Final Examination

• Thursday, December 18
  – 7:00 – 10:00 PM
  – 245 Li Ka Shing (Near Pat Brown's Grill)
• DSP Students – Arrangements TBA Later
• 2-Hour Exam (Across 3 hours)
  – 1st Hour, Noncumulative
  – 2nd Hour, Cumulative
• Review: December 10, 9-10 AM, 50 Birge
  – Narrative Review Posted to bCourses
  – Post Questions to bCourses Discussion Board

Resources for Exam

• Materials on Course Website
  – Lecture Illustrations, Supplements
  – Exam Information, Narrative Review
    • Updated Version Now Posted to bCourses
  – Past Exams (with Scoring Guide)
• Post questions to bCourses
  – By 12:00 Noon Wednesday, December 17

Aspects of Consciousness

• Phenomenal Experience
  – Mental States
    • “Something It’s Like”
• Intentionality
  – “Aboutness”
    • Mental States Represent Things Outside the Mind
• Meta-Consciousness
  – Personal Consciousness
  – Voluntary Control

Views of Development

• Phylogenetic
  – Evolution of a Trait Across Species
  – Comparative Psychology
• Ontogenetic
  – Emergence of a Trait Within Individual
  – Life-Span Developmental Psychology
• Cultural
  – Effects of Social/Cultural/Economic Development
  – Social/Cultural Psychology
    • Sociology, Anthropology, Political Science
Descartes (1596-1650)
- Substance Dualism
  - Body
  - Mind
- Animals as Reflex Machines
- Humans with Souls
  - Mind
  - Free Will
  - Legitimized Concepts of Sin, Crime
- Humans as the Highest Stage of Development
  - Except God, Angels

Origin of Species by Natural Selection
Darwin (1859)
- Evolution by Natural Selection
- Adaptation to Environmental Niche
  - Passed on to Offspring
- Different Species Descended from Common Ancestors
- Doctrine Applied to Morphological Similarity
  - What About Mental Similarity?

Descent of Man
Darwin (1871)
There can be no doubt that the difference between the mind of the lowest man and that of the highest animal is immense.... Nonetheless, the difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind. We have seen that the senses and intuitions, the various emotions and faculties, such as love, memory, attention, curiosity, imitation, reason, etc., of which man boasts, may be found in an incipient, or even sometimes in a well-developed condition, in the lower animals....

If it could be proved that certain high mental powers, such as the formation of general concepts, self-consciousness, etc., were absolutely peculiar to man, which seems extremely doubtful, it is not improbable that these qualities are merely the incidental results of other highly-advanced intellectual faculties; and these again mainly the result of the continued use of a perfect language.... That such evolution is at least possible, ought not to be denied, for we daily see these faculties developing in every infant; and we may trace a perfect gradation from the mind of an utter idiot, lower than that of an animal low in the scale, to the mind of a Newton.

Consciousness in Brutes
T.H. Huxley (1868)
"The consciousness of brutes would appear to be related to the mechanism of their body simply as a collateral product of its working, and to be completely without any power of modifying that working as the steamwhistle which accompanies the work of a locomotive engine is without influence upon its machinery."

Animal Intelligence
George John Romanes (1882)
- Anecdotal Evidence
  - Intelligence
  - Consciousness
- Dog and Its Food Dish
- Coordinated Baboon Attack on Humans
- "Fellow-Feeling" and Sympathy in Ants

"This observation seems unequivocal as proving fellow-feeling and sympathy, so far as we can trace any analogy between the emotions of the higher animals and those of insects."
Mental Evolution in Man
Romanes (1888)

• Improbable that Body Continuous, but Mind Discontinuous
• "[There is a] very strong *prima facie* case in favour of the view that there has been no interruption of the developmental process in the course of psychological history; but that the mind of man, like the mind of animals... has evolved."

Introduction to Comparative Psychology
C. Lloyd Morgan (1894) -- a Student of Romanes!

