves the early items into long-term memory.
- Recency reflects items still in short-term memory. A 30-second distracting task removes recency but leaves primacy.

Worked example: interference

A student changes a password. Old passwords keep coming to mind when she types the new one. Months later, she cannot remember the old one.

- Old disrupting new: proactive interference.
- New disrupting old: retroactive interference.
- Name the memory being lost and the memory causing the problem before choosing the label.

Worked example: naming the memory

- Riding a bicycle after years without practice: procedural (implicit).
- Remembering a tenth birthday party: episodic (explicit).
- Completing "ele____" as "elephant" because the word appeared earlier, without remembering having seen it: priming (implicit).
- Knowing that Paris is the capital of France: semantic (explicit).

Common errors

- Treating working memory as a single store.
- Calling every forgetting "decay".
- Mixing up proactive and retroactive interference.
- Saying a distracting task removes primacy; it removes recency.
- Treating 7 ± 2 as an exact, universal capacity.

Key terms

working memory: A limited system that holds and works on a small amount of information for a short time.

implicit memory: Memory shown in performance without conscious recollection.

procedural memory: Memory for skills and habits.

priming: Easier processing of a stimulus because of earlier exposure to it or something related.

proactive interference: Older learning disrupting the memory of newer material.

retroactive interference: Newer learning disrupting the memory of older material.

serial position curve: The pattern of better recall for the first and last items of a list.

Check yourself

- Learning Spanish makes it harder to recall French learned earlier. Which interference is this?
- A list is followed by 30 seconds of counting backwards. Which part of the serial position curve disappears?
- Which kind of memory did Henry Molaison keep for new skills?

Answers: retroactive. Recency. Procedural (implicit) memory.

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Language structure, perception and acquisition

GRE Subject Test · GRE Psychology

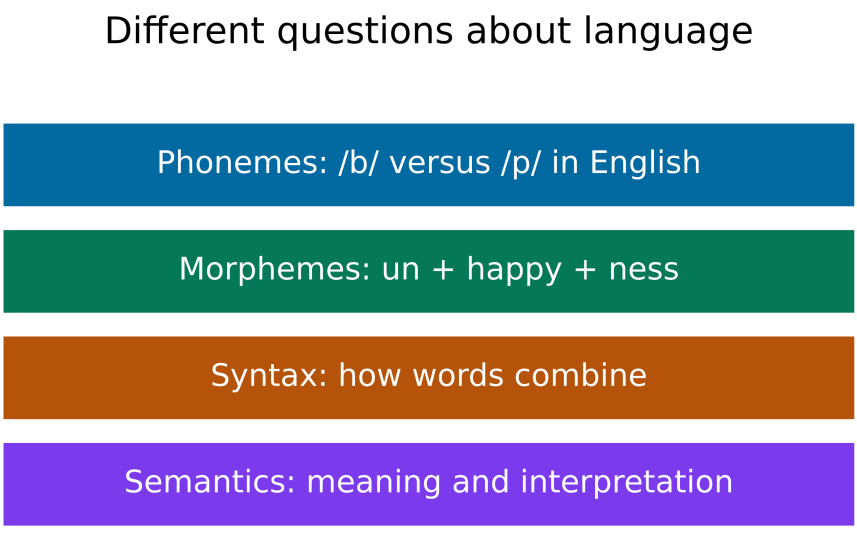
In 1996 Jenny Saffran, Richard Aslin and Elissa Newport played eight-month-old babies two minutes of a made-up language: a smooth stream of syllables such as "bidakupadotigolabubidaku…", with no pauses between "words". Inside a word, one syllable always followed another; across word boundaries, the next syllable varied. Afterwards the babies listened longer to new syllable strings than to the "words" they had heard. In two minutes they had begun to find word boundaries from statistics alone. Speech has no gaps between words: the listener finds them.

GRE Psychology language questions ask you to:

- Separate the levels of language: sounds, meaningful parts, word order, meaning and use.
- Explain **categorical perception** 范畴知觉 and speech segmentation.
- Describe the two routes in reading.
- Interpret children's errors and age effects in learning a language.

Levels of language

- A **phoneme** 音位 is the smallest sound unit that changes meaning: /b/ and /p/ separate "bat" from "pat".
- A **morpheme** 语素 is the smallest unit with meaning: "un-happy-ness" has three.
- **Syntax** 句法 is the rules for combining words into phrases and sentences.
- **Semantics** 语义学 is meaning, and **pragmatics** 语用学 is how meaning depends on context: "Can you pass the salt?" is a request, not a question about ability.
- Syntax and semantics can separate. Chomsky's "Colourless green ideas sleep furiously" is grammatical but has no sensible meaning.



Each level of language asks a different question about the same utterance

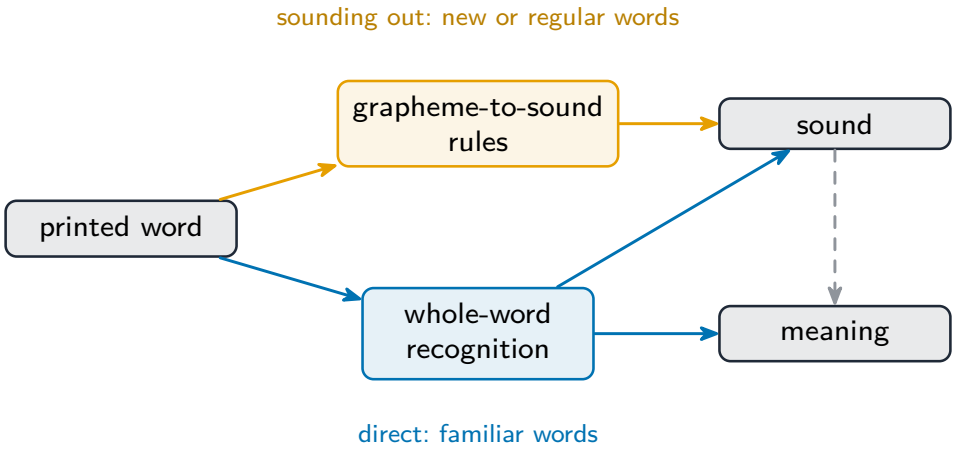
Speech perception

- Categorical perception: sounds that vary smoothly (from /b/ to /p/) are heard as one category or the other, with a sharp boundary. Differences inside a category are hard to hear.
- Segmentation: listeners find words in a continuous stream using the likelihood that one syllable follows another, stress patterns and known words.
- Infants can tell apart the sounds of every language, but by about 10–12 months they lose many contrasts their own language does not use.

Reading

Skilled readers use two routes from print.

- Sounding out: letters are converted to sounds by rules. This route reads new and made-up words (“blick”).
- Whole-word recognition: familiar words go directly to meaning and pronunciation. This route reads irregular words (“yacht”).
- Damage to the sounding-out route makes made-up words hard; damage to the whole-word route makes irregular words come out “regularised”.
- The eyes move in fixations and quick jumps (saccades), not a smooth glide.



Two reading routes: sounding out and direct recognition.

Acquisition

Children go from babbling (about 6 months) to first words (about 12 months) to two-word phrases (about 18–24 months).

- **Overregularisation** 过度规则化: a child who said "went" begins to say "goed". The child has learned a rule (add -ed) and applies it too widely.
- Children's errors show that they produce new forms rather than only copying.
- Language learning gets harder with age of first exposure, especially for accent and grammar, but there is no single sharp cut-off age for a second language.
- Bilingualism does not lower intelligence; when schooling replaces the first language rather than adding to it, both languages can suffer.

Worked example: counting units

- "Unhappiness": three morphemes (un, happy, ness).
- "Cats": two morphemes (cat, plural -s), one syllable, four phonemes (/k/, /æ/, /t/, /s/).
- Morphemes are counted by meaning, not by letters or syllables.

Worked example: a child's error

A child says "walked" correctly, and later says "goed".

