ANBI 159: Biological and cultural perspectives on intelligence

Winter 2009

Instructor: Jim Moore jjmoore@ucsd.edu, 534-5572 SSB 276

Lectures: MWF 9:00 WLH 2204 **OH**: T 1-2, W 11-12 or by appt.

Many of our judgments -- unconscious prejudices and carefully considered decisions -- about other people and other animals are based in part on our perceptions of their intelligence (many people are concerned about dolphins accidentally killed by tuna fishermen, but I have yet to hear any outcry about the individual sharks that also are netted). Conversely, having already judged someone, we tend to attribute intelligence to them proportional to our regard: if you're attractive, you must be smart. An understanding of the biological and cultural bases of "intelligence" is relevant to a wide variety of decisions you will have to make in the future.

Readings: Required (available at **Groundworks Bookstore**)

Byrne, R. (1995). The Thinking Ape: Evolutionary Origins of Intelligence. Oxford: Oxford University Press. Excellent and readable overview of the topic from a primatological viewpoint. ("**B**")

Gould, S. J. (1981, 1996) Mismeasure of Man. Norton Press. This is a classic on how biology can be (un)consciously used to support ideological positions. ("**G**")

Article pdfs will be on the class website. I do not produce hardcopy readers on assumption you'd rather save money & trees.

Grades: There will be 100 points possible in the course:

Midterms (2):	30 each
Final:	40

Exams: These may be mainly objective (T/F, multiple choice etc.) but I'm deciding. They are intended to be fairly painless ways of reinforcing the readings and lectures--not as grueling tests of your ability to memorize everything. That said, I'm accused of asking picky questions. The final will cover material *from the whole course*. If you miss a test without ***prior*** arrangement (or doctor's note of ***emergency*** appointment), ***zero points, no makeups***.

Final exam is on Wednesday March 18, 8:00 - 11:00am

READINGS: The nature of this course is that we cover a variety of topics that vary in how important they are (a) to understanding "intelligence", and (b) to you in life beyond ANBI159. If you don't understand the Sally/Ann test, a chunk of the course won't make sense but no big deal in the greater scheme of things; if you don't understand the material on race and intelligence, the consequences might be greater.

Gould covers important concepts that will be lectured on for only a few lectures. I've tried to spread the assignments out to correspond with other material, but you should plan to *read all of the book* and not to worry too much if you don't see the immediate connection to the week's lectures.

Readings are often chosen to amplify on a topic or provide a different perspective; I will *not* be basing lectures on the assignments. Please *do* ask questions in class if anything in readings is unclear.

Assignments tend to be longer early in the course; *this is deliberate*, to provide background early on as well as to free up time for studying/reviewing later in the quarter.

WEBSITE: Syllabus, articles, and lecture notes will be available on the class website (http://weber.ucsd.edu/~jmoore/courses/web159/), BUT: I have only so much disk space, and as a result the lecture notes will NOT be available indefinitely. I will post them ASAP after each lecture (within a few days); they will remain available for at least a week *but may be deleted anytime after that*. Please ***do not*** request copies of deleted files. If you want to consult the online notes, do so within a week of the lecture in question!

NOTE: the website will ***not*** include films or video clips.

What you're getting into: CAPE and ratemyprofessor reviews frequently mention that my lectures are too fast and disorganized, and that I am arrogant and unapproachable. I get pretty excited about the material (usually) and know that I try to cram too much in (leading to speed); I also tend to teach by examples (requiring you to work out connections and how they fit, and easily interpreted as disorganized if you don't do this). I'm trying to scale it all back this year. I honestly don't know where the arrogant/unapproachable thing comes from, since in fact interaction with students is probably my favorite part of teaching. It's very possible that I don't in my manner *invite* approach, but I think I'm very receptive to approaches… Anyhow, I mention these issues to put them on the table in hopes that it'll be easier to 'fix' them if you know I know.