• Double Induction
  – Objective
  – Subjective
• "Lloyd Morgan’s Canon"
  – Instincts
  – Trial-and-Error Learning
  • Always interpret behavior in terms of the lowest psychological process....
  • A human process is scientifically interesting to the extent that it can be studied in animals.

John B. Watson
Psychology as a Behaviorist Views It (1913)
Psychology from the Standpoint of a Behaviorist (1919)

• Consciousness and Intelligence Play No Role in Animal Behavior
  – Reflex
  – Instinct
  – Conditioned Response

Animals Don’t Have Consciousness – and Humans Don’t, Either!

The Paradox of Continuity
Darwin vs. Descartes

• Everybody Agrees on Evolutionary Continuity of Mind
• Romanes: Extend Intelligence Down to Nonhuman Animals
• Thorndike, Watson: Extend Reflexes and Instincts Up to Humans!
• Morgan Segregates Some Capacities as Exclusively Human

The Animal Mind
Margaret Ploy Washburn (1908)

• Problem of Other Minds
  – Inference from Words and Actions
  – Assumption that All Human Minds "Built on the Same Pattern"

"The mind of each human being forms a region inaccessible to all save its possessor....
"If my neighbor’s mind is a mystery to me, how great is the mystery which looks out of the eyes of a dog, and how insoluble the problem presented by the mind of... an ant or a spider?"

Mentalistic Comparative Psychology
Washburn (1908)

“[A]ll psychic interpretation of animal behavior must be on the analogy of human experience....
Our acquaintance with the mind of animals rests upon the same basis as our acquaintance with the mind of our fellow-man; both are derived by inference from observed behavior.”
Criteria for Attributing Mind to Animals

• Unsatisfactory Criteria
  – Behavioral Response to Stimulation
  – Approach/Avoidance Behavior
  – Behavioral Adaptation to a Goal
  – Variability of Behavior
• Dual Criterion
  – Anatomical Resemblance to Humans
  – Rapid Learning
    • Past Recalled as “Idea or Mental Image”

Arguably, Washburn was the Direct Target of Watson (1913)

Self-Recognition: Darwin’s Test
Darwin (1871, 1872)

• Orangutans in London Zoo
• Three Stages of response
  – Surprised, Alarmed, Curious
  – Kisses, Grimaces
  – Ignored Object
• But What’s Really Going On
  – Reacting to Image as if Another Ape?
  – Noting What They Themselves Look Like?

Repeating Darwin’s Test
Gallup (1970)

• Chimpanzees
  – Initially, Explored Mirror
    • React to Image As If Another Animal
  – Later, Explored Self (Hidden Parts of Body)
    • React to Image As If a Representation of Self
      – Grooming Otherwise Invisible Body Parts
      – Picking Food from Teeth While Watching Image
      – Visually Guided Manipulation of Anal/Genital Areas
      – Nose-Picking After Inspection of Image

Reactions to Mirror by Chimpanzees
Gallup (1970)

Mirror-Recognition Experiments
Gallup (1970)

• Anesthetize Chimpanzees
  – Prior Experience with Mirror
• Apply Odorless Paint to Foreheads
  – Odorless
  – No Tactile Sensation
• Awaken in Cage with Mirror Present
  – Mirror-Directed Behaviors
  – Self-Directed Behaviors
  – Touching of Marked Spot
• Control: No Prior Experience with Mirror

Self-Recognition Behavior
Gallup (1970)
Self-Recognition by Chimpanzees
Gallup (1970); Suarez & Gallup (1981)

- No Such Recognition in Other Primates
  - Stump-Tailed Macaques
  - Rhesus Monkeys (14 days, 12 hours/day)
  - Crab-Eating (Cynomolgus) Macaques (250 hours)
- Self-Awareness
  - Match Experience with Representation of Self
- Implies Concept of Self

