L01: LIGHT & OPTICS – THE PHYSICAL FOUNDATION OF VISION

PSYC2016 Vision | EM Spectrum, Wavelength-Frequency, Ambient Optic Array, Evolutionary Eye Designs, Refraction | Prof. Bart Anderson

Core Concept · Foundation · Key Insight · Critical Trap · Evidence · Advanced

LEARNING OUTCOMES

1. Explain the **electromagnetic spectrum** and why visible light is optimal for vision
2. Understand the relationship between light **wavelength and frequency**
3. Describe **'ambient optic array'** and its role in visual sampling
4. Compare different **evolutionary designs of eyes** and their sampling methods
5. Distinguish between **compound, pinhole, and lens-based eyes**

WHAT IS LIGHT?

Electromagnetic radiation = energy propagating through space as oscillating electric and magnetic fields perpendicular to each other.

The EM spectrum is **CONTINUOUS**. "Visible," "UV," "infrared" are just convenient labels for wavelength ranges—physically, only wavelength varies.

Region	Wavelength	Why NOT used for vision?
Gamma/X-rays	<10nm	Penetrate tissue; break DNA
UV	10-380nm	Damages cells (DNA breaks)
Visible	**380-700nm**	Optimal window!
Infrared	700nm-1mm	Self-emission problem
Radio	>1mm	Diffracts; no spatial structure

WHY VISIBLE LIGHT? THE 4 CONVERGING CONSTRAINTS

Visible light isn't arbitrary—it's where **four independent physical constraints converge**:

#	Constraint	Mechanism	If Violated
1	**Peak Solar Energy**	Sun peaks ~500nm; atmosphere transmits 380-700nm	Insufficient photons
2	**Surface Reflection**	Visible λ reflects from pigments → spatial structure	X-rays penetrate; radio diffracts
3	**No Self-Emission**	37°C bodies emit infrared continuously	IR receptors saturated
4	**No Cell Damage**	UV breaks DNA phosphodiester bonds	Receptors degrade

Central insight: Visible light represents an EVOLUTIONARY OPTIMIZATION under converging physical constraints—not an arbitrary choice.

THE INFRARED SELF-EMISSION PROBLEM

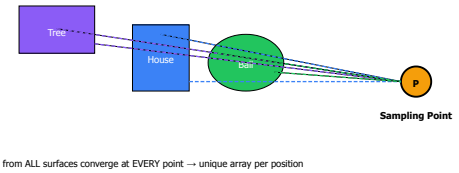
Why can't mammals use IR vision?
Warm-blooded animals (~37°C) emit continuous infrared radiation. IR photoreceptors would be **bombarded by their own thermal signature**, masking environmental signals.

Exception: PIT VIPERS can use IR—they're COLD-BLOODED!

This is a HIGH-YIELD SAQ topic. Always explain the mechanism, not just state "mammals can't use IR."

THE AMBIENT OPTIC ARRAY (GIBSON)

"Light reflected from surfaces projects a set of intersecting rays to **EVERY point in space**."



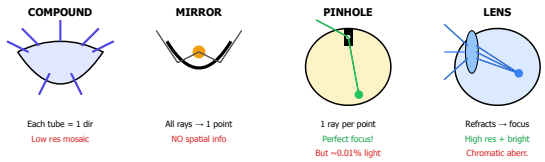
from ALL surfaces converge at EVERY point → unique array per position

Term	Definition
Ambient Optic Array	Structured set of light rays converging at every point from all visible surfaces
Position-Dependence	Each location has UNIQUE array (different occlusions, angles, distances)
Sampling	Eyes don't "see" the array—they SAMPLE it at their position

Gibson's Ecological Optics: The array contains MORE information than any eye can capture. Vision is always a SELECTIVE SAMPLING PROBLEM.

Why This Matters:
Different eye designs = different sampling strategies optimized for different ecological niches. No eye is "better"—each is an optimal trade-off.