And about lecture descriptions: if the lecture topics actually stay right on schedule, it'll be a first. We'll start at the beginning and get to the end …

LECTURE AND ASSIGNMENT SCHEDULE

(do reading *early in the week*, certainly BY week's end; *some assignments are too long to do in one night* so PLAN AHEAD)

Week 1

I: Concepts

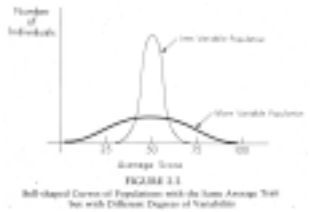
Read: **B** chap 1,2 & 14; **G** chap 2, start on 3
http://weber.ucsd.edu/~jmoore/courses/allometry/allometry.html

1/5 Introductory quiz; the study of intelligence involves the study of *behavior*

How do we interpret what we see?
It's not easy. Philosophical tools:
Occam's Razor: make no more assumptions than necessary (principle of ***parsimony***, applies to all sciences & life in general)
Morgan's Canon (1898): parsimony applied specifically to animal behavior = interpret in terms of 'lowest' possible psychological mechanism (*assumes* "lowest" is *always* most parsimonious)
Historical progression from dualism (Descartes) to evolutionary perspective: "Nothing in biology makes sense except in the light of evolution" (T. Dobzhansky[1]); ***cognitive adaptations*** (cognitive processes including "thinking" potentially species-specific – we *all* think, differently).

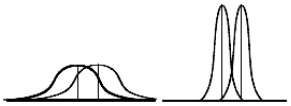
How can we make sense of differences & data? Through *statistics* (oh, yay)

Following is basic but critically important. Frequency distribution (number of hairs on a head, points on an IQ test, whatever…)

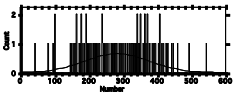


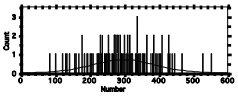
Count a bunch of things & likely to get a ***normal distribution***: some individuals score low, some high, most sort of average. "Bell curve". *TWO* key parameters: the ***mean*** (=average) and the ***variance*** (a measure of spread around the mean). Figure shows 2 populations, same mean, different variances.

How can we tell if two *sample* distributions come from "different populations" (i.e., with respect to the thing being measured, the observed difference between groups is real, not just chance). Statistics uses patterns like normal distribution to put a number on the ***probability*** of a difference being real. In the pair of pairs below, the difference in means is the same but in the first case, the variances are so large that the overlap in samples is great and so there is a good chance the samples come from the same real population (shown by dashed line at left). In the second (right) case, variances are so low that there is little overlap in the distributions and the difference in means is likely to be real.



[1] Dobzhansky was a Russian Orthodox Christian and evolutionary biologist who believed in theistic evolution; the quote comes from an article on the *compatibility* of evolution and religion. They are compatible in this class, too.





Group Info for Number
Grouping Variable: group

	Count	Mean	Variance	Std. Dev.
1	167	283.359	8952.304	94.617
4	167	298.802	8103.882	90.022

Unpaired t-test for Number
Grouping Variable: group
Hypothesized Difference = 0

	Mean Diff.	DF	t-Value	P-Value
1, 4	-15.443	332	-1.528	.1274

In this example (from lecture), two samples of 167 each have been drawn; do they represent different populations? The mean of sample 4 (lower) is greater (298 vs. 283) but variances (& standard deviation, which is more commonly used & is just square root of variance) are large. The probability that the 2 samples come from a single larger population (i.e., the difference is just chance) is 12.74%; by convention, that is not significant – we ***cannot*** conclude that they are from different populations. This *doesn't* mean we've shown they *are* from the *same* population; in fact, they are from different ones, but the difference is so small relative to the variance that it takes a larger sample to *show* that the difference is statistically significant – to be confident that it is real.

