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Evolutionary Origins of Religious Cognition: Possible Contributions of Neanderthal and Denisovan Genetic Heritage to Human Religious Concepts

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Abstract

Although Homo sapiens remains the only species with clearly documented religious systems, archaeological evidence suggests that other archaic humans may have exhibited behaviors associated with proto-religious thought, including symbolic practices and possible mortuary rituals. In particular, Homo neanderthalensis and the population known as Denisovans possessed large and complex brains, including well-developed frontal regions associated with social cognition and symbolic processing. This article explores the possibility that these archaic humans possessed early conceptualizations of death and mortality that could represent precursors to later religious ideas. By examining archaeological evidence, genetic research on archaic introgression, and theories from evolutionary anthropology and cognitive science of religion, the study investigates how interactions between archaic humans and modern humans may have contributed to the cognitive and cultural foundations of religious thought. Particular attention is given to the potential influence of archaic genetic heritage on cognitive traits related to agency detection, social cohesion, and attitudes toward death. The article also discusses whether such evolutionary and cognitive influences may have indirectly shaped later religious traditions in different cultural contexts, including both Western and Eastern religious systems. While direct causal connections remain difficult to establish, this study aims to provide an interdisciplinary framework for understanding how archaic human populations may have contributed to the deep evolutionary roots of human religiosity.

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Introduction

Religious belief represents one of the most distinctive cognitive and cultural characteristics of Homo sapiens. Across diverse societies and historical periods, humans have developed complex systems of beliefs concerning supernatural agents, moral order, death, and the possibility of an afterlife. Despite the near universality of religion in human cultures, the evolutionary origins of religious cognition remain an open question in fields such as Evolutionary Anthropology, Cognitive Science of Religion, and Archaeology.

A growing body of archaeological evidence suggests that certain behaviors often associated with symbolic thinking and proto-religious concepts may have existed prior to the emergence of fully developed religious systems. In particular, evidence from Homo neanderthalensis indicates the presence of mortuary practices and potentially symbolic behavior. Discoveries at sites such as Shanidar Cave and La Chapelle-aux-Saints suggest that Neanderthals intentionally buried their dead and may have engaged in ritualized treatment of bodies. Such practices could indicate an emerging awareness of mortality and possibly early conceptualizations of death that go beyond purely practical behavior. Evidence related to the population known as Denisovans remains more limited, largely

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due to the fragmentary nature of the fossil record. However, archaeological findings from Denisova Cave reveal the presence of sophisticated tools and symbolic artifacts, suggesting that Denisovans possessed advanced cognitive capacities comparable in some respects to those of other archaic humans.

Recent advances in paleogenomics have further complicated our understanding of human evolution. Genetic studies have demonstrated that modern populations of Homo sapiens retain a measurable genetic contribution from both Homo neanderthalensis and Denisovans as a result of interbreeding events that occurred tens of thousands of years ago. This genetic introgression raises the possibility that certain cognitive traits present in modern humans may have been influenced, at least in part, by archaic human populations. While previous research has extensively examined the archaeological and genetic interactions between archaic and modern humans, relatively little attention has been given to the potential implications of these interactions for the evolutionary origins of religious cognition. In particular, the possible role of archaic human cognition in shaping early human interpretations of death, agency, and the supernatural remains largely unexplored.

This study proposes a conceptual framework for understanding how interactions between archaic humans and modern humans may have influenced early perceptions of mortality, symbolic thinking, and the emergence of religious concepts in later human societies.

Main

1. Neuroanatomical Differences and Cognitive Implications in Archaic Humans

Understanding the cognitive capacities of archaic human populations is essential for exploring the possible evolutionary origins of religious cognition. Two of the most significant archaic human groups that interacted with modern humans were Homo neanderthalensis and the population known as Denisovans. Although both groups are extinct, fossil evidence and genetic research provide important insights into their neurological characteristics and potential cognitive abilities.

Studies of fossilized skulls indicate that the brain size of Homo neanderthalensis was comparable to, and in some cases slightly larger than, that of modern Homo sapiens. However, differences appear to have existed not only in absolute brain size but also in the overall structure and organization of the brain. Neanderthal skulls tend to exhibit a more elongated cranial shape and a larger occipital region, suggesting that a greater proportion of neural resources may have been devoted to visual processing and sensorimotor coordination.

