

# Sensation, perception and psychophysics

GRE · GRE Subject Test · GRE Psychology

## Scope and prerequisites

Supported GRE topic 12 (SP.1). Use the overview measurement lesson VI when interpreting research evidence. Existing official questions are traced in bank\_review\_form.yaml; original tasks below are not ETS items.

## Concepts and method

**difference threshold** : The minimum detectable change in a stimulus, a constant fraction of the baseline by Weber’s law. **transduction** : Conversion of physical stimulus energy into neural signals by receptors.

Psychophysics relates physical intensity to experience. An absolute threshold is a stimulus level meeting a specified detection criterion under specified conditions, often 50% detection; a difference threshold is a detectable change under a stated criterion. Weber’s law states that the difference threshold is a constant fraction of the baseline:  $\Delta I/I=k$ . With  $k=.02$ , a 100 g weight needs a 2 g change, while 200 g needs 4 g. Fechner proposed that perceived intensity grows logarithmically with physical intensity.

Real detection is noisy, so signal detection theory separates sensitivity from bias. Presenting signal or noise on each trial gives four outcomes: hits, misses, false alarms and correct rejections. Sensitivity  $d'$  measures how separated the signal and noise distributions are; the criterion measures the observer’s willingness to say yes. A payoff change can move the criterion without changing  $d'$ , so hit rate alone is not sensitivity.

Sensation begins with transduction: receptors convert physical energy into neural signals, as photoreceptors convert light and hair cells convert sound pressure. Sensory adaptation reduces response to a constant stimulus. Dark adaptation is the recovering sensitivity of the visual system in low light.

Perception organises input rather than copying it. Gestalt principles group by proximity, similarity, closure and good continuation. Bottom-up processing builds percepts from features; top-down processing applies context and expectation. Categorical perception treats continuous acoustic variation as discrete phonemes: within a category, differences are hard to hear even when physically present.

A threshold is defined by a detection criterion under specified conditions, often 50% detection for an absolute threshold, rather than a sharp physical boundary between always seen and never seen. Weber’s approximation predicts changes proportional to a baseline within its useful range. Transduction changes energy into neural signalling; perception groups and interprets that input. A change in reporting incentives primarily concerns decision criterion, while changes in physical contrast may affect sensitivity.

## Worked reasoning

With Weber fraction .02, detecting a change from 50 g needs 1 g, and from 500 g needs 10 g. A radiologist who says yes more often after a pay-per-hit scheme shifts criterion, not  $d'$ . A listener who cannot distinguish two within-category speech sounds shows categorical perception of a physically continuous dimension.

With a fictional Weber fraction  $k=.03$ , estimate the just noticeable difference for 100 g and 300 g baselines.

$\Delta I/I=k$ , so  $\Delta I=kI$ .  $\Delta I=.03\times 100\text{ g}=3\text{ g}$ ;  $\Delta I=.03\times 300\text{ g}=9\text{ g}$ . The fraction is dimensionless and the result has the baseline’s unit. A constant 3 g prediction at both baselines would ignore the proportional model. The approximation does not establish identical thresholds for all observers or intensities.

## Signal detection: four outcomes separate sensitivity from bias

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

## Independent transfer

A listener says yes on more signal and more noise trials after a warning. Explain why sensory adaptation is not the only or best initial explanation.

Attempt independently, then use the matching skill sheet solution.

## Review and source limits

Avoid this error: Treating the difference threshold as a fixed amount rather than a fraction of the baseline, or reading a higher hit rate as better sensitivity when the observer simply says yes more. Teaching scope comes from teaching.yaml and the source/key/crop review in bank\_review\_form.yaml. Detailed current diagnostic criteria require an authenticated manual; neither historical ETS practice nor this educational reference certifies them.