Why did the humans evolve hyper-intelligent brains?
Zahra Amran, Gowerton Year 12

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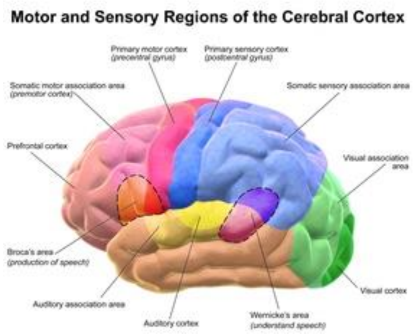
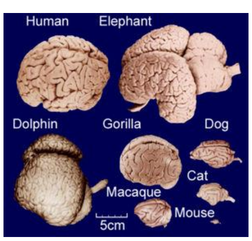
Indubitably, with a hyper-intelligent brain, humans are the dominant species of the planet and have been for centuries. Exclusively, humans' consciousness and inquisitiveness led them to using their freedom to explore peculiar concepts that are abstract and intensely difficult to comprehend. As a result, humans became highly skilful in cognition compared to their primatal ancestors, advancing to rule over the planet with their intelligence. However, humans ambiguously took on this presiding role despite having a weaker physical build compared to their primatal relatives and have evolved to have a highly extortionate brain. This essay will discuss the major theories that have developed to explain the reasons as to why the human brain evolved to become hyper-intelligent despite the costs and what scenarios impelled the human brain to become substantially enhanced.

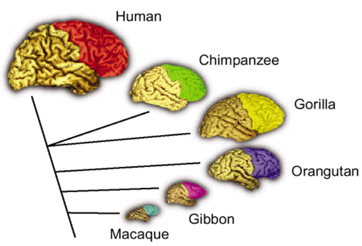
What makes human brains unique and intelligent?



Typically, primates and dolphins are said to be the 'most intelligent' species, and this is determined by several factors. Firstly, primates and dolphins can build large social groups with complex and immediate connections, such as having alliances and rivalries, along with extensive social understanding. Their profound level of communication is more advanced compared to other animals' and is essential for cooperating with each other to formulate plans during problem solving. Moreover, something that is incredibly unique to these animals is that they have obtained a theory of mind where, unlike most animals, they convey an understanding of others' psychological circumstances and can perceive and understand the ambitions, intentions and attitudes of others, using them to their own advantage via tactical deception. [1]



Every brain carries out the same generic function of processing senses to exhibit a behavioural response. Although more intelligent animals generally have larger brains, it does not exactly pinpoint the magnitude of intelligence. [2][3] Even though human brains are large; they do not have the largest brain of all animals and they are not large enough to explicitly differentiate them to being hyper intelligent.



Nonetheless, one of the main factors when differentiating individuality between our brains is our highly folded, densely neuron packed cortex, the most developed and evolved part of our brain. The cortex involves the unique features of human intelligence such as speech and language, planning, memory, sense of time, learning, adapting, problem solving, culture, abstract thought (e.g., mathematics) and directing crucial emotions (e.g. love, rage, aggression). [4] Although humans do not have the largest brain of all species and have a similar total amount of neurons in the brain compared to other primates, they have the largest brain **within** primates and the **most cortical** neurons. Humans have the strongest power and fastest speed of processing information due to highly dense cortical connections and shorter 'inter-neuronal distance.' Neurons process and turn information into action. Henceforth, due to human's densely neuron-packed cortex, more of the information is processed in the cognitive area of the brain at a faster rate; specifically allowing humans to have efficient behavioural flexibility, and so be able to adapt and act methodically against their instincts depending on different situations. [5] Thereupon, humans advance to having more developed behavioural traits, compared to their primatal relatives, to a grand capability.

Overall, the volume and density of "information processing" cortical neurons in the brain is what specifically measures intelligence based on the brain. An advanced cortex leads to advanced cognition and advanced ability to obtain and apply knowledge to learn new skills; propelling humans to have behavioural flexibility and strengthen unique and logical features present in the smartest and most conscious animals.

Why the human brain chose to evolve despite the costs?

Unquestionably, an evolved, hyper intelligent brain like our own comes with extensive costs and has a place of origin. The potential reasons why the brain chose this path of evolution despite the immense drawbacks hasn't yet been identified within the scientific community and theories are continuing to develop to explain this evolution.

