THE
HUMAN
INSTINCT

How We Evolved to Have Reason,
Consciousness, and Free Will

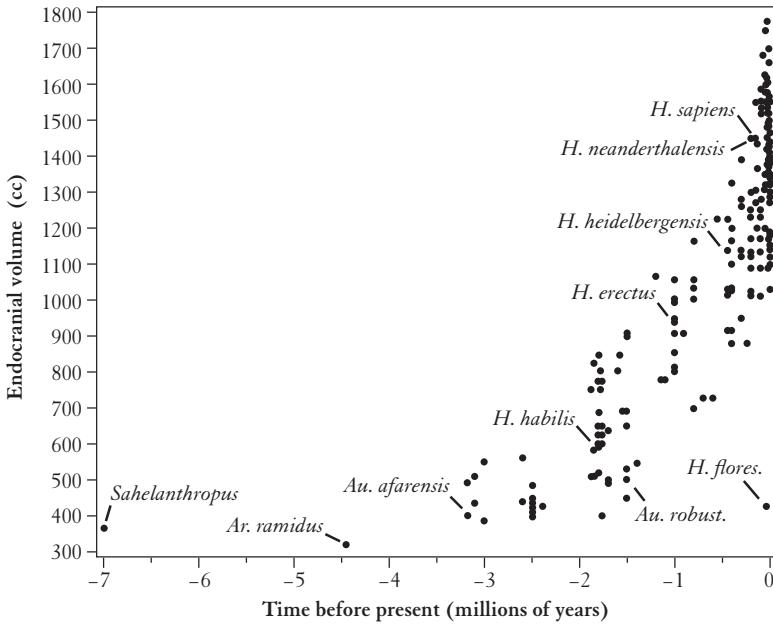## Kenneth R. Miller

Evolution of hominin brain size

Figure 2-1: A graph of cranial capacity plotted against fossil age for human and prehuman skulls. Each point on the graph represents a specific specimen, and the labels indicate generally accepted scientific names for individual species and subspecies. *Buckner and Krienen, 2013*
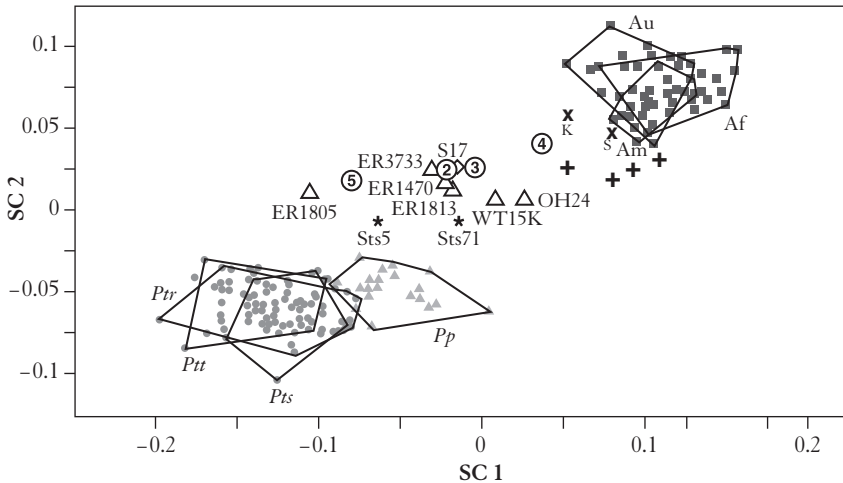

