L01: Introduction to Developmental Psychology

What is Developmental Psychology?

Perspective	Description
As a Method	Study phenomena during developmental windows to maximize variance
As Theoretical Commitment	Early experiences shape trajectories (not just accumulation)
As a Window	Into adult processes via child development
As a Tool	Apply developmental lens to any psychological domain
Multidisciplinary Hub	Integrates genetics, neuroscience, education, anthropology, philosophy

Exam Tip: Dev psych is "perhaps most flexible psychology discipline" - can approach through biological, social, cognitive, or clinical lens

Nature vs Nurture Dialectic

Position	Core Claim
Empiricism (Nurture)	Blank slate shaped entirely by experience
Rationalism (Nature)	Innate structures constrain development
Modern View	*FALSE DICHOTOMY* - dynamic interaction of both

Interactionist Examples

Domain	Nature	Nurture	Interaction
Language	Universal grammar	Environment triggers	Biological readiness + input
Intelligence	Hereditary baseline	Education, nutrition	Potential realized via scaffolding
Personality	Temperament	Parenting, peers	Goodness-of-fit model
Executive Function	PFC maturation	Practice, stress	Neural readiness + experience

Learning Outcomes (LOs)

LO	Skill Required
LO1	**Deep understanding:** Explain how theories support/undermine each other (not just describe)
LO2	**Methods:** Recognize conclusions are prisoners of their methods
LO3	**Communication:** Clear explanation (Pilates instructor, not bad food critic)
LO4	**Application:** Bridge lab findings to real-world (education, policy, clinical)

Critical: Essay emphasis on critical synthesis across frameworks - NOT research report format

Rate of Change Principle

Domain	Peak Change Period	Research Implication
Height	0-3 years, puberty	Study during growth spurts
Vocabulary	0-6 years	Explosive early acquisition
Executive Function	4-5 years (sharp slope)	Max variance in 1-year span

Key Principle: Study phenomena during rapid change for maximum observable variance
Example: Compare 4-5yo (steep EF slope) vs 25-30yo (flat) - former shows more developmental insight

Developmental Appropriateness

- **12-month-old:** CANNOT have malicious intent (no Theory of Mind until ~4 years)
- **Food throwing:** Not deliberate annoyance - lack cognitive architecture to model others' mental states
- **Implication:** Attributing adult motives to young children = fundamental misunderstanding

Tutorial Quiz System (Flipped Learning)

Timeline	Action
Monday (week before)	Readings released on Canvas
Friday	Quiz question released
Weekend	Read & compose response (~200 words)
Monday 8am	Submit to Canvas assignment box
Tutorial	Discussion (NO reading during session)

Scoring Rubric

Score	Criteria
0	No response OR didn't read material
1	Read + generally understood
2	Thoughtfully considered + reflected

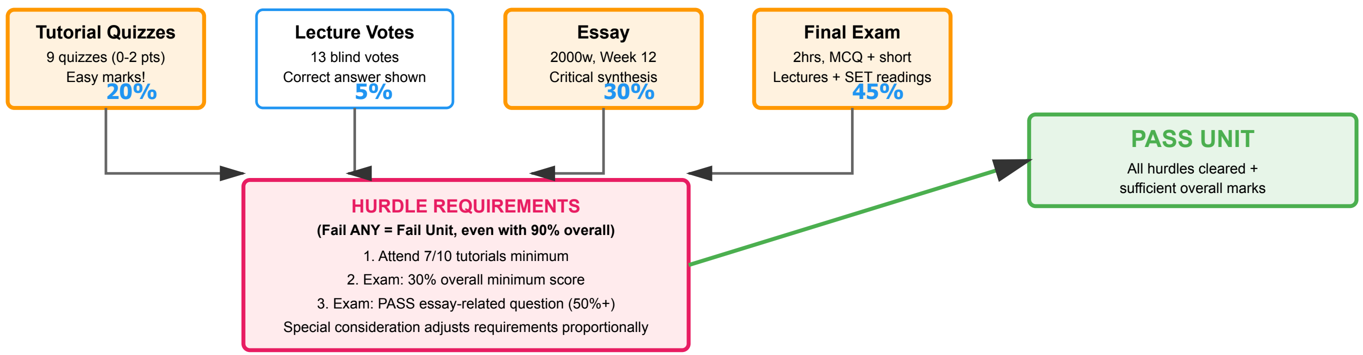
Easy 20%: Do readings weekly + thoughtful reflection = full marks. Total 18 possible points (9 quizzes × 2)

AI Usage Policy

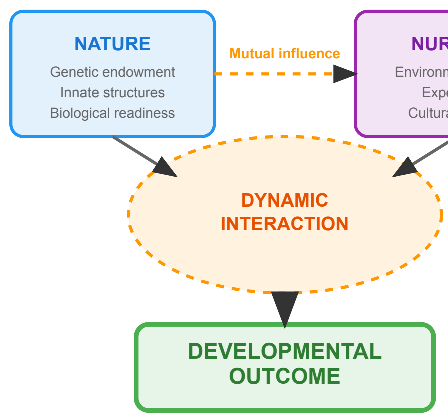
Use Case	Allowed?	Declare?
Literature search	YES	Yes
Outline/skeleton	YES	Yes
Concept exploration	YES ("Google on steroids")	Yes
Writing paragraphs	NO	-
Citations	Risky (fabricates sources)	Yes if used

Essay-Exam Link: If AI wrote essay, you CAN'T pass exam question (lack deep understanding). This is intentional anti-AI mechanism.
Detection: University uses MULTIPLE undisclosed methods - don't trust "AI-beating" tools

Assessment Architecture Flowchart



Nature-Nurture Interaction Model



Key: NOT binary choice - question is HOW genes & environment interact dynamically across time

L02: Nature vs Nurture - The Genetics-Environment Debate

Philosophical Positions

Position	Nature (Nativism)	Nurture (Empiricism)
Core Claim	Innate qualities present from birth; naturally unfold	Blank slate (tabula rasa); shaped by experience
Key Figures	Chomsky, Plato (rationalism)	Watson, Locke (behaviourism)
Language Example	Universal grammar module; kids learn syntax without teaching	Learned via environmental reinforcement
Development	Minimal environmental cues needed	Personal experiences create outcomes
Extreme Quote	"You are what you're born as" (inflexible)	"Give me a dozen infants, I'll make them anything" (Watson, 1930s)

Reality: FALSE DICHOTOMY - Both operate jointly. "Nature vs Nurture" debate is 50 years out of date.

Heritability: Core Formula

$$P = G + E$$

Phenotype = Genetic effects + Environmental effects

Term	Meaning
Phenotype (P)	Observable/measurable trait variation in population (e.g., height range 130cm-210cm)
Genetic effects (G)	Variance in phenotype caused by genetic differences
Environmental effects (E)	Variance in phenotype caused by environmental differences
Heritability (h^2)	$h^2 = \frac{V_G}{V_P}$ = Proportion of variance due to genetics

CRITICAL: Heritability ≠ Inherited
Heritability = population variance ratio (changes with environment)
Inherited = passing genes parent→offspring

Chomsky's Poverty of Stimulus

Component	Explanation
Argument	Natural language grammar is unlearnable given limited data available to children
Evidence	Kids acquire spoken language + grammar WITHOUT explicit teaching; but need intensive training for reading/writing
Conclusion	Innate linguistic capacity: genetically inherited neurological module for universal syntax
Module Function	Born with universal grammar understanding; fine-tuned by native language exposure
Example	Kids say "I brung my jumper" (overgeneralize rules) - demonstrates innate rule application, not imitation

- **Implication:** Certain abilities (language syntax) are natively present, not learned
- **Contrast:** Reading/writing = not innate, requires explicit training
- **Link to L03:** Theory of mind also related to syntax processing

Heritability Mechanics

Factor	Effect on h^2	Mechanism
↑ Genetic variance	h^2 increases	Outbreeding (tall family marries short family) → more genetic variation in offspring
↓ Environmental variance	h^2 increases	Optimize environment (good nutrition for all) → genetic differences become more apparent
↑ Environmental variance	h^2 decreases	Poor nutrition in some groups → environment masks genetic potential

Height Example:
Same genes: Good nutrition = 184cm | Malnutrition = 168cm (16cm difference)
h^2 = 85% (wealthy, good nutrition) vs h^2 = 40% (poverty, variable nutrition)
Same genes, different heritability due to environment

- **Paediatrician height formula:** (Father height + Mother height) / 2, ± adjustment for sex
- **Critical period:** Height window closes ~age 18; early malnutrition = permanent stunting
- **Cancer/illness effect:** Body prioritizes health over growth → temporary growth plateau

Measuring Genetics: SNPs

Term	Definition
SNP	Single Nucleotide Polymorphism (pronounced "snip")
What it is	One location on DNA with 2 possible amino acid variants
Notation	Common variant = A (big), Rare variant = a (small)
Genotypes	AA (homozygous dominant), Aa (heterozygous), aa (homozygous recessive)

Association Study Method:

1. Recruit 2 groups: Cases (with trait/disorder) vs Controls (without), matched on age/SES/education
2. Extract DNA (cheek swab, saliva, blood)
3. Scan for SNP frequency at specific genomic locations
4. Statistical comparison: If SNP frequency significantly different between groups → "associated"

CRITICAL: Association ≠ Causation
SNP may not cause disorder directly - may just "tag" nearby functional gene region

GWAS: Genome-Wide Association Scan

Component	Details
What it is	Scan hundreds of thousands of SNPs simultaneously in massive samples
Method	"Fishing trip" - no a priori hypothesis; use statistical power via huge N
Advantage	Discover unexpected genetic regions associated with traits
Problem 1	Random SNPs pop up with unclear functional relevance
Problem 2	May identify non-coding DNA regions (unknown function)
Solution	Hypothesis-driven molecular genetics: target known neurotransmitter systems (e.g., dopamine for ADHD)

Rob Plomin (1993): "Gene identified for dementia → opens door to investigate effects earlier in life, comorbid disorders, G×E interactions"
Finding one functional gene unlocks many research pathways

Measuring Environment: Methods

Method	Pros	Cons
Direct observation	Real-time, in-context data	Expensive, observer effects, reactivity bias
Self-report (8+ yrs)	Quick, easy, scalable	Subjective, response bias, poor inter-rater correlation
Parent/teacher reports	Practical for children, multiple perspectives	Subjective, low correlation (parent vs teacher reports often disagree)
Clinical interview	Depth, nuanced understanding	Interviewer bias, time-consuming, not scalable
Public/social records	Objective, easy access (varies by country)	Limited to recorded data, lacks context

Environment Types: Physical (garden, stairs), Internal (diet, inflammation), Social (living arrangements), Family (parenting), Emotional (stress, support)

SES Brain Study (Martha Farah)

Finding	Details
Research Question	Why do poor children perform worse on IQ tests and in school?
Method	Brain scans of hundreds of children from wide SES range
Key Finding 1	NO brain architecture differences at birth between rich and poor
Key Finding 2	By age 12: Physical differences emerge - poverty → smaller hippocampus, thinner prefrontal cortex
Hippocampus	Learning, memory, stress regulation - slower growth in poverty
Prefrontal cortex	Memory coordination, perception, motor control - thinner in poverty
Mechanism	Lack of cognitive stimulation (reading, conversation, interesting places) + poverty stress

CRITICAL IMPLICATION: Biological differences ≠ genetic causes
Environment changes brain structure (same genes at birth, different brains by age 12)

- **NAPLAN results:** ~33% of rural/poor kids "developing or lower" vs ~10% in cities
- **Not genetic:** Environmental deprivation causes biological change

Key Distinctions (Exam Traps)

Term	Definition
Heritability	Proportion of variance in POPULATION due to genetic differences
Inherited	Passing genes from parent to offspring (DNA transmission)
Genotype	Genetic makeup at specific locus (AA, Aa, aa)
Phenotype	Observable/measurable trait (height, IQ, aggression)
Reaction range	Genetically possible range; environment determines position within range
G×E interaction	Genetic effect depends on environment (e.g., MAOA×maltreatment)

L03: Behaviour Genetics I: Twin Studies & Heritability

Core Terminology

Term	Definition
Heritability (h^2)	Proportion of *variation* in a trait in a *population* due to genetic differences. NOT individual determination.
Phenotype	Observable trait = Genetic effects (G) + Environmental effects (E)
Monozygotic (MZ)	Identical twins; share 100% genes, 100% common environment
Dizygotic (DZ)	Fraternal twins; share 50% genes (like siblings), 100% common environment
Common Environment (C)	Events affecting both twins in the *same way* (e.g., family SES, neighborhood, school)
Unique Environment (E)	Events affecting one twin only, OR both twins *differently* (includes measurement error)
Additive Genetic Effects (A)	Genetic variance assuming effects sum linearly (1 risk allele = +R; 2 alleles = +2R)
Dominant Genetic (D)	Non-additive effects from dominance/epistasis (gene-gene interactions)
Narrow-sense h^2	Heritability from additive effects only (A)
Broad-sense H^2	Total genetic variance (A + D)

Twin Studies: Logic

- **Naturalistic experiment:** Twins occur naturally; no manipulation required
- **Key comparison:** MZ correlation vs DZ correlation on same trait
- **Power source:** MZ share 100% genes; DZ share 50% genes; both share common environment
- **If trait highly heritable:** MZ correlation >> DZ correlation
- **If environment important:** MZ and DZ correlations both high and similar

Critical Insight: Heritability estimates are POPULATION-SPECIFIC and CONTEXT-DEPENDENT. Cannot generalize across populations or apply to individuals.

