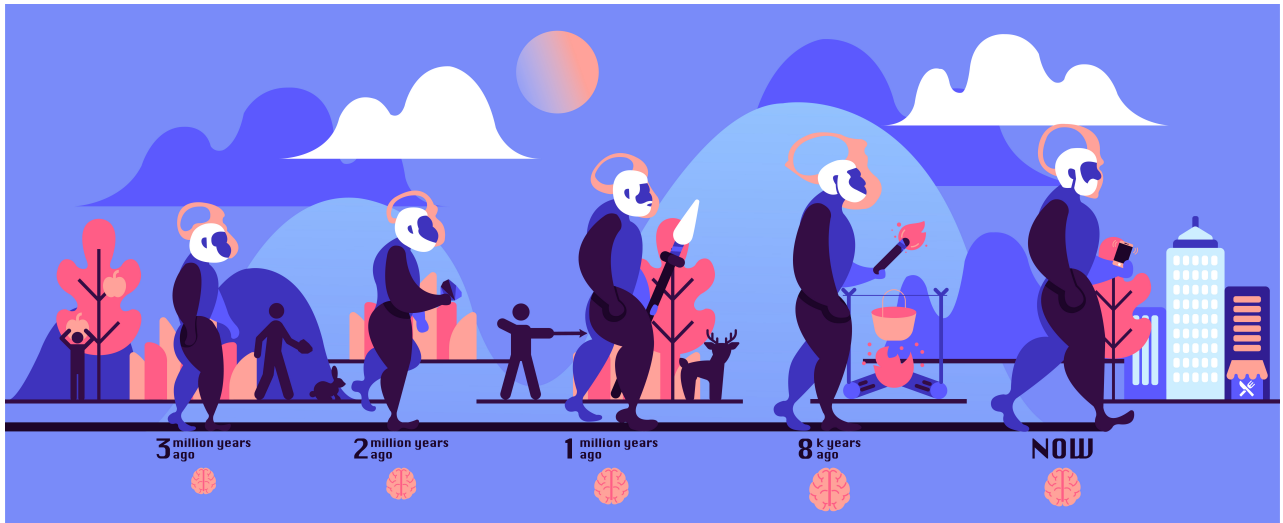


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Project Summery

During the past 2 million years, the human brain has tripled in volume, especially during the period of 800,000 to 200,000 years ago. The human brain had grown significantly in order to adapt to the constantly changing environment. Because of this progress, human had made brilliant achievements and created complex social behaviors. During the evolution of the human brain, while the culture evolved, human evolution in conjunction with changing behaviors and societies produced the first forms of hand tools[7]. And these tools influenced human diet which then provided more nutrients for the growth of human brain as the tools were being more and more sophisticated. Thus, there are loops that exists between human brain capacity, human cultural capacity, human tool creation, and their diet.

What are unique about humans are our complex behavior and cognition, which are directly related to the expansion of the human brain and its capacity. During the process of evolution, the creation and use of tools was an essential aspect of human behavioral changes. Tools allowed for humans lives and work to become more efficient and convenient, and also helped human hands and brains to become more dexterous and advanced[5]. The evolution finally leads to the development of an essential function of the nervous system. During this development, the human nervous system had more neurons. The information each nerve signal could carry increased and the time for them to reach each other reduced[1]. As the human brain became more effective, our intelligence advanced, and the tools that we invented and used became more sophisticated and delicate. As Atsushi Iriki and Miki Taoka explain in their article [3], they give the idea that during the process of human evolution and human history, our ancestors created new habitats. Our habitats

begun to grow from advanced hunting–harvesting environments, to rural landscapes and villages, and eventually to modern civilized technological cities. The evolution of various new cognitive abilities, including the ability to invent, use, and manufacture tools, has enabled these ecological transformations. This new cognitive ability is, in turn, the result of a dramatic expansion of the human brain and new functional brain regions.