Mirror Self-Recognition in Human Infants

- Pretend Play
- Synchronic Imitation
- Mirror Self-Recognition
- Deferred Imitation

Critique of Mirror Self-Recognition

- Artifact of Ambient Face-Touching
  - Anesthesia Depresses Face-Touching
  - Increases Reflect Recovery from Anesthesia
- Response
  - Examine Marked and Unmarked Areas

Comparison of Marked and Unmarked Facial Regions
Povinelli et al. (1997)

Mirror-Contingent Behaviors
Povinelli et al. (1993)

- Contingent Body Movements
- Contingent Facial Movements
- Self-Exploratory Behavior

Self-Recognition and Mirror Behavior
Povinelli et al. (1993)
Differences in Self-Recognition

Recognition
- Chimpanzees
  - Aged 4-15
  - Raised in Groups
  - Prior Mirror Experience
- Orangutans
- Bonobos
- Human Infants
  - Aged 18-24 months

No Recognition
- Chimpanzees
  - Aged < 4 or >16
  - Raised in Isolation
  - No Mirror Exposure
- Gorillas?
  - Koko’s Double-Take
    - “Me, Koko!”
- Baboons
- Monkeys
- Non-Primates

Self-Recognition in Gorillas

- Koko (Paterson, 1978)
  - Anecdotal
- Suarez & Gallup (1981)
  - N = 4, 80 Hours of Exposure
- Ledbetter & Basen (1982)
  - N = 2, 400 hours of exposure

Self-Recognition in Primate Evolution

Self-Recognition appears to have arisen independently at least twice in evolution.

Old-World Monkeys
- Gibbons
- Orangutans
- Humans
- Gorillas
- African Apes
- Chimpanzees

Self-Recognition in Non-Primates?

Elements of a Theory of Mind

- Mental States are Representations
  - Not Direct Reflections of Reality
  - May or May Not Be Accurate
- Other People Have…
  - Beliefs, Knowledge, and Thoughts
    - May Be True or False
    - May Differ from Our Own
  - Feelings and Desires
    - May Differ from Our Own

“False Belief” Task Example

- Experimenter, Child and Puppet
- Experimenter makes puppet hide ball in oatmeal container
- Puppet put away
- Experimenter and child switch ball to box
- Puppet returns: Where will it look?
  - 3,4-year-olds, Box
    - “Because that’s where it is”
  - 4,5-year-olds, Oatmeal Container
    - “Because that’s where he thinks it is”
The “Theory of Mind” as Mindreading  
Baron-Cohen (1995)

The Ability to Infer the Contents of Someone Else’s Mind

- Elements of Mindreading
  - Intentionality Detector
  - Eye-Direction Detector
  - Shared-Attention Mechanism
  - Theory-of-Mind Mechanism

- Cognitive Modules
  - Brain Modules

The Theory of Mind in the Brain  
Saxe & Kanwisher (2003)

- Adult fMRI Study
- Read Stories
  - True and False Beliefs
    - Boy Making Papier Mache Goes to Store for Glue
    - Mother Throws Out Newspaper Strips While Gone
  - Mechanical Inference
    - Teakettle Left Boiling on Stove All Night
    - No Water Left in the Morning
  - Human Action (No True/False Beliefs)
    - Woman Walking to Work
    - Detours to Avoid Crane

Brain Activation During Theory-of-Mind Reasoning  
Saxe & Kanwisher (2003)

<table>
<thead>
<tr>
<th>Brain Region</th>
<th>% Signal Change</th>
<th>LRLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPJ</td>
<td>ToM</td>
<td>0.8</td>
</tr>
<tr>
<td>EBA</td>
<td>MI</td>
<td>0.7</td>
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Do Infants Have a Theory of Mind?  
Onishi & Baillargeon (2005)

- 15-Month-Old Infants
- Totally Nonverbal Task
  - Violation of Expectancies
    - Familiarize Child with Situation
    - Target’s Behavior Violates Expectancies
    - Infants Look Longer at Counterexpectational Events