- "Goed" applies the regular past-tense rule to an irregular verb: overregularisation.
- It shows the child is using a productive rule, not only repeating forms heard from adults, who never say "goed".
- It does not prove that input or feedback do not matter. A single error cannot decide between theories of acquisition.

Common errors

- Counting morphemes by letters or syllables.
- Thinking spoken words are separated by audible pauses.
- Treating syntax and semantics as the same level.
- Reading overregularisation as a step backwards rather than as evidence of rule learning.
- Claiming one sharp critical age for learning any second language.

Key terms

phoneme: The smallest sound unit that changes meaning.

morpheme: The smallest unit of language that carries meaning.

syntax: The rules for combining words into phrases and sentences.

semantics: The study of meaning in language.

pragmatics: How the meaning of an utterance depends on its context and purpose.

categorical perception: Hearing smoothly varying sounds as distinct categories.

overregularisation: Applying a regular grammatical rule to words that are exceptions.

Check yourself

- How many morphemes are in "replayed"?
- A patient reads "yacht" correctly but cannot read the made-up word "blick". Which reading route is damaged?
- "It's cold in here" is used to ask someone to close a window. Which level of language explains this?

Answers: three (re, play, ed). The sounding-out route. Pragmatics.

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Thinking, problem solving and intelligence

GRE Subject Test · GRE Psychology

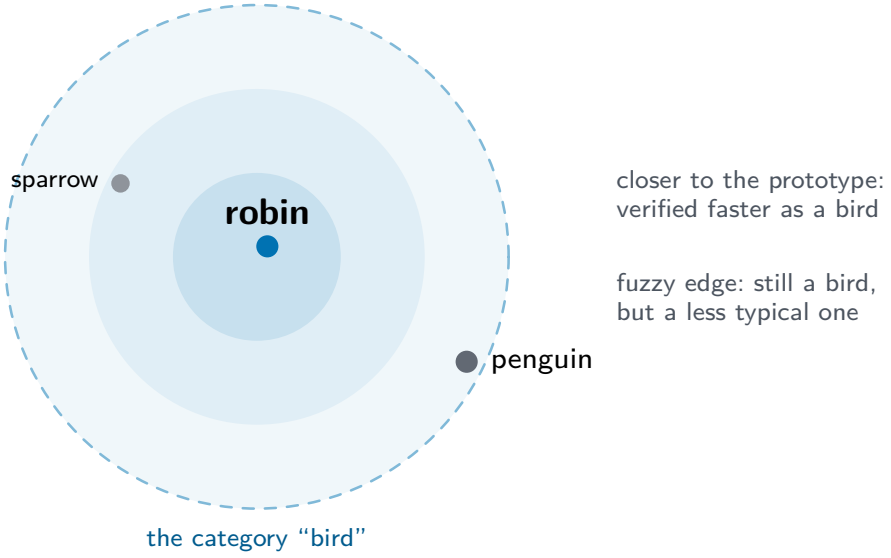
In 1983 Amos Tversky and Daniel Kahneman described Linda: 31, single, outspoken and very bright, a philosophy graduate who cared about discrimination and social justice. Which is more likely: that Linda is a bank teller, or that she is a bank teller and active in the feminist movement? Most people chose the second. But a combination can never be more likely than one of its parts. People judged by how well the description fitted a stereotype, not by probability. Work like this earned Kahneman the 2002 Nobel Prize in economics.

GRE Psychology thinking questions ask you to:

- Describe concepts, prototypes and schemas.
- Tell an **algorithm** 算法 from a **heuristic** 启发式, and name common heuristics and biases.
- Recognise obstacles to problem solving.
- Compare theories of intelligence and interpret test scores carefully.

Concepts and schemas

- Natural concepts have fuzzy edges and are built around a **prototype** 原型, the most typical member. People confirm “a robin is a bird” faster than “a penguin is a bird”.
- A **schema** 图式 is organised knowledge about a topic; a script is a schema for a sequence of events, such as ordering in a restaurant.
- Schemas speed up understanding, but they also bend memory toward what was expected.



Natural concepts are graded around a prototype.

Heuristics and biases

An algorithm is a procedure that guarantees a solution if followed correctly. A heuristic is a fast shortcut that usually works but can fail in predictable ways.

- **Availability heuristic** 可得性启发式: judging frequency by how easily examples come to mind. After news coverage of a plane crash, people overestimate the risk of flying.
- **Representativeness heuristic** 代表性启发式: judging probability by similarity to a type, while ignoring base rates. The Linda problem is an example.
- Anchoring: estimates stay close to a starting number, even an irrelevant one.
- Framing: “90% survive” and “10% die” lead to different choices, though they mean the same.
- Confirmation bias: looking only for evidence that supports a belief.

Problem solving

- Functional fixedness: seeing an object only in its usual role. In Duncker’s candle problem, people fail to use the box of tacks as a shelf.
- Mental set: using a method that worked before when a simpler one is available.
- Useful strategies: means–end analysis (reduce the gap to the goal step by step), working backward from the goal, and setting the problem aside, which sometimes leads to sudden insight.

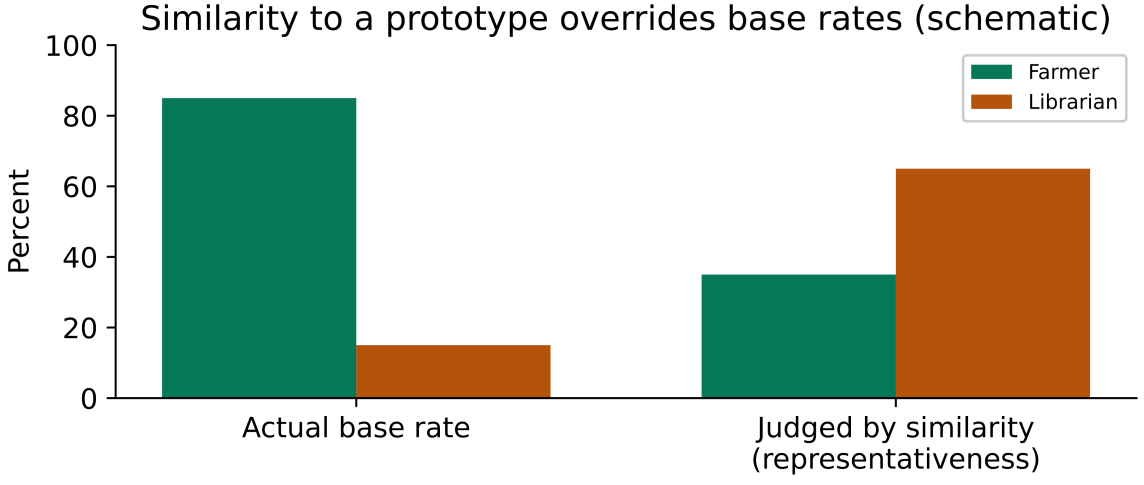
Intelligence

- Spearman (1904) found that scores on different tests correlate, and proposed a general factor, g.
- Cattell separated fluid intelligence (solving new problems, which declines in later adulthood) from crystallised intelligence (knowledge and vocabulary, which stays or rises).
- Gardner proposed multiple intelligences; Sternberg proposed analytical, creative and practical abilities.
- IQ tests are scaled to a mean of 100 and a standard deviation of 15. A score describes performance on that test under its conditions, with known reliability and validity; it is not a fixed measure of a person's worth.

Worked example: base rates

A shy, tidy man who loves books is described. Is he more likely a librarian or a farmer?

- The description fits the librarian stereotype: this is representativeness.
- In the United States, farmers outnumber male librarians by more than 20 to 1.
- Even if the description is four times as common among librarians, farmers remain more likely. Similarity cannot replace the base rate.



The representativeness heuristic lets similarity to a stereotype override the base rate

Worked example: naming the process

- Thinking shark attacks are common after a summer of shark news: availability.
- Offering €200 for a used bike because the seller first asked for €300: anchoring.
- Trying to unblock a sink only with a plunger, because that worked last time, when the trap simply needs unscrewing: mental set.