Food provides humans with the energy and nutrients we need for life, which has a correlation with the evolution of brain capacity and intelligence[6]. In the process of tool development, the amount of meat in our diet was getting larger and larger, because the tools we were using had become advanced enough for us to successfully hunt more often. The animal protein in the food was getting more, and the food was more nutritious, which provided sufficient energy and nutrition for brain's development of expansion. This then laid a good foundation for the evolution of brain capacity that grew with the development of human tool culture. One article that supports this idea can be found, which in the article[2], Alex R. DeCasien, Scott A. Williams and James P. Higham proposed that the only factor that seemed to predict which species had larger brains was their diets. The reason may be attributed to the fact that the nutritional value of meat is higher than that of fruits and plants. So then the amount of nutrients being absorbed by humans became abundant, which provided the opportunity for the human brain to evolve faster than any other species on earth. Another reason may be that in some ways, meat is also a hard–to–get food. For example, meat is more irregular in space and time because animals are harder to be traced than plants, so it is more complicated to find. It required the use of tools during the process of obtaining the food. So, as the tools humans used allowed us to obtain more nutritious food, our diet changed to allow for greater nutrient acquisition, which then lead to the continuing grow of the larger brain and as our intelligence grow and evolved so did our tools[4].

However, since the Stone Age, the human brain has been shrinking. Over the past 20,000 years, the average volume of the human brain has decreased from 1,500 cubic centimeters to 1,350 cc, losing a chunk the size of a tennis ball. The reason for this loss of volume is due the the fact that the organ itself requires 20 percent of all the calories we consume. So although a bigger brain can presumably carry out more functions, it takes longer to develop and it uses more energy. Although our brain capacity has decreased, that does not mean that humans' intelligence decreased. The brain finds a balance between capacity and energy consumption to allow the brain to yield the most intelligence by using the least amount of energy.

So within the image I create, I drew a timeline of human evolution which includes five figures. These figures include four human ancestors and one modern human that represent five pivotal time points of the expansion of the brain expansion and the development of tools. Around the brain of each of them, I drew a more precise profile of the brain and the capacity of the brain which can be seen that they are continuously getting larger until the modern human's brain which shrieked a little bit compared to the previous one. This part of the picture explains the theory that the larger the brain, the more there are neural circuits, and the more effective the brain. So theoretically, human are

getting smarter through this process. And under the bottom of the timeline, I use specific numbers of the time and brain capacity at each time point to show the exact amount that the brain capacity have been changing through out the time.

In addition, each of the figures is holding a different tool which outlines what kind of tool the intelligence allowed human to make at the time. All tools they hold also shows the process of tool culture development. Based on the intelligence which relates to the brain capacity,]tools develop through simply sharp flake stone tools, to more sophisticated tools (such as hand axes), and to the invention of fire, to more mature and complicated tools(such as phone). So this part of image, try to explain how the way human gains food has been changed. In the beginning, human use bare hand to collect fruits; then we use tools and weapons to hunt; and then we use fire to cook the food to disinfect it and make it more delicious; until modern days we invented mobile phones and we don't even need to go out side to have out food delivery.

Above the figures are the specific scenes of the progress of the human diet. I use scenes of the activity of obtaining food and cooking to show how the development of tool culture helps the advance of food culture. The food progress is drawn above each figure which represents the food is the strong relevance with the increase of brain capacity. As the diet improves from fruits, raw meat, and cooked meat, the nutrients in diet get more abundant, which provides the opportunity for the human brain to evolve.

At the end of the timeline, the modern figure's brain capacity is drawn smaller since compared with the hunting ancestors, the capacity of the modern human brain has dropped by 10%. The decline occurred mainly in nearly 10,000 years. High energy consumption is one of the reasons that prevent brain growth. Although the brain weighs only 2% of the body's weight, it consumes 25% of the body's energy and much more than any other organ part. If the brain continues to grow, it will take away more energy and nutrients from other essential organs, and the survivability of the human being is threatened. Although the brain capacity has decreased, it does not mean that humans' intelligence decreased. There is a balance between capacity and energy consumption thus though the modern brain capacity has been shirked, but we have the most convenience way of gaining food.

My image is made for children who are interested in human science. I hope to find a balance between science and comprehensibility through design, by making the product fun. So I used bright colors and inaccurate geometric shapes to represent human figures to make it different from the typical scientific illustrations to stimulate the interests of children. I also uses simple cartoons to express the activities of humans obtaining food. The image looks more lively and follows the way of children's understanding. In the image I barely used any text such as sophisticated scientific terms, but numbers. Any other information are all designed to be conveyed by illustration. I want this image to become friendly and likely to children, and comprehensible of explaining the loops of human brain capacity, human cultural capacity, human tool creation, and their diet.

