Biological psychology

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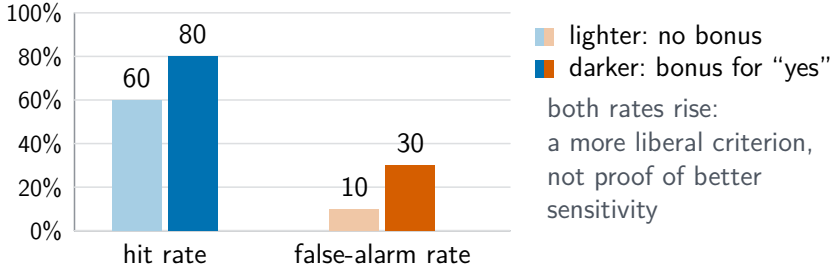
Biological psychology

- 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.

Figure: Sensation and perception



- Both rates rise together: a shifted criterion, not proof of better sensitivity.
- Match each part of the diagram to the text.

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.

Studying the brain (2)

- 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

- 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.

Figure: Worked example: an alarm bonus

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
- Match each part of the diagram to the text.

Worked example: a brain scan

- 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.

Common errors (2)

- Naming one brain area as the whole basis of a behaviour.
- Mixing up the James–Lange and Cannon–Bard theories.

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?