Common errors

- Calling a heuristic an error in itself; heuristics are efficient, and their failures are predictable.
- Confusing availability (ease of recall) with representativeness (similarity).
- Thinking a combination of events can be more likely than one of them.
- Saying fluid and crystallised intelligence decline together.
- Treating an IQ score as fixed and complete.

Key terms

prototype: The most typical member of a category.

schema: An organised body of knowledge that guides understanding and memory.

algorithm: A step-by-step procedure that guarantees a solution when followed correctly.

heuristic: A mental shortcut that is fast but can lead to errors.

availability heuristic: Judging how common something is by how easily examples come to mind.

representativeness heuristic: Judging probability by similarity to a type, often ignoring base rates.

Check yourself

- A student cannot see that a coin could be used as a screwdriver. What is this called?
- Which kind of intelligence usually keeps rising into later adulthood?
- Why must "teller and feminist" be less likely than "teller"?

Answers: functional fixedness. Crystallised intelligence. Every feminist teller is also a teller.

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Social cognition, attribution and social influence

GRE Subject Test · GRE Psychology

In 1951 Solomon Asch, at Swarthmore College, showed students a line and asked which of three comparison lines matched it. The answer was obvious: alone, people made almost no errors. But in Asch's groups, every other "participant" was an actor who, on certain trials, gave the same wrong answer. About a third of the real participants' answers on those trials went along with the group, and three quarters of them conformed at least once. When just one actor gave the right answer, conformity fell sharply.

GRE Psychology social questions ask you to:

- Explain **attribution** 归因 and its typical biases.
- Separate **normative influence** 规范性影响 from **informational influence** 信息性影响, and **conformity** 从众 from **obedience** 服从.
- Explain **cognitive dissonance** 认知失调.
- Use the elaboration likelihood model of persuasion.

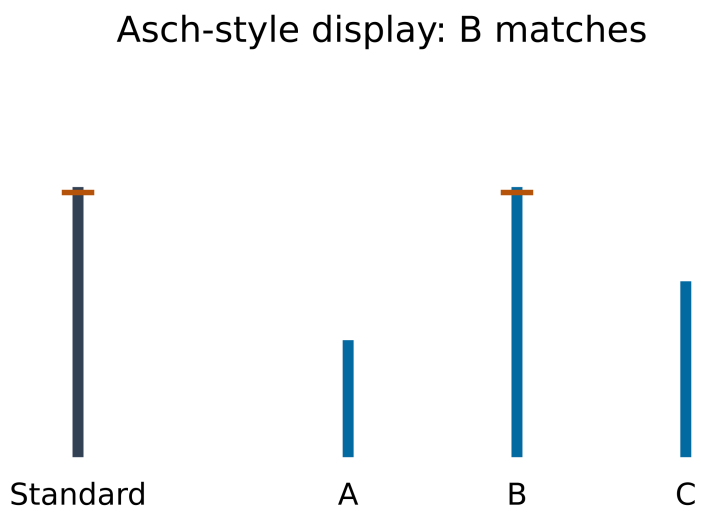
Attribution

We explain behaviour either by the person (dispositional) or by the situation (situational).

- **Fundamental attribution error** 基本归因错误: explaining other people's behaviour too much by their character and too little by their situation.
- Actor–observer difference: we explain our own actions more by the situation.
- Self-serving bias: we credit our successes to ourselves and blame failures on circumstances.
- An action tells us most about a person when it was freely chosen and unusual for the situation.

Conformity and obedience

- Normative influence: going along to be accepted or to avoid rejection, as in Asch's studies.
- Informational influence: going along because others seem to know better, especially when the situation is unclear.
- Obedience is following a direct order from an authority. In Stanley Milgram's 1963 study, 65% of participants continued to what they believed was a 450-volt shock when told to by the experimenter.
- Conformity is pressure from equals; obedience is pressure from an authority.



Stimulus schematic; the drawing does not measure conformity.

The correct answer is unambiguous, so any conforming errors come from social pressure

Cognitive dissonance

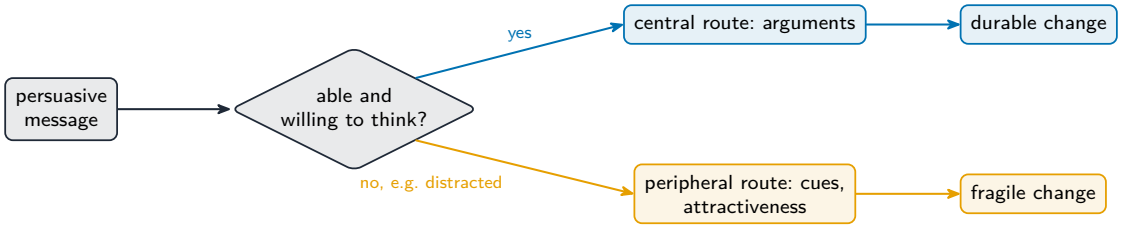
Holding two inconsistent beliefs, or acting against a belief, creates discomfort that people reduce by changing an attitude or a justification.

- In Festinger and Carlsmith's 1959 study, students paid 1$to tell other s a boring task was fun lat$
- With little outside justification, people change their attitudes to fit their behaviour.

Persuasion

The elaboration likelihood model asks whether the audience is able and willing to think about the message.

- Central route: the strength of the arguments decides. Change lasts and predicts behaviour.
- Peripheral route: cues such as attractiveness, fame or the number of arguments decide. Change is weaker and fades.
- Distraction, low interest or time pressure push people to the peripheral route.



The elaboration likelihood model's two routes.

The self

- Self-monitoring: adjusting how we present ourselves to fit the situation.
- Self-verification: seeking feedback that confirms what we already believe about ourselves.
- Self-affirmation: after a threat, restoring self-worth by thinking about a strength in another area.
- Excitation transfer: leftover arousal from one event (exercise, a near-accident) makes a later emotion stronger.

Worked example: two kinds of influence

A new student follows a group across campus.

- If they follow because they think the group knows the way: informational influence.
- If they follow to avoid looking odd: normative influence.
- The same action can come from different processes. Answering privately or anonymously usually reduces normative conformity but not informational conformity, which helps tell them apart.

Worked example: attributions

A student arrives late, and the teacher decides the student is lazy. In fact, the bus broke down.

- The teacher made the fundamental attribution error.
- The student is likely to explain the lateness by the bus, the situation: the actor–observer difference.
- A better judgement checks consistency: is the student late often, and are other students on that bus late too?

Common errors

- Merging conformity (equals) and obedience (authority).
- Treating every trait-based explanation as an error; the error is ignoring the situation.
- Expecting larger rewards to produce more attitude change in dissonance studies.
- Assuming peripheral-route persuasion lasts as long as central-route change.
- Forgetting that one dissenter strongly reduces conformity.

Key terms

attribution: Explaining the cause of behaviour, by the person or by the situation.

fundamental attribution error: Over-explaining others' behaviour by their character while neglecting the situation.

normative influence: Conforming to be accepted or to avoid rejection.

informational influence: Conforming because others' behaviour seems to show what is correct.

conformity: Changing behaviour or belief to match a group.

obedience: Following a direct instruction from an authority.

cognitive dissonance: Discomfort from inconsistent beliefs or actions, which people reduce by changing an attitude or justification.

Check yourself

- A tourist copies locals' behaviour in an unfamiliar temple. Which influence is this, most likely?
- In dissonance studies, which group changes its attitude more: those paid little or those paid a lot?
- A tired, distracted viewer is persuaded by a famous face in an advert. Which route is this?

Answers: informational influence. Those paid little. The peripheral route.

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Groups, relationships and intergroup processes

GRE Subject Test · GRE Psychology

In 1968 John Darley and Bibb Latané asked New York students to talk about college life over an intercom, one at a time. Suddenly one voice, a recording, began to choke and call for help during what sounded like a seizure. Students who believed they were the only listener went for help 85% of the time before the recording ended. Students who believed four others could also hear went only 31% of the time. Each person waited for someone else. The study was prompted by press reports of the 1964 murder of Kitty Genovese, though those reports exaggerated how many witnesses saw it and did nothing.

