

Box 2.1 The Notable Neocortex

Primate brains are bigger, relative to their body size, than those of other animals, and human brains are bigger still. But it isn't our entire brains that are so relatively big. Instead, it is a particular part, called the **neocortex**, that is responsible for cognitive abilities such as reasoning and consciousness and that in primates makes up 50 to 80 percent of the total brain's volume (Finlay and Darlington, 1995). In insectivorous mammals, the neocortex is about the same size as the medulla, a primitive part of the brain that controls basic body functions such as respiration and heart rate. In prosimians, the neocortex is ten times larger than the medulla, in monkeys and apes, it is 20 to 50 times larger, and in humans, the neocortex is a whopping 105 times larger than the medulla.

In a comparative analysis of primate brains, primatologist Robin Dunbar (1988) explored the various hypotheses that have been advanced to explain why evolution might have led to expansions in the size of the neocortex. Usually, **morphological**, or anatomical, traits that distinguish primates from other animals and that have obvious functional advantages are attributed to ecological selection pressures associated with compromises between the need to find food and mates as well as to avoid predators. However, Dunbar found a stronger relationship between the size of the neocortex and the size of primate social groups, which led him to develop "the social brain hypothesis."

Comparing the size of the neocortex relative to the rest of the brain provides a neocortex ratio, which can then be compared across primates that differ from one another in body size, rates of development, and energetic requirements. When Dunbar and his colleagues compared primate neocortex ratios, they found three different, parallel clusters seemingly corresponding to the relationship between group size and neocortex ratios in the prosimians, monkeys, and apes. However, closer scrutiny revealed that within each of these "grades," the primates with the largest grooming networks were those with the correspondingly largest neocortex ratios. Subsequent analyses showed more clearly that the relationships between social complexity and neocortical volume transcend the taxonomic differences, *per se*. Indeed, the brain "architectures" of New World monkeys with the largest groups and most complex social systems, such as capuchin monkeys, spider monkeys, and woolly monkeys, are strikingly similar to those of some Old World monkeys despite their distant ancestries (Clark et al., 2001).

Having a large neocortex may be equally important for cooperating as it is for competing. Indeed, mutual cooperation stimulates the reward centers of the brain, which are located in the neocortex (Rilling et al., 2002). A large neocortex may also provide critical advantages under a variety of ecological conditions, including remembering where food occurs over a large home range and extracting foods, such as termites, from a mound of dirt (Clutton-Brock and Harvey, 1980; Gibson, 1986; Harvey and Krebs, 1990). But the strongest effects of large brains still appear to be related to the strength and complexity of social bonds (Dunbar, 2009).

In fact, most mammals have fully developed brains by the time they are weaned, whereas much of primate brain development occurs during the long socialization period between weaning and adulthood (Joffe, 1997). Thus, primate sociality may have been as necessary to the evolution of large brains in primates as large brains have been to the evolution of primate sociality. Whether social or ecological pressures were responsible for primate brain evolution, there is no doubt that primates have social brains, or that ours are the most social brains of all.

Web box 2.1 Bibliography

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