Core ACE/PACE Equations

Component	Formula	Notes
Phenotype Variance	$V_P = V_G + V_E$	Total variance = Genetic + Environmental
ACE Decomposition	$1 = h^2 + c^2 + e^2$	A (additive) + C (common env) + E (unique env)
MZ Correlation	$r_{MZ} = h^2 + c^2$	100% genes + common environment shared
DZ Correlation	$r_{DZ} = \frac{1}{2}h^2 + c^2$	50% genes + common environment shared
Falconer's Formula	$h^2 = 2(r_{MZ} - r_{DZ})$	Estimate heritability from twin correlations
Common Environment	$c^2 = 2r_{DZ} - r_{MZ}$	Or: $c^2 = r_{MZ} - h^2$
Unique Environment	$e^2 = 1 - r_{MZ}$	Includes measurement error

When Falconer's Formula Fails ($h^2 > 1$)

Problem: If $h^2 > 1.0$, the simple ACE model is violated
Causes:

- **Dominant genetic effects (D):** MZ share 100% of D; DZ share only 25% of D
- **Assortative mating:** Non-random partner selection inflates genetic similarity
- **Equal environments assumption violated:** MZ treated more similarly than DZ

Solution: Use ADE model (Additive + Dominant + unique Environment)

Model Selection Decision Tree

Condition	Model	Interpretation
$r_{DZ} \approx \frac{1}{2}r_{MZ}$	**AE**	Additive genes + unique environment; no common environment
$r_{DZ} > \frac{1}{2}r_{MZ}$	**ACE**	Common environment substantial; use full ACE model
$r_{DZ} < \frac{1}{2}r_{MZ}$	**ADE**	Non-additive genetic effects (dominance/epistasis) present
$h^2 > 1.0$	**ADE**	Falconer's formula fails; fit dominance model

Worked Example: Childhood Anxiety

Given: $r_{MZ} = 0.70$, $r_{DZ} = 0.50$

Step 1: Check r_{DZ} vs $\frac{1}{2}r_{MZ}$
$\frac{1}{2}(0.70) = 0.35$; $r_{DZ} = 0.50 > 0.35$ → Use ACE model

Step 2: Calculate $h^2 = 2(r_{MZ} - r_{DZ}) = 2(0.70 - 0.50) = 0.40$

Step 3: Calculate $c^2 = r_{MZ} - h^2 = 0.70 - 0.40 = 0.30$

Step 4: Calculate $e^2 = 1 - r_{MZ} = 1 - 0.70 = 0.30$

Result: 40% genetic, 30% common environment, 30% unique environment

L04: Behaviour Genetics II - Interactions & Epigenetics

Missing Heritability Problem

Aspect	Details
Definition	Gap between twin study heritability and GWAS findings
Twin studies	~50% heritability for most psychological traits
GWAS findings	Only 2-3% variance explained by identified variants
The gap	47 percentage points unaccounted for
Replication issue	Gene-disorder associations rarely replicate (~20 years ago)
Key formula	$h^2 = 2(r_{MZ} - r_{DZ})$

Potential Explanations

Category	Explanation
Wrong genes	Not looking at correct genes or incomplete gene sets
Gene functionality	Genes don't do what we think; receptors vary by region (e.g., serotonin in gut vs brain)
Gene networks	Missing parts of system; need whole network, not isolated genes
Protein issues	Proteins don't function as expected (e.g., oxytocin doesn't cross blood-brain barrier)
Sample problems	Phenotype imprecise, ethnicity not tracked, age range too broad
Interactions	Gene-gene (epistasis), gene-environment effects not captured
Epigenetics	Methylation and other regulatory mechanisms not measured

Heritability Calculation Example

Scenario: Aggressive behavior study

- MZ correlation (r_{MZ}) = 0.65
- DZ correlation (r_{DZ}) = 0.35

$h^2 = 2(r_{MZ} - r_{DZ})$
$h^2 = 2(0.65 - 0.35)$
$h^2 = 2(0.30) =$ **0.60 or 60%**

Interpretation:

- 60% of variance is heritable
- If GWAS finds 4% variance explained
- Missing heritability = 60% - 4% = **56%**

Why Replication Failed

- **Underpowered:** N < 200 typical
- **Publication bias:** Positive findings published preferentially
- **No correction:** Multiple testing without alpha adjustment
- **Winner's curse:** Inflated effect sizes in initial findings

Mediation vs Moderation: Critical Distinctions

Aspect	Mediation	Moderation
Key Question	HOW / WHY?	WHEN / FOR WHOM?
Function	Specifies **mechanism** (transmits effect)	Specifies **boundary condition** (changes strength/direction)
Relationship	Mediator is in the **causal pathway**	Moderator is **external to pathway**
Structure	X → M → Y (sequential chain)	X × Z → Y (interaction term)
Effect type	Indirect effect through pathway	Interaction effect (strength varies by Z)
Genetic example	Serotonin 1B gene → neurotransmission efficiency → callous-unemotional traits	NR3C1 gene × intervention → externalizing disorder
Non-genetic example	Homework → practice papers → exam performance (practice explains why homework helps)	Negative social contacts × drinking to cope → home drinking (effect only for high copers)
Statistical test	Test indirect effect (a×b path)	Test interaction term (X×Z coefficient)
Without it	Know THAT relationship exists, not WHY	Miss subgroup differences; average obscures pattern

Coffee Example (from lecture)

Statement	Type
"Coffee makes you more efficient because it makes neurons fire faster"	**Mediation** (explains HOW)
"1-3 cups increases efficiency; 4+ cups decreases efficiency"	**Moderation** (dose moderates effect direction)
"Coffee makes neurons fire faster, which is why 4+ cups frazzles neurons"	Mixed (mediation + moderation)

L05: Social Cognition I - Comparative Developmental Foundations

THE DEVELOPMENTAL PARADOX: Infants understand OTHERS' goal-directed intentions at 6-9mo (mummy-ball paradigm) BUT fail mirror self-recognition until age 2 (50% pass Rouge test). Social cognition develops NON-LINEARLY through parallel pathways, NOT sequential building blocks (A→B→C). Challenges intuitive assumption that self-awareness must precede other-awareness.

Mirror Self-Recognition: Rouge Test

Age	Pass Rate	Developmental Marker
18mo	~25%	Emerging recognition
24mo	**50%**	Touch marked face (not mirror)
36mo	~90%	Reliable self-recognition

Great Ape Comparison

- **Chimpanzees:** 75% pass by adolescence
- **Orangutans:** 60% pass (variable performance)
- **Gorillas:** 30% pass (higher if human-reared in enriched environments)
- **Bonobos:** Similar to chimps (~75%)

Cognitive Architecture Required

- Visual detection → proprioceptive body schema mapping (cross-modal representation)
- Frontal lobe maturation + language emergence ("me/you" conceptual anchors)
- Self-other differentiation: creates conceptual space for "others have independent minds"

Rouge Test Methodology & Controls

Phase	Procedure	Purpose
Baseline	Count face-touching frequency (e.g., 3 touches/min)	Establish normal touching rate
Marking	Apply rouge to face while cleaning (tactilely undetectable)	Visual but not proprioceptive cue
Test	Present mirror, observe response	Measure mark-directed touching
Scoring	Mark-directed > baseline = PASS	Confirm genuine recognition

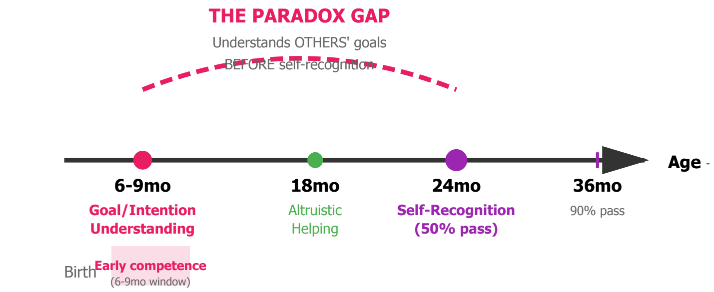
False Positive Prevention

- **Mark-specificity ratio:** If baseline = 3/min, post-mark = 8/min, mark-directed = 6/min → Ratio = 6/(8-3) = 1.2 (exceeds 1.0 threshold)
- Must touch marked area specifically (not random face exploration)
- Rouge chosen for visual salience but tactile imperceptibility

Mirror-Inexperienced Progression

- Initial: Treat mirror as conspecific (attacking/socializing)
- Exploration: Investigate mirror properties
- Contingency testing: Test correspondence between self and image
- Recognition: Self-directed behavior when viewing reflection

Developmental Timeline: The Paradox Visualized



Affective Empathy: Contagious Yawning

Stimulus Type	Chimp Yawn Rate	Interpretation
Familiar human	+3.0/session	Strong in-group contagion
Unfamiliar human	+1.5/session	Cross-species but reduced
In-group chimp	+3.1/session	Conspecific affiliation
Out-group chimp	+0.3/session	**Threat suppresses**
Gelada baboon	+0.2/session	No contagion (threat species)

Selectivity Index Calculation

Formula: (Familiar - Baseline) / (Gelada - Baseline)
Example: (4.0 - 1.0) / (1.2 - 1.0) = 3.0/0.2 = **15.0**
15-fold stronger contagion for affiliative vs neutral → confirms social modulation, not automatic mimicry

Key Findings

- **Social mechanism:** Requires perceived safety/affiliation
- **Threat override:** Evolutionary wariness blocks empathic resonance (gelada baboon = natural predator threat)
- **Cross-species possible:** Semi-free ranging chimps + positive human experience = contagion maintained

Affective vs Cognitive Empathy: Critical Distinction

Type	Mechanism	Response Pattern	Example
Affective	Emotional contagion Automatic mirroring Mirror neurons	SAME emotion as target	Crying when others cry Anxious face when presenter nervous Yawning when others yawn
Cognitive	Perspective-taking Understanding needs Deliberate response selection	APPROPRIATE (may differ from target)	Encouraging smile to nervous presenter Retrieving dropped pen Providing requested object

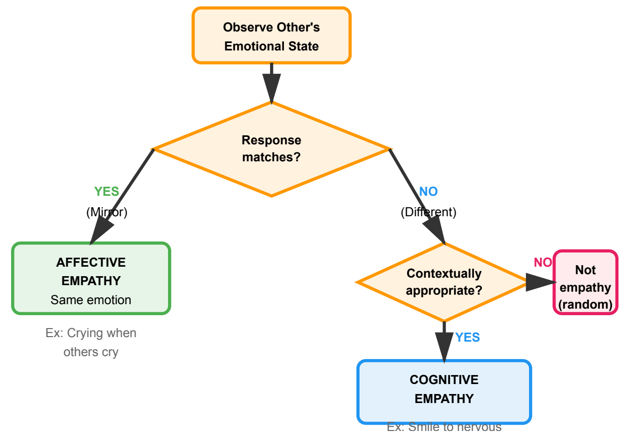
Contagion Properties

- **Automatic:** No understanding of cause/context required
- **Stranger-capable:** Works with unfamiliar individuals (within safety boundaries)
- **Internal state change:** Feeling tired/anxious when others yawn, beyond motor copying
- **Mirror neuron role:** Fire for both performing and observing actions (embodied simulation hypothesis)

When Contagion Fails as Empathy

- No contextual modulation (yawning during distress = reflexive only)
- Threat context suppresses (out-group chimps, gelada baboons)
- May impede helpful responding (overwhelmed by mirrored distress)

Empathy Types: Decision Flowchart



L06: Social Cognition II: From Triadic Interactions to False Belief Understanding

This lecture traces the developmental progression from **dyadic sociality** (infant-caregiver face-to-face interaction) to **metarepresentational capacity** (tracking others' false beliefs), revealing how infants construct a cognitive framework for understanding others as information-bearing agents. Three transformative shifts occur: (1) emergence of **triadic interactions** (9-15 months) incorporating external referents through joint attention and declarative pointing, (2) development of **social referencing** using others' emotional appraisals to resolve uncertainty, and (3) capacity to track **perception-knowledge correspondences** where infants understand others know what they've seen. The central paradox: 15-month-olds show **implicit false belief understanding** via looking time (Onishi & Baillargeon) yet fail explicit tasks until age 4, while chimpanzees track uninformed competitors successfully but fail with misinformed ones, suggesting either metarepresentational limitations or cognitive load constraints.

📅 Developmental Timeline: Social Cognition Milestones

Age	Capacity Emerges	Key Evidence
0-6 months	Dyadic interaction only; no evidence of understanding others as minded agents	"Dance of communication" - stimulus-response without external referents
9-15 months	Triadic interactions: joint attention, gaze following, declarative pointing	Carpenter et al. (1998): 13 months = majority pass all three components
12 months	Social referencing: using others' emotional appraisals to guide behavior	Visual cliff: 74% cross with joy, 0% with fear (Sorce et al., 1985)
12-14 months	Perception-knowledge tracking: understanding seeing leads to knowing	Selective pointing to inform: M=1.27 when adult missed event vs M=0.53 when witnessed
15 months	Implicit false belief understanding (looking time measures)	Onishi & Baillargeon watermelon task: longer looking at belief-inconsistent searches
18-24 months	Mirror self-recognition	Rouge test - recognize own reflection
4 years	Explicit false belief understanding	Sally-Anne task: correctly predict search based on false belief

🔑 Joint Attention Development Metrics (Carpenter et al.)

Age	Mean Episode Duration	Fold Increase
9 months	4.2 seconds	Baseline
12 months	11.3 seconds	2.7x increase
15 months	18.6 seconds	4.4x increase from 9mo

Measurement criteria: (1) infant looks at toy ≥2 seconds, (2) shifts gaze to caregiver within 3 seconds, (3) returns to toy within 3 seconds while caregiver maintains attention. If caregiver not engaged = object exploration, NOT joint attention.

📚 Core Concepts & Definitions

Term	Definition
Dyadic Interaction	Face-to-face infant-caregiver exchange (0-6 months) without external referents; caregiver treated as stimulus, not minded agent
Triadic Interaction	Infant-caregiver-object triangulation (9-15 months); incorporating external referents into social exchanges via joint attention, gaze following, pointing
Joint Attention	Coordinated attention between infant, adult, and object with gaze alternation; NOT incidental co-attention or parallel looking
Gaze Following	Infant follows adult's line of sight to locate referent; demonstrates understanding that looking is referential and informative
Declarative Pointing	Pointing to share interest (not request); includes checking looks to adult; distinguishes from imperative pointing (requesting)
Social Referencing	Using others' emotional appraisals to resolve uncertainty about ambiguous situations; requires signal decoding, referential specificity, communicative appreciation
Perception-Knowledge Link	Understanding that seeing leads to knowing; tracking what others have/haven't witnessed to update their knowledge states
Uninformed State	Agent lacks information (didn't see event); requires tracking presence/absence during events
Misinformed State	Agent holds incorrect belief conflicting with reality (saw initial state, missed change); requires dual representation of reality + false belief
Implicit False Belief	Expectation violation via looking time (15 months); measures automatic prediction without deliberate reasoning
Explicit False Belief	Verbal prediction/explanation (4 years); requires deliberate reasoning and inhibitory control to override reality

⚠️ Critical Distinctions (Common Exam Confusions)

Easily Confused Pair	Key Difference
Joint Attention vs. Parallel Looking	Joint = gaze alternation + coordinated engagement; Parallel = both looking at same thing without coordination
Declarative vs. Imperative Pointing	Declarative = sharing interest (checking looks); Imperative = requesting object (no checking looks)
Uninformed vs. Misinformed	Uninformed = binary (didn't see); Misinformed = dual representation (saw X, doesn't know Y)
Informing vs. Sharing	Informing = epistemic (updating knowledge gaps); Sharing = affiliative (social bonding when positive affect)
Implicit vs. Explicit ToM	Implicit = automatic expectation (15mo, looking time); Explicit = deliberate prediction (4yr, verbal response)

L07: Social Cognition III - Advanced Theory of Mind & Two-Pathway Hypothesis

Lecture Backbone: This lecture resolves the apparent paradox of theory of mind (ToM) development by demonstrating that false belief understanding emerges through two distinct pathways—**implicit (automatic, eye-gaze based, 9 months, phylogenetically ancient)** and **explicit (cognitive, verbally mediated, 4 years, human-unique)**. The central thesis challenges the single-mechanism view of ToM: **shared intentionality transforms individual cognition into collaborative frameworks**, with belief-desire psychology emerging around age 4 as children acquire the capacity to hold both "true state" and "represented state" simultaneously in working memory. **Critical insight:** ToM deficit in autism is pathway-specific, not absolute—explicit ToM can be learned through compensatory top-down processing even when bottom-up implicit system is impaired.

