Proceedings of the International Conference on Global Politics and Socio-Humanities
DOI: 10.54254/2753-7048/46/20230884

The Evidence Against Hunter-gatherer Theory: The Evolution of Gender Differences

Shiyu Guo[1,a,*], David Yang Chen[2,b], Wenxi Ye[3,c]

[1]University of Illinois at Urbana Champaign, IL, 61820, United States
[2]Shanghai Pinghe School, Shanghai, 201206, China
[3]Changjun High School International Department, Changsha, 410013, China
a. shiyug2@illinois.edu, b. chendavidyang@shphschool.com, c. 2761514552@qq.com
**corresponding author*

Abstract: Hunter-gatherer theory in evolutionary psychology has been the theoretical underpinning of many modern ideas and stereotypes. However, modern archaeology and biology advancements suggest a more flexible understanding of female-male roles during the Stone Age than previously believed. This paper critically examines the recent evidence that challenges the conventional Hunter-gatherer theory, addressing the topic through three distinct lenses: Firstly, Drawing from contemporary archaeological findings, the authors argue that the prehistoric division of labor diverges from the Hunter-gatherer theory's traditional stance on female gathering and male hunting. Recent studies, for instance, have unveiled evidence of female hunters in ancient societies, challenging long-held beliefs. Secondly, the authors delve into the gender dynamics of long-distance running ability, a specific manifestation often attributed to gender differences by the Hunter-gatherer theory. This exploration seeks to understand the balance between male and female capabilities. Thirdly. Through a comparative analysis of historical variances in dietary preferences and height differences, juxtaposed with their societal implications, the authors introduce the "Gender Binary Cycle" as a more fitting framework to elucidate the origins of contemporary gender disparities.

Keywords: Evolutionary Psychology, Anthropology, Hunter-Gatherer theory, Gender Binary Cycle, Gender differences

1. Introduction

In ancient times, humanity's ancestors mainly obtained food foraging in the natural environment. There were two ways of foraging, one of which was a direct collection of edible plants with females in the role, and the other was hunting wild animals with males and thus was called Hunter-gatherer, also known as "forager". Hunter-gatherer cultures have been a considerable part of human history and are considered the most primitive, enduring, and successful form of competitive adaptation in human history [1]. The allocation between genders and the justifications for such divides have been intriguing and contentious issues. As an academic theory, Hunter-gatherer serves as a fundamental research object in many fields such as anthropology, evolutionary psychology, and gender studies. There has been a noticeable increase in interest in studying sex differences. In explaining sex differences, the Hunter-gatherer theory as a historical source is persuasive and widely used, as if

DOI: 10.54254/2753-7048/46/20230884

foraging styles could influence the development of almost any trait over long evolutionary periods: strength, height, vision, sense of direction, dietary preferences, and even personality. However, in an era when male-biased inequality has been institutionalized and scientifically validated worldwide, foraging styles can either be the cause of differences or the rhetoric that rationalizes them.

In modern societies where gender equality is one of the UN's Sustainable Development Goals [2], there are still many career opportunities, resource allocations, and aesthetic standards that restrict women's rights based on gender differences, and the process of lifting the restrictions continues to be impeded in the face of the overwhelming scholarly evidential support for these gender-based distinctions. Thus, research that intentionally avoids the effects of bias in experiments and analysis of results is needed, providing critical new perspectives on the study of gender differences.

While evidence from modern archaeological studies of female-male labor roles in Hunter-gatherer cultures can visualize the oversimplification of Hunter-gatherer's definition of the gender division of labor, analyzing modern female-male traits permits us to analyze the potential causes of differences based on their specific manifestations. This review will specifically analyze the abilities of endurance running, height, and food preferences, which have been assumed to be gender-differentiated traits developed based on the Hunter-gatherer theory. It also analyzes the cyclical relationship between Hunter-gatherer theory and the formation of gender bias, as well as gender differences from a socio-gender and psychological perspective based on the Gender Binary Cycle.

2. Contradictions with the Hunter-gatherer Theory from Modern Archaeological Evidence

The primary implication of the Hunter-Gatherer theory is that it describes prehistoric societies in which the division of labor for foraging was gendered, with males specializing in hunting and females specializing in gathering. Many societal perceptions suggest that the gender differences between women and men that are evident in modern times follow the natural, rather than artificial, rules of gender role division in the past. However, such notions have been challenged in numerous recent studies. Researchers from the anthropology department at the University of California Davis, while examining hunter burials at the Andean highland site of Wilamaya Patjxa, discovered hunting toolkits with stone projectile points and animal processing tools in the burials. Not only that, the sex of the hunter in the burial was female through osteology, proteomics, and isotope analysis [3]. However, this was initially thought to be a handful of cases until researchers found eleven female burials with hunting toolkits in ten Late Pleistocene or early Holocene sites throughout the Americas, a statistic that has a demographic parity with early male hunter burials. This data has demographic parity with early male hunter burials [3]. This finding suggests that it was common for women to play hunters in subsistence labor patterns in early American populations, with little of the gender differences that hunter-gatherer theory suggests and, instead, a higher percentage of female hunters than would be expected.