Figure 2-2: A plot of facial shape variation (SC1) versus cranial size (SC2) for the Dmanisi skulls, including data from chimpanzees (*Ptr, Ptt, Pts*) and bonobos (*Pp*) at the lower left, modern humans (including individuals from native populations in Australia, Africa, and the Americas) at the upper right, as well as other *Homo* and *Australopithecus* specimens. *Redrawn, with permission, from Lordkipanidze, D., et al, 2013*
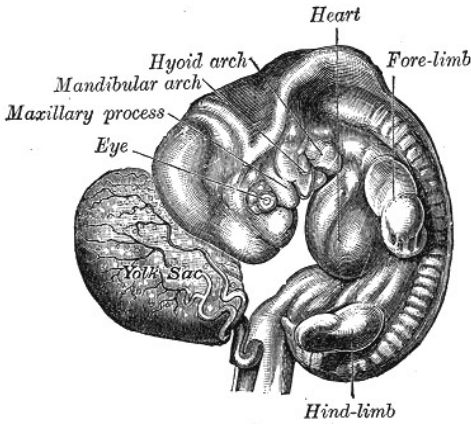
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Figure 2-3. A human embryo at 31–33 days of development, as depicted in *Gray's Anatomy*, a classic medical textbook. Note the presence of the yolk sac which, despite its name, does not contain the yolk protein vitellogenin.
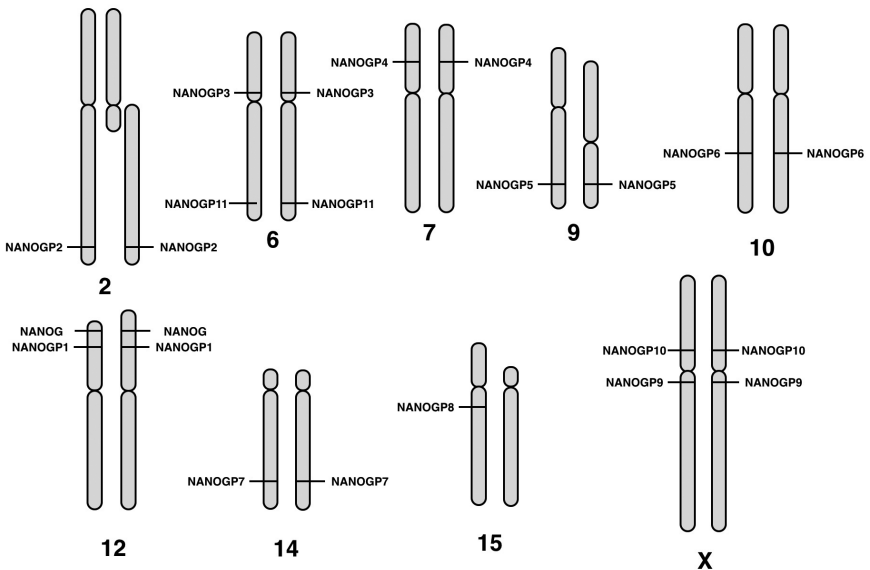

Figure 2-4: The approximate location of the "Daughters of NANOG," the processed pseudogenes scattered randomly throughout the human and chimpanzee genomes. Note that the locations of these randomly inserted sequences match on all but chromosome 15, which contains a NANOG sequence found only on the human chromosome. (Human chromosomes are shown at left, chimpanzee ones on the right.) *Redrawn, with permission, from Fairbanks, 2007*
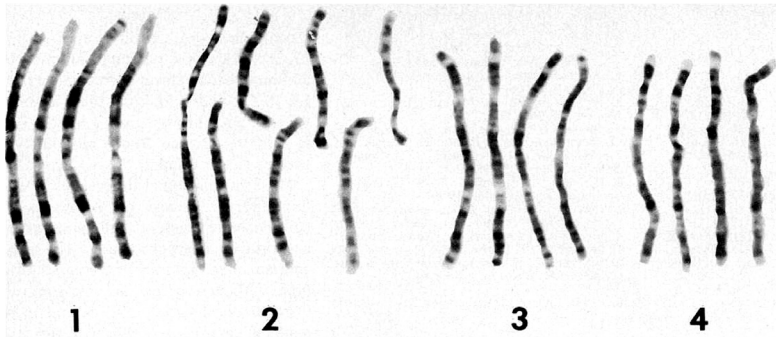
Figure 2-5: Photomicrograph of chromosomes 1, 2, 3, and 4 from four primate species, humans, chimpanzees, gorillas, and orangutans, arranged left to right in order. *Yunis & Prakash, 1982*
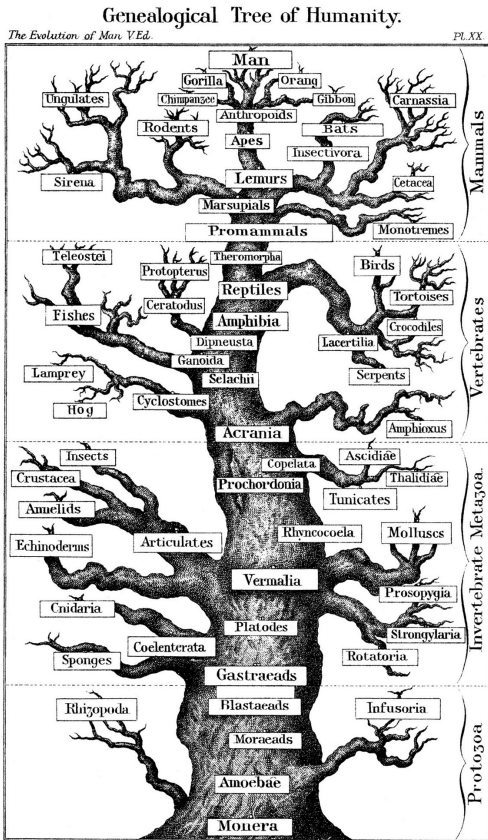