EVOLUTIONARY EYE DESIGNS: TRADE-OFFS, NOT HIERARCHIES



Type	Sampling Method	Advantage	Fatal Flaw	Example
Compound	Array of tubes (ommatidia)	~230° FOV, motion	Resolution ∝ 1/distance	Insects
Concave Mirror	Reflects broad region	Simple, efficient	ZERO spatial detail	Scallops
Pinhole	1 ray per point	Perfect focus ALL depths	~0.01% light	Nautilus
Lens-Based	Refracts rays to retina	High res + brightness	Chromatic aberration	Vertebrates

Pinhole vs Lens Trade-off: Pinhole ~0.3mm vs pupil ~4mm → $(4/0.3)^2 \approx$ **177× more light with lens!** Evolution chose brightness over optical perfection.

GARY LARSON MISCONCEPTION

WRONG: Compound eyes see "multiple copies" of the world.
CORRECT: Each ommatidium samples ONE direction; together they form a **low-resolution mosaic** (like pixels). Resolution improves as objects get closer (subtend more ommatidia).

This is a COMMON EXAM TRAP. Know the correct mechanism!

L11: AUDITION I – SOUND AND TIMBRE

PSYC2016 Higher Cognition | Physical vs Perceptual Properties | Frequency/Pitch, Amplitude/Loudness, Complexity/Timbre | Ear Anatomy | Tonotopy | Prof. Alais

Core Definition Framework Key Insight Critical Trap Evidence

LEARNING OUTCOMES

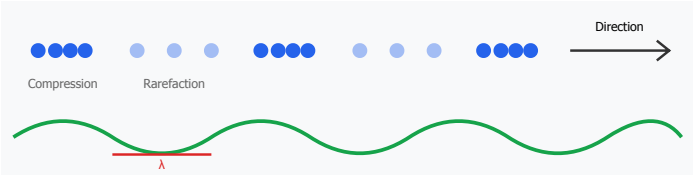
1. Understand the **physical & perceptual properties** of sound
2. **Define sound** (longitudinal pressure waves)
3. Understand **frequency ≠ pitch** (related but not identical)
4. Understand **amplitude ≠ loudness** (related but not identical)
5. Understand **complexity (timbre)**: fundamental → pitch; harmonics → timbre
6. Understand **loudness depends on distance** (inverse square law)
7. Describe structure/function of **outer, middle, inner ear**
8. Explain **tonotopic selectivity** of the basilar membrane

CORE DEFINITION: SOUND

"Sound is a **repetitive change in air pressure over time** – a longitudinal mechanical wave of compression and rarefaction."

Key Term	Meaning
Longitudinal	Particles oscillate PARALLEL to wave direction
Compression	High-pressure region (particles closer)
Rarefaction	Low-pressure region (particles spread)
Mechanical	REQUIRES medium (no sound in vacuum)

Wavelength formula: λ = v/f where v = 343 m/s in air. Range: 1.7 cm (20 kHz) to 17 m (20 Hz)



SOUND VS LIGHT WAVES

Property	Sound	Light
Wave type	Longitudinal (mechanical)	Transverse (electromagnetic)
Wavelength	1.7 cm – 17 m	400–700 nm
Speed	343 m/s (air)	3×10^8 m/s
Propagation	Omnidirectional, diffracts	Straight lines, shadows
Information	Object physical properties	Surface properties

Sound wavelengths ~1 million times longer than light → diffracts around corners; heard 360°

TIMBRE: COMPLEXITY AND HARMONICS

Timbre: The perceptual "color" or "texture" that distinguishes sounds of equal pitch and loudness.

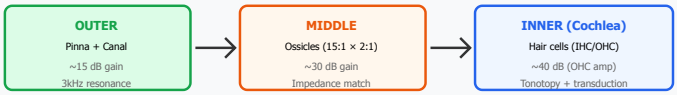
Component	Determines	Example
Fundamental (f_0)	**PITCH**	Lowest frequency; "which note"
Harmonics ($2f_0$, $3f_0$...)	**TIMBRE**	Integer multiples; "which instrument"

Instrument Harmonic Profiles:

Instrument	Pattern	Timbre
Flute	Few harmonics	Mellow, hollow
Violin	Moderate, weak high	Warm, woody
Trumpet	Strong high harmonics	Bright, brassy
Oboe	Dense to 4000 Hz	Nasal, reedy

ALL natural sounds are BROADBAND (complex). Pure tones exist ONLY artificially!