Moreover, the contributions women make to hunting worldwide are astonishing. To tally the evidence of female hunting, researchers from the biology department at Seattle Pacific University and the anthropology department at the University of Washington analyzed data from the literature of 63 different foraging societies worldwide, including Africa, Asia, Australia, North America, Oceania, and South America [4]. The results showed that 50 of the 63 foraging societies documented evidence of female hunting, and 36 societies documented that female hunting activity was intentional rather than opportunities [4]. Most notably, female participation in hunting in societies that viewed hunting as an essential activity was 100% [4], suggesting that women's roles in hunting are not exclusively those traditionally thought to be involved in gathering and cannot even be seen as supportive, but rather are largely intentionally involved in hunting activities. Therefore, it is not rigorous to arbitrarily conclude that males are hunters and females are gatherers and use this as a definitive basis for gender labeling categorization.

DOI: 10.54254/2753-7048/46/20230884

In addition, the proponents of Hunter-gatherer theory argue that women's fertility plays a significant determining factor in this gender division of labor [4]. Since women are responsible for caring for their offspring, they can only work in jobs with a lower risk factor. However, the presence of children did not trap women in the home; instead, children accompanied their parents on their adventures. In the Hadza and the Aka, more than fifteen percent of the hunts are accompanied by children who may be as young as preschool age [4].

Unfortunately, because of the Hunter-gatherer theory, evidence that women were hunters is more difficult for researchers to recognize. For example, projectiles that appear in male burials are associated with hunting tools, but those that appear in female burials are reluctant to be considered hunting tools [3]. Images of being solid and adventurous align with societal expectations of men, so evidence of men being hunters is always more likely to be seen as plausible. It shows that based on the influence of bias, much of the evidence showing the importance of women's abilities and roles has yet to be addressed or underestimated to some extent. According to the theory of Confirmation Bias in cognitive psychology, it is easy for people to search for evidence that supports what they believe rather than objective evidence. These biases also influence how people interpret the evidence, and this manipulation is usually unconscious [5]. Moreover, this "no intention" leads to experimental arguments being unquestioningly considered logically correct and convincing. However, analyzing the evidence for gendered labor provided by modern archaeology, it is easy to see that the labor role of women in foraging societies is an inescapable departure from the division of labor described by the Hunter-gatherer theory.

3. Examining Endurance Running Ability as a Reflection of Prehistoric Gender Roles

Evolutionary psychology posits that the evolution of sex traits in women and men depends on the adaptive problems they face [6]. For instance, men's evolution of long-distance running abilities is often attributed to their roles as hunters. At the same time, women, traditionally seen as gatherers, are not expected to require such skills. Therefore, there should be a significant gap between women and men in long-distance running ability, according to the hunter-gatherer theory. However, researchers analyzed men's and women's endurance running abilities from physiological, biomechanical, and neuromuscular perspectives, concluding that there is little difference between men and women regarding running economy [7]. This groundbreaking discovery challenges long-held beliefs that there are intrinsic gender differences in physical ability and further questions the accuracy of Hunter-gatherer theory. This paragraph is going to synthesize the specific manifestations of gender distance running differences and discuss the history of gender bias in the marathon.

Admittedly, some research and social stereotypes suggest that males have better performance in long-distance running. Take maximal oxygen uptake (VO2 max), a typical indicator of endurance running, as an example. The higher VO2 max one has, the better endurance running ability he or she gets [8]. It is shown that the average difference between men and women in VO2 max is related to sex differences in body size, relative body fatness, and other truly sex-related biological factors, where males perform better than females [8]. Nevertheless, this is only a single facet rather than a holistic view. As women's participation in endurance running has increased significantly, plenty of research focusing on the gender equality of long-distance running has been done. For instance, Besson et al. [7] conducted a detailed narrative review that considered complex factors that differentiate between sexes in prolonged running exercises, analyzing the complex web of physiological, biomechanical, and neuromuscular factors that underpin the gender-based performance differences in endurance running and concluded that most of these gender differences disappeared when maximal aerobic speed or anthropometric measurements were standardized.