Shared Intentionality (Tomasello)

Individual Act	+ Shared Frame →	Collaborative Act
Gaze following (directional tracking)	Mutual knowledge of shared attention	**Joint attention** ("we are attending together")
Group activity (parallel individual goals)	We-mode representation	**Collaboration** (role differentiation + shared goal)
Social learning (passive observation)	Common ground framework	**Instructed learning** (shared teaching frame)

Key: Human cognition differs not by brain size but by collaborative capacity. Chimps lack "we are doing X together" representation—only "I am doing X near others." **Example:** Hide-and-seek pointing: 14-month infants infer hidden object from point; chimps see "bucket, so what?" Missing shared attentional frame.

Three Critical Distinctions

Distinction	Simpler	Complex
1. Ignorance vs Belief	**Ignorance:** Track info access only ("doesn't know X")	**False Belief:** Dual representation ("thinks X when Y true")
2. Coordination vs Collaboration	**Coordination:** Parallel goals (chimps pick berries)	**Collaboration:** Role differentiation (shake tree, hold bucket)
3. Implicit vs Explicit ToM	**Implicit:** Automatic eye gaze (9mo, apes)	**Explicit:** Conscious reasoning (4yr, verbal)

Common Error: Equating "doesn't know X" with "believes not-X"—these require different cognitive demands. Ignorance = absence of knowledge (single representation). False belief = contradictory mental content (dual representation + inhibition).

Belief-Desire Psychology

Age ~3: Desire Psychologist	Age ~4+: Belief-Desire Psychologist
Subjective desires only	Desires + beliefs as internal representations
Can't separate represented state from real state	Hold dual: "true state" AND "other's belief"
"Biscuit loop": persists asking despite "none left" (reality doesn't constrain desire)	Inhibits reality bias to report false belief

Behavior Formula: Action = Desire × Belief

- **Same desire + different beliefs → different actions** (both want apple: Person A believes fridge → goes to fridge; Person B believes cupboard → goes to cupboard)
- **Same beliefs + different desires → different actions** (both know apple in fridge: Person A wants it → gets it; Person B doesn't want it → ignores it)
- **Beliefs trump desires:** If you don't believe X is possible, desire for X won't generate action

False Belief Understanding: Cognitive Architecture

Sally-Anne Task Structure

Phase	Protagonist	Subject (Child)	Cognitive Load
T1: Shared knowledge	Sees apple in basket	Sees apple in basket	1 representation: [basket=apple]
T2: Protagonist absent	—	Sees apple→banana switch	Update: [basket=banana]
T3: Test (returns)	Believes: apple in basket	Knows: banana in basket	**DUAL:** [reality=banana] + [Sally's belief=apple] + inhibit "banana" response

Pass age 4: Prefrontal development enables dual representation + inhibitory control. Question: "What does Sally think is in the basket?" → Answer: "Apple" (correct).

Fail before 4: Reality bias dominates → answer "banana" (reality, not Sally's false belief). Cannot maintain metarepresentation (representing someone's representation of reality).

Why Age 4 Specifically?

- Prefrontal cortex maturation (executive control)
- Working memory capacity for dual representations
- Language development ("thinks that" structures)
- Inhibitory control to suppress reality bias

ASD & ToM: The Paradox

Explicit Success Despite Implicit Failure

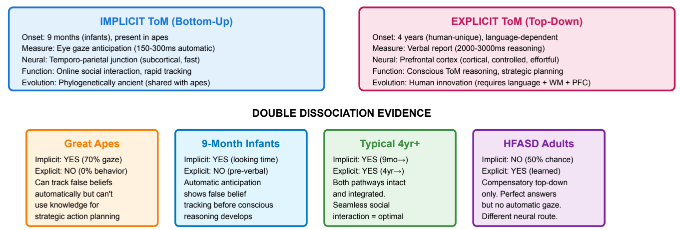
Study	Sample	Key Finding
Baron-Cohen 1985	Autism (CA 11yr, VMA 5yr) vs Down (CA 10yr, VMA 5yr) vs Typical (CA 4yr)	Autism: 20% pass Sally-Anne. Down+Typical: ~85% pass. Initial "no ToM" conclusion.
Scheeren 2013	n=194 HFASD vs TD (matched IQ)	**NO differences** in 2nd-order false belief, faux pas, sarcasm by adolescence. **Delay, not deficit.**
Senju 2009	HFASD adults (IQ 115, perfect explicit ToM)	Eye-tracking: **50% chance level** (fail implicit). Same answer via different neural route (prefrontal effort vs automatic TPJ).

Developmental Trajectories

- **Typical:** Implicit (9mo) → Explicit (4yr) [Both pathways intact]
- **ASD:** No implicit → Explicit (10-14yr via compensatory learning) [Top-down only]
- **Apes:** Implicit (yes) → Explicit (never) [Ancient system only]

Clinical Implication: High performance on structured ToM tasks doesn't indicate typical social processing. Real-world social interaction relies heavily on automatic implicit ToM (150-300ms), explaining why high-functioning individuals still experience social challenges despite understanding ToM concepts intellectually (2000-3000ms conscious reasoning too slow).

Two-Pathway Hypothesis: Visual Model



Core Insight: Pathways are dissociable and can operate independently. Real-world social function requires IMPLICIT (automatic, fast). Explicit knowledge provides understanding but ≠ natural social ease.

L08: Moral Development I

Prerequisites: Self-Awareness

Age	Capability	Moral Significance
18 mo	Self-awareness (Rouge Test: 50% pass at age 2)	Moral agency emerges - "you" exists as responsible entity
2 yrs	Pride, shame, embarrassment (WITH audience)	Self-conscious emotions require external feedback
4-6 yrs	Emotions differentiated from basic (pride ≠ happiness)	Transition: beginning internalization
8 yrs	Self-appraisal WITHOUT audience	Internalized moral standards (autonomous conscience)

Key Principle: Without self-concept, no responsibility/accountability. External feedback → internalized conscience (age 2 to 8).

What Kohlberg Measures

Question Type	What It Is	What It Is NOT
Moral Reasoning	What people think SHOULD be done in hypothetical dilemmas	NOT what they would actually do
Method	Structured interviews with moral dilemmas (e.g., child drops roll in water - will mother give another?)	NOT behavioral observation
Cognitive Component	Reasoning, justification, "thinking side"	NOT feelings, emotions, or actual behavior

EXAM CRITICAL: Moral reasoning ≠ moral behavior. Same behavior (e.g., helping) can stem from Stage 2 (self-interest), Stage 3 (social approval), or Stage 6 (universal principles).

Two Theoretical Traditions

Tradition	Rationalist (Kohlberg)	Sentimentalist (Social Domain)
Question	What SHOULD be done?	Is it right or wrong?
Focus	Cognitive reasoning (thought)	Evaluative appraisal (intuition/emotion)
Development	Slow hierarchical stages (6 stages)	Early-emerging distinction (30 months)
Method	Hypothetical dilemmas, verbal justification	Harm perception, rule contingency judgments
Age Competence	Adolescence for conventional morality	30 months for moral-conventional distinction

- **Integration:** Neither predicts behavior alone; reasoning without emotion = empty principles; intuition without reasoning = can't handle complex dilemmas

Kohlberg's 6 Stages of Moral Reasoning

Level	Stage	Primary Question	Motivation Source	Example Reasoning	Typical Age
Pre-Conventional (Egocentric, external consequences)	**1. Punishment Avoidance**	Will I be punished?	Avoid punishment	"Drawing on wall is wrong because I got told off"	Early childhood
	2. Self-Interest	What's in it for me?	Personal benefit	"Do homework because I get to go to cinema"	Early-mid childhood
Conventional (External expectations, social/legal rules) *MOST ADULTS*	**3. Social Approval** ("Good girl/good boy")	What will others think?	Social expectations	"Help elderly person cross road - that's what good people do"	Adolescence+
	4. Law & Order	What do rules require?	Maintain social order	"Report friend's shoplifting despite social cost - upholding laws maintains order"	Adolescence+
Post-Conventional (Abstract principles, independent ethics) *10-15% ADULTS*	**5. Social Contract**	What benefits majority?	Democratic principles, changeable laws	"Stealing food for starving child justified - life preservation > property rights"	10-15% adults
	6. Universal Principles	What is ethically right?	Personal conscience, self-chosen ethics	"Bonhoeffer (pacifist pastor) tried to assassinate Hitler - stopping genocide > personal beliefs/laws"	Very rare (~1%)

EXAM TRAP: Everyone thinks they're Stage 5-6, but most adults are Stage 3-4. Very hard to know what motivates your own reasoning (social group vs independent principles).

Stage Reasoning: Scenario Analysis

Scenario	Stage 1-2	Stage 3-4	Stage 5-6
Drawing on wall	"I got told off"	"Damages property, disrespectful to parents"	N/A (minor issue)
Should do homework?	"Get to go to cinema"	"That's what students should do"	"Enhances learning, fulfills potential"
Help elderly person cross road	"Might get reward"	"Society expects it / right thing to do"	"Protecting vulnerable"
Friend shoplifts	"I'll get in trouble too"	"Must uphold laws to maintain social order"	"Property rights violated"
Steal food for starving child	Can't reason at this level	"Wrong: breaks law"	"Right: life preservation > property"
Man punches bus harasser	"Impress woman" (2)	"Meet social expectations" (3) / "Stop injustice" (4)	"Protect vulnerable" (6)

Key Insight: SAME BEHAVIOR can stem from DIFFERENT STAGES - cannot infer reasoning from behavior alone.

Theory of Mind Requirement

Stage	Requires ToM?	Reasoning
Stage 1-2 (Pre-conventional)	NO	Egocentric, focuses only on self (punishment, reward)
Stage 3 (Social Approval)	**YES**	Must understand what OTHERS think/expect ("good girl/boy")
Stage 4 (Law & Order)	**YES**	Must consider societal perspective, how others view behavior
Stage 5-6 (Post-conventional)	**YES**	Requires perspective-taking to weigh competing principles

CRITICAL CONNECTION: Theory of Mind emerges age 4-5, enabling transition from pre-conventional (egocentric) to conventional (social perspective) morality.

L09: Moral Development II - Sentimentalist Tradition & Emotional Binding

CORE THESIS: Moral development transitions from **outcome-weighted judgments** and **emotionally-unbound rule knowledge** (age 4) toward **intention-privileging judgments** and **emotionally-binding moral understanding** (age 8). Young children simultaneously **know moral rules yet attribute positive emotions to successful transgressors**, revealing that moral knowledge develops before the emotional binding that makes violations feel personally aversive. The central developmental shift involves integrating cognitive rule understanding with emotional response systems through the Violence Inhibition Mechanism (distress cues → withdrawal) and Darwin's dual-instinct model (social instincts vs appetites).

Theoretical Frameworks

Theory	Core Mechanism
Sentimentalism (Hume, Darwin)	Moral behavior emerges from **emotion/empathy**, not pure reasoning
Rationalism (Kohlberg)	Moral behavior emerges from **cognitive reasoning** about principles
VIM (Blair, 2005)	Violence Inhibition Mechanism: **distress cues → withdrawal response → negative reinforcement**
Darwin's Dual Instinct	**Social instincts (constant, moderate)** vs **Appetites (sudden, strong)**. Dissatisfaction = guilt

Key Distinction: Sentimentalist privilege **feeling** over reasoning; rationalists privilege **thinking** over emotion. Most behavior involves BOTH systems.

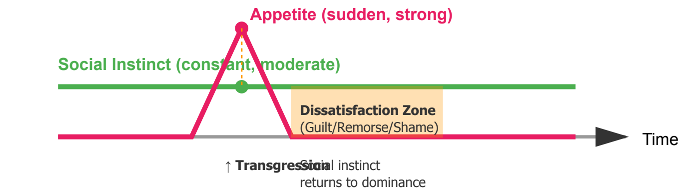
Blair VIM Studies (Psychopathy Model)

Study Component	Finding
Emotion Recognition	High psychopathy group: **impaired fear/sadness recognition** (4.73 vs 2.20 errors). Normal for other emotions
M/C Distinction	High PSD: **smaller moral-conventional gap**. Seriousness diff: 1.23 (high) vs 1.84 (low)
Predictive Power	M/C "failers" scored **higher on PSD** (21.95 vs 18.39), motivation facet, impulsivity

EXAM TRAP: Blair himself **revised VIM theory** - children with psychopathic traits CAN feel empathy under certain conditions. VIM doesn't explain all antisocial behavior!

Mechanism: VIM creates negative reinforcement loop: distress cue (80% intensity) > threshold (60%) → withdrawal → ΔR = -0.2 units. Over 10 episodes: cumulative = -2.0 units.

Darwin's Dual-Instinct Model



Model Formula: S = 5 (constant). $A(t) = 10 \times e^{-t/2}$. At t=0: A(0)=10 > S=5 (transgression). At t=2: A(2)=3.7 < S=5. Dissatisfaction D = S - A(2) = 1.3 guilt units.

Intention vs Outcome Weighting

Age	Weighting Pattern	Formula
Under 7	**Outcome-dominant**: Use BOTH but overweight outcome	β≈0.7, α≈0.3 (5:1 ratio)
Adults	**Intention-dominant**: Intention primary determinant	α≈0.8, β≈0.2 (4:1 ratio)

Classic Example: Chris breaks 1 cup intentionally vs Billy breaks 15 accidentally. Under 7: Billy naughtier (outcome). Factorial design: B>C (outcome effect), C>A (intention effect), D>B (both factors).

Cultural Link: Cancel culture mirrors **kindergarten moral reasoning** - emphasizing outcome (who was hurt) over intention (what was meant).

Heyman & Gelman (1998) Water Hose Study

Scenario: Tima sprays Ashira with water. Manipulate: Intention (P+/P-) × Outcome (O+/O-).

Condition	Kindy Rating	Adult Rating
P+ / O+ (thinks cool, is happy)	8/10	7/10
P+ / O- (thinks cool, is upset)	3/10	6/10
P- / O+ (thinks upset, is happy)	7/10	3/10
P- / O- (thinks upset, is upset)	2/10	2/10

Analysis:

- **Kindergarten:** Outcome effect = [(8+7)/2 - (3+2)/2] = 5.0. Intention effect = [(8+3)/2 - (7+2)/2] = 1.0. **Ratio 5:1**
- **Adults:** Intention effect = 4.0. Outcome effect = 1.0. **Ratio 4:1 (reversed)**

Moral Judgment Weighting Formula

General Model:

$$\textbf{Judgment} = \alpha \times \textbf{Intention} + \beta \times \textbf{Outcome}$$

Age Group	α (Intention)	β (Outcome)	Interpretation
Age 5 (Kindy)	0.3	0.7	Outcome-dominant: β/α = 2.33
Age 8	0.6	0.4	Transitional: α/β = 1.5
Adults	0.8	0.2	Intention-dominant: α/β = 4.0

Key Insight: Children DON'T ignore intention - they use BOTH dimensions but weight them differently. Not a categorical shift but a **continuous reweighting**.

L10: Abnormal Development - Callous-Unemotional Traits

Core Thesis

Callous-unemotional (CU) traits arise not from absent empathy or fearlessness but from **impaired automatic attention allocation** (underactive basolateral amygdala) that causes children to miss crucial social learning opportunities, creating **cascading developmental failures** that manifest as severe antisocial behavior.

Critical Insight: Subtle cognitive deficits present from birth snowball through development. These children show intact explicit processing but impaired implicit/automatic processing.