With humans growing to have a highly advanced brain, it became an increasingly energy consuming organ. A higher quality diet had to arise to support the brain's basic necessities for nutrients and its growth in size. If the brain contained cells like muscles where energy can be stored for later usage, more inter-neuronal space would be consumed, consequently, requiring more energy as the electrical signals would have to travel further distances. In reality, the brain must constantly be supplied with oxygen and energy and takes the extreme amount of 20-25% of the body's calorie intake *at rest*, creating greater pressure for the heart to pump blood. To compensate for the larger brain, humans lost overall muscle mass, development periods increased, they obtained a smaller skull and reduced jaw size. Inevitably, compared to other primates, humans became much more vulnerable and susceptible to predators and injuries due to the repercussions of the evolved brain. [6] [7]

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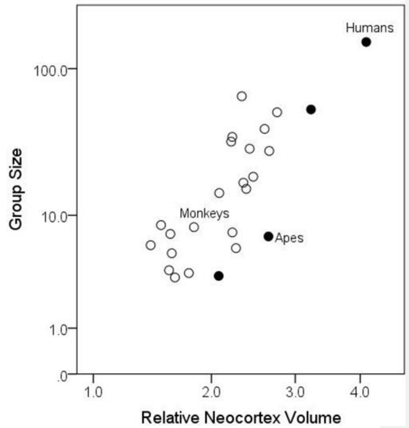
Social Brain Hypothesis

One of the major theories, the Social Brain Hypothesis, developed by Robert Dunbar, suggests that living in extremely intricate social groups resulted in the expansion of the primate brain to become more intelligent and manage the exceedingly calculating demands of social groups. The expansion of social groups was the primate's key survival tactic as it solved environmental problems through collaboration. However, larger groups placed greater antagonism within the group, creating a much higher demand for cognition to maintain unity within groups. To compensate for the constraints of larger, more complex social groups and a higher demand of behavioural flexibility, the cortex size increased allowing flourishment in survival. The pivotal expansion of the cortex amplified social skills including deception, forming alliances, 'reciprocal altruism' and theory of mind. [8] Ultimately, humans having the largest groups and most complex social interactions relates to the size of the cortex as more processing power is needed for cognition to control the copious amount of computing relationships between humans.



Evidence to support the Social Brain Hypothesis mainly focuses on the correlation between the mean social group size of primates and the brain size. [9] Unlike most animals that are antisocial and choose to live alone (excluding mating), only primates and dolphins appear to live in the 'complex' societies we know. They act as companions, forming various relationships with others. Equally, studies like the Baboon Assignment (Alberts 2018) show that primates' strong ties are maintained within large social groups via grooming, which releases endorphins and builds trust, providing comfort between individuals, compensating for the pressures of an overly complicated large social group. Evidently, humans survive and perform better when they are socially connected. Likewise, Dunbar relates the idea of grooming to how language arose within humans. Humans having the largest groups and most social interactions lead to a higher demand for grooming. Language emerged to act as humans' efficient way of 'grooming', where gossip and laughter was an effortless way to maintain and build connections within larger groups. Consequently, the neocortex volume had to increase as there was also a higher demand of neurones from the cortical region of the brain for language.

Nevertheless, the Social Brain Hypothesis holds many problems. Firstly, different animals have extremely computing social groups yet do not require such a large brain, such as meerkats and insects where they live in complex social hierarchies. This implies that building social networks between intelligent species is what made social groups complex, not the contrary, so a direct correlation between brain size and social groups is not provided. Equally, the hypothesis prioritises the idea that the only component that altered in the human environment were social groups but, fails to elaborate on why the social groups had originally advanced and why other species did not manage to approach the path of complicated social groups. [10] To many, it seemed as if the expansion in group size did not primarily change, but it was the environmental factors that had led to humans adapting. Alternative hypotheses such as the Instrumental

Brain Hypothesis and the Aquatic Ape Hypothesis focus on the environment initially changing and that led to social groups changing.[11]

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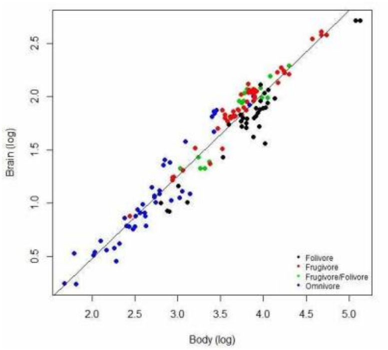
Instrumental Brain Hypothesis