Furthermore, in-depth studies carried out by several academics have shed more light on the complex features of gender-based variations in long-distance running, revealing the prominent

DOI: 10.54254/2753-7048/46/20230884

advantages of women over men in distance running. For example, research by Almonroeder et al. [9] and Chumanov et al. [10] illuminated the unique running mechanics displayed by women. Their research shows that women typically have more hip and knee joint motion in non-sagittal planes, indicating a unique biomechanical strategy that differentiates them from their male counterparts. This intriguing finding highlights the unique advantages and strategies of females participating in long-distance running, challenging the conventional wisdom that running styles are gender-neutral. Additionally, Phillips et al.'s [11] research showed that females use a different metabolic strategy than males, relying more on fatty acids while conserving carbohydrates. Women may have more endurance due to this metabolic adaptation, allowing them to maintain themselves for longer periods of time while utilizing their energy more efficiently. Moreover, Hunter's [12] discovered that female runners have less neuromuscular fatigue and peripheral impairments during endurance and ultra-endurance running. All this evidence makes women's dominance in long-distance running starts to emerge.

In addition, it is noteworthy that societal biases once barred women from marathon participation until 1972, based on unfounded beliefs about their physiological limitations. Kathrine Switzer's 1966 marathon participation, where she outperformed most male competitors despite societal constraints, stands as a testament to women's capabilities [13]—subsequent years witnessed a surge in women's running speeds, matching male speeds from four decades prior by the year 2000 [14]. In 2016, five women won a long-distance running race, outpacing their male counterparts [13]. This exemplifies how prejudice and domestication have limited women's physical athletic potential.

Although the authors still need more research focusing more on the factors that contribute to male and female distance running ability, current studies offer a more holistic view of male-female differences to be gained. It indicated that females' diverse adaptations in endurance running are inconsistent with the Hunter-gatherer theory's predictions, prompting a reevaluation of long-held beliefs.

4. Exploring the Gender Binary Cycle as a Better Explanation

After arguing the flaws of the Hunter-Gatherer theory, it's necessary to find an alternative theory to explain the universal gender differences in modern society. By analyzing food preference and body size as examples, the Gender Binary Cycle theory in gender studies has been found to be able to explain the universal gender differences instead of the Hunter-Gatherer theory. The Gender Binary Cycle was developed by Tamar Saguy, who argued that gender inequality is due to the insistence of gender consciousness on the differences between the sexes. This belief in the inevitability of gender differences, based on the biological differences between the sexes, is called "biological-essentialist." [15]. This conception leads to a non-egalitarian gender ideology, whereby individuals act out their gender according to labels, promoting a binary gender environment, which in turn supports biological-essentialists [15]. In this cycle, the shaped environment of gender inequality leads people to come infinitely closer to their own gender image. The effects are multifaceted, encompassing consciousness, behavior, brain, and even genes. Therefore, it was hypothesized that this cycle is relevant to the creation of gender differences.

In 2009, Julia Colette Berbesque and Frank W. Marlowe studied the dietary preferences of Hadza foragers and concluded that "gender makes a difference in food preferences." Through one-on-one interviews, gender differences were found in Hadza's ranking of berries and meat, with females favoring berries and males favoring meat [16]. This difference was considered potentially valuable in understanding the origin and development of the gendered division of foraging labor in human evolution, known as the Hunter-gatherer theory. However, according to the authors' presentation of the Hadza's cultural concepts, it was found that there is much gender-based labeling in the tribe, such as males who have killed big game are called "real men," and females who eat specific parts of meat

DOI: 10.54254/2753-7048/46/20230884

(e.g., giblets) are considered to be dangerously taboo [16]. These cultural conceptualizations of double standards for both genders likely play an essential role in influencing female and male food preferences. A man's preference for meat is likely related to the honor it brings, while a woman's dislike of meat may be related to "taboo." Conducting experiments in cultures where gender perceptions are inherently biased should consider the influence of cognitive factors on the results of the experiments, or else it will be caught in a gender binary cycle.