- Apparent Contradiction
  - Mirror Self-Recognition by Age 2
  - Pass False Belief Test by Age 5
- Clements & Perner (1994)
  - 2- and 3-year olds
    - Say Where the Puppet Will Look
      - Incorrectly Identify New Location
    - Look Where the Puppet Will Look
      - Correctly Identify the Old Location
  - Understanding Not be Expressed Verbally
    - Competence vs. Performance Distinction

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    - Target’s Behavior Violates Expectancies
    - Infants Look Longer at Counterexpectational Events
Familiarization Trial

- Trial 1
  - Actor Hides Watermelon
    - In Green Box
    - Not Yellow Box
- Trials 2, 3
  - Actor Returns
  - Reaches into Green box

Belief-Induction Trial

- True Belief Green
  - Actor Watches as Yellow Box Moves Toward Green
- True Belief Yellow
  - Actor Watches as Watermelon Moves to Yellow
- False Belief Green
  - Actor Ignorant as Watermelon Moves to Yellow
- False Belief Yellow
  - Actor Watches as Watermelon Moves to Yellow
  - Ignorant When Watermelon Moves Back to Green

Test Trial

- Actor opens doors
  - Reaches into Green box
  - Reaches into Yellow box

Looking Times in the Non-Verbal False-Belief Task

Infants Have a Theory of Mind!

- Infants Know What Others Believe
  - Might be incorrect
  - Beliefs May Differ From Their Own
- Infants Expect Others to Behave in Accordance With Their Beliefs
  - Surprised When They Do Not

Does the Chimpanzee Have a “Theory of Mind” as Mindreading?

- Chimpanzees Pass Mirror Self-Recognition
- Do They Have a Theory of Mind?
  - Intentionality Detector
  - Eye-Direction Detector
  - Shared-Attention Mechanism
  - Theory-of-Mind Mechanism
Non-Verbal False-Belief Task
Call & Tomasello (1998)

- "Hider" Hides Reward in 1 of 2 Containers
  - In View of "Communicator"
    - Previously Shown to be Reliable
  - Invisible to Subject
- Then Communicator Leaves Room
- Hider Switches Location of Reward
  - In View of Subject
- Communicator Returns to Room
  - Marks Old Box as Correct
- Which Box Does Subject Choose?

False-Belief Task Performance
Call & Tomasello (1998)

Primate Cognition Test Battery
Hermann et al. (2007), after Call & Tomasello (1997)

- Physical Skills
  - Space
    - Spatial Memory
    - Object Permanence
    - Rotation
    - Transposition
  - Quantities
    - Relative Numbers
    - Additive Numbers
  - Causality
    - Noise
    - Shape
    - Tool Use
    - Tool Properties
- Social Skills
  - Social Learning
  - Communication
    - Comprehension
    - Pointing at Cups
    - Attentional State
  - Theory of Mind
    - Gaze Following
    - Intentions

Comparative PCTB Performance
Herrmann et al. (2007)

- 106 Chimpanzees (M age = 10)
- 32 Orangutans (M age = 6)
- 105 Children aged (M age = 2.5)
Comparative Performance on PCTB
Herrmann et al. (2007)

- Gaze
- Intentions

% Correct

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

Chimp ORG

Critique of Primate Social Cognition
De Waal et al. (2008); Herrmann et al. (2008)

- Confounds
  - With Parents vs. Confined Alone
  - Laboratory vs. Field Studies
  - Verbal vs. Nonverbal Instructions
  - Experimenter: Conspecific or Not
- Conclusions
  - Plenty of Social Learning from Other Apes
  - Apes May Have a Theory of the Ape-Mind!