Key Concepts & Definitions

Term	Definition
Callous-Unemotional Traits	Reduced empathy, low guilt/shame, limited prosocial emotions, reduced affect. Childhood analogue of psychopathic personality traits.
Hot Children	~70% of antisocial children: emotionally volatile, reactive aggression only, comorbid anxiety/ADHD, respond well to parent management training.
Cold Children	~30% with CU traits: unemotional, proactive + reactive aggression, low anxiety, heritability 0.81-0.82, poor treatment response.
Reactive Aggression	Response to triggers/provocations. Present in both hot and cold children.
Proactive Aggression	Goal-directed, planned harmful behavior. Specific to CU traits, predicts adult criminal behavior.
Primary Psychopathy	Genetic/neurodevelopmental origin, low anxiety, early onset, male predominant (5-10:1), heritability ~0.81.
Secondary Psychopathy	Trauma/abuse response, high anxiety, balanced sex ratio (2:1), reactive attachment disorder pattern.
Limited Prosocial Emotions	DSM-5 specifier for conduct disorder indicating CU traits (clinical term avoiding "psychopathy" label).
Basolateral Amygdala (BLA)	Automatic attention allocation, encodes specific stimulus features, rapid prediction error response. UNDERACTIVE in CU traits.
Central Amygdala (CeA)	General valence encoding (approach/avoid), explicit processing, physiological fear response. INTACT in CU traits.

Critical Distinctions

Comparison	CU Traits	ASD
Cognitive Empathy	INTACT (understands why)	IMPAIRED
Affective Empathy	IMPAIRED (doesn't feel)	INTACT
Attention Issue	Automatic social attention	Intense focus, shifting difficulty
Aggression	Proactive + reactive	Rare, defensive only

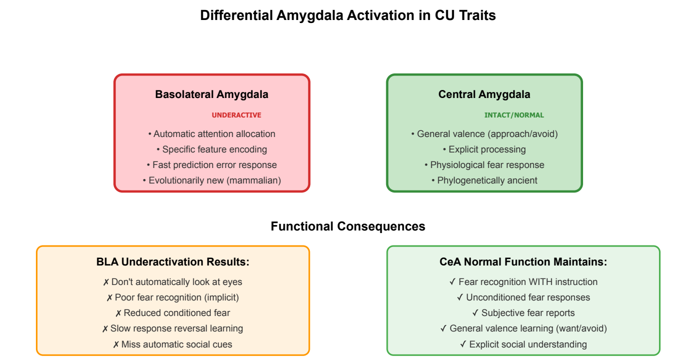
Assessment Trap: Questionnaire items overlap between ASD and CU traits. Key differentiator: empathy pattern reversal.

Four Theoretical Frameworks

Theory	What's Intact?	What's Impaired?	Why Incomplete?
1. Empathy Deficit	Cognitive empathy	Affective empathy only	Can't explain learning deficits in non-social tasks
2. Low Fear	Unconditioned fear, subjective fear reports	Conditioned fear only	Fear system partially intact; attention modulates "fearlessness"
3. Punishment Insensitivity	Acquisition learning	Response reversal, passive avoidance	Only insensitive when rewards present; behavioral inflexibility, not true insensitivity
4. Amygdala Dysfunction	Varies by study	Varies by study	Contradictory findings until BLA vs CeA separated

Theoretical Evolution: Each theory captures partial truth. Solution emerges from differential amygdala activation model distinguishing BLA (automatic) from CeA (explicit).

Differential Amygdala Activation Model



Clinical Implication: When you direct CU children to "look at the eyes," fear recognition normalizes because you bypass damaged automatic system (BLA) and engage intact explicit processing (CeA). This proves explicit systems remain functional.

Three Main Replicated Findings

1. Fear Recognition & Eye-Tracking

Dadds et al. (2006): CU children don't look at eye region of faces. When instructed "look at the eyes," deficit disappears entirely.

Mechanism: Subcortical visual pathway (dark/white ratio detection → BLA activation → gaze shift to eyes) is disrupted. Attention allocation failure, not recognition impairment.

2. Response Reversal & Behavioral Flexibility

Pattern: Intact acquisition (learn button = reward) but impaired reversal (continue pressing when button → loss).

Mechanism: BLA encodes specific features ("this button in this context"), CeA encodes general value ("wanting"). BLA underactivation = contextual updating fails while general approach continues.

3. Conditioned Fear & Attention

Newman et al. (2010): Reduced conditioned fear normalizes when explicitly directed to attend to threat cues.

Mechanism: Deficit isn't in fear capacity but automatic threat detection. Intact CeA generates normal fear when threats enter awareness through top-down attention.

L11: Adolescent Development - Timing Mismatches & Paradoxes

Conceptual Backbone - The Fundamental Asynchrony

Central Thesis: Adolescent development = temporal mismatch between THREE systems: (1) Hormonal changes triggering sensation-seeking/reward-orientation (begins ~10.5 girls, 11.5 boys via PUBERTY), (2) Chronologically-driven cognitive control via PFC maturation (continuing through age 25), (3) Social amplification via peer influence (peaks 14-16). **The paradox:** By age 15, adolescents match adults in hypothetical risk assessment (cold cognition), yet show 2-3x higher real-world risk-taking because peer presence doubles risk-taking in adolescents but has ZERO effect on adults. **Critical error students make:** Conflating chronological age with developmental stage—a 15-year-old at Tanner 5 faces fundamentally different challenges than same-aged peer at Tanner 3, as HORMONE LEVELS (not birthdays) drive arousal/risk while cognitive control develops on fixed timeline.

Three Stages Framework

Stage	Core Challenge	Physical	Cognitive	Social
Early 10-15	Managing rapid body changes with concrete thinking	Max mismatch: adult hormones, child cognition	Minimal abstract thought	Intense but unstable friendships, mood volatility
Middle 14-17	Navigating peer influence while PFC develops	Mostly complete, limbic dominates	Abstract emerging but inefficient	PEAK peer influence, authority challenges
Late 16-19	Integrating adult capabilities, neural efficiency growing	Complete	Abstract present, PFC still maturing to 25	Individual relationships dominate, peer wanes

Exam Key: Stages overlap (fuzzy boundaries), determined by MULTIPLE indicators (Tanner stage + age + social behavior), NOT age alone. Same age = different stages based on pubertal timing.

The Expanding Maturity Gap

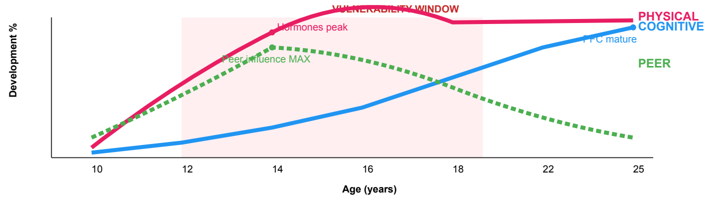
Measure	1920s	Now (2020s)	Change
Puberty onset (F)	14.6 years	10.5 years	4.1 yr EARLIER
School leaving	14 years	17 years	3 yr LATER
Employment age	14 years	17-18 years	3-4 yr LATER
NET GAP	~0 years	**~7 years**	MASSIVE EXPANSION

Consequences

- **1920s alignment:** Biology, education, work synchronized - coherent transition
- **Modern crisis:** Biological adulthood (10.5) without social recognition (17) = 7-yr frustrated maturity
- **Antisocial behavior peak 11-17:** Gang leadership provides status/respect schools can't offer biologically mature but socially restricted 14-year-olds
- **Teenage pregnancy stable (~2.5-2.8%):** 10x exposure window offset by contraception (10x window × 0.1x per-encounter risk = stable)

Theory Link: Adolescent-limited antisocial behavior (Moffitt) = rational response to irrational social structure demanding biological adults perform as children

Developmental Timelines: The Fundamental Mismatch



Maximum vulnerability: Ages 13-15, when hormonal acceleration outpaces cognitive control development. Physical changes are Tanner-stage driven (variable), cognitive changes are age-driven (fixed).

Physical & Hormonal Changes

Age	Females	Males	Both Sexes
10-11	Onset: breast buds, body shape changes	-	Adrenarche begins (body odor, pubic hair initial)
11-12	**Growth spurt PEAKS**	Testes/penis enlarge, erections + ejaculation	Bone growth > muscle = clumsiness phase
12-14	Menarche (range 8-13), cycles irregular 3-5 yrs	**Testosterone 10-fold increase** (5-50 → 220-800 ng/dL)	Appetite/sleep needs increase
14-15	Growth plates close, near adult height	**Growth spurt PEAKS**, voice changes	Secondary characteristics established
16-17	Physical maturity, regular cycles	Growth plates close, facial hair	Adult body configuration

Key Features

- **Bone > muscle growth:** Proprioception lag → clumsiness (knocking things, falling)
- **Growth spurt includes:** Height, weight, heart/lung size, muscular strength
- **Sleep needs:** 9-10 hrs (genuine biological requirement, not laziness)
- **Females 2-yr earlier:** Puberty 10.5 vs 11.5, peak growth 12 vs 14

Social consequence: Same-age classroom spans "little boys" to "men" (Year 9 photo) → differential status, sport ability, social expectations despite identical chronological age

Hormonal Cascades & Behavioral Impacts

Hormone	Change Magnitude	Behavioral Impact	Stabilization
Testosterone (M)	**10-fold:** 5-50 → 220-800 ng/dL (ages 10-14)	Aggression ↑, competitiveness ↑, sexual interest, muscle dev	~17-18 yrs
Testosterone (F)	2-fold gradual increase throughout puberty	Arousal, mild aggression increase	Cycles w/ menstruation
Estrogen/Progesterone	Cyclical, irregular 3-5 yrs post-menarche	Mood cyclicity, breast dev, fat distribution, bone density	Regular ~16-18
Growth Hormone	Peaks during spurts (F:12, M:14)	Rapid height, ↑ appetite, ↑ sleep needs	Plates close F:14-15, M:16-17

Sensation-Seeking Formula (Worked Example)

SS Score = 2.3 + (0.014 × testosterone ng/dL) + (1.2 × Tanner stage)

- **13-yr male, Tanner 3, T=326:** SS = 2.3 + 4.56 + 3.6 = **10.46** (moderate risk: skateboarding, competitive gaming)
- **15-yr male, Tanner 5, T=691:** SS = 2.3 + 9.67 + 6.0 = **17.97** (high risk: substance experimentation, dangerous driving)

Obesity link (Lee 2007): 354 girls age 3→12. Overweight girls: 80% breast dev before age 9. **Causation confirmed:** Body fatness CAUSES early puberty (not reverse), BMI triggers hormonal cascade independent of age.

Tanner Scale Assessment (1-5)

Stage	Physical Markers	Hormonal Status	Behavioral Correlates
1	Prepubertal - no development visible	Baseline hormones	Child-like behavior, low sensation-seeking
2	Initial: breast buds (F), testes enlarge (M)	Hormones rising	Mood changes begin, body image issues emerge
3	Continued dev, pubic hair increases	Mid-puberty surge	**Sensation-seeking BEGINS**, parent conflict ↑
4	Advanced, approaching adult configuration	**HIGH hormones**	**PEAK parent-adolescent conflict**, max risk-taking
5	Adult body configuration	Stabilizing (M) / Cycling (F)	Conflicts decrease, behavior stabilizes

Critical Correlations (Exam-Essential)

- **Parent-adolescent conflict:** r = 0.71 with Tanner stage vs r = 0.23 with age (HORMONES drive conflict, NOT age)
- **Sensation-seeking (11-14 yr olds):** NO correlation with age, SIGNIFICANT correlation with pubertal stage
- **Assessment method:** Self-report using visual guides (privacy-protected, non-invasive, culturally sensitive)

Clinical application: Two 14-yr females: Student A (Tanner 4, T=50 ng/dL) shows emotional volatility + conflict; Student B (Tanner 2, T=10 ng/dL) emotionally stable. Identical age, 5x hormone difference explains behavioral divergence despite cognitive equivalence.

L12: Adult-Child Interaction - Theory & Practice

CENTRAL THESIS: The four principles (Consent, Comfort, Reliability, Do No Harm) form a hierarchical decision structure where context doesn't just modify application—it fundamentally redefines meaning. Consent in research (parent signs, child assents) transforms into rights-based architecture in forensic contexts (freedom to speak vs understanding of rights) and mutates again in clinical settings (engagement vs refusal as therapeutic data). **Context-dependency is the critical hinge**: a child's silence in research signals withdrawal of assent (stop immediately), in forensic interviews preserves legal rights (document and respect), and in therapy becomes clinical information itself (explore gently). Same behavior, opposite responses based on professional context.

Four-Principle Architecture

Principle	What It Gates	Context Transformation	Failure Mode
1. CONSENT	Whether interaction proceeds at all	Written forms (research) → Miranda-like rights (forensic) → therapeutic contracts (clinical)	Legal liability, invalid data, ethical violations
2. COMFORT	Quality and quantity of information obtained	Physical environment (research) → trauma-informed spaces (forensic) → therapeutic milieu (clinical)	Reduced disclosure, defensive responding, session termination
3. RELIABILITY	Validity of conclusions drawn	Inter-rater reliability (research) → legal admissibility (forensic) → clinical utility (therapeutic)	False positives, wrongful convictions, misdiagnosis
4. DO NO HARM	Justification for any intervention	Minimal risk (research) → justice (forensic) → therapeutic benefit (clinical)	Retraumatization, developmental disruption, trust erosion

EXAM KEY: Principles form hierarchical dependency chain—consent gates all interaction, comfort enables data collection, reliability justifies interaction, harm prevention validates purpose. Failure at any level cascades downward.

Consent: Tripartite Architecture

Context	Primary Consent	Child Override?	Refusal Signals	Proceeding Without = ?
Research	Parent (consent) + Child (assent)	**YES** - child refusal overrides parental consent	Verbal "no", behavioral withdrawal, distress signals, looking at door	IRB violations, data inadmissible, potential assault charges
Forensic (Witness)	Child has autonomous rights	N/A - child is primary agent	Silence, "I don't want to talk"	Violated testimony inadmissible, mistrial potential
Forensic (Suspect)	Child + Guardian + Legal counsel	Complex - depends on competency	Request for parent/lawyer, silence	Miranda violations, confession excluded, case dismissal
Clinical	Parent/Guardian (unless emancipated)	Cannot override but can refuse participation	Non-engagement, selective mutism, behavioral resistance	Cannot force treatment, document refusal, consider mandated reporting if neglect

Research Consent Specifics

- **Age 8-9+:** Written consent form; **Younger:** Verbal assent ("Do you want to play this game now?")
- **Informed Check:** "Tell me what we're doing today" (child repeats back)
- **Explaining vs Cajoling:** Explain = "Task takes 20 minutes on computer"; Cajole = "Super fun task! Really quick!"
- **Incentivizing vs Bribing:** Incentive = "Thanks for concentrating, here's a sticker"; Bribe = "If you complete, I'll give you a sticker"
- **Essential Details:** Where? Parents present? Camera/recording? Toilet access? Fed/hydrated recently?

