Q8(c)

Critically discuss the synergistic effect of biological and cultural factors in human evolution.

UPSC Civil Services Mains 2024 · Anthropology GS 1 · 15 marks · Biological and Cultural factors in human evolution.

(a) Biological and Cultural factors in human evolution.

Core demand of the question

- Explain biological-cultural synergy in human evolution
- Use feedback examples across diet, technology, disease, life history and genes
- Include fossil, genetic, ethnographic and Indian evidence
- Critically avoid both biological and cultural determinism

Revision summary

Biocultural evolution is reciprocal feedback among genes, development, behaviour and constructed environments.

Bipedalism enabled new carrying and tool behaviours; technology then changed foraging and cooperation.

Cooking may raise energy return, but its chronology cannot alone explain early Homo.

Dairying/lactase persistence and malaria/HbS are gene-culture-ecology examples.

Yajnik's thin-fat phenotype shows developmental mismatch in India.

Hrdy, Hawkes and niche-construction theory connect cooperative care, long childhood and cumulative culture.

Introduction

- **Human evolution is biocultural:** inherited bodies create cultural possibilities, while learned behaviour modifies diet, disease, mating and ecology, thereby altering development and natural selection. The relationship is recursive, not biology first and culture later.

Body

Feedbacks that made humans

Bipedalism and technology: Mosaic habitats selected habitual bipedalism before large brains, as Laetoli footprints show. Freed hands could carry food and infants and later make tools; tool-assisted foraging then favoured learning and cooperation. This is feedback, not the discarded claim that tools alone caused upright posture.

Diet, fire and brains: Stone cutting expanded access to meat and marrow. **Richard Wrangham's** cooking hypothesis argues that fire increased digestibility and reduced chewing and gut costs, supporting an energy-expensive brain. Yet secure habitual cooking is later than the earliest Homo, so cooking cannot alone explain initial encephalisation. Teeth, isotopes and

Oldowan cut marks provide independent evidence.

Gene-culture coevolution: Dairying created selection for adult lactase persistence in several pastoral populations through different regulatory variants. Starch-rich diets are associated at population level with higher **AMY1** copy numbers, though causality and effect size are debated. Agriculture increased population density and infectious exposure; malaria ecology plus settlement helped maintain HbS in some regions. Allison's sickle-cell case links gene, pathogen and subsistence landscape.

Developmental plasticity: Culture changes bodies within a lifetime. Childhood nutrition, workload and disease affect stature and pelvic growth. Barker's developmental-origins work and **C. S. Yajnik's** Indian thin-fat phenotype show how foetal constraint can meet later urban abundance to raise metabolic risk.

Social brain and life history: Long childhood, alloparenting, language and cumulative learning form a cooperative package. **Sarah Hrdy's** cooperative-breeding model and **Kristen Hawkes's** grandmother hypothesis connect care networks to survival and longevity. Culture supplies information beyond one genome; biology supplies plastic brains and prolonged dependence.

- **Niche-construction theorists such as** F. John Odling-Smee **formalise this reciprocity:** organisms modify selective environments. But not every cultural practice is adaptive, and genetic stories require population evidence. Cultural diffusion can outpace genes, while inequality distributes biological costs unevenly.

Flow diagram

Biological variation and plasticity -> Cultural innovation

Cultural innovation -> Constructed diet disease and social niche

Constructed diet disease and social niche -> Development and selection

Development and selection -> Biological variation and plasticity

Cultural innovation -> Cumulative learning

Cumulative learning -> Cultural innovation

Conclusion

Humans did not escape evolution through culture; culture became a major evolutionary environment. Tools, cooking, dairying, farming and cooperative care repeatedly changed selection and development. A biocultural model explains the feedback without reducing culture to genes or biology to custom.

Facts & figures

Lactase persistence

Adult milk digestion evolved through different regulatory variants in several dairying populations, a classic convergent gene-culture case.

Laetoli

Footprints around 3.66 million years old demonstrate habitual bipedal locomotion well before major Homo brain expansion.

Cooking hypothesis

Wrangham links cooked food to higher energy returns and reduced digestive costs; archaeological timing remains a major limitation.

Cooperative breeding

Hrdy argues that care by individuals beyond the mother helped shape human social cognition and prolonged childhood.