GRE Psychology group questions ask you to:

- Predict how other people's presence changes performance.
- Explain the **bystander effect** 旁观者效应 by its two mechanisms.
- Describe what predicts attraction and how relationships are evaluated.
- Separate **stereotype** 刻板印象, **prejudice** 偏见 and **discrimination** 歧视, and say what reduces conflict between groups.

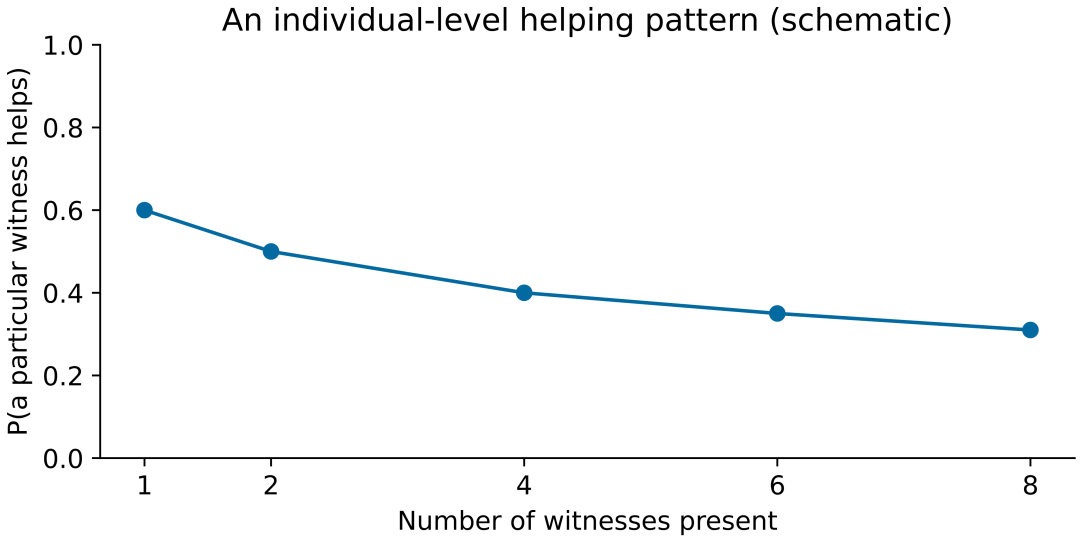
Groups and performance

- Social facilitation: other people's presence strengthens the dominant (most practised) response. It helps on easy, well-learned tasks and hurts on new, hard ones.
- **Social loafing** 社会惰化: people put in less effort when their contributions are pooled and cannot be identified.
- Deindividuation: anonymity in a crowd lowers self-restraint.
- Group polarisation: discussion pushes a group further in the direction it already leaned.
- **Groupthink** 群体思维: a close group under pressure silences doubts and makes a poor decision. Janis studied the 1961 Bay of Pigs invasion as an example.

Helping

The bystander effect: the more witnesses, the less likely any one of them is to help.

- Diffusion of responsibility: each witness feels less personally responsible because others could act.
- Pluralistic ignorance: each witness sees others staying calm and decides there is no emergency.
- Helping is more likely when one person is clearly asked ("You in the red coat, call an ambulance").



Invented values; not a universal crowd forecast or the probability anyone helps.

Diffusion of responsibility: each witness is less likely to help as the crowd grows

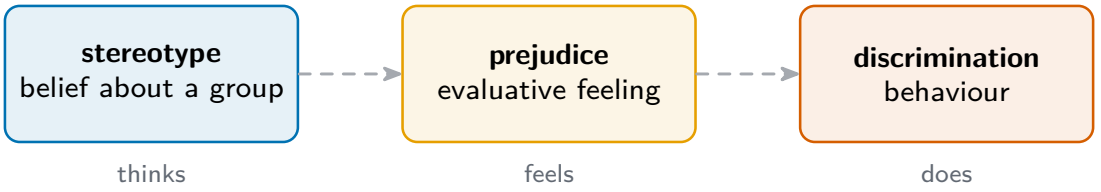
Attraction and relationships

- Proximity is the first predictor: people become friends with those they meet often, such as neighbours on the same floor.
- Mere exposure: repeated contact usually increases liking.
- Similarity and reciprocal liking (liking those who like us) also predict attraction.
- Social exchange theory: people judge a relationship by its rewards minus its costs, compared with what they expect and with the alternatives.

Intergroup processes

- A stereotype is a belief about a group (thinking), prejudice is a feeling about it (feeling), discrimination is action toward its members (doing). One can occur without the others.
- Minimal groups: in Henri Tajfel's studies, people favoured their own group even when groups were assigned by a trivial task.
- Realistic conflict: competition for scarce resources raises hostility, as in Sherif's 1954 Robbers Cave camp study.
- The contact hypothesis: contact reduces prejudice when the groups have equal status, shared goals, cooperation and support from authorities. Contact alone is not enough.

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links are possible, not automatic: each needs its own evidence

Thinks, feels, does: three different claims.

Worked example: a crowded platform

A man collapses on a busy train platform, and no one moves for a minute.

- If each person thinks someone else, perhaps staff, will act: diffusion of responsibility.
- If each person reads the others' calm as a sign that he is only resting: pluralistic ignorance.
- To tell them apart, ask witnesses whether they thought it was an emergency. Crowd size alone cannot decide.

Worked example: naming the process

- A rowing crew's times fall when each rower's effort is measured separately: this reduces social loafing.
- A skilled pianist plays better with an audience, a beginner worse: social facilitation.
- After discussion, a cautious committee becomes even more cautious: group polarisation.

Common errors

- Using stereotype, prejudice and discrimination as synonyms.
- Claiming that any contact reduces prejudice.
- Mixing up groupthink (silenced doubts) with polarisation (a more extreme position).
- Predicting that an audience always improves performance.
- Thinking a larger crowd makes help more likely because there are more possible helpers.

Key terms

bystander effect: The fall in helping by each person as the number of witnesses grows.

social loafing: Reduced effort when individual contributions are pooled and cannot be identified.

groupthink: Poor decision-making in a close group that silences doubts.

stereotype: A belief about the characteristics of a group's members.

prejudice: A negative feeling or judgement toward a group and its members.

discrimination: Unfair treatment of people because of their group.

Check yourself

- A student refuses to hire anyone from another town but says nothing negative about them. Which of the three is this?
- Why might a student sing worse in front of the class than alone, if the song is new?
- Name two conditions that make contact between groups reduce prejudice.

Answers: discrimination. Social facilitation strengthens the dominant response, which for a new task is often wrong. Any two of: equal status, shared goals, cooperation, support from authorities.

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Attention limits and non-associative learning

GRE Subject Test · GRE Psychology

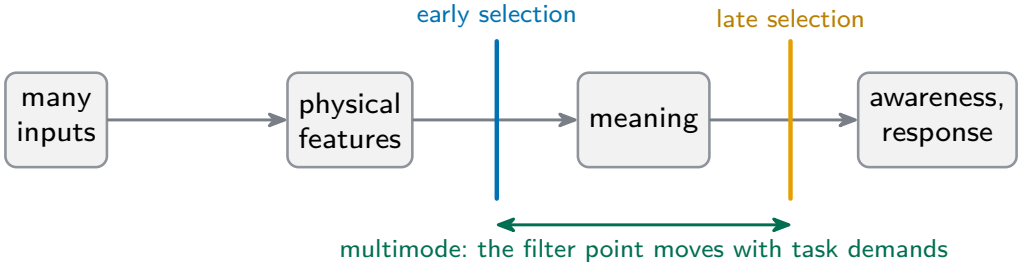
In 1953 Colin Cherry, an engineer in London, played two different spoken messages through headphones, one to each ear, and asked listeners to repeat one message aloud as they heard it. They managed well, but afterwards could say almost nothing about the other message. They did not notice when it switched to German or was played backwards. They did notice when the speaker changed from a man to a woman. Cherry called it the "cocktail party problem": how do we follow one voice among many, and what happens to the rest?