Comfort: Five-Factor Model

Factor	Problem Solved	Implementation	Success Marker
Familiarity	Novelty-induced stress suppressing recall	Pre-meeting tour, multiple sessions, consistent location	Child initiates conversation, explores space independently
Environment	Physical discomfort disrupting attention	Child-sized furniture, clear exit paths, soundproofing	Child settles physically within 5 minutes
Explanation	Uncertainty anxiety blocking disclosure	Explicit process maps, duration clarity, role definition	Child can repeat back what will happen
Affect	Adult emotional leakage contaminating responses	Video self-review, neutral responding, matched energy	Child mirrors your emotional state
Language	Comprehension mismatches creating false data	Vocabulary matching, "own words" encouragement, no jargon	Child uses their natural vocabulary freely

MULTIPLICATIVE EFFECTS: Excellence in 4 factors cannot compensate for failure in the 5th. All must be optimized.

L13: Juvenile Justice Systems

Key Concepts & Definitions

Term	Definition
Minimum Age of Criminal Responsibility	Absolute threshold (10 years in NSW) below which no child can be prosecuted for any offense; requires welfare response instead
Doli Incapax	Latin: "incapable of wrong." Rebuttable presumption ages 10-14 that child lacks criminal capacity unless prosecution proves they knew act was seriously wrong (not merely naughty)
Remand	Pre-trial detention while awaiting court proceedings or bail determination; legally presumed innocent but held in custody
Sentenced Detention	Post-conviction custodial punishment ordered by magistrate; reserved for serious/repeat offending after alternatives exhausted
Diversion	Police discretion to keep youth out of court through cautions or youth justice conferences; 70% don't reoffend
Crossover Kids	Young people cycling between child protection (out-of-home care) and youth justice systems; high overlap population
FASD	Fetal Alcohol Spectrum Disorder; neurodevelopmental impairment from prenatal alcohol exposure; vastly overrepresented in custody
Justice Cascade	Cumulative filtering process where Indigenous youth face higher punitive outcomes at each decision stage (proceed, convict, remand, sentence)
Age Crime Curve	Peak offending years typically 17-24; most young offenders "age out" of crime without intervention
Performance Crime	Offending amplified for social media documentation (filming victims, high-speed chases); post-COVID phenomenon increasing in regional NSW

Critical Legal Distinctions

Comparison	Minimum Age (10)	Doli Incapax (10-14)
Nature	Absolute bar to prosecution	Rebuttable presumption of incapacity
Burden	None - age alone determines	Prosecution must prove beyond reasonable doubt
Evidence Required	Birth certificate	Moral understanding (not just illegality knowledge)
Post-2016 Impact	No change in NSW (other states raised)	Evidentiary bar raised (harder to convict)
Outcome if Not Met	No charges; welfare referral	Not guilty verdict; exits justice system

Exam Trap: "Knew it was illegal" vs. "Knew it was gravely wrong" - only moral culpability (latter) rebuts doli incapax post-2016 High Court ruling.

Custody & Cost Statistics

235 young people in NSW custody on any night (76% remand, 24% sentenced)
$1 million per youth per year (vs. $80k-$200k for adults)
6 youth justice centers, 250 staff per 70-bed center
50% adult recidivism within 2 years (poor ROI despite high cost)

Filtering Pyramid (NSW 2024)

- 21,400 young people proceeded against by police
- 11,400 went to court (rest diverted)
- 225 in custody on any night
- Only 53 serving sentenced detention

National Context

- ~1000 youth in custody Australia-wide
- Queensland highest (300), NSW second (235)
- Separate facilities from adults (contamination prevention)

Indigenous Overrepresentation

8% of NSW youth population = 60% of custody population (7.5x overrepresentation)

System Stage	Indigenous %	Rate Multiplier
Police court actions	57%	16x higher
Found guilty	53%	16x higher
Bail refused (remand)	70%	29x higher
Sentenced custody	57%	17x higher
Out-of-home care	—	7-8x higher

Worsening Despite Closing the Gap: Justice metrics deteriorating, not improving, suggesting system bias + insufficient justice-specific interventions.

Health Survey Data - Trauma Pathways

Three waves of detention health surveys (2003, 2009, 2015) show cumulative disadvantage:

Risk Factor	% in Custody	Notes
Out-of-home care history	40-50%	10x community rate
Parental incarceration	50-60%	Intergenerational cycling
Witnessed domestic violence	70-80%	Normalized violence exposure
Substance dependence	60-70%	Self-medication + boredom
Neurodevelopmental impairment	High (FASD epidemic)	Historically under-diagnosed
De-schooled before 16	Majority	Schools exclude, don't retain
Head injuries	High prevalence	Linked to impulsivity, violence

Young Women in Custody (Hyper-Marginalized)

- ~15 girls (2015) down to ~6 currently
- Higher rates: out-of-home care, abuse, self-harm, suicide ideation
- Many pregnant before 14
- System designed for boys; interventions don't translate

L14: Classic Theories of Cognitive Development

Central Epistemological Question

Where does knowledge come from? How do children transition from knowing nothing at birth to possessing structured symbolic knowledge by age 2?

Three Classic Answers:

- **Piaget (Constructivism):** Self-constructed through sensorimotor exploration and reflective abstraction. Child = agent of own development.
- **Vygotsky (Socioculturalism):** Culturally transmitted through scaffolded social interaction. Knowledge = internalized cultural tools.
- **Chomsky (Nativism):** Genetically specified innate cognitive structures. Language faculty = biologically determined.

Semiotic Function: Capacity to use symbols (signifiers) to represent objects/events (significates). KEY developmental achievement enabling language and abstract thought. *How it emerges is the theoretical battleground.*

Piaget: 6 Sensorimotor Stages (0-24m)

Stage	Age	Key Achievement	Diagnostic Example
1. Reflex Mod	0-1m	Reflexes voluntary; first agency	Spontaneous grasping (not reactive)
2. 1° Circular	1-4m	Repeat actions on own body for pleasure	Thumb sucking (discovered by chance, repeated)
3. 2° Circular	4-8m	Repeat actions on objects; vision+grasp integration	Shake rattle for noise; systematic object exploration
4. Coord 2°	8-12m	Means-ends separation; intentional goals	Move obstacle to get toy; A-not-B error; Jacqueline juice/soup
5. 3° Circular	12-18m	"Infant scientist"; deliberate variation	Drop ball from different heights to test bounce
6. Mental Comb	18-24m	Internal representation; symbolic play; deferred imitation	Lucienne's doll carriage (pause → solve); matchbox+mouth

Critical Transition: Stage 6 = overt exploration becomes covert. External physical problem-solving → internal mental simulation. Enables language explosion (18-24m).

Piaget: Core Mechanisms & Assumptions

Concept	Definition/Implication
No Innate Knowledge	Born with reflexes ONLY + capacity to learn. No cognitive structures/content.
Active Organism	Innate tendency to exercise skills. Autodidactic (self-teaching) through exploration.
Assimilation	Fit new experiences into existing schemes (use rattle-grasp on newspaper).
Accommodation	Modify schemes when they fail (adjust grasp for newspaper texture/shape).
Equilibration	Tension between A/A drives stage transitions when disequilibrium occurs.
Logical Necessity	Universal sequence = discovering world's logico-mathematical structure. NOT age-based!
Constructivism	Rejects empiricism (passive learning) AND nativism (innate structures). Child constructs knowledge.

Endpoint: Formal operations (abstract hypothetical reasoning over symbolic representations = "peak" human cognition)

Vygotsky: Sociocultural Critique

Dimension	Piaget	Vygotsky
Starting State	Autistic/egocentric infant (oriented to own body)	Inherently social from birth (seeks engagement)
Source of Symbols	Self-constructed via correspondences (mouth ↔ matchbox)	Culturally provided (language, tools transmitted socially)
Role of Adults	Minimal; child autodidactic	Central; scaffolding in ZPD drives development
What's Internalized	Logical-mathematical structure of objective reality	Cultural ways of thinking; culture-specific tools
Dev Direction	Individual → Social (egocentrism fades with age)	Social → Individual (external speech internalized)
Egocentric Speech	Immaturity; fades as child becomes less egocentric	Private speech for self-regulation; increases with task difficulty
Universal Patterns	Logical necessity (discovering world structure)	Universal human sociality (all cultures scaffold)
Cultural Differences	Superficial (content varies, structures same)	Fundamental (different tools shape cognition)

ZPD (Zone of Proximal Development): Gap between independent capability and scaffolded performance. Learning LEADS development (not readiness-dependent). Example: 4yo solves puzzle alone (current level) vs. with father's hints "corners first" (ZPD level) → internalizes strategy.

Core Critique: Why make every child reinvent symbols? Culture provides ready-made symbolic systems. Piaget "hides behind wall of facts" without explaining symbol origins.

Chomsky: Nativist Challenge

Poverty of Stimulus Argument: Language complexity + universality cannot arise from sensorimotor construction OR social learning. Children acquire intricate grammatical knowledge without adequate input/correction.

Linguistic Phenomenon	What Children Know (Without Teaching)	Why Experience Can't Explain
Pronoun Reference	"John believes *he* is intelligent" (*he* = John or other) "John believes *him* to be intelligent" (*him* ≠ John ever)	No explicit teaching; never make errors; no corrective feedback; abstract syntactic binding principles
Structure-Dependent Questions	"Who is Sam waiting for?" ✓ *"Who did Susan ask why Sam was waiting for?" ✗	Never extract from embedded clauses; rule not in stimulus; know syntactic islands implicitly
Auxiliary Placement	"The man who is tall is in room" → "Is the man who is tall in room?" (move main-clause *is*)	Never produce *"Is the man who tall is in room?"; know hierarchical phrase structure (not linear "move first *is*")
Adjective Order	"The red car" (never "the car red" in English)	No one teaches this; already correct before school; cross-linguistic parametric variation

Chomsky's Claim: Universal Grammar (UG) = genetically determined language faculty specifying constraints on humanly accessible grammars. Language develops like any organ (eye, heart) via biological maturation, NOT construction.

Core Critique: Sensorimotor exploration cannot yield abstract syntactic knowledge. If symbolic representation (language) requires innate structures, Piaget's entire anti-nativist framework collapses.

Three-Way Theoretical Comparison

Question	Piaget	Vygotsky	Chomsky
What's innate?	Reflexes + learning capacity only	Social engagement capacity	Domain-specific structures (UG)
Role of experience?	Necessary for construction; discover reality	Central; provides cultural tools/scaffolding	Triggering; sets innate parameters
Why universal?	Logical necessity of world structure	Universal human sociality	Shared genetic endowment
How symbols emerge?	Discovered via correspondences	Transmitted by culture	Innate symbolic capacity
What drives dev?	Equilibration (A/A conflict)	Social interaction in ZPD	Biological maturation
Can teaching accelerate?	Limited; must be ready (stage)	Yes; teaching in ZPD IS development	Can't teach genetically impossible
Main empirical challenge?	Infants competent earlier; language too complex	Universal sequences despite input variation	Must specify innate/learned boundary; plasticity

L15: Infant Cognition I - Research Methods & Habituation Paradigm

Core Challenges of Infant Research

Challenge	Implication for Methods
Cannot talk	No verbal reports or self-reflection; must infer from behavior
Cannot follow instructions	Cannot use explicit task paradigms; rely on natural responses
Short attention span	Trials measured in seconds; sessions must be brief (10-20 min)
Limited behavioral repertoire	Can only: suck, turn head, reach, look, crawl (older infants)
Rapid development	Methods valid for 4-month-olds may fail at 6 months; age-specific designs needed

Historical Context: Piaget's limitations - unsystematic observations of own children, no quantification, informal tests (e.g., hiding objects for object permanence). Modern methods require systematic measurement.

Experimental Methods Toolkit

Category	Measure	Use Case
Behavioral	**Looking time**	PRIMARY measure; reveals cognitive processing
	Sucking rate	Newborns; rate increases with stimulus interest
	Head turning	Auditory localization; orienting responses
	Reaching	Manual exploration; object preference
	Crawling	Spatial navigation; only if studying locomotion
Physiological	Heart rate	Arousal/attention; deceleration = engagement
	ERPs	Event-Related Potentials; neural discrimination
	fMRI/optical imaging	Brain activation patterns (less common in infants)

- **Endpoint of infant methods:** ~15-18 months when verbal comprehension and pointing emerge
- **Why looking time dominates:** Available from birth, non-invasive, reveals processing without requiring responses

Key Terminology

Term	Definition
Habituation	Systematic decrease in looking time with repeated exposure to same/similar stimuli; indicates encoding & boredom
Novelty Preference	Looking longer at novel vs. familiar stimulus after habituation; proves discrimination ability
Familiarity Preference	Looking longer at familiar during early exposure; "I'm trying to get it" phase before full habituation
Dishabituation	Recovery of looking time when novel stimulus presented; synonym for showing novelty preference
Generalization of Habituation	Remaining habituated to novel stimuli that fit learned pattern; indicates category/pattern learning
Baseline	Average looking time in first 3 trials; individual infant's initial interest level
Criterion	Pre-defined rule for ending habituation (typically: 3 consecutive trials < 50% baseline)

Habituation Paradigm Setup

Physical Environment

- **Room:** Dark, minimal distractions
- **Seating:** Infant on caregiver's lap facing screen
- **Caregiver control:** Headphones with masking audio to prevent inadvertent attention direction based on stimulus exposure
- **Screen:** Controlled visual display for stimuli
- **Camera:** Records infant's face/eyes for coding

Trial Sequence

1. **Attention getter:** Swirling visual (e.g., red star) + chime sound to orient infant to screen
2. **Stimulus presentation:** Target image/video appears
3. **Looking time recording:** Researcher/software tracks duration of fixation
4. **Look-away:** Infant disengages, trial ends (or fixed duration in familiarization)
5. **Inter-trial interval:** Return to attention getter
6. **Repeat:** Continue until habituation criterion met

Classic vs. Modern Measurement

Method	Process
Classic (manual)	Researcher watches camera feed, holds keyboard button while infant fixates; releases on look-away
Modern (automated)	Eye-tracking software detects gaze direction & duration; automatic trial termination

Habituation Criterion Formula

Standard Criterion (Most Common)

Step 1: Calculate Baseline

$$\text{Baseline} = \frac{T_1 + T_2 + T_3}{3}$$

Average of first 3 trials

Step 2: Set Threshold

$$\text{Threshold} = 0.50 \times \text{Baseline}$$

50% of baseline (some studies use 60%)

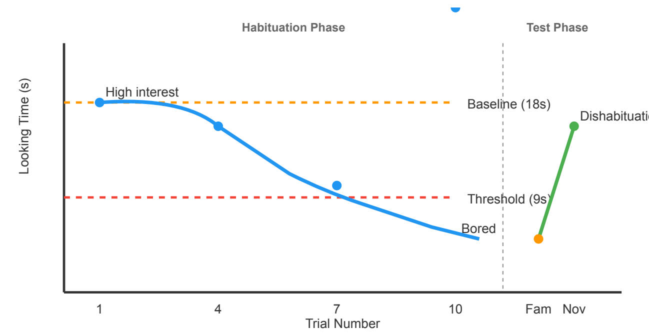
Step 3: Apply Criterion Rule
Habituation achieved when:
3 consecutive trials ALL < Threshold

Example Calculation:
Trials: 18s, 16s, 20s, 14s, 11s, 9s, 8s, 7s, 6s
Baseline = (18+16+20)/3 = **18s**
Threshold = 0.50 × 18 = **9s**
Trials 7-9 = {8s, 7s, 6s} all < 9s → **Criterion met at Trial 9**

Key Properties

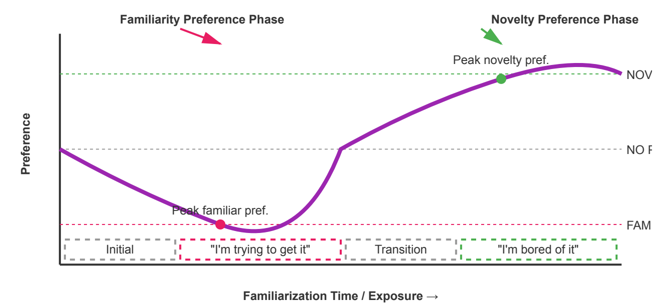
- **Individualized:** Each infant's criterion based on their own baseline (accounts for temperament)
- **Pre-registered:** Criterion rule specified before data collection (prevents researcher bias)
- **Variable exposure:** Fast habituators (~6 trials) vs. slow (~15+ trials) see different total stimulus time

Idealized Habituation Curve (Monotonic Model)



- **Assumption:** Looking time monotonically decreases with exposure
- **Test logic:** Novel > Familiar indicates discrimination
- **Limitation:** Oversimplified - real pattern is non-monotonic (see Hunter & Ames)

Hunter & Ames (1988): Non-Monotonic U-Shaped Curve



Key Insights

- **NOT monotonic:** Preference changes direction over exposure time
- **Early exposure:** Brief familiarity preference as infant encodes/processes stimulus
- **Full habituation:** After sufficient encoding, novelty preference emerges
- **Implications:** Null results ambiguous - could reflect insufficient exposure OR genuine discrimination failure

L16: Infant Cognition II - Nativism vs Constructivism

Core Theoretical Framework: What Are They Really Arguing About?