Figure 3-1: Haeckel's representation of the "Human Family Tree." The labels on this copy of the diagram have been translated from the original German.
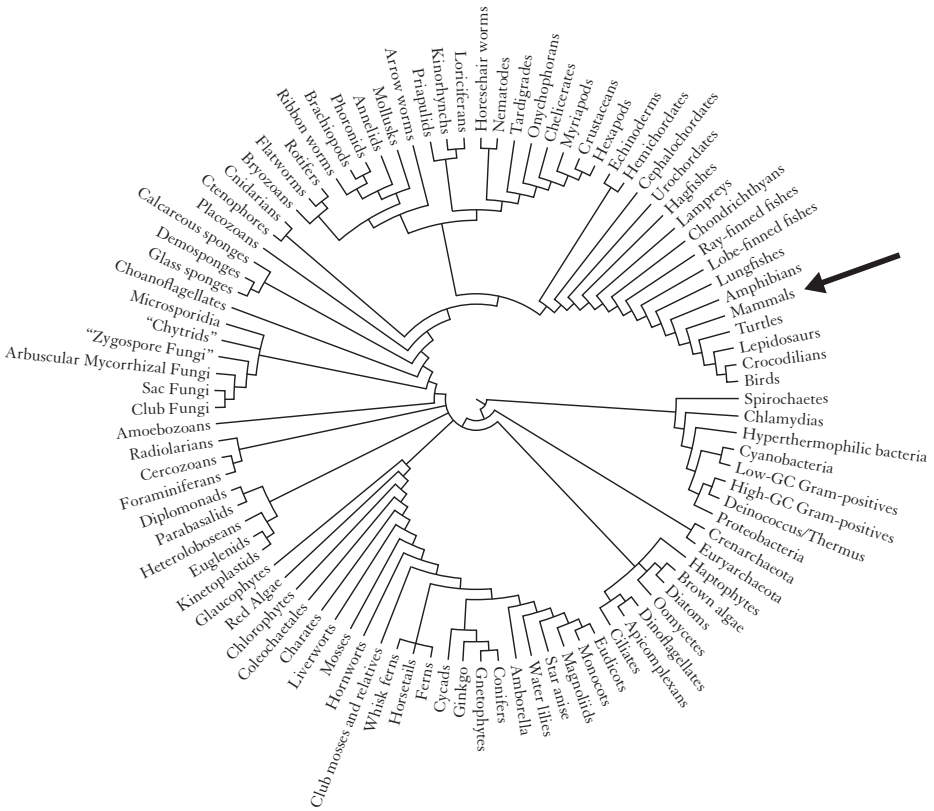
Figure 3-2: A highly simplified modern version of the tree of life, emphasizing the diversification of species from a common ancestor. In this radial version no species occupies a privileged position. *Courtesy of Dr. David Hillis*
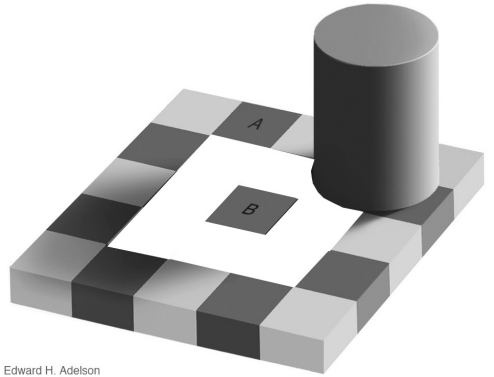
$$N = R^* \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_c \cdot L$$