Chimpanzee Psychology
Call & Tomasello (2008)

- Cognition Goes Beyond Behavioral Rules
- Have Perception-Goal Psychology
  - Understand Others’ Perception and Knowledge
  - Understand Others’ Goals and Intentions
- Lack Belief-Desire Psychology
  - Others Have Beliefs About World
  - Beliefs Determine Actions Even When Wrong

If Consciousness Entails a Theory of Mind

- Adult Humans Have It
  - And Young Children Have It
- Even Infants Might Have It
  - Or At Least the Beginnings Of It
- Autistic Children Might Not Have It
  - Or Maybe Not Too Much Of It
- Apes Don’t Seem To Have It
  - At Least As Far As We Can Tell
  - But Have We Always Had It?

The Cultural-Historical Perspective

- Humans Have a Theory of Mind
  - Differentiates Us from Other Animals
- But Did We Always Have It?
  - Part of Phylogenetic Heritage
- Or did it Develop in Historical Time
  - Over Cultural History of Our Species

The Origins of Consciousness in the Breakdown of the Bicameral Mind
Jaynes (1976)

- Reading Homer’s Iliad
  - No Evidence of Consciousness
    - Nobody Makes Decisions
    - Nobody Introspects
    - Nobody Reminisces
  - Gods Tell Men What To Do
    - Men Go Out and Do It
    - Not Merely a Poetic Device
The Rage of Achilles
Homer, The Iliad

Rage -- Goddess, sing the rage of Peleus’ son Achilles, murderous, doomed, that cost the Achaean her countless losses, hurling down to the House of Death so many sturdy souls, great fighters’ souls, but made their bodies carrion, feasts for the dogs and birds, and the will of Zeus was moving toward its end.

Begin, Muse, when the two first broke and clashed, Agamemnon lord of men and brilliant Achilles.

Book 1, Lines 1-8
(trans. Robert Fagles)

Some Events in the Iliad

• (Paris Kidnaps Helen)
• Helen on the Walls of Troy (Book II)
• Duel Between Menelaus and Paris (III)
• Achilles Returns Hector’s Body to Priam (XXIV)

The Judgment of Paris
Master of the Judgment of Paris, 1430-1440
(Museo Nazionale di Bargello, Florence)

The Judgment of Paris
Rubens, 1600
(National Gallery, London)

The Language of the Iliad

• Psyche (Soul)
  – Life-Substance, Blood, or Breath
• Thumos (Emotion)
  – Motion
• Phren (Mind)
  – Localized in Midriff
• Soma (Body)
  – Corpse

Athena Inspires the Prince
Homer, The Odyssey

Sing to me of the man, Muse, the man of twists and turns driven time and again off course, once he had plundered the hallowed heights of Troy.

Many cities of men he saw and learned their minds, many pains he suffered, heartsick on the open sea, fighting to save his life and bring his comrades home.

But he could not save them from disaster, hard as he strove -- the recklessness of their own ways destroyed them all, the blind fools, they devoured the cattle of the Sun and the Sungod blotted out the day of their return.

Launch out on his story, Muse, daughter of Zeus, start from where you will -- sing for our time too.
Some Events in the Odyssey

- Odysseus with Calypso (Books V-VI)
- Odysseus with the Cyclops Polyphemus (IX)
- Odysseus with Circe (X-XI)
- Odysseus with his Mother in Hade (XI)
- Odysseus with the Sirens (XII)

Intersubjectivity in the Odyssey

Odysseus ("Nobody") and Polyphemus (Book IX)

Jason and King Aietes

Apollonius, Argonautica (3rd c. BCE)

Jason sat silent where he was, his eyes fixed on the ground before his feet, unable to speak, at a loss as to how to deal with his wretched situation. For a long time he turned over and over what he should do: it was impossible to accept with confidence, as the challenge seemed overwhelming.