EAR STRUCTURE: OUTER, MIDDLE, INNER



Division	Structures	Function	Gain
Outer	Pinna, ear canal	Directs sound; ~3 kHz resonance	~15 dB
Middle	Eardrum, ossicles	Impedance matching (air→fluid)	~30 dB
Inner	Cochlea, hair cells	Frequency analysis; transduction	~40 dB (OHC)

Middle Ear Impedance Matching:

- **Problem**: >99% energy lost at air-fluid boundary
- **Area ratio**: Eardrum 15× larger than oval window → **15:1**
- **Lever ratio**: Malleus longer than stapes → **2:1**
- **Combined**: 15 × 2 = ~30× pressure = **~30 dB gain**

L16: ATTENTION I – BOTTLENECKS & OVERT/COVERT ATTENTION

PSYC2016 | William James (1890) | Bottleneck Architecture | Overt vs Covert Attention | Deubel & Schneider Coupling | Dr. Daniel Pearson

Definition Evidence Key Insight Common Error Core Concept Study

LEARNING OUTCOMES (THIS SHEET)

1. Describe aspects of attention (**William James' definition**): selective, external/internal, limited resource
2. Understand the role of attention in the **'bottleneck' metaphor** for information processing
3. Define **overt and covert attention**
4. Explain how they are **tightly linked together**

WILLIAM JAMES (1890): CLASSIC DEFINITION

Full Quote: "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of **ONE out of what seem several** simultaneously possible objects or trains of thought. It implies **withdrawal from some things** in order to deal with others."

Aspect	James Quote Evidence	Modern Example
1. SELECTIVE	"ONE out of SEVERAL simultaneously possible"	Cocktail party: focus on one conversation among many
2. EXTERNAL/INTERNAL	"Objects OR trains of thought"	External: traffic light | Internal: mental math, planning
3. LIMITED RESOURCE	"WITHDRAWAL from some things to deal with others"	Reading text = cannot monitor peripheral motion

Mnemonic: S.E.L. — Selective | External/Internal | Limited Resource (withdrawal principle)

THE BOTTLENECK METAPHOR

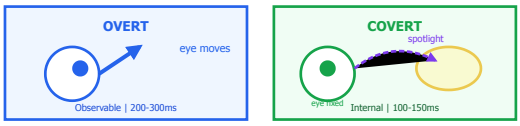
Core Architecture: Perceptual systems = PARALLEL (millions of receptors) | Cognitive systems = SERIAL (1 or few items) | Attention = GATEKEEPER

ANDERSON ET AL. (2005): QUANTIFYING THE BOTTLENECK

Processing Stage	Information Rate	Interpretation
Retinal Input	~126 million photoreceptors	Massive parallel processing
Optic Nerve Output	**~3 × 10^6 bits/sec**	After retinal compression
Attentive Scrutiny	**~10^4 bits/sec**	What reaches conscious processing
Reduction Ratio	**100:1**	**Only ~1% passes bottleneck!**

Key Statistic: Optic nerve carries 100× more information than cognitive processing can handle. Attention is ESSENTIAL for selection.

OVERT VS COVERT ATTENTION: DEFINITIONS



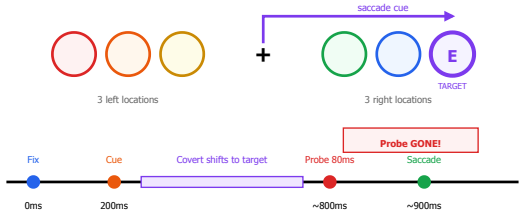
Feature	Overt Attention	Covert Attention
Definition	Physically directing sensory organs to gather information	Mentally directing processing resources without moving organs
Observable?	YES — others can see (eye movements, head turns)	NO — internal process, invisible
Why Needed?	Overcome SENSORY limits (visual field ~180°, foveal acuity)	Overcome COGNITIVE bottleneck (select among available stimuli)
Speed	Slow: **~200-300ms** (saccade planning + execution)	Fast: **~100-150ms** shifts
Lecture Demo	"Attend to camera behind you" → Everyone turns head	Fixate center, attend to letters C, F, A without eye movement
Relationship to Bottleneck	Gets info TO sensory organs (pre-bottleneck)	Controls what passes THROUGH bottleneck (selection mechanism)