What about correlations? If an individual has two attributes of interest (say, brain size & IQ), are they related? ***Correlations*** (or regressions, we'll not distinguish them) ***do not prove causation*** – but they sure suggest something's worth studying further. *Strong inference as a way of knowing*. A relevant example: relative brain size and *allometry*.

Week 2

Read: **B** chap 3, 4; Yam (*Intelligence considered*), Gould & Gould (*Reasoning in animals*)

1/12 Animal intelligence – just give them a test, right? The *comparative method*

Attempts to create species-fair measures of intelligence yield counterintuitive results (monkeys – even rats – may outperform humans; that *can't* be right…). *Comparative method* offers an approach: look for patterns across species, use patterns to generate predictions that then (hopefully) can be tested with new/different data. *Experimental*: Match-to-sample task as probe; prospective encoding demonstrates existence of learning-based *expectations* and hence minds.

Animal learning theory, and Theory of Mind (When Harry met Sally/Ann)
Minds are for making predictions based on detecting and remembering reliable, relevant event correlations. How do we learn correlations? Depends on species – adaptation (key example: the Garcia Effect). (One) species-neutral *definition of intelligence*: variability of repertoire. Deception and "Theory of Mind". Can easily see logic for importance of ToM *re* 'intelligence', but some unexpected results. Shift gears (again) to look at what mental representations are *for* – <u>functional</u> approach to understanding 'intelligence'.

Week 3 [Monday HOLIDAY]

II: What's it for?

Read: **B** chaps 7-10, 12,13; K. Milton (*Diet and primate evolution*, Sci. Amer. 2006); C. van Schaik (*Why are some animals so smart?*, Sci. Amer. 2006)

1/21 On to what's "it" <u>*for*</u>? Ecological and social hypotheses

Animals face ecological demands (including the need to eat and avoid being eaten), as well as social (competition, cooperation, convincing [mates]). In what arena do we find the main selective pressures promoting intelligence in animals? Comparative analysis of relative brain size and of brain parts – hippocampus and spatial performance in cowbirds and taxi drivers (introduction to concept of mental modules).

Ecological & social hypotheses continued
Examples of social complexity: coalitions among male langur monkeys and intercommunity violence among chimpanzees. In some ways the two show similar complexity – but chimpanzees are *different*.

Week 4

III: What's it made of?

Read: http://weber.ucsd.edu/~jmoore/courses/nerves.html
SA Holloway (*Seeking 'smart' drugs*); M. S. Gazzaniga (*Smarter on drugs* Sci. Amer. 2005); M. S**.** Gazzaniga (*The Split Brain Revisited* Sci. Amer. 2002)

1/26 Neurophysiology (this should be fast review for nearly everyone; if it's confusing, use OH!)
Brains are biological organs, made up of particular *structures* that *do* the thinking, via interconnected neurons. The reason for including Module III in the class is to make concrete the physical side of intelligence. Factors that influence tissue health and growth can (and do) powerfully influence thinking. This is the stuff that epigenesis "works with".

FRIDAY MIDTERM #1 (covering Modules I & II)

Week 5

IV: Human Intelligence

Read: review *if needed*: http://weber.ucsd.edu/~jmoore/courses/allometry/allometry.html
B chap 14, 15; **G** chap 3; K. Wong (*The morning of the modern mind,* Sci. Amer. 2006); W. H. Calvin (*The emergence of intelligence*, Sci. Amer. 2006), J. Horgan (*Trends in Social Science: The new social Darwinists* Sci. Amer. October 1995)

2/2 Evolution of human brains – the fossil record
The fossil record of our hominid ancestors (& their cousins) goes back more than 5 my (my = million years; cf. ky = thousand years; adding an 'a' = "ago" as in "5mya"). Fossil skulls—brain structure and size. Brain size linked <u>*loosely*</u> with technological change. Two models for why our brain size increased — in one, it's an adaptation for intelligence (sensu lato), in the other, being smart played little part. Population density & cultural interactions may have been key to UP Revolution, *not* any recent biological change.