It was hypothesized that overlooked gender cognitive biases are more likely to be responsible for differences in dietary preferences than the gendered division of labor among foragers. To prove this point, relevant literature in the field of anthropology that analyzes dietary components was examined, finding a relationship between the degree of gender equality and differences in dietary preferences. By comparing the 13C and 15N isotope contents of bone collagen from female men in two distinct Chinese periods with different degrees of gender equality (Yangshao period and Eastern Zhou period) through stable isotope analysis, it is possible to analyze the dietary differences between genders. The Yangshao culture (5000-2900 BC) belonged to an early farming society with no evidence of gender inequality, and the staple food of the locals was millets, whereas the Eastern Zhou period (771-221 BC), which is a patriarchal society, introduced wheat and barley, which were regarded as the food of inferior people [17]. Since different plants accumulate different stable isotopes at different rates, millets absorb more 13C and are known as C4 plants, while barley wheat absorbs less 13C and is known as C3 plants [17]. Therefore, the researchers used 13C content to detect cereal dietary categories. Furthermore, 15N can reflect the source of protein, with animal proteins high in 15N and legume proteins low in 15N [17]. According to the results of the study, there is no gender difference in both 13C and 15N content in human bones of Yangshao culture, while both 13C and 15N in female bones of the Eastern Zhou period are significantly lower than those of males and are similar to the 15N content in the bones of pigs and dogs of the same period [17]. This suggests that most of the grains consumed by Eastern Zhou women were barley-wheat and that the sources of protein intake were similar to those consumed by poultry. By comparing the results, it can be seen that food preferences are highly correlated with social ideology.

Furthermore, lower levels of 13C are more likely to suffer from porotic hyperostosis and Cribra Orbitalia [17], which can influence height [18]. This finding also argues for a possible cause of female-male body size differences. Examining the human skeleton during the Eastern Zhou period revealed that the maximum lengths of the femur and tibia were significantly reduced in females compared to the Yangshao period, while there was no significant change in males, and by using kernel density estimate (KDE), female-male height and size differences were found being greater during Eastern Zhou [17]. More than just height, the diminished strength of women has been evident throughout world history. According to research, prehistoric women's level of physical labor far exceeded that of modern women: the interlimb strength ratios of Neolithic, Bronze Age, and Iron Age women are only comparable to those of modern semi-elite rowers, and the humerus of women during the agricultural period was even more rigid than that of living athletes [19]. All of these results suggest that there is a large degree of possibility that most feminine traits are being shaped later in life rather than born in nature, leading to differences from men in multiple ways. One takes traits that have been domesticated by Gender Bias as evidence in support of sex differences, forming what appears to be a logical closure but is a pseudoscience.

One potential critique is that androgens, one of the recognized causes of male strength gains by modern science and technology, may explain the male strength advantage as more than a simple role of diet. However, some modern science also proves that estrogen levels have something to do with female muscle strength. Studies have shown that estrogen deficiency induces apoptosis in skeletal muscle, which can lead to loss of mass and strength [20]. It could also be evidence that estrogen can help with strength growth, but more definitive research evidence still needs to be included.

DOI: 10.54254/2753-7048/46/20230884

5. Conclusion

The gender-biased environment brought about by biological essentialism has shaped an irrefutable male-biased gender bias, which has led researchers to ignore and underestimate evidence of female predation and has thus served as evidence in support of the hunter-gatherer theory, which continues to reinforce the gender bias's circumscription of gender roles, and, ultimately, has contributed to the creation of unnatural gender differences from all sides consistently in the direction of female frailty and male superiority. Therefore, it's reasonable to conclude that the hunter-gatherer theory is both a consequence and a cause of gender differences.

Assessing the complete veracity of the hunter-gatherer theory remains a complex endeavor. The prevailing social milieu, molded by male-dominated biases, has undeniably influenced the evolution of modern gender expressions and genetic traits. Given this pervasive influence, seeking an untouched natural environment for comparison becomes elusive. Therefore, it is untenable to use the modern gender structure to extrapolate the gender structure of the past, and it is also unrealistic to use samples based on regimented environments to corroborate whether or not gender differences are a rule of nature.

More research focused on comparing prehistoric women's strengths to modern women, as well as the comparison of males, is expected to be conducted objectively to exclude the influence of bias as much as possible. However, the ultimate goal of studying gender differences is to reduce these differences and the discrimination and inequality they bring about, so it is more important to focus on the inequality that already exists, develop practical solutions, and pay attention to the issue of equality than to explain the differences.

References

[1] *Lee, R. B., Daly, R. H., Daly, R., & Press, C. U. (1999). The Cambridge. Encyclopedia of Hunters and Gatherers. Cambridge University Press.*

[2] *Sustainable Development Goals | United Nations Development Programme. (n.d.). UNDP. https://www.undp.org/sustainable-development-goals*

[3] *Haas, R., Watson, J. T., Buonasera, T., Southon, J., Chen, J. C., Noe, S. J., Smith, K., Llave, C. V., Eerkens, J. W., & Parker, G. J. (2020). Female hunters of the early Americas. Science Advances, 6(45). https://doi.org/10.1126/sciadv.abd0310*

