

What Made Us Human: Analysis of Richard Wrangham's Cooking Hypothesis

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After the genus *Homo* split from Apes six to eight million years ago, there were several transformations within the hominid line, eventually creating modern humans. The evolution within the genus is a widely debated topic in relation to what caused these changes. Hominids over time showed an increase in brain size or cranial capacity, decrease in features that enabled climbing and overall smaller facial features. One popular school of thought to explain these changes is Man-the-Hunter, or the idea that humans evolved due to the physical necessities required to hunt and the biological ramifications of meat eating. However, that concept fails to address the significance of gathered foods, since hunting would not always yield a sufficient amount of calories.

Richard Wrangham, in his book "Catching Fire: How Cooking Made Us Human," proposes a new hypothesis. His cooking hypothesis stems from the idea that the control of fire and the cooking of food lead to the creation of the modern human.

The core of Wrangham's argument is based on the differences between eating raw food versus cooked food. Due to changes in chemical properties, cooked food consistently provides more energy because it is easier to digest. The extra energy saved can be utilized to increase development in other parts of the body. In the case of hominids, extra energy was used to fuel the brain, thus increasing brain size and the level of intelligence over time. The increased level of intelligence coincides with behavioral adaptations such as social structure and the beginnings of culture, essentially distinguishing humans from other species. By allowing a higher consumption of calories, cooked food also aided in growth and development of hominids. In turn, those that consistently consumed cooked food would have had a greater chance of survival and be favored in natural selection. Therefore, those better adapted would pass on their genes, creating an anatomy fit to the consumption of cooked food. Wrangham concludes that the transformations that lead to modern humans occurred due to the shift to a diet of cooked food and a reliance on the controlled use of fire.

Wrangham uses data from studies of people eating only raw food in order to compare effects of a raw diet versus a cooked diet on the human body (Koebnick et al., 1999). Common outcomes such as a decrease in BMI (Body Mass Index) and chronic energy deficiency are related to raw foodists. Although some may attribute this to a lack of meat, vegetarians prove it must be something else since they show no differences in body weight with meat eaters. The study also shows that a rate of fifty percent infertility was present among raw foodists, which would have detrimental effects among our hunter-gatherer ancestors since group survival is dependent on successful reproduction. Although some people have managed to survive in wild habitats on raw food, there are no reports of anyone's long-term survival. This is because sufficient energy cannot be obtained from raw food, at least for an extended period of time. Overall, modern comparisons of humans on raw versus cooked food diets demonstrate why our ancestors who ate cooked food would have a greater chance of survival, thus making cooking a key factor in evolution.

Since ancestors on a diet of cooked food experienced various health benefits, natural selection would have favored those with anatomy more suitable to process cooked foods. Compared to other primates, hominids have considerably smaller features including: guts, jaws, teeth, stomachs, colons and intestines, which add up to an anatomy adjusted to the consumption of less food due to the high digestibility of cooked food. Based on studies where one group of animals is fed hard food and the other group soft food, Lieberman et al. (2004) focus on the effects food has on facial growth and determine that “masticating softer, more processed (cooked) foods while the animals are growing can lead to reduced facial growth in mammals with retracted molar rows (674).” Their study shows that despite increases in body size throughout the hominid line, human faces have become smaller due to the reduced amount of strain from chewing softer or cooked food.

Wrangham uses data from their experiment to support his cooking hypothesis and proves humans are anatomically adapted to eating cooked food. Factors of cooked food such as softness, high caloric density, low fiber content and high digestibility allow for these anatomical changes to occur because they increase the efficiency of digestion. That allows for a reduction in features that aid in chewing and digestion, providing extra energy for other metabolic activities. If humans evolved due to the increased consumption of meat, the mouth, teeth and jaws would have adapted differently due to the toughness and difficulty of processing raw meat. One can attribute our relatively small large intestine, less than sixty percent of expected mass based on body weight, to our inability to retain fiber. This inability means humans cannot utilize plant fiber as effectively as the great apes, meaning they must have obtained more calories from less food. In order to obtain necessary calories, a reliance on cooked food was a necessity. Simply, humans taste preferences alone support the idea that humans are adapted to cooked food. For most humans, primate foods taste bad due to the high amount of toxins. Fortunately, cooking destroys many of the toxins found in raw food. Also, we are not biologically resistant to toxins in raw meat, suggesting the evolutionary influence of cooked meat. Overall, our anatomy proves we have adapted to eating cooked food.