Key Distinction: OVERT overcomes SENSORY limits | COVERT overcomes COGNITIVE limits

DEUBEL & SCHNEIDER (1996): TIGHT COUPLING

Core Finding: Before you move your eyes to a location (shift overt attention), covert attention moves there FIRST during saccade preparation.

Experimental Design:



- 6 colored placeholder locations around central fixation (3 left, 3 right)
- Colored arrow cues which location to saccade to
- Delay period: **150-1000ms** before saccade execution
- Discrimination probe (E or ∃) flashes for **80ms** at one location
- **CRITICAL:** Probe disappears BEFORE eyes begin moving!

Probe Location	Discrimination Accuracy	Interpretation
AT saccade target	**~80-90%**	Covert attention already there during delay
OTHER locations	**~50% (chance!)**	Covert attention LOCKED to saccade target

Key Logic: Probe disappeared BEFORE eyes moved → High accuracy at saccade target CANNOT be foveal acuity → MUST be covert attention allocation during delay!

L21: MEMORY I – COGNITIVE FOUNDATIONS

PSYC2016 | Dr Caleb Owens | Marr's Levels | Seductive Allure (Weisberg 2008) | 4 Approaches | Computer Metaphor vs Connectionism

LO-1: Cognitive Psychology LO-2: Frameworks LO-3: Neuro-Cog Interaction LO-4: Four Approaches

LEARNING OUTCOMES

1. Describe what **cognitive psychology** is
2. Describe how **frameworks for cognition changed** from the 1950s to now
3. Explain how cognitive psychology and **neuroscience interact**
4. Distinguish between the **4 approaches** to studying cognition

WHAT IS COGNITIVE PSYCHOLOGY? (LO-1)

Cognitive psychology provides a **functional description** of mental processes—thinking, perceiving, remembering, learning—at a level distinct from both neural code and behavioral contingencies.

Aspect	Cognitive Psychology	Behaviorism	Neuroscience
Focus	Internal mental processes	Observable S-R relationships	Neural mechanisms
Level	Functional + Conceptual	Functional I/O only	Hardware
Internal States	Central constructs	Rejected/forbidden	Identified with brain states
Method	RT, errors, interference	Conditioning, reinforcement	fMRI, PET, ERP, lesions

Key Distinction: Cog psych asks HOW information is processed—not WHERE in brain (neuroscience) or WHAT observable behaviors result (behaviorism).

MARR'S LEVELS OF DESCRIPTION (1982) (LO-3)

David Marr proposed cognitive systems can be understood at **three levels** that are partially independent but mutually constrain each other.

Level	Question	Focus	Face Recognition Example
COMPUTATIONAL	WHAT/WHY?	Problem identification	Identify person from visual input
CONCEPTUAL	HOW?	Algorithms, representations	Structural encoding → FRUs → PINs
HARDWARE	WHERE?	Physical substrate	Fusiform Face Area (FFA)

Why Marr Matters: Different levels ALL contribute to understanding. You can't understand WHY forward models exist (conceptual) without knowing neural delays (hardware).

Computational = WHAT/WHY | Conceptual = HOW | Hardware = WHERE — These are NOT the same question!