GRE Psychology attention questions ask you to:

- Compare early-selection, late-selection and flexible models of **selective attention** 选择性注意.
- Predict the costs of **divided attention** 分配性注意.
- Use load theory to predict when distractors break through.
- Explain **habituation** 习惯化 and **dishabituation** 去习惯化, and use them to test infants.

Where is the filter?

- Early selection (Broadbent, 1958): a filter picks one message by physical features such as ear, pitch or loudness. Meaning is processed only after the filter.
- Attenuation (Treisman, 1964): the unattended message is weakened, not blocked, so important words such as your own name can get through.
- Late selection (Deutsch and Deutsch, 1963): all messages are processed for meaning, and selection happens just before response.
- Multimode theory (Johnston and Heinz, 1978): the filter can move. Selecting later uses more capacity.



Where the filter sits is what the theories disagree about.

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Divided attention

- Two tasks interfere when together they need more central capacity than is available, or when they need the same kind of processing.
- A hands-free phone call still slows a driver's braking (Strayer and Johnston, 2001). The bottleneck is central, not in the hands.
- Practice can make a task automatic, so that it needs less capacity.

Load theory

Lavie's load theory separates two kinds of load.

- High perceptual load in the main task uses up perception, so distractors are not processed.
- High working-memory load weakens control, so distractors break through more.
- The two kinds of load make opposite predictions, so the type of load must be named.

Habituation

Habituation is the simplest kind of learning: the response to a repeated stimulus weakens. It is **non-associative learning** 非联想学习, because nothing is paired with anything else.

- Dishabituation: a changed stimulus restores the response.
- Habituation is not sensory adaptation (the receptors tiring) or fatigue: after habituation the response returns at once to a new stimulus.
- Infant researchers use it: a baby looks less at a repeated picture, and looks longer again if it notices a change. Recovery of looking shows the baby can tell the two apart.
- Extinction is different: it removes a learned association; habituation needs no association.

Worked example: a listening study

A listener shadows the right ear while the left ear plays a list containing the listener's name.

- Early selection, with a strict filter, predicts that the name will not be noticed.
- Attenuation predicts that the name sometimes gets through, because important words need little signal. About a third of listeners do notice their name (Moray, 1959).
- Noticing the name therefore argues against a strict early filter.

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Worked example: an infant study

Looking time falls across six showings of a red square, then rises when a green square appears.

- The fall is habituation; the rise is dishabituation.
- It shows the infant can discriminate red from green squares.
- It does not show that the infant has colour words or adult colour concepts. A control is needed to check the green square is not simply brighter.

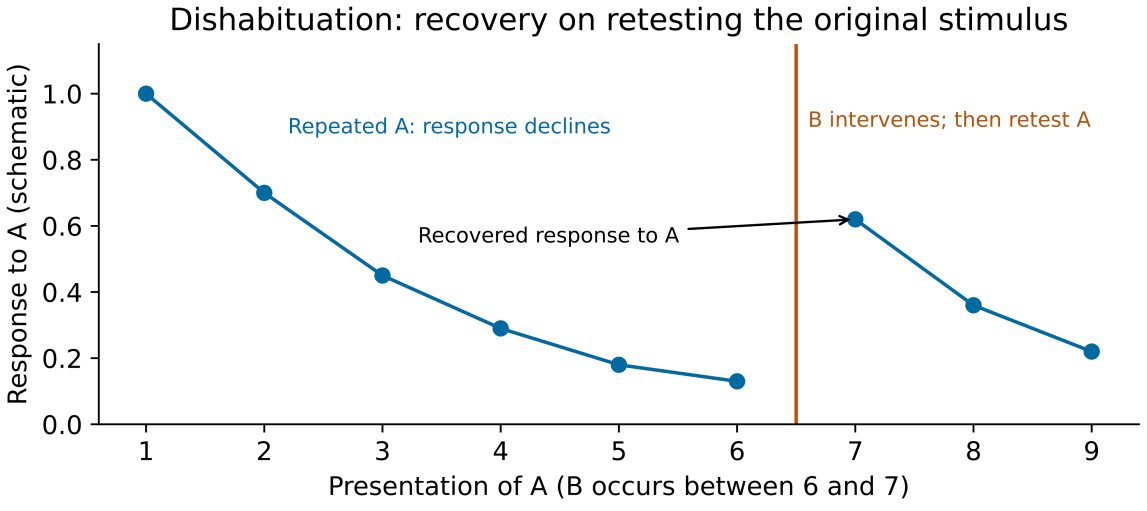


Illustration only; matched controls help rule out recovery due to rest.

Dishabituation: a different stimulus restores the response to the original one

Common errors

- Calling habituation a form of conditioning.
- Confusing habituation with sensory adaptation or fatigue.
- Saying all dual tasks fail equally; costs depend on load and on what the tasks share.
- Treating hands-free phones as safe because the hands are free.
- Using "load" without saying whether it is perceptual or working-memory load.

Key terms

selective attention: Focusing on some information while ignoring the rest.

divided attention: Sharing limited capacity between tasks done at the same time.

habituation: A weakening response to a stimulus that is repeated without consequence.

dishabituation: The return of a habituated response after the stimulus changes.

non-associative learning: Learning from repeated exposure to one stimulus, without pairing it with another.

Check yourself

- A listener notices their name in the unattended ear. Which model does this support over a strict early filter?
- A family stops noticing a clock's ticking, but notices at once when it stops. Name both effects.
- Does high perceptual load in the main task make distraction more or less likely?

Answers: attenuation (or late selection). Habituation, then dishabituation. Less likely.

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Evolutionary and comparative perspectives

GRE Subject Test · GRE Psychology

In 1938 Konrad Lorenz and Niko Tinbergen watched greylag geese retrieve eggs that had rolled out of the nest. The goose stretched its neck and rolled the egg back with the underside of its bill. If the egg was taken away halfway, the goose went on with the movement until its head reached the nest, rolling nothing. It would also roll back a doorknob or an oversized model egg. In 1973 Lorenz, Tinbergen and Karl von Frisch shared the Nobel Prize for founding ethology, the study of animal behaviour in its natural setting.

GRE Psychology evolutionary questions ask you to:

- Use **inclusive fitness** 广义适合度 and Hamilton's rule for **kin selection** 亲缘选择.
- Describe a **fixed action pattern** 固定行为模式 and its **sign stimulus** 信号刺激.
- Explain **prepared learning** 预备性学习.
- Match an evolutionary or comparative claim to the evidence it needs.

Kin selection

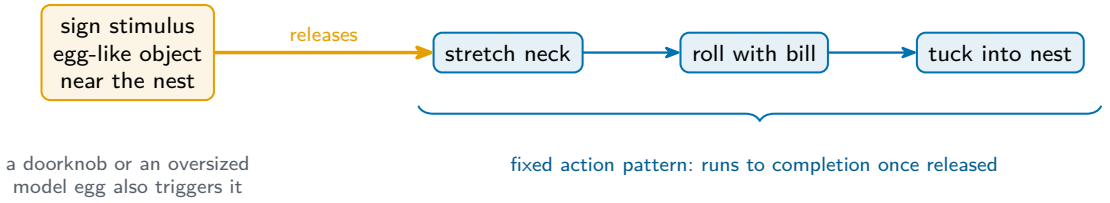
A gene can spread by helping relatives who carry copies of it, as well as by helping its carrier have offspring. Hamilton (1964) put this in one inequality:

$$rB > C$$

- r is relatedness: 0.5 for full siblings and for parent and child, 0.25 for half-siblings, 0.125 for first cousins.
- B is the benefit to the recipient and C the cost to the helper, measured in the same units of reproductive success.
- With equal B and C, help to a sibling is favoured before help to a cousin. The rule predicts direction, not exact human choices.

