# Evolution of Intelligence


Brian O'Meara

EEB464 Fall 2018

# Learning objectives

- Understand evolution of a convergent trait
- Appreciate difficulties in discretizing traits

# What is intelligence?

California Academy of Sciences

# What is intelligence?

California Academy of Sciences

# What is intelligence?

Jane Goodall Institute

Intelligence is the ability to respond flexibly to new or complex situations, to learn and to innovate

van Schaik and Burkart (2011), quoting Byrne (1995)

# What might lead to selection for higher intelligence?

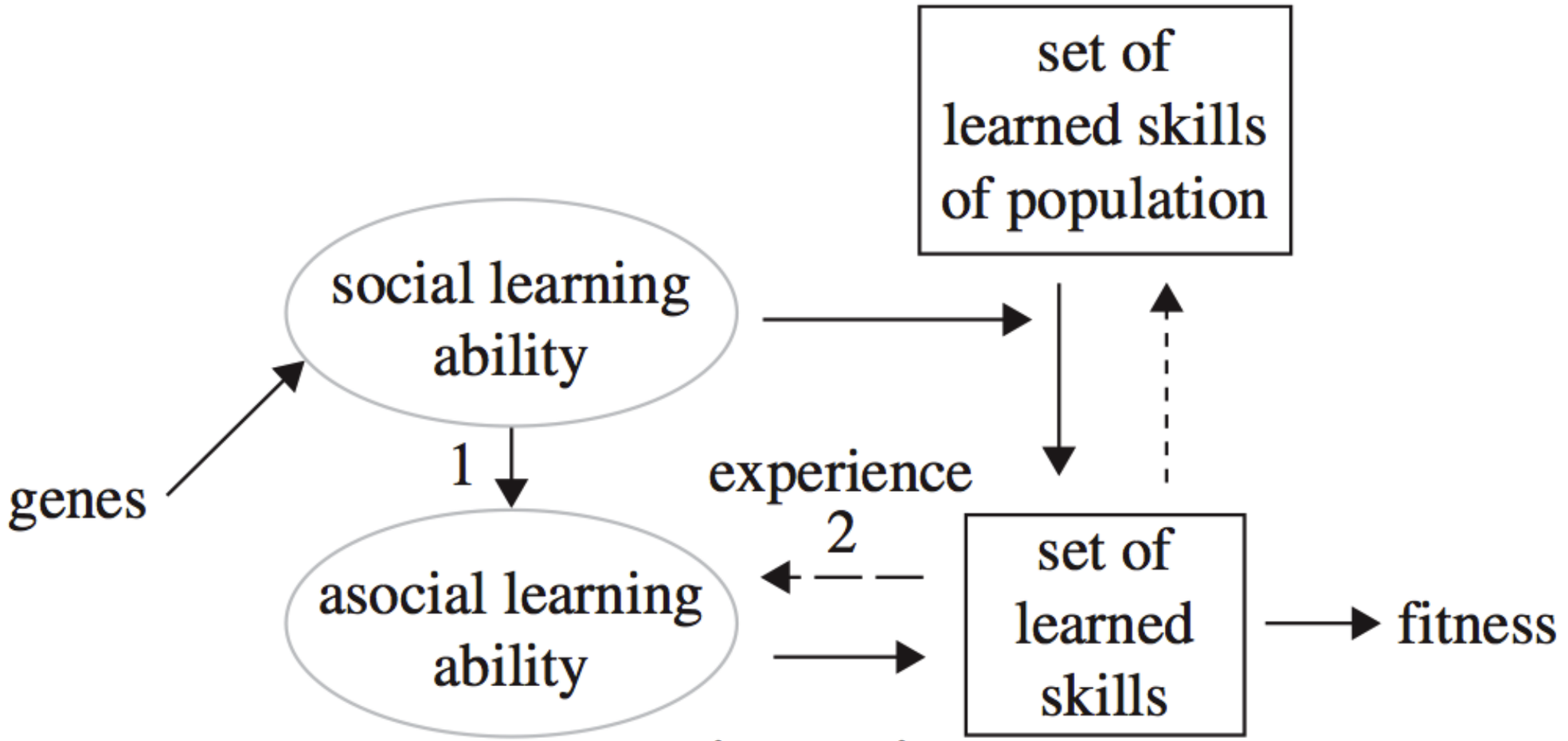



Figure 2. The evolution of intelligence through cultural feedback. Selection on an increased set of learned skills is achieved by improved social learning. Owing to the high cognitive overlap, social learning improves the asocial (individual)-learning ability (i.e. intelligence; shown by arrow 1). More learned skills also improve the latter through stronger experience effects (arrow 2).