FOUR APPROACHES TO COGNITIVE SCIENCE (LO-4)

Approach	Method	Strengths	Limitations
1. Experimental	Test via RT, errors	Foundation; systematic	Indirect; paradigm-specific
2. Neuropsychology	Brain damage → dissociations	CAUSAL links; double dissociation	Single cases; assumes modularity
3. Computational	Simulate HUMAN performance	Forces precision; quantitative	Bonini's paradox; CAN ≠ DO
4. Neuroscience	Brain measurement + tasks	TMS = causal; diverse toolkit	Correlational; reverse inference

Key Insight: Computational models must simulate human ERRORS, not just successes. Face recognition AI doesn't care about orientation, but humans show strong inversion effects.

DOUBLE DISSOCIATION – GOLD STANDARD (LO-4)

Pattern	Inference	Problem
Single Dissociation Patient A: Impaired X, Normal Y	WEAK—X may just be HARDER	Difficulty, not separate systems
Double Dissociation A: Impaired X, Spared Y B: Impaired Y, Spared X	STRONG—X and Y SEPARATE	Rules out difficulty explanation

HM Problem: So much theory based on ONE individual. Yonolaiss paper reveals issues—HM was exception in many ways. Single-case reliance is dangerous!

Double dissociation RULES OUT difficulty explanation—if X were just harder, Patient B couldn't do X while failing Y.

NEUROSCIENCE TECHNIQUES – SPATIAL VS TEMPORAL (LO-4)

Technique	Spatial	Temporal	Reveals
fMRI	Excellent (mm)	Poor (seconds)	WHERE
ERP/MEG	Poor (cm)	Excellent (ms)	WHEN
TMS	Moderate	Excellent	CAUSAL
PET	Moderate	Very Poor	Metabolic

TMS Unique: ONLY technique providing CAUSAL inference—disrupt region, observe impairment.
MEG = Sweet Spot? Good spatial AND temporal, but ~$50 million each.

L27: THINKING I – INTRODUCTION TO HIGHER-ORDER COGNITION

PSYC2016 Higher Cognition | Definition of Thinking, Cognitive Illusions, Uncertainty & Induction, Heuristics, Conspiracy Beliefs | Dr. Bruce Burns

Core Definition · Theme · Key Insight · Critical Trap · Study

LEARNING OUTCOMES

1. Describe what **'thinking'** is
2. Explain how **cognitive illusions** can be informative as to how a complex system functions
3. Understand that **uncertainty** is involved in decision making and understanding the world
4. Explain what a **'heuristic'** is
5. Explain how **confirmation bias and heuristics** can influence conspiracy beliefs

HOLYOAK & MORRISON DEFINITION

"Thinking is the **systematic transformation of mental representations** of knowledge to characterize actual or possible states of the world, often in service of goals."

Key Term	Meaning
Systematic	Follows patterns; not random
Transformation	Changes representations; CREATES new knowledge
Mental representations	Internal models of world
In service of goals	Purposeful, directed activity

Higher-Order Cognition: Thinking operates ON products of perception/memory/language, not directly on sensory input.

THINKING VS FOUNDATIONAL PROCESSES

Process	Function	Relation to Thinking
Perception	EXTRACTS from environment	Provides input
Memory	STORES/retrieves experiences	Provides stored knowledge
Language	CONVEYS knowledge	Delivers linguistic input
Thinking	TRANSFORMS & CREATES	Operates ON their products

Key Distinction: Perception/memory/language EXTRACT; Thinking TRANSFORMS and CREATES new knowledge.

FOUR ASPECTS OF THINKING

Aspect	Definition	Example
Problem Solving	Generating route to goal	Fixing electrical fault
Decision Making	Evaluating alternatives	Choosing treatment
Reasoning	Drawing inferences	Logic (PSYC3012)
Expertise	Knowledge becomes routine	Chess (PSYC3012)

Neural Substrate:

- **Frontal lobes**: Most distinguish human brain; evolutionarily recent
- **VMPFC**: Differentially activated in ALL thinking tasks

FIVE THEMES OF THINKING

#	Theme	Core Idea	Conspiracy Link
1	**Make Errors**	Cognitive illusions informative	NOT stupidity
2	**Uncertainty**	Future predictions uncertain	False certainty
3	**Shortcuts**	Heuristics: hard→easy	Biases exploited
4	**Old Info**	Apply past via analogies	Watergate etc.
5	**Representation**	Format determines solution	Evidence reinterpreted

THEME 1: COGNITIVE ILLUSIONS INFORMATIVE

Why Errors Don't Mean Stupidity:

- **Thaler**: "People aren't dumb, the world is hard"
- **Optical illusion analogy**: Perceptual illusions don't prove vision broken
- **Tolstoy**: "Happy families alike; unhappy families unhappy in own way" — Correct answers uninformative; errors reveal process

Systematic errors reveal HOW an effective system works, not that it's broken.