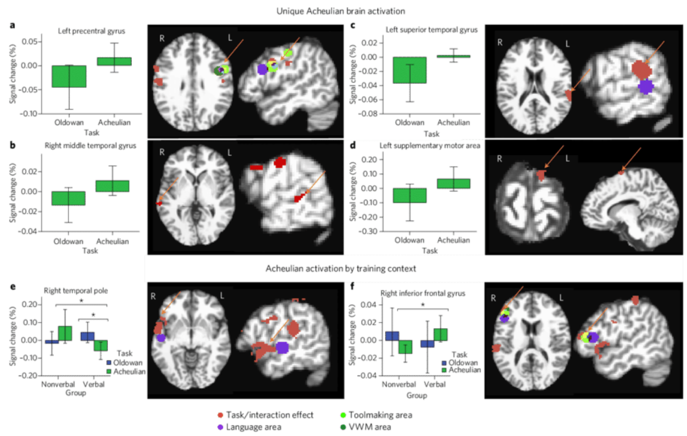
The Instrumental Brain Hypothesis proposes that the ecological pressure of environmental change forced the cognitive, explorative brain to be selected as the ideal approach to tackle the problems that materialised. Foraging skills had to be enhanced as finding food was getting increasingly challenging. Consequently, a higher standard of mental maps with larger foraging ranges and the ability to be more inventive when finding new foods had to emerge. To handle the escalated amount of predators, humans crafted new tools and fundamentally got better at hunting. Generally, contrary to the Social Brain Hypothesis' explanation, the complexity of finding new food and enhanced foraging expertise promoted brain evolution.



Experiments (see right figure) show that diet predicted brain size instead of sociality. Particularly, frugivores simply had larger brains than folivores as finding fruit was more complex since broader ranges and more activation of the cortex was needed to efficiently search for fruit.[12] There is also a slight correlation between the ratio of the neocortex and foraging range, suggesting that finding food had a role in promoting human brain growth. Furthermore, in early periods, long before societies appeared, humans regularly made tools in an incredibly unique yet complicated way, which was a major adaptation that led to the brain thriving. The entire human population switched to more intricate tool making of Acheulean technology, requiring much more precision, mobility and future planning dexterity which led to a shift in perceptive ability.

The Instrumental Hypothesis views language and social skills, highlighted in the Social Brain Hypothesis, as a pathway to spreading knowledge on tool making. Experiments of participants creating tools with verbal or nonverbal instructions show that the cortical, language area of the brain was activated. Dunbar fails to mention that tool making becomes enhanced through social communication. [13]

Nonetheless, many animals use tools and forage for difficult foods without large brains. Likewise, the correlation between neocortex volume and foraging range is weaker than that of the social brain hypothesis and "doesn't test group complexity but only predicted group size, home area size and the mating system." Humans also are not the only ones to use tools but what is unique about primates and humans is that they have evolved to have larger social groups which benefit them in survival.[14]



Problems that arise in both hypotheses include the fact that they simply favour upon applying their results to a subset of animals rather than providing a general explanation for all animals. Neither of the hypotheses provide secure evidence explaining how brain size specifically impacts our cognition and how it is behaviourally demanding. The testing for alternative theories lacks the ability to support each of their respective hypotheses with other types of evidence and focus too much on one, producing many results for one type of evidence. They both also assume the hypotheses subvert each other rather than potentially being related. [11]

In conclusion, I presume that environmental change propelled the formation of larger social groups as a means of surviving efficiently rather than building to have more muscular and stronger bodies. Larger groups heightened defence against predators through teamwork, however this led to increased competition within the groups and the need to control instinctual behaviours to benefit the group. Consequently, maintaining social connections due to the increased pressure was important to build confidence and reduce tension within the group, which was done by grooming. Nevertheless, larger groups meant that there would be increased time spent on grooming and the production of highly advanced tools, resulting in language emerging as a means of working as a social group efficiently. The use of language is cognitive and, hence, required a significant amount of processing power from the cortex, causing it to expand. Equally, a new diet had to arise to support the functions of the advanced brain and so demanded advanced exploration and teamwork skills, requiring sociality, ingenuity and using language as a means of communication. Altogether, this led to further evolution of the cortical brain as it placed excessive pressure among humans' cognition, therefore resulting in an enhanced ability of curious investigation, considerable level of theory of mind and behavioural flexibility.

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