van Schaik and Burkart 2011

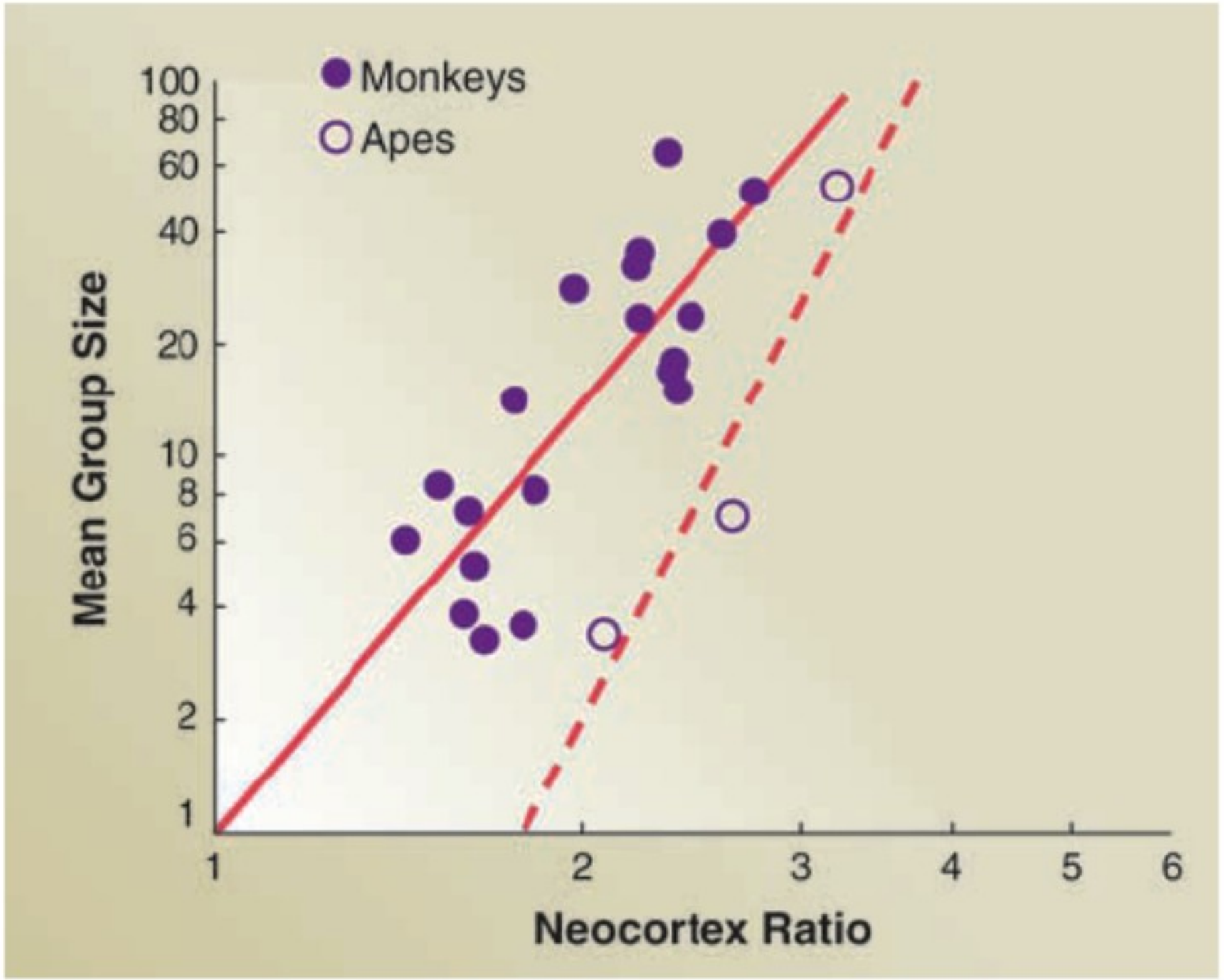



**Fig. 1.** In anthropoid primates, mean social group size increases with relative neocortex volume (indexed as the ratio of neocortex volume to the volume of the rest of the brain). Solid circles, monkeys; open circles, apes. Regression lines are reduced major axis fits. [Redrawn from (*47*)]