[4] *Anderson, A., Chilczuk, S., Nelson, K., Ruther, R., & Wall-Scheffler, C. M. (2023). The Myth of Man the Hunter: Women's contribution to the hunt across ethnographic contexts. PLOS ONE, 18(6), e0287101. https://doi.org/10.1371/journal.pone.0287101*

[5] *Pohl, R. F. (2012). Confirmation bias. Cognitive Illusions: A Handbook on Fallacies. and Biases in Thinking, Judgement and Memory. Psychology Press.*

[6] *Krasnow, M. M., Truxaw, D., Gaulin, S. J. C., New, J., Ozono, H., Uono, S., Ueno, T., & Minemoto, K. (2011). Cognitive adaptations for gathering-related navigation in humans. Evolution and Human Behavior, 32(1), 1–12. https://doi.org/10.1016/j.evolhumbehav.2010.07.003*

[7] *Besson, T., Macchi, R., Rossi, J., Morio, C. Y., Kunimasa, Y., Nicol, C., ... & Millet, G. Y. (2022). Sex differences in endurance running. Sports Medicine, 52(6), 1235-1257.*

[8] *Cureton, K. J. (1981). Matching of male and female subjects using VO2 max. Research quarterly for exercise and sport, 52(2), 264-268.*

[9] *Almonroeder, T. G., & Benson, L. C. (2017). Sex differences in lower extremity. kinematics and patellofemoral kinetics during running. Journal of sports sciences, 35(16), 1575-1581.*

[10] *Chumanov, E. S., Wall-Scheffler, C., & Heiderscheit, B. C. (2008). Gender. differences in walking and running on level and inclined surfaces. Clinical biomechanics, 23(10), 1260-1268.*

[11] *Phillips, S. M., Atkinson, S. A., Tarnopolsky, M. A., & MacDougall, J. D. (1993). Gender differences in leucine kinetics and nitrogen balance in endurance athletes. Journal of Applied Physiology, 75(5), 2134-2141.*

[12] *Hunter, S. K. (2016). The relevance of sex differences in performance fatigability. Medicine and science in sports and exercise, 48(11), 2247.*

[13] Ross, A. (2019b). The woman who crashed the Boston marathon. JSTOR Daily. https://daily.jstor.org/the-woman-who-crashed-the-boston-marathon/
[14] Admin. (2014). The marathon and gender equality. Sociology Lens Insights. https://www.sociologylens.net/topics/collective-behaviour-and-social-movements/the-marathon-and-gender-equality/13203
[15] Saguy, T., Reifen-Tagar, M., & Joel, D. (2021). The gender-binary cycle: the. perpetual relations between a biological-essentialist view of gender, gender ideology, and gender-labelling and sorting. Philosophical Transactions of the Royal Society B, 376(1822), 20200141. https://doi.org/10.1098/rstb.2020.0141
[16] Berbesque, J., & Marlowe, F. W. (2009). Sex Differences in Food Preferences of. Hadza Hunter-Gatherers. Evolutionary Psychology, 7(4), 147470490900700. https://doi.org/10.1177/147470490900700409
[17] Dong, Y., Morgan, C., Chinenov, Y., Zhou, L., Fan, W., Ma, X., & Pechenkina, K. (2017). Shifting diets and the rise of male-biased inequality on the Central Plains of China during Eastern Zhou. Proceedings of the National Academy of Sciences of the United States of America, 114(5), 932–937. https://doi.org/10.1073/pnas.1611742114
[18] Marciniak, S., Bergey, C. M., Silva, A. M., Hałuszko, A., Furmanek, M., Veselka, B., Velemínský, P., Vercellotti, G., Wahl, J., Zariņa, G., Longhi, C., Kolář, J., Garrido-Pena, R., Fernández, R. F., Corral, A. M. H., Simalcsik, A., Müller, W. A., Sheridan, A., Miliauskienė, Ž.,. Perry, G. H. (2022). An integrative skeletal and paleogenomic analysis of stature variation suggests relatively reduced health for early European farmers. Proceedings of the National Academy of Sciences of the United States of America, 119(15). https://doi.org/10.1073/pnas.2106743119
[19] Macintosh, A. A., Pinhasi, R., & Stock, J. T. (2017). Prehistoric women's manual. labor exceeded that of athletes through the first 5500 years of farming in Central Europe. Science Advances, 3(11). https://doi.org/10.1126/sciadv.aao3893
[20] Collins, B. C., Laakkonen, E. K., & Lowe, D. A. (2019). Aging of the. musculoskeletal system: How the loss of estrogen impacts muscle strength. Bone, 123, 137–144. https://doi.org/10.1016/j.bone.2019.03.033