In contrast, the brain organization of modern humans appears to involve a relatively expanded parietal region, which is associated with complex integration of sensory information, spatial cognition, and aspects of symbolic thought. Some researchers have proposed that these structural differences may have influenced patterns of social cognition, communication, and abstract reasoning. However, direct conclusions about cognitive differences remain limited due to the indirect nature of the fossil evidence.

Despite these structural differences, certain fundamental components of the human emotional and motivational system appear to have remained relatively conserved across these species. In particular, the limbic system, which plays a central role in emotional processing, memory formation, and responses to threat or social stimuli, does not appear to differ dramatically between archaic humans and modern humans based on current anatomical reconstructions. This relative continuity suggests that basic emotional responses to death, loss, and social bonding were likely shared among these populations.

One brain region that is frequently associated with higher cognitive processes in humans is the prefrontal cortex. In modern Homo sapiens, the prefrontal cortex plays a key role in executive functions such as planning, decision-making, social reasoning, and the ability to construct complex mental representations. Within this region, the dorsolateral prefrontal cortex (dlPFC) is particularly important for abstract reasoning, working memory, and cognitive flexibility. The strong development of the dlPFC in modern humans is often associated with the ability to construct highly complex symbolic systems, including language, philosophy, and organized religious thought.

Another important region is the ventromedial prefrontal cortex (vmPFC), which is involved in emotional evaluation, moral judgment, and social decision-making. Although the differences between archaic humans and modern humans in this region are less clear, the vmPFC is considered crucial for integrating emotional and social information with higher-level cognitive processing. This integration may play an important role in the formation of moral norms, social cohesion, and belief systems that later became central components of religion.

A third region of interest is the ventrolateral prefrontal cortex (vlPFC), located in the lower lateral portion of the frontal lobe. This area plays an important role in response inhibition, motor control, and aspects of speech regulation. Fossil evidence suggests that the frontal base of archaic humans, including both Homo neanderthalensis and Denisovans, was relatively broad compared with that of modern humans. Reconstructions based on cranial morphology and endocranial casts have therefore led some researchers to speculate that regions corresponding to the vlPFC may have been relatively wide or robust in these archaic populations. If this interpretation is correct, the vlPFC in Denisovans may have been particularly well developed for tasks involving motor planning, manual manipulation of tools, and rapid inhibitory control. However, such a configuration might have been less specialized for the complex syntactic and linguistic processing that characterizes modern human language systems. Due to the fragmentary nature of Denisovan fossil material, these interpretations remain hypothetical and require further empirical investigation.

Knowledge of the neuroanatomy of Denisovans remains considerably more limited, primarily because the fossil record consists of only a few bone fragments and teeth discovered in Denisova Cave. However, genetic and morphological analyses provide several indirect insights into their possible anatomy and cognitive characteristics.

Genetic markers suggest that Denisovans possessed broader facial structures and possibly wider jaws than those of Homo neanderthalensis. This observation has led some researchers to propose that their cranial base may also have been somewhat broader and more robust. Additionally, the wide geographic distribution of Denisovans—from the Altai region to parts of Southeast Asia—may indicate a degree of ecological and cognitive flexibility that allowed them to adapt to diverse environments.

Recent studies involving the analysis of DNA methylation patterns have also suggested regulatory differences in genes associated with neuronal development. Some of these regulatory differences appear to involve genes related to the development of the temporal lobes, which are regions associated with auditory processing, memory formation, and aspects of language comprehension. Such findings have led to hypotheses that Denisovan neural organization may have been adapted to particular acoustic environments or communication patterns.

Altogether, these genetic and anatomical indications raise the possibility that certain regulatory differences in neural development may have affected prefrontal and temporal cortical organization in Denisovans. Some researchers have therefore proposed that specific areas of the prefrontal cortex, including regions functionally comparable to the ventromedial prefrontal cortex and parts of the dorsolateral prefrontal cortex, may have shown developmental patterns somewhat closer to those seen in modern humans than those inferred for Neanderthals. However, due to the limited fossil evidence, such interpretations remain speculative and require further investigation.

Overall, the available evidence suggests that archaic human populations possessed neurological and cognitive capacities significantly more advanced than those of earlier hominin species. Archaeological findings indicating tool complexity, social cooperation, and possible mortuary practices further support the view that these populations were capable of sophisticated cognitive and social behavior.

Taken together, these observations suggest that archaic humans likely possessed cognitive systems capable of supporting symbolic thought and early interpretations of mortality. While these capacities cannot be equated with fully developed religious systems, they may represent an important evolutionary foundation upon which later human religious cognition developed.