Dunbar & Shultz 2007

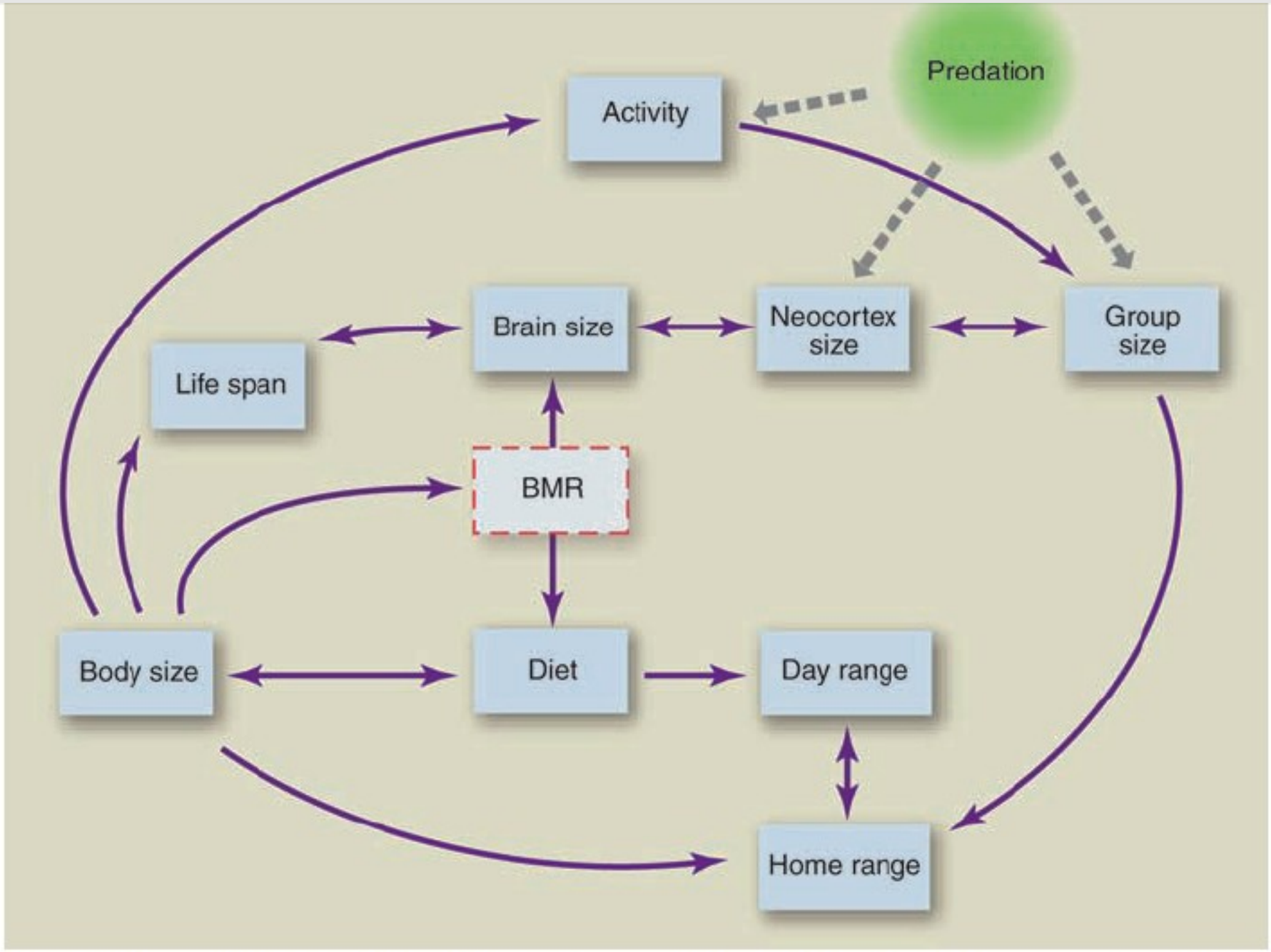



**Fig. 2.** Path analysis of correlates of brain size in primates. The best model for group size included just three variables (neocortex size, activity, and range size). Factors that are more remote in the path diagram provide a significantly poorer fit, suggesting that they act as constraints rather than driving variables. BMR, basal metabolic rate. [Reproduced with permission from (*16*)]