Figure 3-3: The Drake equation attempts to calculate N, the number of civilizations in our galaxy, by multiplying seven factors together. In order, they are (R*) the rate of formation of stars that could support life, the fraction of those stars (f_p) with planetary systems, the number of planets per solar system (n_e) suitable for life, the fraction of suitable planets on which life appears (f_l), the fraction of those on which intelligent life appears (f_i), the fraction of intelligent civilizations that communicate by releasing detectable signals into space (f_c), and the length of time that such civilizations release detectable signals (L).
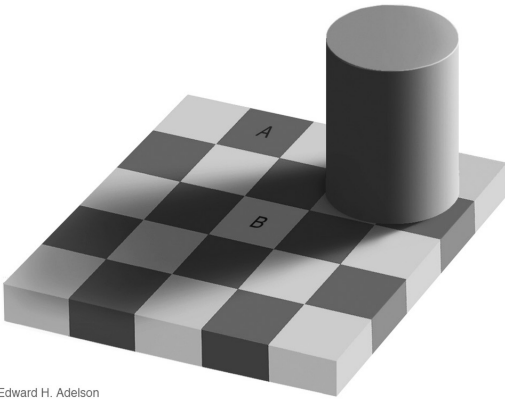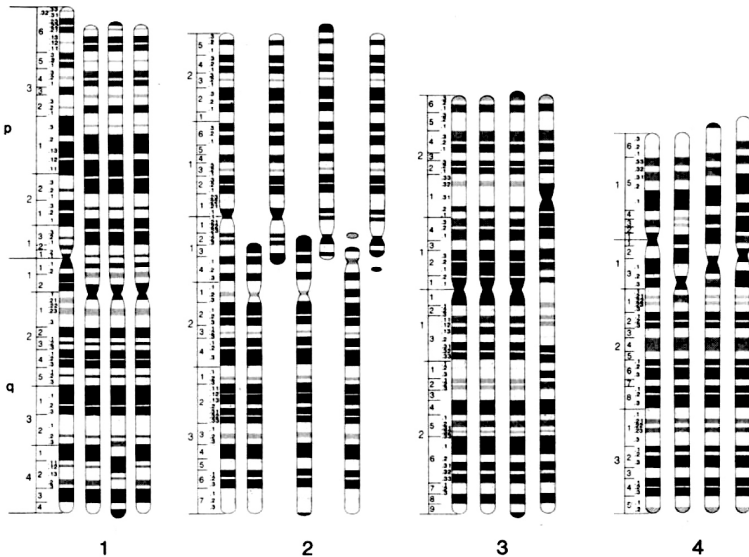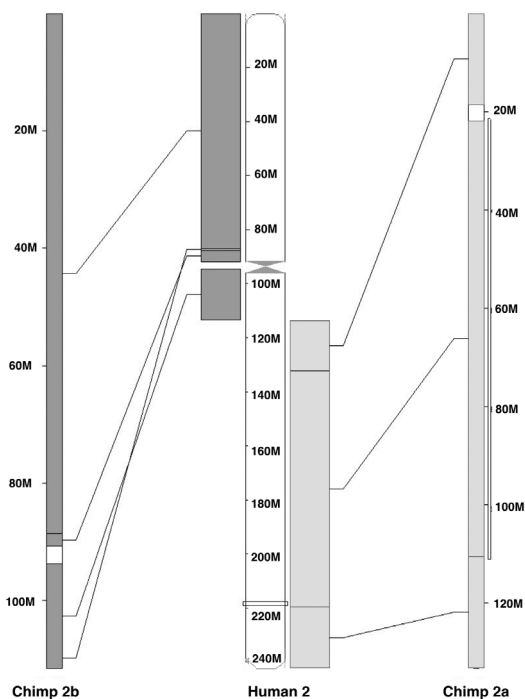
Illusion crafted by Edward Adelson

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Schematic representation of the banding patterns in chromosomes 1 through 4 of humans, chimpanzees, gorillas, and orangutans. Note that the two halves of human chromosome 2 line up with chromosomes that are still separate in the other primates.

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Ensembl comparison demonstrating synteny between human chromosome 2 as compared to chimpanzee chromosomes 2A and 2B.
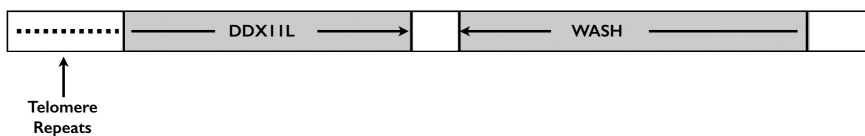
All members of the DDX11L pseudogene family are flanked by telomere repeat sequences on one side, and by a member of the WASH gene family on the other side, transcribed in the opposite direction, as shown above. This includes DDX11L2, the pseudogene located at the chromosome 2 fusion site, confirming its identity as derving from an ancestral telomere region.