By studying the chemical processes involved in cooking, one can see that cooked food consistently provides more energy. This increased level of energy gained would have played a significant role in human evolution. Those that consumed cooked food would have had a greater chance of survival and thus a greater chance of passing on their genes. One way energy is gained is through increased digestibility, which is achieved by gelatinization and denaturation. Essentially, gelatinization is when starch granules are warmed up by water and begin to swell, the bonds weaken which loosens the structure and then gelatinizes. Denaturation is promoted by heat, acidity, sodium chloride and drying, which causes bonds to weaken and then open up. Also significant are the physical effects cooking has on food. Cooking is intended to increase the tenderness of food, which in turn allows for more rapid and complete digestion. When food is digested faster, less metabolic effort is required, resulting in energy gain. In conclusion, ancestors that regularly consumed cooked food would have experienced significant evolutionary benefits.

After establishing the benefits from a diet of cooked food, Wrangham turns his attention to when cooking first began. There are two ways to attempt to solve this: archaeological and biological evidence. Concrete archaeological evidence for the controlled use of fire is difficult to

discern, forcing one to look at other factors. Therefore, Wrangham relies on biological evidence to determine when it first emerges.

Major changes in diet would lead to rapid and obvious anatomical changes. Since cooked food provides more energy and survival benefits, its origins should coincide with times of large evolutionary changes within the hominid line. McHenry's and Coffing's study (2000) looks at the taxonomy of Hominids and the changes that occurred over time. Wrangham uses the data from this study in order to prove that cooking emerged between 1.9-1.8 million years ago during the transformation from *Homo habilis* to *Homo erectus*. Figures show that the largest transformation within the hominid line occurred in this time period, particularly in brain size; leading Wrangham to believe this is when cooking must have first emerged. Remains of *H. habilis* show similarities with australopithecines (ancestors from around 2.5 million years ago), such as small body size, relatively small hindlimbs and large forelimbs and more flexible feet, but their reduction in the masticatory system and their increased brain size classify them as members of the genus *Homo*. Transformations in forelimbs, shoulders and trunks, tooth size, femoral length, legs and the brain demonstrate that large changes occurred between *H. habilis* and *H. erectus*. Therefore, changes in the morphology from *H. habilis* to *H. erectus* where a large reduction in tooth size and a 42% increase in cranial capacity support the idea that cooking was the key factor in the evolution of *H. erectus*.

Anatomy in relation to climbing ability also supports that the controlled use of fire and cooked food explains the evolution from habiline to *H. erectus*. The first distinguishing feature is the size of the arm relative to the forearm. Fossil evidence shows that forelimbs dramatically decreased in size after *H. habilis*, suggesting a transformation in locomotion from climbing to bipedalism (McHenry and Coffing, 2000). *Australopithecus* and *H. habilis* retained climbing features in the shoulder and trunk, which are not present in later hominids. If hominids lost climbing ability after *H. habilis*, they would have no longer been able to climb a tree to find a safe spot to sleep, forcing the use of the ground. In order to see and scare away large predators of the time, the light provided from fire is essential. Hominids would not have been able to survive without the consistent use of fire to protect them. This marks an important behavioral adaptation, which is only possible with the consistent reliance on controlled fire.

One major aspect that distinguishes humans from other species is the high level of intelligence due to relatively large brains. Throughout evolution, cranial capacity has increased from 400 to 500 cc among australopithecines to 1,400 cc among modern humans (Aiello and Wheeler, 1995). The largest increase in size in the hominid line occurred in the transformation of *H. habilis* to *H. erectus*. Since brains are metabolically expensive organs, a common question has been how humans can afford or fuel such large brains. Aiello and Wheeler (1995) propose an "expensive-tissue hypothesis" based on the linkage between a high quality diet and the relative sizes of the brain and gut. Humans' overall relative basal metabolic rate (BMR) shows no correlation with relative brain size, leading one to examine other factors. Aiello and Wheeler studied the relative mass of specific metabolically active organs in humans to determine if increased encephalization correlates with a reduction in one of those organs. Results show that the mass of the gastro-intestinal tract is only about 60% of the expected size for a similar sized primate. Overall, primates with smaller guts had larger brains and they attribute this to the fact that "a high-quality diet relaxes the metabolic constraints on encephalization by permitting a

relatively smaller gut, thereby reducing the considerable metabolic cost (Aiello and Wheeler, 2008).” Therefore, the extra energy saved from a reduction in gut size is utilized to fuel the brain.