Perceptual illusions = entertaining. Cognitive illusions = disturbing (thinking feels controllable).

THEME 2: HUME'S PROBLEM OF INDUCTION (1748)

Type	Logic	Certainty	Example
Induction	Past → Future	ALWAYS uncertain	Sun rose → will rise
Deduction	Premises → Conclusion	Certain if premises true	All A are B; X is A → X is B

Sun Example: "Will sun rise tomorrow?" Extremely probable but NOT 100% certain (will become red giant). Future inherently uncertain!

THEME 3: HEURISTICS – MENTAL SHORTCUTS

Heuristic: Rule of thumb that is often effective but not guaranteed. Replaces HARD question with EASY question.

Heuristic	Hard Question	Easy Replacement
Sky Darkness	Will it rain? (uncertain)	Is sky dark? (observable)
Proportionality	What caused this? (complex)	How important is event?
Similarity	Will X have property P?	Is X similar to things with P?
Availability	How common is X?	Can I easily remember examples?

Heuristics are usually HELPFUL! Only lead to predictable errors in specific contexts.

Tversky & Kahneman (1974):
Foundational work showing heuristics produce characteristic judgment biases.

CONFIRMATION BIAS & CONSPIRACY BELIEFS

Conspiracy Theory (Douglas & Sutton, 2008):
Attempt to explain event as **secret plot by covert alliance** rather than overt activity or natural occurrence. Key: UNFALSIFIABLE.

Bias/Heuristic	Normally Adaptive For	Conspiracy Misapplication
Confirmation	Reducing uncertainty	"Rabbit hole" — "Do your own research"
Proportionality	Important outcomes have causes	Reject "accident" for major events
Agency	Detecting threats	Assume deliberate conspiracy
Similarity	Transferring knowledge	Watergate analogy overgeneralized
Coherence	Making sense of world	Conspiracy = coherent story

Uscinski et al. (2022): Specific beliefs change but NO overall increase in conspiracy thinking — exploits STABLE cognitive processes.

NOT about stupidity! These processes USUALLY help us navigate uncertainty.

KEY STUDY: PENNINGTON & HASTIE (1988)

Aspect	Details
Question	Does evidence ORDER (affecting coherence) change verdict?
Method	Mock jury, murder trial, SAME evidence
Story Order	Arranged for coherent narrative
Witness Order	Chronological as witness experienced

Prosecution	Defense Story	Defense Witness
Story Order	59% guilty	**78% guilty**
Witness Order	**31% guilty**	63% guilty

Key Contrast: 78% vs 31% — SAME evidence, only ORDER changed! Demonstrates Theme 5: Representation is critical.

KEY NUMBERS TO MEMORIZE

Quantity	Value
Pennington & Hastie key	**78% vs 31%**
Aspects of thinking	**4**
Themes of thinking	**5**
Neural signature	**VMPFC**

Date	Citation
1748	Hume's induction
1974	Tversky & Kahneman
1988	Pennington & Hastie
2022	Uscinski et al.

COMMON EXAM MISTAKES

Mistake	Correction
"Thinking is any mental activity"	Must TRANSFORM representations
"Heuristics are always bad"	Usually HELPFUL; errors in specific contexts
"Conspiracy believers are stupid"	Adaptive processes MISAPPLIED
"Thinking same as perception"	Thinking TRANSFORMS; perception EXTRACTS
"Induction is certain"	Always uncertain (Hume)
"Pennington & Hastie = jury accuracy"	About REPRESENTATION & coherence

QUICK SELF-TEST

- Can I state Holyoak & Morrison's definition verbatim?
- Do I know why thinking is "higher-order" cognition?
- Can I name all 4 aspects and 5 themes of thinking?
- Can I explain Thaler's quote and Tolstoy's principle?
- Can I explain Hume's problem of induction?
- Can I define heuristic and give hard→easy examples?
- Can I name 3+ biases that support conspiracy beliefs?
- Do I know Pennington & Hastie's manipulation and key result?

