The Domestication of Humans

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The domestication of humans is not an issue of domesticity but of the effects of the domestication syndrome on a hominin species and its genome. These effects are well expressed in the ‘anatomically modern humans’, in their physiology, behavior, genetic defects, neuropathology, and distinctive neoteny. The physiological differences between modern (gracile) humans and their ancestors, robust *Homo sapiens* types, are all accounted for by the domestication syndrome. From deductions we can draw about early human behavior, it appears that modifications are attributable to the same cause. The domestication hypothesis ascribes the initiation of the changes to selective breeding introduced by the consistent selection of neotenous features. That would trigger genetic pleiotropy, causing the changes that are observed.

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The origin of our subspecies, *Homo sapiens sapiens*, is arguably the most divisive topic in hominin evolution. It is generally agreed that during the Late Pleistocene, robust hominins, including the Neanderthals and Denisovans, were replaced with gracile forms called ‘anatomically modern humans’. At least in Eurasia, this occurred over a relatively short period, a geological instant. A hypothesis was developed during the 1980s, proposing that our kin first arose in an unspecified part of Sub-Saharan Africa. From there, it colonized the three Old World continents and Australia. African Eve’s progeny was not interfertile with the primitive humans they encountered, who were culturally, technologically, cognitively, and intellectually inferior to them. So, they either outcompeted or exterminated them in history’s most comprehensive genocide. This ‘replacement hypothesis’ soon took over nearly the entire discipline, despite the lack of any archaeological, paleoanthropological, or genetic evidence in its favor. Its most severe shortcoming, however, was that it failed to explain the issue. What caused the changes differentiating gracile from robust Late Pleistocene hominins? Science is extensively based on the principle of causation. The causes and effects of the transition from robust to gracile hominins still need to be elucidated.

For instance, the replacement hypothesis does not explain what could have caused the change from the dysteleological progress of evolution to the apparent teleology of cultural development, or why we graciles are such neotenous primates, or what could have suspended the inherent laws of biological evolution. Nor does this failed hypothesis (refuted by the genetic demonstration that the robust and gracile humans were interfertile [1][2][3][4][5][6][7][8]) explain why natural selection failed to select against numerous deleterious genetic predispositions and defects. It also fails to elucidate why brain illness etiologies suggest that they involve mostly the same areas of the brain that are the phylogenetically latest; or why other extant primates are largely, if not entirely, free of such pathologies. Nor does it explain why the graciles are experiencing brain atrophy or any other of the many differences that set

them apart from the preceding robust humans [9]. Until 2008, the preservation of the mutations involved in the significant deleterious etiologies remained essentially unexplained, leading to the proposal of a unified theory of human self-domestication [10]. It explains not just all the questions posed here; it explicates the causes of all factors that constitute the human condition as we know it [11].

When applied to humans, the popular concept of domestication is related to the notion of domesticity. However, the scientific definition of domestication is an expression of the domestication syndrome [12][13]. Traditionally, human auto-domestication has usually been related to the changes in human behavior and lifestyles during the 'Neolithic revolution', with the introduction of agriculture and greater sedentariness [14][15][16]. Thus, the correlation of domestication with domos and the domicile pre-empted a scientific approach to the general issue until recently. Another limiting factor since Darwin [17] has been the implication that, typically, the domesticator has been the human species. This anthropocentrism is severely contradicted by the hundreds of other animal species, ranging from mammals to insects, that have domesticated other animal, plant, or fungi species. Moreover, domestication is a complex process involving symbiosis or mutualism [18][19][20][21] in many cases and can even involve aspects of gene–culture coevolution [22][23].

In vertebrate species, the domestication syndrome [12] is expressed by several universal features [24]. These include a reduction of tooth sizes and changes in craniofacial morphology, such as a shortened muzzle—or, in the case of humans, loss of prognathism. Others are alterations to ear and tail forms, shortening of the spine, reductions in total brain volume and specific brain regions, and depigmentation. Then there are alterations to adrenocorticotropic hormone levels and in concentrations of several neurotransmitters, sometimes accompanied by increased docility and tameness. Of distinctive consequences are the estrus cycles that occur more frequently or are non-seasonal and may even be eliminated entirely; and the preservation of a whole suite of typically neotenous effects, including juvenile behavior. Although it has been argued, based on experiences with foxes, that the concept of a domestication syndrome is inconclusive [25], others responded that the "family resemblance" among domesticates renders the notion useful [26][27]. However, they also proposed that rather than the domestication syndrome, emotional control and social motivation account for the changes in humans. More recently, it has been argued that the domestication syndrome is explained by shared reproductive disruption [28].

The domestication syndrome is facilitated by the mechanism of pleiotropy, an essential factor in domestication that defines when consistent selection for one gene affects two or more apparently unrelated traits in a population. For instance, when humans were the domesticators, they often selected in favor of lower flight response (docility), which introduced several other phenotypic traits coincidentally, such as facial architecture or reduction in dentition size [29].

References

1. Green, R.E.; Krause, J.; Briggs, A.W.; Maricic, T.; Stenzel, U.; Kircher, M.; Patterson, N.; Li, H.; Zhai, W.; Fritz, M.H.; et al. A draft sequence of the Neandertal genome. Science 2010, 328, 710–

722.