Fixed action patterns

- A fixed action pattern is a species-typical sequence that a sign stimulus releases and that runs to the end once started.
- The goose's egg-rolling is the classic case; so is a herring-gull chick pecking at the red spot on its parent's bill to get food (Tinbergen).
- A supernormal stimulus, an exaggerated version of the sign stimulus, can trigger a stronger response than the real thing, as with an oversized egg.
- Real behaviour still varies with the animal's state and context.



Released, then run to completion.

Prepared learning

Some associations are learned much faster than others, because evolution has prepared the learner for them.

- Garcia and Koelling (1966): rats easily linked a taste with later sickness, and a light or sound with shock, but not the other way round.
- Taste aversion can form after one pairing, with hours between the food and the sickness.
- Monkeys learn fear of snakes from watching other monkeys far more easily than fear of flowers (Mineka).
- Prepared learning shows that evolution and learning work together, not as rivals.

Evolutionary explanations

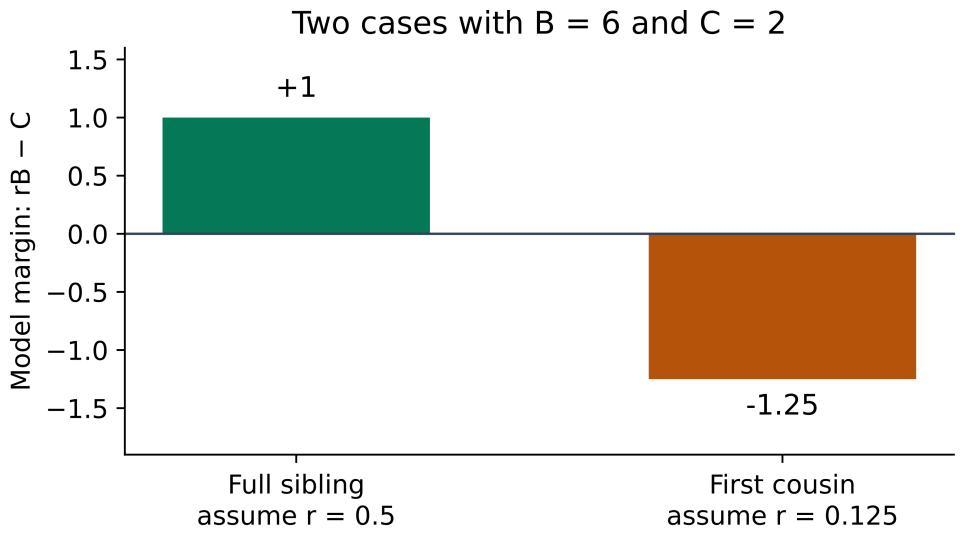
- An evolutionary explanation is about function: how a behaviour raised reproductive success in ancestral environments. It is a hypothesis about history.
- It needs evidence: comparisons across species, predictions tested in new data, or links to genetics, not only a plausible story told after the fact.
- Comparative caution works both ways: do not read human motives into animals (anthropomorphism), and do not assume a human behaviour is purely learned when similar patterns appear across species.

Worked example: Hamilton's rule

An act of help gives the recipient $B = 8$ units of fitness at a cost $C = 3$ to the helper.

- Full sibling: $rB = 0.5 \times 8 = 4 > 3$, so helping is favoured.
- First cousin: $rB = 0.125 \times 8 = 1 < 3$, so it is not.
- For a cousin, helping would need $B > 24$.

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Comparable reproductive units; these are model values, not observed choices.

Hamilton's rule: helping is favoured when $rB > C$, here for siblings but not cousins

Worked example: naming the process

- A goose rolls a doorknob into its nest: a fixed action pattern released by a crude sign stimulus.
- A camper who was sick once after eating clams avoids clams for years: prepared learning (taste aversion).
- A ground squirrel gives alarm calls that put itself at risk, mostly when relatives are near: kin selection.

Common errors

- Treating Hamilton's rule as a precise calculator for human decisions.
- Forgetting that B and C must be in the same units.
- Explaining any behaviour as adaptive after the fact, without evidence.
- Treating fixed action patterns as learned.
- Thinking an evolutionary account rules out learning.

Key terms

inclusive fitness: Reproductive success counting both one's own offspring and the reproduction of relatives, weighted by relatedness.

kin selection: Natural selection for behaviour that helps relatives.

fixed action pattern: A species-typical sequence of behaviour released by a sign stimulus and completed once started.

sign stimulus: A specific feature that releases a fixed action pattern.

prepared learning: Fast learning of associations that were important in a species' evolution.

Check yourself

- What is r for half-siblings?
- A gull chick pecks harder at a stick with three red bands than at its parent's bill. What is the stick?
- Rats learn to avoid a taste after one illness but not a light. What does this show?

Answers: 0.25. A supernormal stimulus. Prepared learning: some associations are learned far more easily.

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Encoding depth and retrieval routes

GRE Subject Test · GRE Psychology

In 1975 Fergus Craik and Endel Tulving, in Toronto, showed people a series of words, each with a quick question. Some questions were about the look of the word ("Is it in capital letters?"), some about its sound ("Does it rhyme with *weight*?") and some about its meaning ("Does it fit the sentence 'He met a _____ in the street'?"). Nobody was told there would be a memory test. In the surprise test, words processed for meaning were recognised far more often than words processed for their letters. What people did with a word mattered more than whether they tried to remember it.

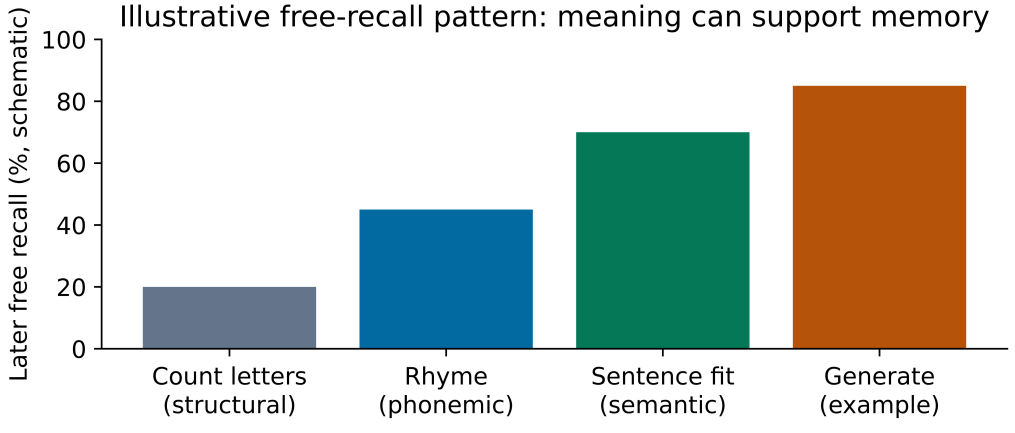
GRE Psychology encoding questions ask you to:

- Explain **levels of processing** 加工水平.
- Separate maintenance from **elaborative rehearsal** 精细复述.
- Use **transfer-appropriate processing** 迁移适宜性加工 and **encoding specificity** 编码特异性.
- Design and read studies that separate encoding from retrieval.

Levels of processing

Craik and Lockhart (1972) proposed that memory depends on how deeply information is analysed.

- Shallow (structural): the look of the word, such as its typeface.
- Intermediate (phonemic): its sound, such as what it rhymes with.
- Deep (semantic): its meaning and links to other knowledge.
- People who process deeply without intending to learn can remember more than people who intend to learn but process shallowly.



Invented values illustrate one pattern, not a universal ranking or a study result.