Critical Insight: The debate is NOT "nature vs nurture" (both sides agree genes and learning matter). It's about the **architecture of learning mechanisms**: domain-specific modules vs domain-general processes.

Dimension	Nativism (Carey, Spelke, Baillargeon)	Constructivism (Cohen, Cashon)
What is innate?	Domain-specific modules with core knowledge (objects persist, solid objects don't interpenetrate)	Domain-general information processing detecting low-level features (color, motion, edges)
What triggers knowledge?	Specific perceptual inputs activate modules (e.g., common motion triggers object module)	Statistical regularities in environment gradually build representations
Why abilities emerge at specific ages?	Perceptual prerequisites mature, allowing pre-existing knowledge to be expressed (competence precedes performance)	Sufficient experience has accumulated to construct the representation
What does gradual development prove?	Gradual maturation of input systems (perception, attention) that feed innate modules	Gradual construction of knowledge through hierarchical integration

Key Concepts & Definitions

Term	Definition
Cognitive Modularity	Mind contains specialized subsystems for specific domains (language, objects, faces) with information encapsulation and innate specification
Core Knowledge	Innate principles about domains (objects persist when occluded, solid objects block motion) that modules apply when triggered
Object Unity	Perceiving spatially separated visible surfaces as parts of single unified object when occluder hides connecting portion
Object Permanence	Understanding that objects continue to exist when completely out of view (deeper than unity - requires representing fully hidden objects)
Common Motion	Coordinated movement of disconnected surfaces in same direction/speed - nativists claim this is the specific trigger for object module
Violation of Expectation	Paradigm where perceptually familiar event is physically impossible; longer looking to impossible event suggests conceptual surprise
Competence-Performance Gap	Knowledge may exist (competence) but not be expressed in behavior (performance) due to motor, memory, or executive function limitations

Quick Reference: Developmental Timelines

Age	Object Unity	Object Permanence
Newborn	Minimal occlusion only (Slater 1996)	No evidence
2 months	Small occluder (Johnson & Aslin)	No evidence
3.5-4 months	Large occluder (Kellman & Spelke)	Violation paradigm success (Baillargeon) - DISPUTED
5 months	Robust	Feature memory YES, spatial continuity NO (Meltzoff & Moore)
8-9 months	Robust	Manual search success + spatial continuity understanding (Piaget's timeline)

L17: Infant Cognition III - Multi-sensory Integration & Dynamic Systems Theory

Core Concepts & Definitions

Term	Definition & Key Points
Dynamic Systems Theory	Development driven by **organism-task-environment** interaction; intelligent behavior EMERGES from brain-body-world coupling, not brain maturation alone
Piecemeal Development	Skills highly context-specific; minimal cross-context generalization. Example: Sitting knowledge ≠ crawling knowledge; must relearn affordances for each motor posture
Embodied Cognition	RADICAL CLAIM: Representations tied to body state; no abstract symbols even in adults (concepts = distributed sensory-motor activations)
Multi-sensory Integration	Brain integrates across modalities (visual, haptic, oral, motor); higher-order correlations formed at integration hubs (ATL, aPFC)
Hierarchical Construction	Higher-level units built from lower-level units. Level 1: Features → Level 2: Feature correlations → Level 3: Meta-patterns
Cognitive Overload Principle	EXAM CRITICAL: When task exceeds capacity, infants REVERT to lower-level processing. More time can = worse performance (7mo E4)
Shape Bias	~18mo generalize novel nouns by shape (not color/texture). Emerges from higher-order correlation: "nouns refer to shape-based categories"
Feature Correlations	Statistical regularities (hooves + giraffe body co-occur). Infants track co-occurrence patterns; form categories via correlation detection
Affordances	What environment permits given bodily capabilities. Learned separately for each motor configuration (sitting vs. crawling vs. walking)
A-not-B Error	Piaget: Incomplete object permanence. **Smith reinterpretation:** Embodied motor memory; postural reset (stand/sit) eliminates error

Landmark Studies & Findings

Study	Finding	Theoretical Interpretation
Thelen - Twins Study	Intensive roller-skating training (Johnny) didn't accelerate sitting/crawling/walking vs. untrained twin (Jimmy)	Motor learning context-specific; minimal cross-task generalization proves piecemeal development
Visual Cliff	New crawlers (6mo) cross deep side; experienced crawlers (9mo) refuse; new walkers must relearn	Risk perception embodied in posture; spatial knowledge doesn't transfer across motor configurations
Gap Crossing	9mo experienced sitters avoid gaps while sitting; SAME infants attempt gaps when crawling	Affordance knowledge posture-specific; understanding of "how far = too far" not abstract
Smith (1999) A-not-B	Standing up/sitting down between A-trials and B-trial eliminates perseveration	Object representation body-state-dependent; postural reset disrupts motor memory trace
Sticky Mittens	2mo given velcro mittens → accelerate to 6mo-level visual inspection + oral exploration	Motor ability CAUSALLY drives perceptual development; enhanced action → richer multi-sensory input → faster learning
Embodied Semantics (fMRI)	"kick" → leg motor cortex; "punch" → arm; "canary" → yellow visual cortex	Word meanings ARE distributed activations (constitutive, not correlational). No abstract semantic layer required
Younger & Cohen (1983)	10mo learn feature correlations (hoof+giraffe); 4/7mo learn features only	Hierarchical construction emerges with age; higher-order units require greater capacity
Younger & Cohen (1986) E1	Easy task (3 features, all corr.): 7mo learn correlations; 4mo features only	Demonstrates capacity threshold; 7mo can do correlations when task simplified
Younger & Cohen (1986) E4	CRITICAL: 7mo given extended habituation → REVERTED to feature-level (like 4mo)	Proves overload principle: attempted correlations → failed → strategic shift to achievable goal (features)
Landau et al. (1988)	18mo generalize "dax" to same-shape objects; ignore color/texture changes	Shape bias operational by 18mo; accelerates word learning via meta-level inference
Gershkoff-Stowe (2004)	Shape bias correlates with vocab: <25 nouns (weak ~30%); 26-50 (emerging ~60%); 51+ (strong ~90%)	Higher-order pattern emerges from experience; learned through word-object pairings, not innate

Younger & Cohen Feature Correlation Paradigm

Method Overview

- **Stimuli:** Line-drawing "animals" varying on 3-5 features: feet (hoof/paw/talons), body (giraffe/elephant/horse), ears (pointed/round), tail (fluffy/thin/curly), legs (2/4)
- **Habituation Phase:** 8-12 trials; programmed correlations preserved (e.g., hoof feet ALWAYS with giraffe body; paw feet ALWAYS with elephant body)
- **Test Phase (3 trial types):**
  - **C (Correlated):** Familiar features + preserves correlations → Should be familiar
  - **U (Uncorrelated):** Familiar features + VIOLATES correlations → Novel IF learned correlations
  - **N (Novel):** Completely new features → Always novel (control)

Interpretation Logic

Pattern	What Infant Learned
C low, U low, N high	**Features only** (both C and U familiar because features seen before)
C low, U high, N high	**Correlations** (U novel because violates learned statistical structure)
Flat habituation (no decrease)	**Attempting correlations but overloaded** (task exceeds capacity)

Complete Results Table

Study	Task Complexity	4 months	7 months	10 months
Y&C 1983	HARD: 4 features, 2 pairs correlated	Features only	Features only	**Correlations ✓**
Y&C 1986 E1	EASY: 3 features, ALL perfectly correlated	Features only	**Correlations ✓**	—
Y&C 1986 E2	MEDIUM: 3 features, only 2/3 correlated	Features only	**No habituation** (overloaded)	**Correlations ✓**
Y&C 1986 E4	MEDIUM + extended habituation time	—	**REVERTED to features** (critical!)	—

Exam-Critical 7-Month Pattern

- **Easy task:** Learn correlations successfully (capacity sufficient)
- **Medium task (12 trials):** No habituation (attempting correlations, overloaded, haven't given up yet)
- **Medium task (extended trials):** Revert to features (attempted → failed → strategic simplification)
- **Implication:** Extended time can produce WORSE outcomes when task exceeds capacity (proves adaptive strategy shift)

L18: Abstract Relational Learning in Infancy

Natural Partitions Hypothesis (Gentner, 1982)

Core Claim: Human cognition parses the world into objects (stable perceptual entities) and relations (dynamic connections between objects).

Objects vs. Relations:

Dimension	Objects (Lower-Level)	Relations (Higher-Level)
Question	"What is this?"	"How are they connected?"
Stability	Stable, cohesive, persistent	Dynamic, context-dependent, transient
Cognitive Load	Low (direct mapping)	High (abstraction needed)
Examples	Dog, blue square, table	Same/different, cause/effect, left-of
Language	Nouns learned early	Verbs/prepositions later, variable
Animals	All recognize objects	Abstract relational matching nearly impossible

Human Uniqueness: Abstract relational thinking (e.g., two blue squares and two red circles both instantiate "sameness" despite zero perceptual overlap) is foundational to human cognition but nearly impossible for non-humans even with extensive training.

Neoconstructivist Framework Principles

Domain-General Hierarchical Learning System

1. **Innate Foundation:** Domain-general information processing system detects low-level features (color, shape, motion)
2. **Hierarchical Construction:** Higher-level units (correlations, categories, relations) formed from relationships among lower-level units through learning
3. **Processing Dependency:** Must first represent objects before representing relations between objects
4. **Efficiency Preference:** Infants use highest-level units available (efficient information compression)
5. **Capacity Constraint:** If system overloaded → revert to lower-level processing

Signature Prediction:

Increasing cognitive load lowers information processing level

Same infant shows relational processing with low-load stimuli but featural processing with high-load stimuli (even when relational structure identical).

Cognitive Load Formula:

$$\text{Relational Processing} = f(\text{Capacity}_{\text{age}} - \text{Load}_{\text{cognitive}})$$

Where

$$\text{Load}_{\text{cognitive}} = \text{Object Complexity} + \text{Object Variability} + \text{Num. Exemplars} + \text{Object Salience}$$

Ferry et al. (2015): 7-9 Months

Method:

Habituation to pairs showing "same" (AA, BB, CC, DD) or "different" (AB, CD, EF, GH). Test: novel objects in familiar vs. novel relation.

Key Results:

Condition	Exemplars	Result
Exp 1	1 pair (AA repeated)	✗ No generalization
Exp 2	4 diverse pairs	✓ Discriminate relations
Novel objects	4 pairs	✓ Strongest evidence
Object Exp only	4 pairs	✗ Salience blocks
Obj Exp + Hab	4 pairs	✓ Success

Critical Finding - Object Experience Effect: When infants *played with* test objects but those objects were **NOT habituated to**, they failed relational discrimination despite succeeding with completely novel objects.

Why: Mere familiarity without habituation increases object salience → consumes resources → blocks relational processing.

Anderson et al. (2018): 3 Months

Method:

Same paradigm, testing youngest possible age with varying exemplar counts.

Key Results:

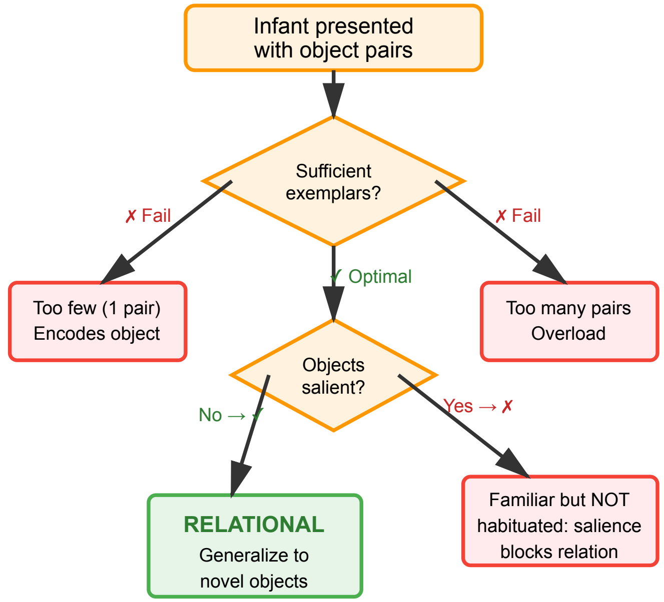
Condition	Exemplars	Result	Interpretation
Exp 1	6 pairs	✗ Fail	Too many - overload
Exp 2	2 pairs	✓ Success	Optimal for 3mo capacity
Novel objs	2 pairs	✓ Success	Generalize to never-seen
Obj Exp only	2 pairs	✗ Fail	Same interference pattern

Age-Capacity Relationship:

- **3 months:** 2 pairs optimal; 6 pairs = overload
- **7-9 months:** 4 pairs optimal; 1 pair insufficient
- **10+ months:** Higher capacity (unless objects complex + variable)

Remarkable: 3-month human infants show more sensitivity to identity relations than adult chimpanzees (who require extensive symbol training for abstract relational matching).