Dunbar & Shultz 2007

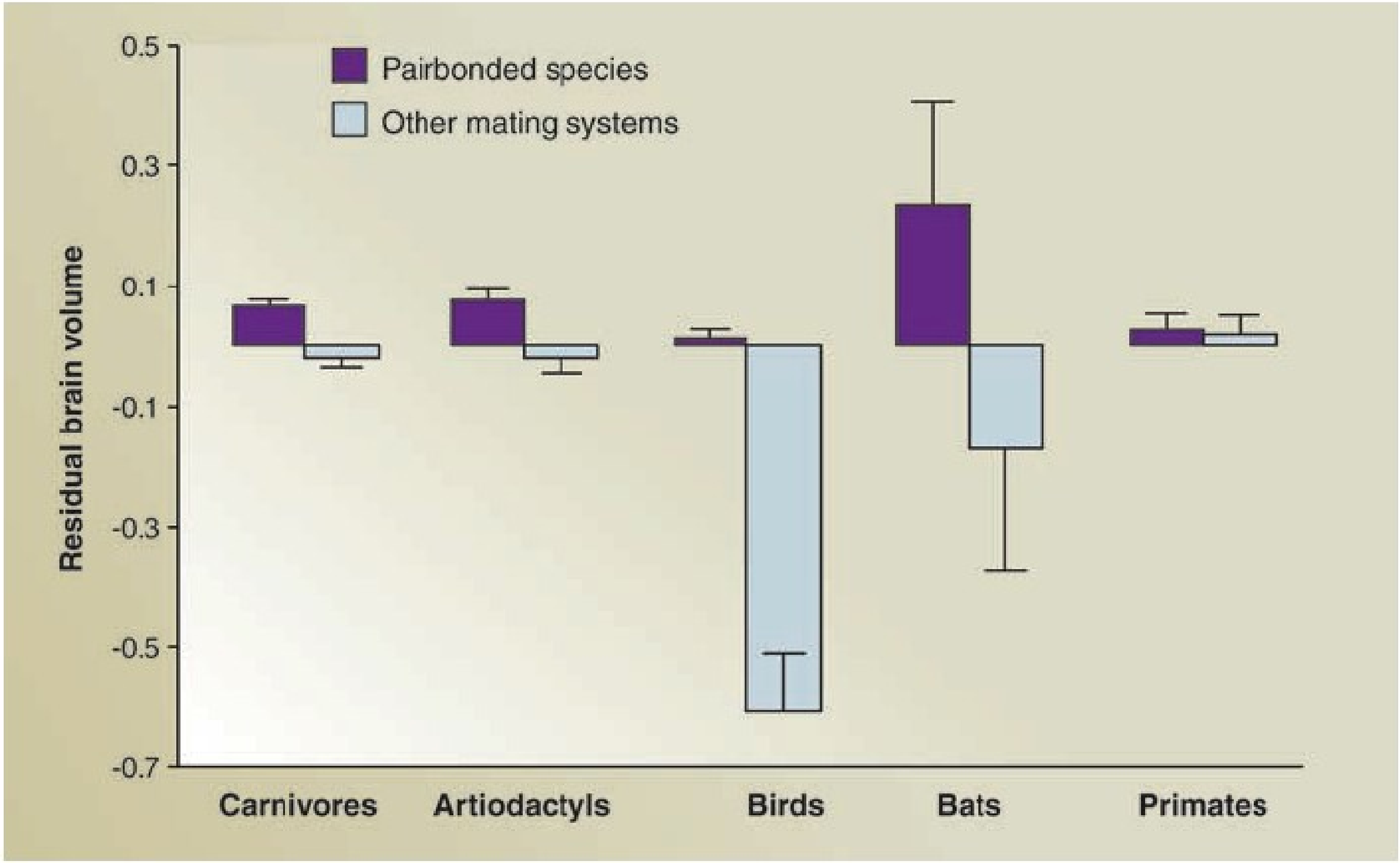
