Hand Preference: Genetics and Evolution

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Introduction

Handedness is the preferential use of one hand over another in various tasks such as writing, eating, and holding objects. On average, the vast majority of the population — approximately 87% — is right-handed, while a minority — approximately 12% —are left-handed. An extremely small percentage, less than 1% of the human population, is ambidextrous, meaning they can perform tasks equally well with either hand (de Kovel, C. G. F., Carrión-Castillo, A., & Francks, C.).

Handedness is closely linked to brain lateralization,which is the way that specific functions are specialized in one side of the brain. The left hemisphere of the brain is responsible for control of the right hand and the right side of the body as a whole.

There are many factors that influence a person's handedness, however the exact reasons behind the trait are not clear yet. This paper will explore our current understanding of the genetic factors that contribute to handedness and also look at perspectives on how and when hand preference might have developed.

Biological and Genetic Factors in Handedness

Hand preference can differ among groups, one factor being sex. Research shows that males are more likely to be left-handed than females. In a U.S. dataset aged 10–86 years, 9.9% of women were non-right-handed, versus 12.6% men (Gilbert, A. N. & Wysocki, C. J. 1992). Data from a UK Biobank cohort study gives similar results to this (Table 1 distribution of responses to question about hand preference), showing that a higher proportion of males were non-right-handed compared to females (de Kovel, C. G. F., Carrión-Castillo, A., & Francks, C.).

Table 1.

Distribution of responses to question about hand preference.

Hand use	Males	Females	Total
Right-handed	199,915 (87.4%)	246,021 (90.1%)	445,936 (89%)
Left-handed	23,792 (10.4%)	23,059 (8.4%)	46,851 (9.3%)
Use both right and left hands equally	4,847 (2.1%)	3,813 (1.4%)	8,660 (1.7%)
Prefer not to answer	169 (0.007%)	114 (0.004%)	283 (0.005%)
TOTAL	228,723	273,107	501,730

Table 1. The distribution of responses to questions about hand preference among a UK cohort from de Kovel, C.G.F, Carrion-Castillo, A, and Francks, C.

The underlying reasons for this imbalance are still unclear and scientists continue to investigate the connection between sex and handedness. However, researchers have identified some of the genetic factors that contribute to handedness itself.

Handedness is a polygenic trait, meaning it is influenced by multiple genes. Up to 40 different genetic loci may contribute to it (Medline Plus, 2020). While on its own, a single gene might have little to no effect, collectively, the genes might be responsible for up to 40% of the expression of the trait. Additionally, children of left-handed parents are more likely, even if by a small percentage, to be left-handed (Medline Plus, 2020). This fact reinforces the claim that genetics is responsible for at least part of the trait. The other approximately 60% of influences include cultural factors, such as pressure to use the “proper hand,” and neurological development.

To date, scientists have identified only a few of the genes linked to handedness, such as the LRRTM1 protein-coding gene, which is one of, if not the first genetic influences on human handedness to be identified. According to research, this gene influences behavioural lateralization – the right or left hemisphere of the brain being responsible for specific behaviors – including handedness. To add to this, it is also possible that the LRRTM1 gene influences this trait more in selected populations because findings detected the gene’s influence in dyslexic siblings but not in the other population (Francks C, Maegawa S, Laurén J, et al 2007). However, it is possible that other external factors like the study’s small sample size contributed to this, and further research is yet to show a precise connection.

Connecting back, some researchers have also hypothesized that at some point in hominid (all great apes: human, chimpanzee, gorilla and orangutan) evolution, a mutation may have produced a "dextral" (D) allele that led to the strong bias towards right-hand dominance (Corballis M. C. 1997).

Evolution of Handedness

When looking at the evolution of handedness and right-hand dominance, the main question is how and when did a hand preference in humans develop. A definitive answer might not be possible since, of course, it isn’t possible to go back in time, but it is possible to make hypotheses based on evidence. Many researchers and scientists have different perspectives based on what they have found and how they have interpreted the results.

One perspective suggests that handedness evolved after hominins transitioned from walking on four legs to walking on two, freeing their hands for tasks like tool-making. This shift may have triggered the development of hand preference, as early humans began using one hand more for efficiently carrying out tasks. Evidence supporting this idea comes from the way stone tools were created, with hominins using either their left or right hand to chip or knap the stone. Research has shown that in Koobi Fora, Kenya, around 1.5 million years ago, tools made by early humans contain signs of right-handedness (Goldman 2014). This aligns with fossil

evidence, such as the Nariokotome Boy, a nearly complete 1.6-million-year-old *Homo ergaster* skeleton, whose arm and shoulder structure indicate a preference for the right hand (Balter 2009).

One critique of this perspective and research is that a single fossil or a single location cannot confirm that the trait of right-handedness was widespread at the time (Balter 2009). Hand preference, also being influenced by other factors such as culture and neurological factors, might have varied significantly across regions. This makes it extremely difficult to pinpoint exactly when the trait of right-hand dominance developed; however, additional evidence relating to teeth wear and tool use does show that by 500,000-600,000 years ago, a clear right-hand preference trait had developed in societies (Balter 2009; Goldman 2014), giving us at least some level of confirmation of the dates.

Another perspective, instead of examining tools and fossils,tries to link communication and gestures to the development of hand preference. Linguistic processing and development of language, connected to the left hemisphere of the brain, is shown to develop in humans between 2 and 4 years of age. Studies have also shown that infants and toddlers show a strong degree of right-hand preference in communicative gestures such as pointing (Cochet, H., & Byrne, R. W. 2013). This evidence suggests that gestural communication and language also played a role in the evolution of hand preferences.

Conclusion

Overall, while research has uncovered some genetic and evolutionary influences on handedness, many questions remain. Researchers have determined how much genetics play a role in the expression of the trait, and they have also identified a few genes that can influence it. However, all the genes have yet to be discovered, and more research is needed to understand the full extent of their effect on the trait. Regarding the evolution and development of hand preference in humans, although considerable evidence related to tool use, fossils, and brain lateralization has been uncovered, the exact timeline and method of evolution remain unknown and a lot about the topic is still unknown. Additionally, a lot more research is yet to be done to explain why the right-hand became dominant instead of the left- Why was the right hand more beneficial to humans? That is something still unknown to us.

References

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