Same/Different: Decision Process



Age-Specific Capacity Limits:
3mo: 2 pairs optimal (6 pairs = overload)
7-9mo: 4 pairs optimal (1 pair insufficient)
10+mo: Higher capacity (unless complex + variable)

L19: Abstract Relational Learning Beyond Infancy

Natural Partitions Hypothesis

Aspect	Description
Core Claim	World = objects/substances + relations among them
Objects	Perceptually cohesive, bounded, persistent, trackable
Relations	Dynamic, unstable, infinite variability, change with movement
Prediction	Children form object categories BEFORE relational categories
Evidence	Early vocabulary dominated by nouns (dog, chair) not prepositions/verbs
Universal	English, Italian, Japanese, Korean, Mandarin, Navajo, Tzeltal - NEVER reversed

Relational Shift (Career of Similarity)

Stage	Focus	Example
Early	Common features (object-based)	Uncle = "beardy guy"
Later	Common relationships (relational)	Uncle = "parent's brother"
Island: "beaches + palms" → "land surrounded by water"		

Why Relations Harder

- No perceptual boundaries
- Constant change (context-dependent)
- Infinite ways to conceptualize
- Not automatically segmented by perception

Key Distinctions

Object vs Relation	Criterion
Object concept	Intrinsic features WITHIN entity
Relational concept	Pattern BETWEEN entities
Test	Cross-mapped: object vs relation conflict
True relational understanding	Choose relation despite different objects

Relational representation = structure mapping independent of object identity

Christie & Gentner (2010): Toma Study

Condition	Design	3-year-olds	4-year-olds
Solo	1 example ("This is a toma")	2% relational	25% relational
Sequential	2 examples shown separately	11% relational	38% relational
Comparison	2 examples shown simultaneously	57% relational*	63% relational*
**Significantly above chance (50%); Comparison advantage for 3yo = 55 percentage points!*			

Design Details

- **Toma =** two same animals facing each other (novel made-up relation)
- **Test choice:** Relational match (turtles facing) vs Object match (pig + fish)
- **Cross-mapped:** Object similarity competes with relational similarity

Key Findings

- Comparison ESSENTIAL for 3yo (2% → 57%)
- Sequential presentation insufficient (working memory limits)
- Must be spatially/temporally contiguous for young children
- Effect size LARGER for younger children (lower baseline)

Analogical Comparison Mechanism

Component	Function
Process	Structural alignment: 1-to-1 correspondences based on ROLES not features
Automatic effect	Highlights common relations, downweights object features
Example	Woman receiving food ↔ Squirrel receiving food (role mapping)
Domain-general	Same process: simple comparisons → complex analogies (Rutherford atom)

When Comparison Fails

- Sequential (not simultaneous) presentation
- Working memory overload
- High object salience (distractors)
- Too many examples (cognitive load)

Markman & Gentner (1993)

- **No comparison:** Woman → woman (object match)
- **After comparison:** Woman → squirrel (relational match)

Language: Dual Mechanisms

Mechanism	How It Works
1. Invitation to Compare	Common label signals hidden commonality → triggers comparison search
Example	"This is toma, this is also toma" → Child: "Why both tomas? Let me compare"
2. Reification	Provides stable symbolic representation for transient perceptual patterns
Example	Spatial relations (in, on, between) are continuous → language discretizes

Spatial Prepositions Special

- Perceptually ill-defined (infinite gradations of "above-ness")
- Languages carve space differently (hard to translate)
- English "in" vs Korean "kkita" (tight) vs "nehta" (loose)
- Trains attention to language-specific distinctions

Gentner et al (2013): Homesigner Study

Group	Age	Neutral Condition	Cross-Mapped Condition
Hearing children	4;10	73% correct	53% correct
Homesigners (deaf)	5;6	45% correct*	35% correct (≈chance)
*Chance = 33% (3 shelves); *Above chance but impaired (28% deficit); Cross-mapped = chance (language essential)*			

Task Design

- **Setup:** Two bookshelves with 3 shelves each (top/middle/bottom)
- **Training:** Prize hidden behind card on Shelf 1 → Find on Shelf 2
- **Neutral:** Blank cards (no object interference)
- **Cross-mapped:** Picture cards (e.g., pizza on different shelf heights)

Interpretation

- **Homesign systems:** Nouns + actions, NO spatial prepositions/relational vocabulary
- **Neutral condition:** Homesigners retain some relational capacity (45% > 33% chance) but impaired vs hearing (73%)
- **Cross-mapped:** Collapse to chance when object features compete with spatial relations
- **Implication:** Language REIFIES spatial relations → without it, representations fragile

Normalized impairment: Neutral = 70% loss; Cross-mapped = 90% loss

L20: Thinking During Play - Bridging Implicit Competence and Explicit Mastery

Central Thesis: The Implicit-Explicit Gap

Core Argument: Young children's play reveals sophisticated abstract thinking (hypothesis-testing, deductive reasoning, mathematical foundations) that contradicts traditional "preoperational" characterizations. However, this **implicit competence diverges sharply from explicit formal reasoning** required for academic success.

Domain	What Play Reveals (Implicit)	What School Requires (Explicit)
Scientific	Hypothesis generation, sensitivity to confounded vs. clear evidence, causal ambiguity resolution	Control of Variables (COV) strategy, systematic testing, domain knowledge
Logical	Deductive reasoning from premises, counterfactual thinking in pretense	Formal syllogisms, multi-step arguments, validity evaluation independent of content
Mathematical	Classification, patterning, magnitude comparison, symmetry construction	Verbalized rules, linear number line representation, fraction reasoning

The Critical Hinge: Educators mishandle the transition by conflating play's latent cognitive foundations with formal operational mastery. The former emerges naturally; the latter requires intentional scaffolding that makes tacit knowledge the object of explicit reflection.

Play Types: Developmental Progression (Piagetian Alignment)

Type	Age Range	Cognitive Functions	Piagetian Connection
Sensorimotor Play	0-2y (50%)	Repetitive action sequences (e.g., opening/closing door), object permanence, causal schemas	Aligns with sensorimotor stage: learning through action
Symbolic/Pretend	~2y+ (semiotic function)	Symbol manipulation (block = phone), dual representation, inhibiting reality-based responses	Marks preoperational entry: symbolic function enables abstraction
Constructive Play	4-6y (50%)	Building, making, spatial reasoning, symmetry, cause-effect in physical systems	Preoperational: plans multi-step projects but reasoning remains intuitive
Dramatic Play	2-3y (parallel) → 3-5y (group)	Role-taking, perspective-taking (ToM), narrative construction, social coordination	Challenges egocentrism claim: successful group pretense requires coordinating perspectives
Games with Rules	Grows 4-7y	Abstract rule representation, adherence vs. immediate desire, fairness reasoning	Transitioning to concrete operations: can represent and follow abstract rules

Play Benefits & Historical Decline

Documented Benefits

Benefit	Evidence
Stress reduction	Anxious preschoolers show measurably lower anxiety after imaginative play sessions
Social skill development	Children who engage in free play offer more sophisticated solutions to hypothetical social conflicts
Creativity enhancement	Divergent thinking improves after object play
Self-regulation training	Sustaining group play requires impulse control and rule negotiation

Historical Decline (1981-1997)

- **25% decline** in free-play time as parents prioritize structured activities (music lessons, organized sports)
- **Gray et al. (2023):** Correlated with rising child psychopathology diagnoses (confounds: changing diagnostic criteria, cultural awareness)
- **Threat:** Decline eliminates natural context for spontaneous hypothesis-testing, social reasoning, creative problem-solving

L21: Executive Functions Development

Core Definition

Executive Function (EF): Higher-order cognitive control system that regulates thoughts, emotions, and behavior in service of goal-directed action.

- **Metaphor:** "Executive of the brain" coordinating domain-specific regions (language, sensory, motor)
- **Functions:** Goal maintenance, monitoring progress, emotion regulation, impulse control, meta-cognition
- **Localization:** Prefrontal cortex (PFC) + connectivity to other brain regions
- **Critical for:** Planning, learning complex concepts, social appropriateness, school success

Three Core Components

Component	Definition	Gold Standard Task
Response Inhibition	Suppress prepotent/automatic responses; delay gratification	Stroop, Day-Night, Marshmallow
Cognitive Flexibility	Switch between mental sets; reconfigure stimulus-response mappings	DCCS (Dimensional Change Card Sort)
Working Memory	Maintain & manipulate information in parallel; relational complexity	Halford relational tasks, n-back

Note: Highly correlated but dissociable via factor analysis. All improve 3-5yo, continue into mid-20s.

Developmental Timeline

Age	Key Milestone
2-3 years	Poor inhibition, can't switch rules (DCCS 0%), tantrums/impulsivity
3-5 years	**DRAMATIC improvement:** 3yo fail Day-Night (70-90% errors) → 5yo pass (10-20%)
5-6 years	DCCS success (~85-95%), school readiness (sit still, follow rules, sustained attention)
7-11 years	**LARGEST PFC growth period**; WM expands; impulse control strengthens
Adolescence	Intelligence > impulse control; PFC-amygdala connectivity matures slowly
Mid-20s	**Peak EF capacity**; car insurance drops (reduced risk-taking)
30s onward	Gradual decline BUT knowledge compensates (crystallized > fluid reasoning)

Response Inhibition: Tasks & Patterns

Task	Prepotent Response	Required Response	Age Pattern	Theoretical Relevance
Stroop (adults)	Read word automatically	Name ink color (ignore word)	Adults struggle (reading = automatic)	Classic inhibition measure
Day-Night Stroop	Say "day" for sun, "night" for moon	Say OPPOSITE	**3yo: 70-90% errors | 5yo: 10-20% errors**	Can't read yet so use semantic associations
Marshmallow Test	Eat 1 marshmallow NOW	Wait unspecified time for 2 marshmallows	Predicts achievement BUT effect weaker than originally claimed	Delay gratification; see Moffitt study (more robust)

Critical Insight: Task failure ≠ lack of rule knowledge. Children can STATE the rule perfectly but cannot inhibit prepotent response. Performance deficit = weak goal representation in working memory (not comprehension failure).

Theoretical Debates Using Response Inhibition

- **Theory of Mind:** False belief failure = response inhibition deficit? Can't suppress own perspective (competence vs performance)
- **Conservation (Piaget):** Failure = can't inhibit perceptual salience (height of water), not logical reasoning deficit
- **Relational reasoning:** Object similarity more salient than relational similarity; requires inhibition to focus on relations

DCCS Task Procedure

Materials: Cards varying on 2 dimensions: Shape (boats vs rabbits) × Color (red vs blue)

Phase 1: Pre-Switch (Shape Game)

- Rule: Sort by shape (ignore color)
- **3yo performance: 100% accuracy**
- **5yo performance: 100% accuracy**

Phase 2: Rule Check (Verbal Knowledge)

- Experimenter: "Where do RED ones go in color game?"
- **3yo: Points CORRECTLY**
- Experimenter: "Where do BLUE ones go?"
- **3yo: Points CORRECTLY**
- **Conclusion: Verbal knowledge 100% intact**

Phase 3: Post-Switch (Color Game)

- Rule: Sort by color (ignore shape)
- Show red rabbit → **3yo sorts to RABBIT pile (perseverates on shape)**
- Show blue boat → **3yo sorts to BOAT pile**
- **3yo performance: 0% accuracy (despite knowing rule!)**
- **5yo performance: 85-95% accuracy (slight switching cost)**

The DCCS Paradox: Can verbally state rule but cannot execute it. Established stimulus-response mapping (shape → pile) cannot be reconfigured despite intact comprehension, attention, and memory.

DCCS Interpretation

NOT a Failure of:

✓ **Attention:** Can attend to both dimensions (succeeds in pre-switch)
✓ **Memory:** Remembers rule (states it correctly in Phase 2)
✓ **Comprehension:** Understands task (verbal knowledge intact)
✓ **Perception:** Can perceive both color and shape

ACTUAL Failure:

✗ **Cognitive Flexibility:** Cannot disconnect established S-R mapping
✗ **Goal Representation:** Cannot maintain new rule representation to guide behavior
✗ **PFC Maturity:** Immature PFC cannot reconfigure behavior according to new rule

Alternative Interpretations

- **Halford/Andrews view:** Really about **working memory**, not switching per se. Must bind color + shape simultaneously (binary relational complexity). Under-5s fail binary relations.
- **Zelazo view:** Age increase in **hierarchical rule complexity** (if-then-else structures)
- **Goal representation view:** Keeping goal prominent allows inhibition of old mapping

L22: Language Development I: Foundations of Acquisition

Four Levels of Language

Level	What It Governs	Example
Phonology	Sound structure & permissible combinations	/st/ legal onset (stop), /pf/ not in English
Morphology	Internal word structure (inflections, derivations)	-s (plural), -ed (past), -tion (V→N)
Syntax	Word order & phrase structure	"dog bites man" ≠ "man bites dog"
Semantics	Meanings & reference	"Dog" = canine; "bachelor" = unmarried male
Pragmatics	Social conventions & language use	"Could you pass salt?" = request, not question

Exam Focus: "Goed" = morphological error (NOT syntax—order correct). Sarcasm = pragmatic (NOT semantic).

Developmental Timeline

Age	Milestone
0-2 mo	Cooing; prefer speech>non-speech; recognize native prosody (from womb)
6 mo	Canonical babbling ("bababa"); universal phoneme discrimination; gaze following
10 mo	**Perceptual narrowing complete**; language-specific babbling; comprehend ~50 words
12 mo	First words; produce 1-10 words, comprehend ~100
18 mo	Vocabulary explosion (~1 word/day); two-word combos ("Daddy work"); preserve word order
24-36 mo	100-2,000 words; **productive morphology** (wug→wugs); overgeneralization ("tooths")
3-5 yr	5,000-20,000 words (~1 word/hour peak); complex sentences; re-learn irregulars
6-8 yr	Metaphor, irony, sarcasm; non-literal language; register variation

Hierarchical Infinite Productivity

Key Insight: Constraints ENABLE productivity, NOT limit it. No constraints → noise; constraints → contrastive structure → infinite combinations.

Level	Finite Components	Constraints Create Meaning
Phonology	~40 phonemes	/st/ legal → /df/ not → patterns learnable
Morphology	Morphemes	Rule-governed inflection/derivation
Syntax	~20,000 words	Word order changes meaning (SVO)
Discourse	Sentences	Coherence requires pragmatic bridging

Recursion: Sentences embed infinitely: "I think [you believe [she knows [...]]]". Finite rules + recursion = infinite utterances.

Perceptual Narrowing

Stage	Details
6 months	Universal discrimination: English + Hindi + Japanese phonemes ALL distinguished
10 months	Language-specific: lose non-native contrasts (Japanese: no /r/-/l/; English: no Hindi /d̪/-/ɖ/)
Mechanism	**Adaptive specialization**, NOT cognitive loss. Collapse irrelevant variance → free resources for word learning
Bilingual	Maintain BOTH phoneme sets if both statistically frequent. NOT delay—appropriate environmental tuning
Adult L2	Struggle with non-native: tuned categorical boundaries ignore contrasts (NOT sensory loss)

Common Error: Narrowing = regression? NO. It's learned category optimization. Bilingual infants maintain both—no delay.

Categorical Perception (VOT)

Comparison	Acoustic Distance	Percept	Discrimination
0ms vs 20ms	20ms	Both /d/	Poor (within-category)
20ms vs 40ms	20ms	**/d/ → /t/**	**Excellent (boundary!)**
40ms vs 60ms	20ms	Both /t/	Poor (within-category)

Eimas et al. 1971: 2-day-olds show categorical perception. High-amplitude sucking: habituate to 20ms, dishabituate to 40ms (cross-boundary) NOT 0ms (within-category).

Key Formula: Equal acoustic steps (20ms each) → Unequal perceptual distances. Boundary sharpens discrimination. From birth!

Speech Segmentation Cues

Problem: No consistent silences between words in fluent speech. How do infants find word boundaries?

