

## Neocortex and Group Size

### Co-Evolution of Neocortex and Group Size

Evolutionary Terms: size of species' neocortex set by range of group size required by the habitat(s) in which it typically lives.

Individual Animal: neocortex size sets limit on number of relationships that can maintain through time, and limits the maximum size of its group

Regression Equation Between Neocortex Ratio And Mean Group Size For The Sample Of 36 Primate Genera:

$$(1) \quad \log(N) = 0.093 + 3.389 \log(CR),$$
$$(r^2=0.764, t(34)=10.35, p<0.001),$$

where N is the mean group size

CR is ratio of neocortex volume to volume of rest of brain

Neocortex ratio for humans is CR=4.1.

50% larger than the maximum value for any other primate species

Equation (1) yields a predicted group size for humans of 147.8.

95% confidence limits around this prediction are moderately wide (100.2- 231.1).

## **Estimates of Group Size in Humans**

Average Size Of Intermediate Level Groups For Hunter-Gather Societies Is 148.4 (Range 90-221.5, N=9).

Estimates Of Size Of Neolithic Villages In Mesopotamia Are Of About Same Magnitude

Figures In Region Of 150 Occur Frequently Among A Wide Range Of Contemporary Human Societies.

Research Specialties In Sciences Tend To Consist Of Up To 200 Individuals,

Most Armies Have A Basic Unit Of About 150 Men

Other Evidence Suggests That 150 May Be A Functional Limit On Interacting Groups Even In Contemporary Western Industrial Societies.

## Grooming and the Evolution of Language

Primate Groups Are Held Together By Social Grooming

Time Budget Constraints On Group, <20%

Time Spent Grooming By Primates Is A Linear Function Of Group Size

$$G = -0.772 + 0.287 N \quad (2) \quad (r^2=0.589, t(20)=5.36, P<0.001)$$

where G is the percentage of time devoted to social grooming during the day

Group Size Predicted For Humans By (1) Would Require 42% Of Time Budget Devoted To Social Grooming

Language Evolved As A "Cheap" Form Of Social Grooming

## **Grooming and the Evolution of Language (Cont.)**

Language as a Bonding (Grooming) Mechanism

Function of Language

Exchange of information about environment  
(e.g. hunting)

Acquisition and manipulation of social knowledge is  
the primary consideration.

Mechanism for social bonding: **Gossip!!!!**

You Can Talk To (Groom) Three People

Chimpanzee Troops Have About 50 Members

If Talk Is Three Times More Effective An Physical  
Grooming, Human "Troops" Should Have About 150  
Members!

## **What Drove Increase In Group Size?**

Risk of Predators in Open (Savanna) Verses Forest Habitat

Other Human Groups

Raiding For Women

Competition for Food and Water

Nomadic Life-Style

## **Overview of Last Half of Dunbar**

### The Ghost in the Machine

Intentionality

Metacognition

Theory of Mind

### Up Through The Mists of Time

Tracing human evolution

### First Words

The Evolution of Language

Dunbar's Views

Compare Dunbar's verses your Authors views

### Babel's Legacy

Why we have dialects and different languages

### The Little Rituals of Life

Making Altruism Work

Mate Selection

Sexual Selection in Evolutionary Theory

## Theory of Mind

### Mental States

Goals, Intentions, Beliefs

My understanding of you goals and beliefs

The Role of Shared Intentions (Goals) In Language

Theory of Mind Means

Understanding another's thinking, goals, etc

### Orders of Intentionality

0 Order: computers, human in a coma

1 Order: have intentions, goals, beliefs

2 Order: understanding that you have intentions, etc. that can be different from mine

3 Order: understanding that you have beliefs about my intentions, etc.

4 Order ....

## Theory of Mind (Cont.)

People seem to be limited to keeping track of 6 orders of intensionality (???)

Daniel Dennett: “I suspect [1] that you wonder [2] whether I realize [3] how hard it is for you to be sure that you understand [4] whether I mean [5] to be saying that you can recognize [6] that I can believe [7] you to want [8] me to explain that most of us can keep track of only about five or six orders [of intensionality].”

Kinderman, Bentall, & Dunbar tested people w/ToM vs. causal stories; at 5th order, errors are 5 times more than for causal events!

Children are not born with ToM; it is acquired during development

Before 4/4.5 years old, kids cannot realize that others (may) hold different beliefs than their own

False-belief test: Sally and Ann test

Autistics never develop ToM

- Failure to pass false belief tests

- Inability to engage in pretend play

- Fail to interpret metaphorical language



## What about other species?

Self-awareness: Gallup test

Great apes pass the test, monkeys do not

Does that mean that apes have ToM & monkeys do not?

Tactical deception (Byrne & Whiten)

e.g., Paul taking Mel's tuber, acoustic hiding

Requires at least 2nd-order intentionality

Virtually absent from the Prosimians, rare among New World monkeys; common among Old World monkeys and great apes

Tactical deception vs. neocortex size = good fit

Dunbar & Pawlowski: MI Hypothesis = relationship b/w male's rank & reproductive success should become less strict as neocortex grows (through use of tactical deception)

...ability to exploit loopholes depends on how much computing power you possess

How do differences b/w species relate to differences in levels of intentionality?...We don't know.

Lecture 18

# Cognitive Phenomena Beyond the Individual

Cultural Evolution

Evolution of Languages

Scientific Progress

Creativity

Adoption of Technology

Social contagion model of transmission of ideas

Fads, Popular Songs, Technology, ...

Darwinian models for all of these processes

# Generate And Test

Problem solvers adhering to the generate-and-test paradigm use two basic modules.

- > One module, the *generator*, enumerates possible solutions.
- > The second, the *tester*, evaluates each proposed solutions, either accepting or rejecting that solution.

All Depends on Properties of Generator

A powerful intelligent Generator will only produce a few "good" solutions including the correct one.

Evolution is an example of Generate-and-Test

All controversies about Darwin and the application of evolutionary ideas focus on the claim that the generator is NOT intelligent.

Blind trial and error

Lecture 18

# Evolutionary Epistemology

Popper's ideas about the progress of science

Falsification, variation, and selective retention

Popper and Eccles (1977)

D.T. Campbell (1974, 1975)

Plotkin (various)

Hull, David (1988a,b)