Intersubjectivity in the Odyssey

"Thus says the LORD…"

Book of Amos, Chapter 1

1 The words of Amos…

2 And he said: "The LORD roars from Zion, and utters his voice from Jerusalem; the pastures of the shepherds mourn, and the top of Carmel withers." 3 Thus says the LORD: "For three transgressions of Gaza, and for four, I will not revoke the punishment; because they have threshed Gilead with threshing sledges of iron. 4 So I will send a fire upon the house of Hazael, and it shall not revoke the punishment; because they have threshed Gilead with threshing sledges of iron. 5 So I will send a fire upon the wall of Gaza, and it shall not revoke the punishment; because they carried into exile a whole people to deliver them up to Edom. 6 So I will send a fire upon the wall of Gaza, and it shall devour her strongholds. 7 I will cut off the inhabitants from Ashdod, and him that holds the scepter from Ashkelon; I will turn my hand against Ekron; and they shall be as Ashdod before me; and Edom shall be desolate before them." 8 I will cut off the inhabitants from Ashdod, and him that holds the scepter from Ashkelon; I will turn my hand against Ekron; and them up to Edom. 9 So I will send a fire upon the wall of Gaza, and it shall devour her strongholds. 10 And when the woman saw that the tree was good for food, and that it was pleasant to the eyes, and a tree to be desired to make one wise, she took of the fruit thereof, and did eat, and gave also unto her husband with her; and he did eat. 11 And they were both naked, the man and his wife, and were not ashamed…. 12 I the Preacher have been king over Israel in Jerusalem. 13 And I applied my mind to know wisdom and knowledge and to know madness and folly. I perceived that this also is but a striving after wind. 14 What is crooked cannot be made straight, and what is lacking cannot be numbered. 15 What is crooked cannot be made straight, and what is lacking cannot be numbered. 16 I said to myself, "I have acquired great wisdom, knowledge increases sorrow. 17 And I applied my mind to know experience of wisdom and knowledge.” 18 And I applied my mind to know experience of wisdom and knowledge." 17 And I applied my mind to know experience of wisdom and knowledge.” 18 And I applied my mind to know experience of wisdom and knowledge.”

Consciousness as Original Sin

Genesis 2:15 – 3:24 (King James Version)

1 The words of the Preacher, the son of David, king in Jerusalem. 2 Vanity of vanities, says the Preacher, vanity of vanities! All is vanity. 3 What does man gain by all the toil at which he toils under the sun? 4 And I applied my mind to know wisdom and to know madness and folly. I perceived that this also is but a striving after wind. 5 For in much wisdom is much vexation, and he who increases knowledge increases sorrow.
The Bicameral Mind

- Analogy to Bicameral Legislature
  - Decision-Making Part
    - Right Cerebral Hemisphere?
  - Follower Part
    - Left Cerebral Hemisphere?
- Humans were Creatures of Habit
- Stress of Decisions Led to Hallucinations
  - Interpreted as Instructions from Gods

Origins of the Bicameral Mind
By Invention of Writing, c. 3000 BCE

- Shift from Hunting/Gathering to Agriculture
  - Way of Controlling Large Groups of People
  - Rigidly Ordered Social Hierarchy
    - God or Idol at Top
      - Spoke Through King
    - Everyone Else: Do What You're Told

Breakdown of the Bicameral Mind
Beginning c. 1400 BCE

- Large, Urban Civilizations
  - Lots of Voices, Don’t Agree
  - Gods Begin to Forsake Men
- Consolidated by “Golden Age” of Greece
  - c. 600 BCE
    - Solon, “Know Thyself”
    - Socrates, Plato, Aristotle
  - Elsewhere in “Axial Age”
    - Buddha (6th c. BCE)
    - Confucius (6th c. BCE)

The Origin of Consciousness is the Origin of the Theory of Mind
Jaynes (1986)

“All that is most human about us, this consciousness, this artificial space we imagine in other people and in ourselves, this living within our reminiscences, plans, and imaginings, all of this is indeed only 3000 years old. And that, ladies and gentlemen, is less than 100 generations. And from that I think we can conclude that we are all still very young.”

Good Advice from the Thane of Cawdor
Cawdor Castle, Nairn, Scotland, c. 1398