Intelligence: it's a complex concept… (Old) film with fun local angle introduces complexity of the idea of intelligence as used specifically among humans. We'll start looking at the use of psychological tests to probe how we (I mean *we*) think.

Week 6

Read: SA Gottfredson (*The general intelligence factor*), Winner (*Uncommon talents*)**;** Gardner (*A multiplicity of intelligences*), D. A. Treffert & D. D. Christenson (*Inside the mind of a savant*, Sci. Amer. 2006); R. Plomin & J. C. DeFries (*The genetics of cognitive abilities and disabilities* Sci. Amer. May, 1998); Sternberg (*How intelligent is intelligence testing?)*

2/9 General 'g' or domain specific? (or, you're being irrational…)
Theories of intelligence; IQ tests and their history/use; heritability
What is intelligence based on? Processing speed, or # variables processed simultaneously? Speed with which knowledge is acquired, or total amount? A capacity or an inclination? Jury's out. But at least we can measure it and base social policy on it, whatever it is … well, we *do*. Heritability – the least-understood widely 'known' concept I know of. It is *not* a measure of the degree to which a trait is genetically determined (they *aren't*, by the way).

Week 7

Read: Sternberg & Grigorenko (2004, *Why cultural psychology is necessary and not just nice: the example of the study of intelligence*. In Sternberg & Grigorenko (Eds.), <u>Culture and Competence.);</u> Gottlieb (2000, Environmental and behavioral influences on gene activity *Curr. Dir. Psych. Sci*. 9: 93)

2/16 Ontogeny (epigenesis): Interaction of development with environment
Environment and genetics are inextricably intertwined in the biological growth & development of the organs that produce behavior. Some variation in human intelligence <u>*is*</u> completely biologically determined.

Week 8

V: Variation

Read: Finish **G** by now (esp. Intro and last 2 chapters); "The eternal triangle: race, class, & IQ" *Curr. Anthropol*. **37**: S143-S181; Beardsley (*For whom did the Bell Curve toll?*)

2/23 Race and IQ in America

Black-White differences in average IQ might well have a strong biological component, but *genetic* group differences play *at most* a minuscule part – far too little to have *any* policy implications at either group or individual level – and most likely, none.

FRIDAY **MIDTERM #2 (covering Modules III & IV)**

Week 9

Read: D. Kimura (*Sex differences in the brain* Sci. Amer. 2002); L. Cahill (*His brain, her brain*, Sci. Amer. 2005)

3/2 Phylogeny (what's a real "group", and do sexes differ in intelligence?)

Unlike races, sexes are biologically and genetically very real and there are strong data suggesting real genetically-based average differences between men and women in some cognitive arenas—but the picture is *far* more complex than "boys are better at math".

VI: Communication

Why communication?

We are penalized if we communicate during an intelligence test, but communicative ability may explain our performance on them. Also, as discussed earlier, communication provides 'windows' into internal mental processes and into how other species understand the world.

Week 10

Read: **B** chap 11; Pepperberg (*Talking with Alex*); Gagneux et al. (2005 *The ethics of research on great apes*); Gallup Jr. and Povinelli debate (*Can animals empathize?*)

3/9 Interspecies: "ape language" research (& parrots, & sealions, & dolphins...)

It is indeed possible to 'talk human' with (some) other animals. This provides us with another way to compare intelligence across species, and recent research suggests that human intellectual superiority may hinge on language – nothing more, or less.

Intraspecies: vervet grunts, dolphin whistles, and their ethical implications

The study of nonhuman communication systems complicates our intuitions about the nature of the relationship among communication, complexity, and intelligence, as well as of our understanding of "our place in nature". The study of nonhuman cognition/intelligence/communication also complicates the ethical aspects of our relationships with nonhumans.