The evolution of your brain: Interview with Emiliano Bruner

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Emiliano Bruner holds a PhD in Animal Biology from La Sapienza Università di Roma. Since 2007, he has been working at the Centro Nacional de Investigación sobre la Evolución Humana (CENIEH) at Burgos. There, he conducts research on Hominid Paleoneurobiology, a discipline in which anthropology and neuroscience converge. He is also a research associate at the Centro de Investigación en Enfermedades Neurológicas (CIEN), at Madrid. In this interview, I talk with Dr. Bruner about evolution, brain and mind, cognitive superpowers (and their side effects), and the critical role that the body and environment play when we try to understand the keys to what makes us human.


Emiliano Bruner. (cc) Carla García Iglesias.

Question - Your research is carried out within the framework of paleoneurobiology. Broadly speaking, what this scientific discipline is about?

Answer - Paleoneurobiology is the discipline that investigates brain anatomy in extinct species, based on the morphology of their endocranial cavity. It is a strictly anatomical field, dealing with macroscopic aspects such as brain volumes and proportions, as well as patterns of cortical gyri and sulci.

Q - To this end, this discipline has specialized in the study of endocranial casts or «endocasts». What is this methodological approach and how does it help us understand the evolution of the human brain and mind?

A - The cranial cavity is a negative mould of the brain, sculpted by the brain as it grows and develops, so it can provide some information about its morphology. This information is limited, but fundamental in the case of fossils, especially in the case of hominids, which have invested so much in brain complexity. However, it is anatomical rather than behavioral or cognitive

information.

Q - When we try to explain the complexity of human beings in the light of the evolution of the brain, it is common to ask about those individual traits that are characteristically ours (e.g., a larger volume in a certain brain region). However, you have pointed out several times that natural selection does not favor individual traits, but rather "packages" of traits. Could you tell us a bit more about this?

A - Biological and genetic traits are connected to each other with multiple links, creating a web of relationships where it is impossible to change one piece without altering many others. So, in the end, natural selection must decide whether a change is more or less reproductively beneficial by considering the overall effects of this change, and not the traits in isolation.

Q - It is common to assume that brain size is a key aspect of the evolutionary success of our species. Are there differences between the size of our brain, either absolute or relative (that is, in relation to the rest of the body) and that of our human and primate ancestors?

A - Brain size does matter, cognitively, metabolically, and ecologically. It has clearly increased during human evolution, in terms of total volume, but also relative to body size, which is probably even more important. Still, it is not a very informative variable. First, it is a measure that is too general, and says nothing about which brain component or cortical region has increased or decreased. Second, it is not easy to estimate, especially if inferences are to be relative to body size. Third, the differences between different hominid species are (sometimes very faint) differences in the average value, but there is a very large overlap in the individual values. And fourth, the correlation between brain size and cognitive aspects is patent, but still very weak, and does not allow for reliable predictions.

Q - What about the different lobes of the brain? Are there any where we see more pronounced changes and that may be particularly important for our evolution as a species?

A - The “lobes” are conventional units, so, actually, they are regions without precise functional value or real anatomical boundaries. At the macroscopic level, if we talk about extinct hominids, it is not very clear if and where there may be differences in the frontal and temporal lobes, although we assume that they have undergone significant evolution, in our species, in more subtle aspects that cannot be observed in an endocranial cast. However, the parietal lobes show the most obvious morphological changes.

Q - Regarding the parietal lobe, there is one specific region that you have paid particular attention to: the precuneus (Figure 1). What cognitive function or functions is the precuneus involved in, and why might it be key to our evolution as a species?