L33: INTELLIGENCE I – HISTORY

PSYC2016 Intelligence | Implicit vs Explicit Theories, Historical Bias, Craniometry, Binet, Wechsler, Norm-Referenced Testing | Dr. Kit Double

🔵 Implicit Theory 🟢 Explicit Theory 🟠 Key Insight 🔴 Critical Trap 🟣 Core Concept

LEARNING OUTCOMES

1. Understand the difference between **implicit** and **explicit** theories of intelligence
2. Explain how **construct** and **criterion-related** evidence supports explicit theories
3. Understand the **historical scientific bias** in intelligence assessment
4. Describe historical approaches: **Morton, Broca, Shockley, Binet, Wechsler, Sternberg**
5. Understand that **mean IQ = 100, SD = 15** and how this applies to normative group testing

IMPLICIT VS EXPLICIT THEORIES

Aspect	Implicit	Explicit
Definition	Personal beliefs about intelligence	Data-driven, testable models
Testable?	NO – cannot be falsified	YES – makes predictions
Evidence	Anecdote, intuition, culture	Construct & criterion validity
Example	"Leaders are smart"	Sternberg's triarchic theory
Risk	Circular reasoning	Oversimplification

Key Distinction: Implicit theories are UNTESTABLE beliefs; Explicit theories make FALSIFIABLE predictions from behavioral data.

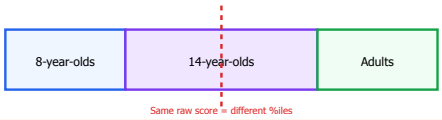
VALIDITY EVIDENCE FOR EXPLICIT THEORIES

Type	Question Answered	Example
Construct	Do subtests correlate as theory predicts?	Verbal & spatial tests show expected r
Criterion	Does IQ predict real-world outcomes?	IQ correlates r ≈ .50-.70 with GPA

Binet's revolution: His tests had criterion validity (r ≈ .50-.70 with school grades) – craniometry had NONE.

NORM-REFERENCED TESTING: CORE PRINCIPLE

Intelligence is RELATIVE: A raw score only has meaning when compared to an age-matched normative group.



Same raw score (e.g., 7/10): 90th %ile for 8yo, 50th %ile for 14yo, 35th %ile for adults. Norm group determines meaning!

IQ STANDARDIZATION: THE FORMULAS

$$z = (X - \bar{X}) / SD \quad | \quad IQ = 100 + 15z$$

Step	Formula	What It Does
1	$z = (X - \bar{X}) / SD$	Standardize to mean=0, SD=1
2	$IQ = 100 + 15z$	Transform to Wechsler scale

Worked Example:

Raw score = 72, Mean = 65, SD = 10
z = (72-65)/10 = **0.70**
IQ = 100 + 15(0.70) = **110.5 ≈ 111**
z = 0.70 → 76th percentile

Z-SCORE TO IQ CORRESPONDENCE

z-Score	IQ	Percentile	Interpretation
-3	55	0.1st	Severe intellectual disability
-2	70	2.3rd	Borderline
-1	85	16th	Low average
0	**100**	**50th**	**Average**
+1	115	84th	High average
+2	130	97.7th	Gifted
+3	145	99.9th	Highly gifted

NORM VS CRITERION-REFERENCED TESTING

Aspect	Norm-Referenced	Criterion-Referenced
Question	"How does person compare?"	"Has person mastered X?"
Score type	Percentile, z, IQ (relative)	Pass/Fail (absolute)
Reference	Standardization sample	Pre-set standard
Use	Ranking, placement, diagnosis	Skill mastery (driving test)