Deeper, meaning-based processing usually supports better recall

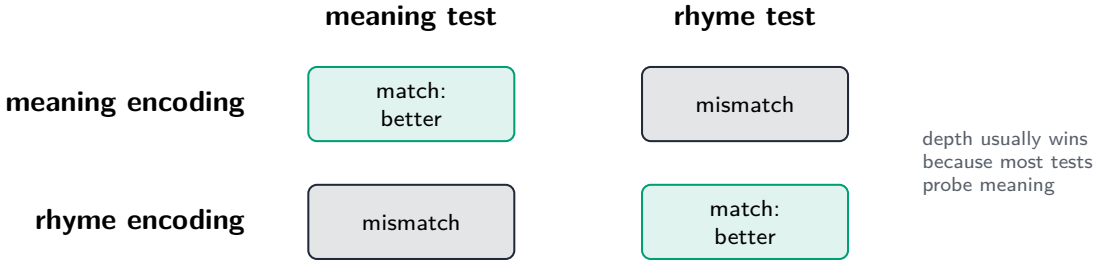
Rehearsal and elaboration

- Maintenance rehearsal repeats material without changing it. It keeps the material active but builds weak long-term traces.
- Elaborative rehearsal links material to meaning, images and what you already know. It builds lasting traces.
- The generation effect: words you produce yourself ("hot – c_ _ _") are remembered better than words you only read.
- The self-reference effect: relating material to yourself is a strong form of elaboration.

Transfer-appropriate processing

Morris, Bransford and Franks (1977) added the retrieval side: memory is best when the processing at encoding matches the processing the test needs.

- On a normal recognition test, meaning-encoded words win.
- On a rhyme test ("Was there a word that rhymed with *eagle*?"), rhyme-encoded words win.
- Depth usually helps because most tests ask about meaning, but the match decides.



The match between encoding and test decides, not depth alone.

Encoding specificity

Tulving's principle: a retrieval cue works if it was part of what was encoded.

- Context: divers who learned words underwater recalled them better underwater than on land (Godden and Baddeley, 1975).
- State: material learned in one physical or emotional state is often recalled better in the same state.
- Context effects are real but modest; good cues from meaning are usually stronger.

Worked example: a two-by-two study

A teacher wants to know whether meaning encoding is always best.

- Group 1 judges each word's meaning; group 2 judges its rhyme. Exposure time is the same.
- Half of each group takes a meaning test and half a rhyme test.
- If meaning wins on the meaning test but rhyme wins on the rhyme test, the result is an interaction: transfer-appropriate processing. If meaning wins on both, depth is the stronger effect.

Worked example: naming the effect

- A student reads a definition five times and forgets it a week later: maintenance rehearsal.
- A student who writes her own example of each term remembers them: elaboration, and the generation effect.
- A witness recalls more details when taken back to the scene: encoding specificity (context).

Common errors

- Equating repetition with learning.
- Thinking the intention to learn matters more than the type of processing.
- Claiming deeper processing wins on every test.
- Confusing transfer-appropriate processing (type of processing) with context effects (setting or state).
- Comparing groups that had different amounts of exposure.

Key terms

levels of processing: The idea that memory strength depends on how deeply information is analysed.

elaborative rehearsal: Linking new material to meaning, images and existing knowledge.

transfer-appropriate processing: The principle that memory is best when encoding matches the processing the test requires.

encoding specificity: The principle that a cue helps recall if it was part of the original encoding.

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Check yourself

- Which question gives the deepest processing: "Is it in capitals?", "Does it rhyme with *cat*?" or "Is it a kind of animal?"
- A rhyme-encoded list is remembered better on a rhyme test. Which principle explains this?
- A student studies with music and is tested in silence. Which principle predicts a small cost?

Answers: "Is it a kind of animal?" Transfer-appropriate processing. Encoding specificity.

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Hormones, stress and behavioural regulation

GRE Subject Test · GRE Psychology

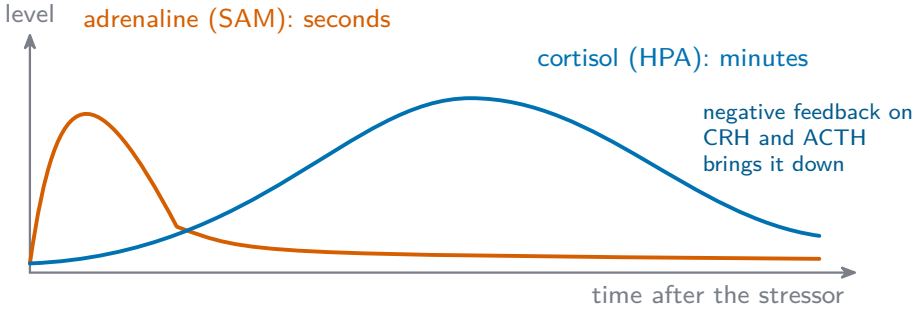
In 1936 Hans Selye, a young researcher in Montreal, injected rats with extracts that he hoped would reveal a new hormone. The rats developed enlarged adrenal glands, a shrunken thymus and stomach ulcers. Then he found that cold, injury, forced exercise and many other harmful treatments produced the same three signs. He described a general response to any demand on the body, with stages of alarm, resistance and exhaustion. Selye's "general adaptation syndrome" started the modern study of stress.

GRE Psychology stress and hormone questions ask you to:

- Compare the fast sympathetic path with the slower **HPA axis** 下丘脑-垂体-肾上腺轴.
- Explain **negative feedback** 负反馈.
- Match major hormones to the systems they regulate.
- Compare hormonal and neural signalling, including the role of **receptors** 受体.

Two stress clocks

- Fast: the sympathetic nervous system signals the adrenal medulla to release adrenaline (epinephrine) within seconds. Heart rate, breathing and blood glucose rise.
- Slow: the hypothalamus releases CRH, the pituitary releases ACTH, and the adrenal cortex releases **cortisol** 皮质醇. Cortisol peaks after about 20–30 minutes.
- Cortisol makes energy available and reduces non-urgent activity such as digestion and some immune responses.



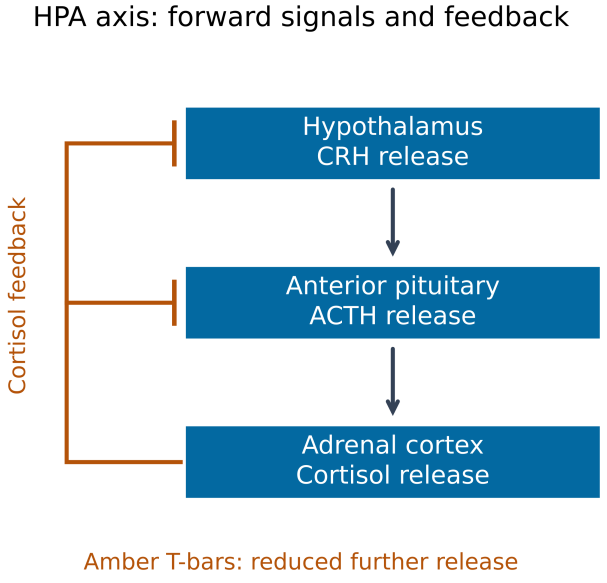
A fast and a slow stress clock.

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Negative feedback

Cortisol acts on the hypothalamus and pituitary to reduce the release of CRH and ACTH.

- This is negative feedback: the output of a system turns the system down, so the response ends when the stressor passes.
- Problems arise when stress is repeated or never ends, or when feedback is weakened. The hormone itself is adaptive.
- Selye's three stages: alarm (the first response), resistance (continued coping) and exhaustion (resources run down under long stress).



Cortisol's negative feedback on the hypothalamus and pituitary limits the stress response

Hormones and their jobs

- Insulin lowers blood glucose; glucagon raises it. They work in opposition.
- Melatonin, from the pineal gland, rises in darkness and helps time sleep.
- Oxytocin causes contractions in labour and the release of milk, and is linked to social bonding.
- Progesterone prepares and maintains the lining of the uterus for pregnancy.
- Thyroid hormones set the body's general rate of metabolism.