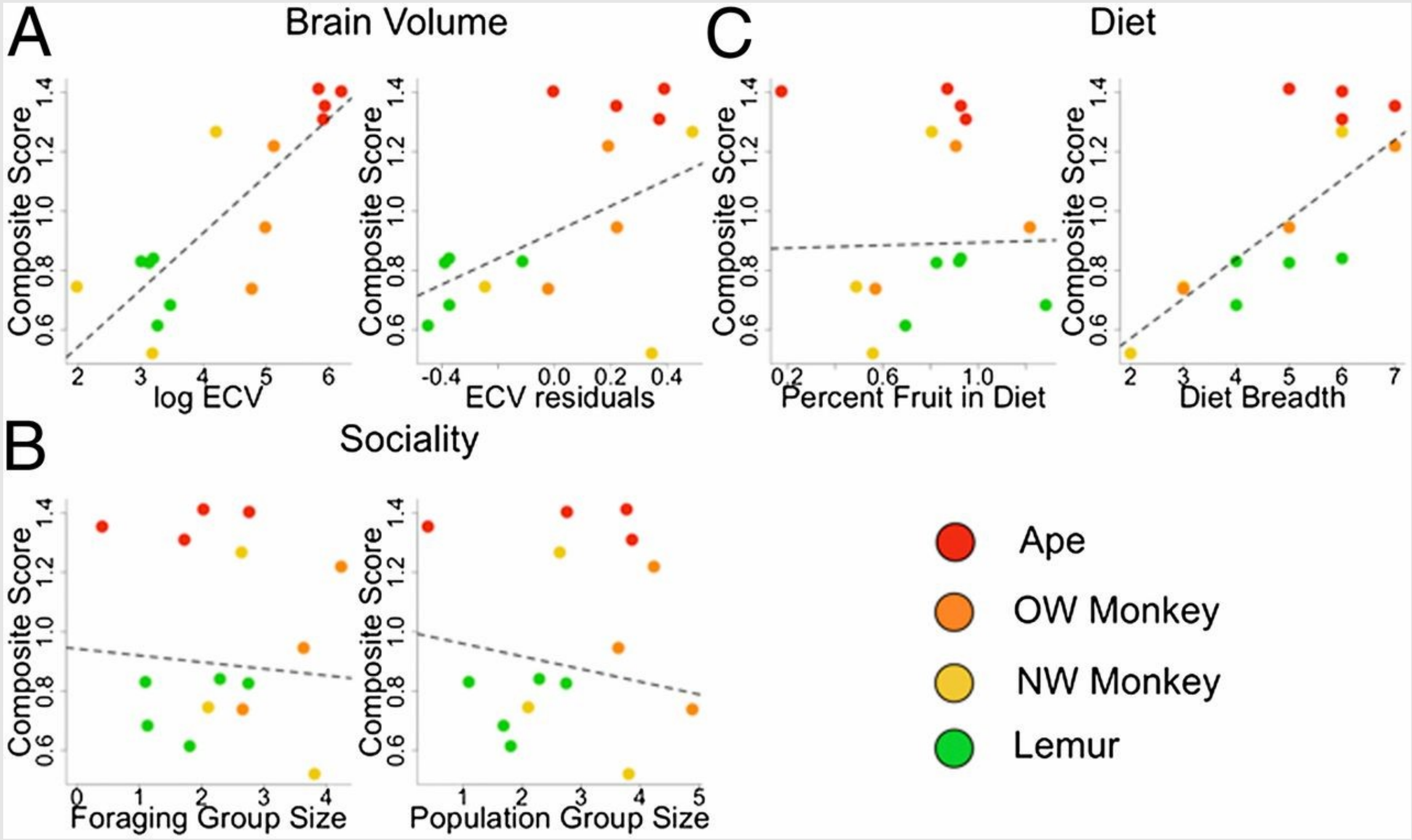