A - It is a much larger brain region in humans than in other primates, and probably larger in our species than in extinct human species. It is involved in integrating somatic information with visual information, body and space. The body becomes a unit of measurement of a space that

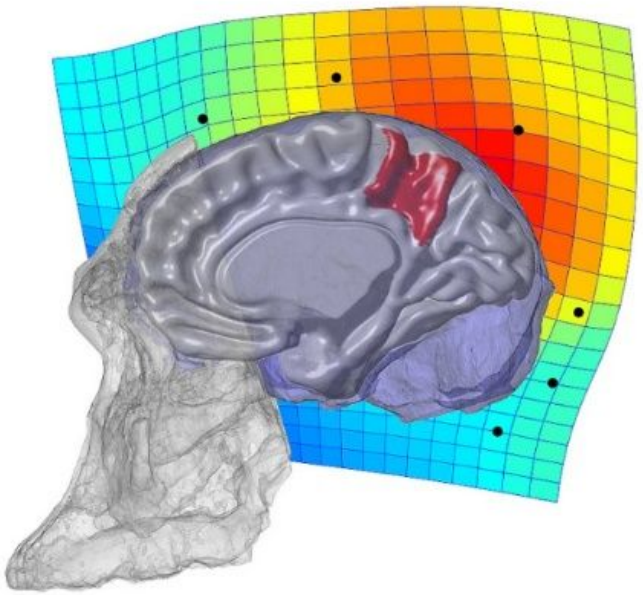

Figure 1. Digital model of skull and endocast of Australopithecus africanus, superimposed with a human brain (in red, the region of the medial parietal cortex corresponding to the precuneus). Behind, deformation mesh representing the expansion of the parietal region in modern humans. (cc) Emiliano Bruner..

is not only physical, but also chronological, mnemonic, and social. The ability to integrate body and vision is the basis of visual imagery, which is fundamental for consciousness, for the development of a self-identity, for remembering and foreseeing, for simulating and doing mental experiments. Oftentimes, the precuneus has been defined as "the mind's eye".

Q - You have sometimes referred to this ability as a «superpower» that we humans have, to add that it is not without its negative counterpart. Could you tell us more about this?

A - The ability to project and simulate images, events that have not happened, memories and predictions, is a crucial key to our cognitive abilities. But of course, an excessive mind wandering, in this sense, is often detrimental, and generates stress and anxiety, something that seems to be a universal condition of our species.

Q - Indeed, various philosophical and contemplative traditions have noted this apparent imbalance between our "narrative self" (projecting from the past and into the future) and our "experiential self" (anchored in the present experience) as a source of suffering for the individual (however adaptive it may be for the species). Meditation has often been proposed as a possible antidote to this condition. What is your opinion on this?

A - I agree. Meditation is a cognitive training to enhance and rebalance the attentional and perceptual system, which generally suffers from the excesses of our amazing capacity for rumination, uncontrolled imagination, and obsessive internal dialogue.

Q - Let's return to the brain. Although it is your main subject of study, you are often critical of positions that try to reduce the mind to the brain (neurocentrism). Instead, you emphasize the importance of the body and the environment, both physical and cultural, in explaining our cognition and behaviour (embodied and extended cognition). Can you tell us more about this?

A - Just as you cannot understand the brain by analysing its neurons alone, I don't think you can understand the mind by analysing the brain alone. They are complex systems, with emergent properties that are activated only by the interaction between the different elements involved. In all animals, cognitive processing involves the interaction between brain, body, and environment. In primates, the social system must be added, because cognitive processing is collective. Finally, in humans, technology must also be added, because cognitive processing is also culture-dependent.

Q - To conclude, a different kind of question. Many of the readers of this interview will be students in the process of launching their careers in science. What would be your advice to any aspiring researchers in cognitive science?

A - There is a striking difference between the public's perception of science and the real science that is done in research centers and laboratories. Usually, the former is highly idealised, while the latter suffers from many limitations which, being less noble, are often swept under the carpet. To maintain and renew motivation and enthusiasm (a fundamental requirement in research), we must try to fly with one's own wings, without relying too heavily on the expectations and promises of our economic and cultural system.

Further reading

Bruner, E. (2023). Cognitive archaeology, body cognition, and the evolution of visuospatial perception. Academic Press.

Bruner, E. (2023). La evolución del cerebro humano: Un viaje entre fósiles y primates. Shackleton Books.

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