2. Genetic Legacy of Archaic Humans in Modern Populations

One of the most significant developments in recent decades for understanding human evolution has been the emergence of paleogenomics. Ancient DNA analysis has revealed that modern populations of Homo sapiens did not simply replace other archaic humans but interacted and interbred with them. As a result, small but measurable portions of archaic DNA remain present in contemporary human genomes. Genomic research has demonstrated that individuals outside of Africa typically carry about 1–2% genetic material inherited from Homo neanderthalensis, reflecting multiple episodes of interbreeding that likely occurred roughly 50,000–60,000 years ago during the expansion of modern humans into Eurasia. In addition to Neanderthal ancestry, certain populations—particularly in East Asia, Southeast Asia, and Oceania—also carry genetic material from Denisovans. In some groups, such as populations of Melanesia and parts of Southeast Asia, Denisovan ancestry accounts for up to approximately 4–6% of the genome, indicating a substantial role for Denisovan gene flow in these regions.

Numerous introgressed genetic variants appear to have been preserved in modern humans because they conferred adaptive advantages in specific environments. For example, variants of the gene EPAS1, inherited from Denisovans, are associated with high-altitude adaptation among Tibetan populations. This gene influences the regulation of hemoglobin production and improves physiological performance under hypoxic conditions, indirectly supporting brain function, including in energy-demanding regions like the prefrontal cortex (PFC). Beyond high-altitude adaptation, other Denisovan-derived variants present in populations of Oceania and Southeast Asia appear to influence neural development and synaptic function. Notably, two genes—TNRC6B and ZNF448—have been identified in these populations as having unique Denisovan alleles. TNRC6B is directly associated with synaptic plasticity, learning, and memory processes. Studies suggest that modern carriers of these Denisovan variants exhibit subtle differences in cortical connectivity, particularly in the prefrontal regions, potentially affecting the way information is filtered and integrated, without implying differences in standardized measures of intelligence.

The GLI3 gene, a key component of the Sonic Hedgehog (Shh) signaling pathway, also shows Denisovan-specific variants in Asian populations. GLI3 is critical for the formation of the prefrontal cortex during embryonic development. These Denisovan alleles may have influenced neuronal density and the microarchitecture of the lower prefrontal regions, including the ventromedial prefrontal cortex (vmPFC). Such subtle structural differences could have affected the integration of social and emotional signals processed in vmPFC, though direct measurement in modern humans remains challenging. Metabolic adaptations provide an additional potential mechanism for Denisovan influence. Variants involved in glucose and oxygen metabolism, including EPAS1, may optimize energy delivery to high-demand brain regions like vmPFC, supporting sustained cognitive function under environmental stress or low-resource conditions. This suggests that in some modern Asian populations, Denisovan alleles could contribute to a more robust energy supply for prefrontal processing, without implying inherent cognitive superiority.

In addition to these Denisovan contributions, both Neanderthal and Denisovan genomes contain archaic variants of adenylosuccinate lyase (ADSL), an enzyme involved in purine metabolism. Comparative analyses indicate that certain purine metabolic pathways in modern humans are downregulated relative to archaic genomes, suggesting that archaic neural energy metabolism may have functioned differently. Such differences could have influenced neural efficiency or synaptic activity in prefrontal regions, including dlPFC and vmPFC. Epigenetic analyses, such as DNA methylation mapping performed by Liran Carmel and colleagues, indicate that Denisovan genes involved in prefrontal and limbic development exhibited distinct regulatory patterns. While it is impossible to derive exact anatomical measurements from methylation alone, these findings suggest possible variations in the development and connectivity of the prefrontal cortex, supporting the notion that Denisovan ancestry may have influenced subtle aspects of neural architecture and functional potential. It is crucial to emphasize that claims about direct effects of archaic genetic variants on cognition remain speculative. Cognitive performance arises from complex interactions among genetic, environmental, developmental, and cultural factors. At present, no robust evidence supports simple associations between Denisovan ancestry and measurable intelligence. However, these genetic contributions may have shaped neural developmental trajectories and functional architecture in modern humans, particularly in regions like vmPFC and dlPFC that are critical for social cognition, emotional regulation, and complex information processing.

From the perspective of the present study, these observations underscore the potential value of considering Denisovan genetic contributions within a broader evolutionary framework for the origins of complex cognitive and symbolic capacities. While direct causal effects on intelligence or religious cognition cannot be established, understanding the influence of archaic gene flow on prefrontal networks may provide insight into the evolutionary background from which uniquely human symbolic thought, social reasoning, and religious conceptualization emerged.