2. Reich, D.; Green, R.E.; Kircher, M.; Krause, J.; Patterson, N.; Durand, E.Y.; Viola, B.; Briggs, A.W.; Stenzel, U.; Johnson, P.L.; et al. Genetic history of an archaic hominin group from Denisova Cave in Siberia. Nature 2010, 468, 1053–1060.
3. Sankararaman, S.; Patterson, N.; Li, H.; Pääbo, S.; Reich, D. The date of interbreeding between Neandertals and modern humans. PloS Genet. 2012, 8, e1002947.
4. Prüfer, K.; Racimo, F.; Patterson, N.; Jay, F.; Sankararaman, S.; Sawyer, S.; Heinze, A.; Renaud, G.; Sudmant, P.H.; De Filippo, C.; et al. The complete genome sequence of a Neanderthal from the Altai Mountains. Nature 2014, 505, 43–49.
5. Sankararaman, S.; Mallick, S.; Dannemann, M.; Prüfer, K.; Kelso, J.; Pääbo, S.; Patterson, N.; Reich, D. The genomic landscape of Neanderthal ancestry in present day humans. Nature 2014, 507, 354–357.
6. Viegas, J. Ancient Human with 10% Neandertal Genes Found. 2015. Available online: https://www.seeker.com/ancient-human-with-10-percent-neanderthal-genes-found-1769961373.html (accessed on 15 June 2023).
7. Kuhlwilm, M.; Gronau, I.; Hubisz, M.J.; De Filippo, C.; Prado-Martinez, J.; Kircher, M.; Fu, Q.; Burbano, H.A.; Lalueza-Fox, C.; de La Rasilla, M.; et al. Ancient gene flow from early modern humans into eastern Neanderthals. Nature 2016, 530, 429–433.
8. Vernot, B.; Tucci, S.; Kelso, J.; Schraiber, J.G.; Wolf, A.B.; Gittelman, R.M.; Dannemann, M.; Grote, S.; McCoy, R.C.; Norton, H.; et al. Excavating Neandertal and Denisovan DNA from the genomes of Melanesian individuals. Science 2016, 352, 235–239.
9. Bednarik, R.G. Doing with less: Hominin brain atrophy. Homo—J. Comp. Human Biol. 2014, 65, 433–449.
10. Bednarik, R.G. The domestication of humans. Anthropologie 2008, 46, 1–17.
11. Bednarik, R.G. The Human Condition; Springer: New York, NY, USA, 2011.
12. Hammer, K. Das Domestikationssyndrom. Kulturpflanze 1984, 32, 11–34.
13. Wilkins, A.S.; Wrangham, R.W.; Fitch, W.T. The ‘domestication syndrome’ in mammals: A unified explanation based on neural crest cell behavior and genetics. Genetics 2014, 197, 795–808.
14. Wilson, P. The Domestication of the Human Species; Yale University Press: New Haven, CT, USA, 1988.
15. Hodder, I. The Domestication of Europe: Structure and Contingency in Neolithic Societies; Basil Blackwell: Oxford, UK, 1990.
16. Leach, H.M. Human domestication reconsidered. Curr. Anthr. 2003, 44, 349–368.

17. Darwin, C. The Variation of Animals and Plants under Domestication; John Murray: London, UK, 1868; Volume 2.
18. Rindos, D. The Origins of Agriculture: An Evolutionary Perspective; Academic Press: Orlando, FL, USA, 1984.
19. Hölldobler, B.; Wilson, E.O. The Ants; Belknap: Cambridge, MA, USA, 1990.
20. Munkacsi, A.B.; Pan, J.J.; Villesen, P.; Mueller, U.G.; Blackwell, M.; McLaughlin, D.J. Convergent coevolution in the domestication of coral mushrooms by fungus-growing ants. Proc. Roy. Soc. B Biol. Sci. 2004, 271, 1777–1782.
21. Mueller, U.G.; Gerardo, N.M.; Aanen, D.K.; Six, D.L.; Schultz, T.R. The evolution of agriculture in insects. Ann. Rev. Ecol. Evol. Syst. 2005, 36, 563–595.
22. Boyd, R.; Richerson, P.J. The Origin and Evolution of Cultures; Oxford University Press: New York, NY, USA, 2005.
23. Richerson, P.J.; Boyd, R. Not by Genes Alone: How Culture Transformed Human Evolution; University of Chicago Press: Chicago, IL, USA, 2005.
24. Price, E.O. Animal Domestication and Behavior; CABI Publishing: New York, NY, USA, 2002.
25. Lord, K.A.; Larson, G.; Coppinger, R.P.; Karlsson, E.K. The history of farm foxes undermines the animal domestication syndrome. Trends Ecol. Evol. 2020, 35, 125–136.
26. Shilton, D.; Breski, M.; Dor, D.; Jablonka, E. Human social evolution: Self-domestication or self-control? Front. Psychol. 2020, 11, 1–22.
27. Sánchez-Villagra, M.R.; van Schaik, C. Evaluating the selfdomestication hypothesis of human evolution. Evol. Anthropol. 2019, 28, 133–143.
28. Gleeson, B.T.; Wilson, L.A.B. Shared reproductive disruption, not neural crest or tameness, explains the domestication syndrome. Proc. Roy. Soc. B 2023, 290, 20222464.
29. Trut, L.; Oskina, I.; Kharlamova, A. Animal evolution during domestication: The domesticated fox as a model. BioEssays 2009, 31, 349–360.