Although Aiello and Wheeler associate a high quality diet with the increased consumption of meat, Wrangham argues that the improved diet quality is from cooked food. There are two main factors that determine gut size: the amount and the digestibility of food one consumes. As previously stated, due to the chemical and physical properties of cooked food it is easier to digest than raw food, thus explaining why humans were able to have a reduction in gut size once they shifted to a diet of cooked foods. Although agreeing about the basic biological principles involved with the expensive-tissue hypothesis, Wrangham’s argument that major anatomical changes would occur with the introduction of cooked food makes more sense when considering the effects cooked food has on the body. The subsequent increases in brain size over time can be explained by the introduction of meat and improvements in cooking methods.

Cranial capacity continued to increase after the biggest transformation occurred from *H.habilis* to *H.erectus*. These changes can be attributed to improvements in cooking methods over time. The energetic quality of food would increase as methods became more sophisticated. Techniques such as earth ovens and containers would have allowed for increased consumption of cooked food. More efficient hunting techniques would have further increased caloric intake, converting into more energy for the brain. Overall, the extra energy from cooked food allowed for increased digestibility, which allowed humans to have smaller guts, transferring the left over energy to the brain and explaining why hominid’s cranial capacity continued to increase over time.

Along with the biological benefits humans achieved from cooked food such as larger brains, they also experienced changes in their use of time or the structure of their day. One important aspect is the amount of time one must spend chewing when eating raw food (Clutton-Brock and Harvey, 1977). Since amount of time spent chewing is related to body size among primates, estimations can be made as to how long humans would have to chew their food on a raw diet in order to consume sufficient calories. Conservative estimates determine that at least 42% of the day would be spent chewing, or just over five hours per twelve-hour period. This means that on a raw diet, the majority of time would be devoted to chewing, leaving little time for other activities such as hunting. The shift to cooked food allowed our ancestors to spend more time hunting and gathering, leading to the possibility of increased caloric intake due to extra time spent devoted to food collection. Essentially, this possibility created the division of labor.

A division of labor was created due to males being able to spend all day hunting without the fear of any success leading to starvation because they knew that at camp a cooked meal was awaiting them. If the food awaiting them were raw, hunting all day would not leave sufficient time to consume the necessary calories. Therefore, they divided tasks, where everyone was able to consume enough calories by some staying behind and cooking or gathering while others hunted. The combination of cooked food and higher intake of animal foods from more time spent hunting improved the quality of ancestors’ lives while at the same time creating a division of labor or economic social structure.

The concept of male-female bonding coincides with the division of labor. Marriage solves issues of who feeds whom and guarantees a food source for both husband and wife. Since

in most cases it is women's role to cook, one can assume that women stayed at camp and cooked and gathered while men were out hunting. Women faced the fear of spending all day cooking only to have it stolen by someone stronger, whereas if men had an unsuccessful day of hunting they would have a day without food. Pair bonds solved both of these issues. Males would provide protection to females and ensure that no one stole from them and in turn females would provide a meal every night for their partner. When hunting was a success, the pair bond would share the food. This essentially created the human universal of a form of marriage, in this case as a purely economic benefit. Unlike other primates, humans were able to form a system of etiquette due to the increased level of intelligence and the role cooked food played.

The introduction of cooking transformed hominids into a very distinct and unique species from ape ancestors. One major difference is the longevity of human lives; we live a few decades longer than great apes. The introduction of controlled use of fire as a way to deter predators may have aided in this evolutionary adaptation. Cooked food aided in the growth and development of the young due to the higher energy value. Furthermore, issues of food shortages would not have affected humans in the same way as other primates since they were better adapted and able to store more energy in the body. The heat fire would have provided during cold nights allowed humans to have a reduction in body hair. This reduction would have helped with issues such as overheating in the desert environment and allowed for extended periods of running. Running is a significant contributor to survival, allowing humans access to more food sources and the chance to escape from predators. In order to cluster around the source of heat, a fire, social skills are required such as cooperation and communication. This led to the development of human's emotional bonding and closeness. Overall, the distinguishing factors of modern humans from other primates coincide with the influence of cooked food and the controlled use of fire.

Wrangham successfully argues that the behavioral adaptation of cooking food and the consistent use of controlled fire led to the transformation of modern humans. The variety of sources he uses, from modern studies on raw-foodists to articles on the taxonomy of ancestors from millions of years ago, provides sufficient evidence to support his hypothesis. By examining these various aspects of the argument, he leaves the reader with little doubt of the importance of cooked food in the evolution of modern humans. Without a diet of cooked food, humans would not have reached the level of intelligence we are at today, which allows for the unique and diverse cultures of the world today.

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