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Hormones and nerves

- Neural signals are usually fast, brief and sent to specific targets.
- Hormones travel in the blood, so they reach the whole body and usually act more slowly and for longer.
- A hormone affects only cells that carry its receptor. That is how a signal sent everywhere can still have selective effects.
- These are tendencies, not rules: noradrenaline works both as a hormone and as a neurotransmitter.

Worked example: a near-miss

A cyclist is almost hit by a car.

- Within seconds: adrenaline from the adrenal medulla. The heart pounds and the hands shake.
- Over the next half hour: CRH, then ACTH, then cortisol rises.
- As cortisol rises, it inhibits CRH and ACTH, and the levels fall back during the next hours.

Worked example: matching hormones

- A student's blood glucose rises after lunch, then returns to normal: insulin.
- A traveller crossing time zones takes a supplement to shift sleep time: melatonin.
- A mother's milk flows when her baby cries: oxytocin.

Common errors

- Giving the HPA order wrongly; it is CRH, then ACTH, then cortisol.
- Calling cortisol harmful in itself; chronic activation and failed regulation cause harm.
- Linking each hormone to one emotion.
- Forgetting receptors when explaining selective effects.
- Treating "nerves are fast, hormones are slow" as an absolute rule.

Key terms

HPA axis: The hypothalamus–pituitary–adrenal chain that produces the slower cortisol stress response.

cortisol: The main stress hormone of the adrenal cortex, which makes energy available.

negative feedback: Regulation in which a system's output reduces further output.

receptors: Proteins on or in cells that bind a specific signalling molecule.

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Check yourself

- Which gland releases ACTH?
- Which stress hormone rises first after a sudden fright?
- How can a hormone in the whole bloodstream affect only some organs?

Answers: the (anterior) pituitary. Adrenaline. Only cells with its receptor respond.

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Epidemiology and clinical evidence

GRE Subject Test · GRE Psychology

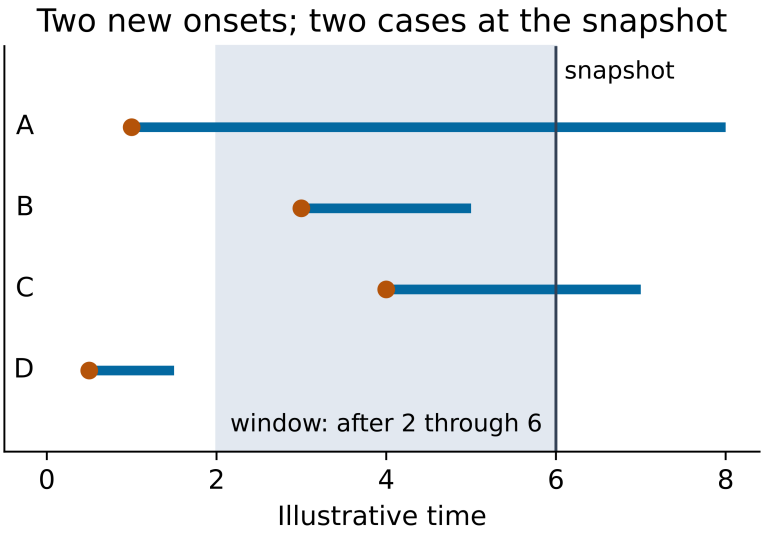
In 1950 Richard Doll and Austin Bradford Hill compared 709 lung cancer patients in London hospitals with 709 patients of the same sex and age who had other illnesses. Almost all the lung cancer patients smoked, and heavy smokers were far more common among them. Doll was so struck that he gave up smoking. A year later they wrote to every doctor in Britain and followed tens of thousands of them for decades: the smokers died of lung cancer far more often. One study looked back from the disease, the other forward from the exposure. Together they settled the question.

GRE Psychology epidemiology questions ask you to:

- Separate **incidence** 发病率 from **prevalence** 患病率, with the right denominators.
- Compare study designs: case–control, **cohort study** 队列研究, randomised trial and meta-analysis.
- Read relative and absolute risk, and the number needed to treat.
- Use base rates to read screening results.

Incidence and prevalence

- Incidence counts new cases in a period. Cumulative incidence divides by the number of people at risk at the start; an incidence rate divides by person-time at risk.
- Prevalence counts all existing cases at one time, divided by the population then.
- Long-lasting conditions can have low incidence and high prevalence. A short outbreak can have high incidence and low prevalence.
- Compare rates, not raw counts, when populations differ in size.



Selected case histories only. Dots = onset; line ends = no longer a case.

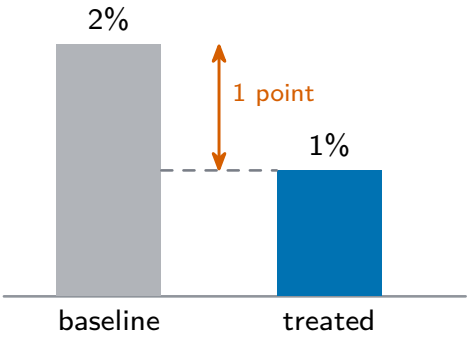
Incidence counts new onsets in the window (two); prevalence counts cases at the snapshot (two)

Study designs

- Case report: describes one or a few patients. It suggests ideas but tests nothing.
- **Case–control study** 病例对照研究: starts from people with and without the disease and looks back at exposures. It suits rare diseases.
- Cohort study: follows exposed and unexposed people forward and counts new cases.
- Randomised controlled trial: chance decides who is treated, which balances confounders, known and unknown, on average.
- Meta-analysis: combines studies. It cannot repair weak studies, and missing negative results bias it.
- The design is a guide, not a guarantee: a badly run trial can mislead more than a careful cohort study.

Risk

- Relative risk reduction compares the treated risk with the baseline: 2% to 1% is a 50% reduction.
- Absolute risk reduction is the difference: 2% to 1% is 1 percentage point.
- The **number needed to treat** 需治疗人数 is 1 divided by the absolute reduction: here 100.
- A relative figure means little without the baseline risk and the follow-up time.



relative: half the risk, a 50% reduction
absolute: 1 percentage point

Relative and absolute reductions tell different stories.

Screening and base rates

When a condition is rare, even an accurate test gives many false positives among its positive results.

- Sensitivity: the share of real cases the test detects.
- Specificity: the share of non-cases the test correctly clears.
- The share of positives who really have the condition depends strongly on prevalence.

Worked example: rates

In a fictional closed group, 12 of 600 initially unaffected people develop a condition during a year. At a later census, 30 of 750 people have it.

- Cumulative incidence: $12/600 = 0.02$, 2% over one year.
- Point prevalence: $30/750 = 0.04$, 4%, counting old and new cases.
- A trial with risks of 4% (control) and 3% (treatment): relative reduction 25%, absolute reduction 1 point, number needed to treat 100.

Worked example: a screening test

A test has 90% sensitivity and 95% specificity. Screen 10,000 people where the prevalence is 1%.

- 100 people have the condition; the test finds 90.
- 9,900 do not; 5% of them, 495, test positive anyway.
- Of 585 positives, only $90/585 = 15\%$ have the condition.

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Common errors

- Reporting a count of new cases as prevalence.
- Mixing person-time and people-at-risk denominators.
- Quoting a relative risk without the baseline.
- Treating a meta-analysis as automatically strong.
- Reading a positive screening result as near-certain for a rare condition.

Key terms

incidence: The number or rate of new cases in a stated period.

prevalence: The proportion of a population with a condition at a given time.

cohort study: A study that follows exposed and unexposed groups forward in time.

case–control study: A study that compares people with and without a disease and looks back at their exposures.

number needed to treat: The number of people who must be treated to prevent one bad outcome, 1/absolute risk reduction.

Check yourself

- A survey counts everyone currently diagnosed with depression in a city. Incidence or prevalence?
- A drug lowers risk from 10% to 5%. What is the number needed to treat?
- Which design suits a very rare disease best: cohort or case–control?

Answers: prevalence. 20. Case–control.

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