Cue Type	Mechanism
Stress Patterns	English words = 1 primary stress (BAbuy, spaGHETti). Consecutive stressed syllables → boundary
Phonotactics	Legal onset clusters (/st/ OK, /df/ not). Distributional learning of sound sequences
Transitional Probability	Within-word: high P(by|ba). Across boundary: low P. Statistical learning (Saffran et al.)
Language-Specific	English: stress-timed (stress cues). French: syllable-timed (phonotactics + function words)

Age: Sensitive to all cues by 8 months (BEFORE first words).

Word Learning Mechanisms

Mechanism	Function	Example/Context
Mutual Exclusivity	Novel word → novel object (lacks known label)	Fork + garlic press: "Give me dax" → 95% pick garlic press (age 3)
Shape Bias	Extend count nouns by shape (default for solid objects)	"This is a blicket" → generalize to same-shape objects
Whole Object	Assume labels refer to whole objects, not parts/properties	"Rabbit" → whole animal (NOT ears/legs/fur)
Pedagogical Sampling	Infer category level from example diversity	3 Dalmatians → subordinate; 3 breeds → basic; dog+cat+bird → superordinate
Comparison	Override shape bias—identify contrastive feature	2 spongy objects (diff shapes) → generalize by texture NOT shape (Graham et al. 2020)
Gaze Following	Track speaker's referential target (by 12mo)	Speaker looks at rabbit → "gavagai" = rabbit (NOT unattended objects)

Integration: Real word learning combines ALL mechanisms. Mutual exclusivity narrows candidates → comparison identifies features → gaze provides grounding.

Morphosyntax Development

Component	Details
Morphemes	Meaningful units: "dog" (1), "tugboat" (2: tug+boat), "dogs" (2: dog+-s)
Inflectional	Add grammatical info, NO category change: -s (plural), -ed (past), -ing (progressive)
Derivational	CHANGE category: destroy (V) → destruction (N); happy (Adj) → happiness (N)
Wug Test	(Berko 1958) "This is a wug. Two ___?" → "wugs" /wʌgz/. Productive rule + allomorph selection
Allomorphs	/-s/ after voiceless (cats); /-z/ after voiced (dogs, wugs); /-ɪz/ after sibilants (buses)
U-shaped	feet (imitate) → foots (overgeneralize rule) → feet (rule + exceptions). ERROR = LEARNING
18 mo	Two-word combos: "Daddy work" (NOT "work Daddy"). Telegraphic but preserve order
24-36 mo	Productive morphology: apply -s/-ed to novel words. Overgeneralize to irregulars (tooths, goed)

Hinge: Overgeneralization = EVIDENCE of rule extraction (NOT delay). Child has abstract NOUN+-s rule, not memorized forms.

Interpreting Child Errors

Utterance	Type	Correct Interpretation
"I have two mouses"	Morphological overgeneralization	Extracted regular plural rule, overapplied to irregular. NOT vocabulary error
"She goed to park"	Morphological overgeneralization	Learned -ed rule, not yet "went" exception. NOT syntactic (order correct!)
"Want cookie" (18mo)	Telegraphic speech	Omit function words but preserve order. NOT lack of grammar—emerging syntax
"I brushed my tooths"	Productive rule learning	ADVANCED (extracted abstract rule), NOT delayed. U-shaped: teeth→tooths→teeth

Morphology vs Syntax: Morphology = internal word structure. Syntax = how words combine. "Goed" has correct syntax, wrong morphology.

L23-24: Language Development II & III: Nativist vs. Constructionist Approaches

Nativist vs Constructionist Overview

Aspect	Nativist (UG)	Constructionist
What is innate?	Language-SPECIFIC constraints: phrase structure (VP=V+NP), structural dependence, recursion	Domain-GENERAL mechanisms: statistical learning, analogical abstraction, social cognition
Initial state	Abstract & verb-general from start (18mo+)	Concrete & item-specific; gradually abstracted (36mo+)
Input quality	IMPOVERISHED - insufficient for learning (poverty of stimulus)	RICH - contains learnable statistical patterns
Key evidence	No SD errors; NSL emergence; sensitive periods	Verb islands; TP-based segmentation; priming confounds

Central Question: Is language a specialized cognitive MODULE or EMERGENT from general cognition applied to linguistic input?

Universal Grammar (UG) - Chomsky's Claims

What UG Specifies (Innate)

- **Hierarchical phrase structure:** S = NP + VP; VP = V + NP
- **Structural dependence:** Syntactic operations reference phrase structure, NOT linear order
- **Recursion:** Clause embedding infinitely: "I think [you believe [she knows [...]]]"
- **Island constraints:** Rules on wh-movement extraction

What Must Be Learned

- Word order parameters (English: V+NP; Turkish: NP+V)
- Specific vocabulary and morphemes
- Phonological patterns

Key Claim: Children NEVER make structure-independent errors because UG prohibits even considering such rules. "Innate schematism" - Chomsky (1971)

Poverty of Stimulus Argument

The Logic

1. Children acquire syntactic knowledge that appears NOWHERE in input
2. No NEGATIVE EVIDENCE available (no one produces ungrammatical sentences to show what's wrong)
3. If learning from input alone, children should overgeneralize then correct from feedback
4. BUT children never make certain error types (e.g., island violations)
5. THEREFORE constraints must be INNATE

Example: Wh-Movement

"Which movie does Susan imagine that Sarah saw *t*?" - wh-word moves respecting phrase boundaries

No child ever produces: "*What did Beth eat peanut butter and *t*?" (coordinate structure island)

Constructionist Counter: Input is RICHER than nativists claim; statistical patterns + distributional cues provide sufficient information

Structural Dependence - "A Parade Case"

Principle: Syntactic operations reference HIERARCHICAL phrase structure, NOT linear word order.

Question Formation Example

Type	Rule	Output
Declarative	--	"The boy who is smoking is crazy"
CORRECT Question	Move MAIN CLAUSE auxiliary	"Is the boy who is smoking crazy?"
***LINEAR Error**	Move FIRST auxiliary	"*Is the boy who smoking is crazy?"

Key Point: Linear rule is SIMPLER but children NEVER produce it. Why? Nativists: UG prohibits structure-independent rules. Constructionists: "who smoking" never occurs in input (TP = 0).

Crain & Nakayama (1987)

Method

- **Participants:** Children ages 3-5
- **Task:** Elicited production of yes/no questions from complex declaratives
- **Sentences:** Contained relative clauses with auxiliary verbs

Results

0% structural dependence errors across 600+ questions

Interpretation (Nativist)

- Perfect performance despite minimal exposure to complex embeddings in CDS
- Supports innate UG constraint - structural dependence is "parade case of innate schematism"
- Children NEVER consider linear-order rules

Crain's Claim: "Structural dependence is a parade case of an innate constraint"

Ambridge et al. (2008) - Counter-Evidence

Critical Finding

Auxiliary	Error Rate	Why?
"is" questions	0%	"who smoking" NEVER occurs (TP = 0)
"can" questions	**7%**	"who smoke" IS grammatical elsewhere!

Example Error

"Can the boy who smoke can drive?" - SD error occurs because "who smoke" is a legal bigram (e.g., "people who smoke")

Challenge to UG: If structural dependence were UNIVERSAL INNATE CONSTRAINT, it should NOT show word-specific variation. The 7% error rate with "can" suggests transitional probability (statistical learning), NOT innate constraint!

Sensitive Periods for Language

Exposure Age	Outcome
Before age 7	No exposure to sign = permanent deficits in complex syntax
Before puberty	First exposure after puberty = never achieve native fluency in grammatical morphology
After puberty	Second language learners struggle with inflectional morphology despite fluent vocabulary

Evidence for Biological Timing

- Cannot be explained by general cognitive decline - adults learn chess, math, music
- Suggests LANGUAGE-SPECIFIC neural windows
- Strongest evidence: children GENERATE language beyond input

Nativist Interpretation: Genetically-driven maturation of UG-related neural circuits

Nicaraguan Sign Language (NSL) - Senghas, Kita & Ozyurek (2004)

Natural Experiment

1980s Nicaragua: Deaf children with no prior language brought together in schools. First cohort invented home signs; second cohort (exposed during sensitive period) SYSTEMATICALLY COMPLEXIFIED the language.

Componentiality Data

Group	% Componential (Sequential)
Spanish gesturers	~35% (65% simultaneous)
NSL Cohort 1 (adults)	~25%
NSL Cohort 2 (children)	**~75%**
NSL Cohort 3	~73%

Key Finding: Children generated compositional structure BEYOND their input! Cohort 2 children had Cohort 1 adults as models but produced MORE linguistic structure. Evidence for innate drive to impose language structure during sensitive period.

Compositional Structure

Definition

Language splits meaning into COMPONENTS that can be RECOMBINED. Hallmark of true linguistic structure vs. holistic gesture.

Motion Event Example

Type	Expression	Structure
Simultaneous	Rolling-down (one gesture)	Holistic: manner+path fused
Sequential	Roll, then down (two gestures)	Compositional: manner separate from path

Why Compositionality Matters

- Allows RECOMBINATION: "roll down" + "roll up" + "slide down" etc.
- Productive syntax requires separable components
- NSL Cohort 2's sequential structure = TRUE linguistic compositionality

Exam Point: Cohort 2 children RESTRUCTURED input according to linguistic principles despite impoverished models - supports UG-driven acquisition

L25-26: Culture & Conceptual Development

Core Thesis & Central Principle

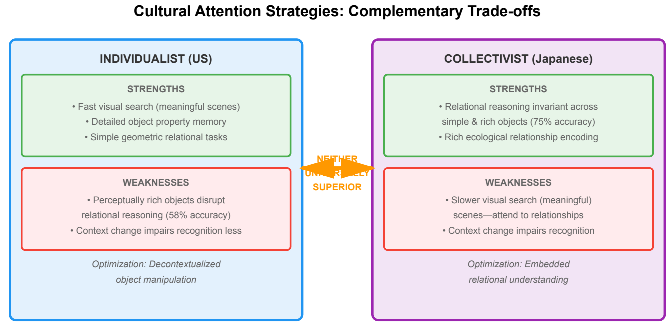
ATTENTION IS THE KEY COGNITIVE MEDIATOR: Cultural values shape attention strategies → attention determines what's learned/remembered → creates complementary cognitive architectures

- **Not universal trajectory:** Western theories misapplied cross-culturally → misdiagnose cultural differences as deficits
- **Complementary trade-offs NOT deficits:** Each culture optimizes for different ecological/social demands
- **Values realized as strategies:** Individualism/collectivism aren't abstract beliefs—they're moment-to-moment cognitive operations
- **Self-determination principle:** When Indigenous communities control design, "gaps" disappear

Individualism vs Collectivism Dimension

Aspect	Individualist	Collectivist
Self-construal	Independent (autonomous self)	Interdependent (embedded in group)
Core values	Independence, competition, uniqueness, self-sufficiency	Harmony, duty, group belonging, context-sensitivity
Attention strategy	Selective focus on isolated objects	Distributed across relationships/context
Memory encoding	Object properties (context-free)	Object-context bindings
Eye-tracking	Narrow fixation on focal object	Broad scanning of entire scene
Development	Detectable by age 4 in preschoolers	
Countries	USA, Canada, Australia, UK, N. Europe	East Asia, Central America, Indigenous communities

Attention & Memory Trade-offs



Kuwabara & Smith (2012): Relational Reasoning

Task Condition	US Children (4yr)	Japanese Children (4yr)
Simple geometric shapes	75% correct	75% correct
Perceptually rich objects (clocks, keys, chairs)	58% correct (↓17%)	75% correct (no drop)
Visual search (meaningful)	Faster (ignore context)	Slower (attend to relationships)
Visual search (random)	Equal speed	

- **Interpretation:** US object-focus → vulnerable to perceptual distraction when relations matter
- **Japanese relational focus:** Automatically filters surface features to extract abstract patterns
- **NOT deficit:** US would excel at detailed object property memory tasks

Memory Encoding: American vs Hong Kong Chinese

- **Task:** Remember animals shown against background scenes; later test with same/swapped backgrounds
- **Instructions:** "Remember the animal" (explicit object focus)
- **Americans:** Equivalent recognition regardless of background match (object-only encoding)
- **Asians:** Impaired recognition when backgrounds swapped (object-context binding)
- **Eye-tracking:** Americans fixate narrowly on object; Asians distribute across scene
- **Key insight:** Cultural training overrides explicit task demands—relational encoding is default

Parental language input: US parents: more object labeling ("that's a duck"); Asian parents: more event descriptions ("duck swimming to eat") → creates feedback loops reinforcing attention strategies

Intent Participation vs Assembly-Line Instruction

Feature	Intent Participation	Assembly-Line
Physical context	Children present during authentic adult work; multi-age	Age-segregated classrooms; learning decontextualized from application
Attention structure	**Simultaneous:** monitor model + execute own + track environment	**Alternating:** must pause to attend model OR work
Collaboration	Spontaneous mutual help; complementary skills valued	Requires permission; goal = individual ranking
Learning from others	High (62% sustained attention to others)	Low (31% sustained attention—tune out non-directed info)
Historical origin	Pre-industrial apprenticeship; current indigenous	Factory metaphor explicit (~1900): children = raw products

Correa-Chávez et al. (2005): Origami Attention Patterns

Group	Simultaneous Attention	Alternating Attention
Traditional Mayan (basic schooling)	**48%**	Lower
Mixed Mayan (more Western schooling)	**35%**	Moderate
European American (high schooling)	**27%**	Higher

- **Simultaneous attention:** Fold own paper WHILE monitoring adult + other children + environment
- **Correlation:** Simultaneous attention negatively correlated with question-asking (extract info via observation)
- **Western schooling effect:** More schooling → less simultaneous attention capacity

Toy-Building Study: Peripheral Learning

- **Design:** Child A taught mouse toy; Child B taught frog toy. Later swap: A must build frog, B must build mouse
- **Easy toy (mouse):** No group differences—all succeed
- **Difficult toy (frog):** Traditional Mayan children need **43.5%** help; European American need **58.8%** help
- **Sustained attention to others' instruction:** Traditional Mayan 62%, Mixed 55%, European 31%

Efficiency calculation: Mayan child during own mouse instruction allocates 40% attention to sibling's frog = 1.2 min prior learning. European child allocates 5% = 0.15 min. When building frog: Mayan needs 1.5 min help (total 2.7 min); European needs 4 min help (total 4.15 min). Ratio: 0.37 (Mayan need only 37% as much help due to observational learning)

Factory Model: Explicit Design Principles

- **1916 Stanford Dean of Education:** "Schools are factories in which raw products (children) are shaped...to meet demands of life"
- **Not retrospective metaphor:** Conscious institutional design principle
- **Modularization:** Math, reading, history as separate "production lines" (like car doors, seats, engines)
- **Teacher role:** Manager delivering pre-specified information; students = receptacles
- **Quizzing:** Teacher asks questions she knows to test information receipt (not authentic inquiry)
- **No rationale:** Teacher directs actions without explanation (workers don't need factory logic)
- **Cultural mismatch:** Indigenous children punished for collaboration (seen as "cheating" vs normative problem-solving)
- **Assessment mandate:** Must rank high vs low performers → collaborative learning incompatible even if enhances outcomes