**Fig. 3.** Mean (±SE) of residual brain volume (controlling for body size and phylogeny) in species with pairbonded (purple bars) versus all other mating systems (gray bars) in birds and four orders of mammals. The differences are significant in all cases except primates.

Dunbar & Shultz 2007

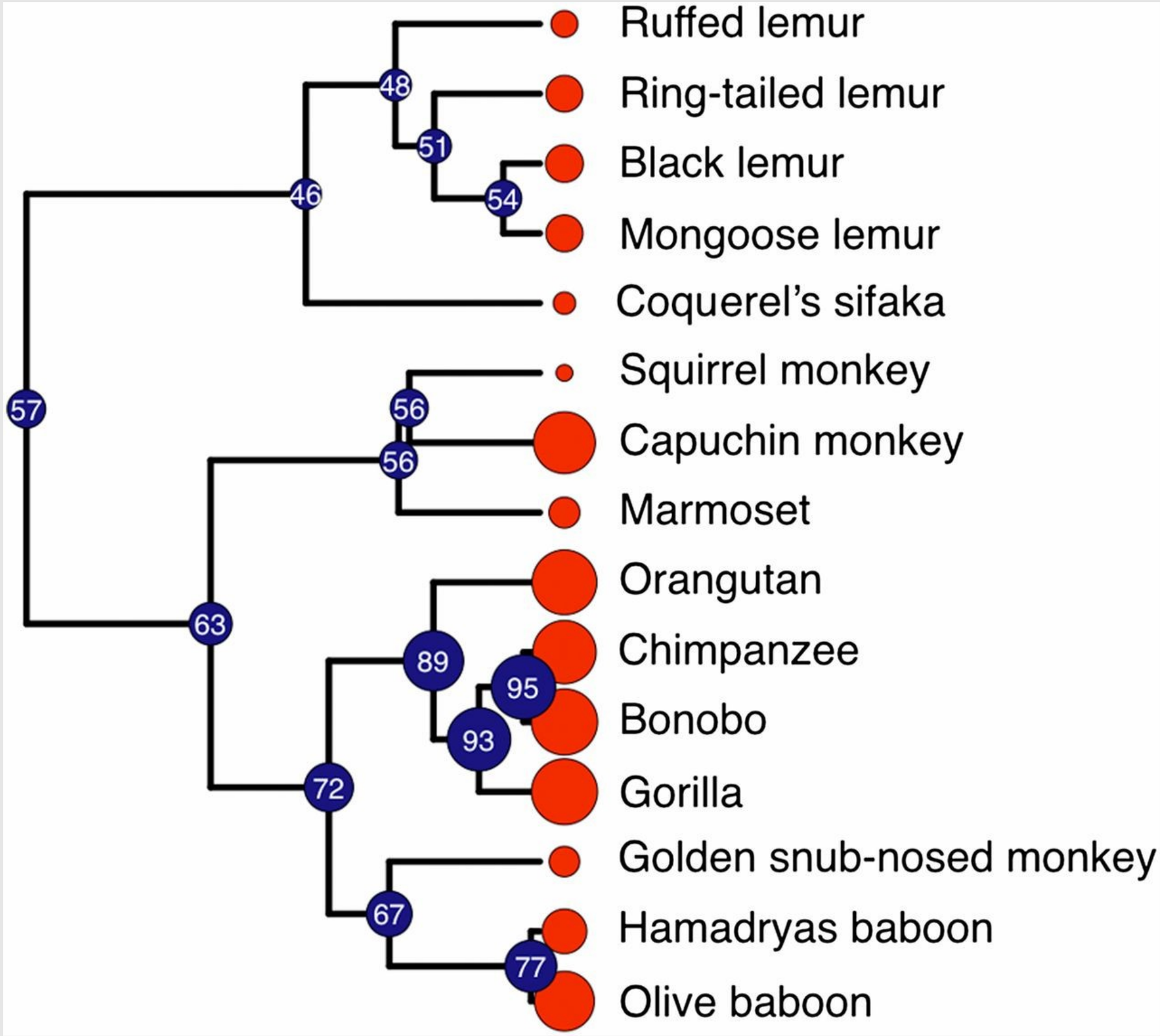
Evan L. MacLean et al. PNAS 2014;111:E2140-E2148

Cognitive scores for primates as a function of (A) absolute and residual endocranial volume (ECV), (B) foraging and population social group size, and (C) frugivory and dietary breadth.




Evan L. MacLean et al. PNAS 2014;111:E2140-E2148

Ancestral state reconstruction of cognitive skills for self-control.




Evan L. MacLean et al. PNAS 2014;111:E2140-E2148

Our phylogenetic comparison of three dozen species supports the hypothesis that the major proximate mechanism underlying the evolution of self-control is increases in absolute brain volume. Our findings also implicate dietary breadth as an important ecological correlate, and potential selective pressure for the evolution of these skills. In contrast, residual brain volume was only weakly related, and social group size was unrelated, to variance in self-control. The weaker relationship with residual brain volume and lack of relationship with social group size is particularly surprising given the common use of relative brain volume as a proxy for cognition and historical emphasis on increases in social group size as a likely driver of primate cognitive evolution

Human intelligence seems higher than that of other animals.

What could have led to this?

How would you test this?

# Swarm intelligence