Bibliography

- [1] Allen, John S. *The Lives of the Brain: Human Evolution and the Organ of Mind*. Belknap Press of Harvard University Press, 2012.
This book systematically introduced the ingredients of human brain, how does the brain work, and how the brain evolved . It mainly describes how neurobiological evolution approaches to the evolution of human behavior and how the brain and the behavior it produces are what truly set us apart from the other apes and primates.
- [2] Decasien, Alex R., et al. "Primate Brain Size Is Predicted by Diet but Not Sociality." *Nature Ecology & Evolution*, vol. 1, no. 5, 2017, doi:10.1038/s41559-017-0112.
This article proposes that primates, especially anthropoids, have relatively large brains compared to other mammals. The reason the article gives is that ecological factors, such as diet, explain relative brain size variation in non-human primates. This is consistent with the idea that processing of meat and other foods contributed to subsequent increases in brain size fulfilling corresponding higher energy requirements.
- [3] Iriki, A., and M. Taoka. "Triadic (Ecological, Neural, Cognitive) Niche Construction: a Scenario of Human Brain Evolution Extrapolating Tool Use and Language from the Control of Reaching Actions." *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 367, no. 1585, 2011, pp. 10-23., doi:10.1098/rstb.2011.0190.
The article tells that hominin evolution has involved the use of tools and to the establishment of linguistic faculties. The expansion of the brain that accompanied additions of new functional areas would have supported such continuous evolution. Extended brain functions would have driven rapid and drastic changes in the hominin ecological niche, which in turn demanded further brain resources to adapt to it.
- [4] Paul, Robert A. *Mixed Messages: Cultural and Genetic Inheritance in the Constitution of Human Society*. The University of Chicago Press, 2015.
This book talks about the situation of When genetic and cultural reproduction diverge. It introduces the theory called dual inheritance theory. And it also talks about the sources of human sociality. Dual inheritance theory based on the theory that humans are informed by two different kinds of heritage, one biological, the other cultural. They are used to be studied separately, but in recent years some have begun to explore them together. This book discusses dual inheritance model does a better job of accounting for the distinctive character of actual human societies based on its explanation of how ecology and culture co-function on human evolution.
- [5] Richerson, Peter J., and Robert Boyd. *Not by Genes Alone: How Culture Transformed Human Evolution*. The University of Chicago Press, 2006.
The title of the book clearly introduced its essential topic that how culture transformed human evolution. It discusses the relationship between human evolution and culture transformation which can be a side discussion of my topic. Drawing on work in the fields of anthropology, political science, sociology, and economics with cases, Richerson and Boyd convincingly

demonstrate that culture and biology are inextricably linked, and they show how to think about their interaction in a way that yields a richer understanding of human nature.

- [6]Kaplan, Hillard, et al. "A Theory of Human Life History Evolution: Diet, Intelligence, and Longevity." *Evolutionary Anthropology: Issues, News, and Reviews*, vol. 9, no. 4, 2000, pp. 156–185.,[10.1002/1520-6505\(2000\)9:4<156::aid-evan5>3.3.co;2-z](https://doi.org/10.1002/1520-6505(2000)9:4<156::aid-evan5>3.3.co;2-z).

In this academic article, it discusses human brain is a distinctive feature of our species , with its associated psychological attributes: increased capacities for learning, cognition, and insight. In this paper, it proposes that unites and organizes these observations and generates many theoretical and empirical predictions. it presents some tests that compare biologists, archeologists, paleontologists, biological anthropologists, demographers, geneticists, and cultural anthropologists.

- [7]Somel, Mehmet, et al. "Human Brain Evolution: Transcripts, Metabolites and Their Regulators." *Nature Reviews Neuroscience*, vol. 14, no. 2, 2013, pp. 112–127., doi:[10.1038/nrn3372](https://doi.org/10.1038/nrn3372).

This article discusses about what evolutionary events led to the emergence of human cognition. It specifically talks about that Human brain evolution may be divided into an early phase that is shared among Homo species and included a gradual increase in cranial volume and possibly increased communication skills since the development of neurons lead to the ability to deal with complex messages. This article also tells about a recent and rapid evolutionary phase that is possibly specific to the Homo sapiens species. This recent phase is characterized by a remodelling of brain development that enhanced human infant abilities for social learning.