3. Cultural Practices of Neanderthals and Denisovans and Their Potential Influence on Later Human Societies

While genetic introgression demonstrates a biological legacy of archaic humans in modern populations, it is equally important to consider their cultural contributions. Archaeological evidence provides insights into the material culture, technological skills, and symbolic practices of Neanderthals and Denisovans, which may have indirectly shaped aspects of Homo sapiens behavior, social organization, and symbolic cognition.

Although the Denisovan fossil record is limited, several artifacts recovered from Denisova Cave suggest a remarkable level of technological sophistication. Notably, a finely crafted chloritolite bracelet exhibits traces of high-speed drilling and meticulous polishing, techniques that would appear in Homo sapiens contexts only tens of thousands of years later. Such craftsmanship indicates that Denisovans possessed advanced motor skills, conceptual understanding of material properties, and knowledge of precision toolmaking. These observations support the hypothesis that Denisovan populations were capable of high-precision technological innovation, and that prolonged cohabitation and interbreeding with Homo sapiens over multiple generations could have facilitated the transfer of both genetic and cultural information, including terminologies for animals, plants, and landscape features, as well as technical know-how for tool production and clothing manufacture. The presence of Denisovan-derived alleles in modern populations of Oceania and Southeast Asia, where up to 4–6% of the genome derives from Denisovans, is consistent with the idea that these interactions were sustained over extended periods, potentially establishing hybrid communities in which cultural exchange occurred alongside genetic introgression. Intriguingly, certain mythological motifs in these regions, such as narratives of spirit beings inhabiting mountains and possessing secret knowledge, have been interpreted by some researchers as residual cultural echoes of archaic human interactions, although such interpretations remain speculative.

In Europe and Western Asia, Neanderthals exhibit a similarly rich cultural repertoire. Evidence from sites such as El Sidrón Cave indicates the use of medicinal plants, including species with antibiotic or analgesic properties, suggesting practical knowledge of local flora that may have been transmitted to Homo sapiens populations arriving in these regions. Mortuary practices, including deliberate burial with associated ornaments, the use of ochre, and body adornment, have been documented at sites such as La Chapelle-aux-Saints, demonstrating ritualized attention to the deceased. Such practices indicate an early form of symbolic engagement with mortality, which may have influenced the development of ancestor veneration, ritual behavior, and social norms in later human societies. Technological innovations, including specialized bone tools known as lissoirs for processing hides, also predate similar Homo sapiens tools, providing concrete examples of cultural transmission of practical knowledge. Furthermore, evidence for early abstract art, including red linear motifs and hand stencils in Spanish caves, demonstrates symbolic expression and visual communication by Neanderthals prior to the arrival of Homo sapiens, suggesting that cognitive capacities for abstraction and symbolism were already present in these populations.

Taken together, these observations support the hypothesis that prolonged interactions between archaic humans and Homo sapiens facilitated not only genetic introgression but also cultural exchange, encompassing technology, social practices, and symbolic behaviors. Denisovans appear to have contributed advanced technological skills and possibly influenced the organization of social and ritual practices in hybrid populations, whereas Neanderthals provided knowledge of local ecology, burial customs, symbolic expression, and tool specialization. Over successive generations, these cultural elements may have been assimilated and transformed within Homo sapiens populations, contributing to diverse strands of material culture, social organization, and symbolic cognition that later became embedded in Western and Eastern cultural traditions. While it is not possible to claim direct inheritance of religious systems, these findings suggest that the behavioral and technological practices of Denisovans and Neanderthals established a foundational substrate upon which later human symbolic thought, ritual behavior, and cultural complexity were built.

4. Social Contacts and Interactions between Archaic Humans and Homo sapiens

The prolonged coexistence and interactions between archaic humans, including Denisovans, Neanderthals, and early Homo sapiens, provide a potentially significant context for understanding the evolution of both cognitive and cultural traits. While direct evidence for specific religious behaviors is unavailable, integrating archaeological, genetic, and neuroanatomical data allows for careful hypotheses regarding the transmission of cognitive predispositions, symbolic behaviors, and cultural practices.

Recent studies have highlighted Homo juluensis, a population from East Asia previously classified variably as archaic Homo sapiens or “Chinese Neanderthals,” as likely representing Denisovans or their closest eastern branch. Fossil evidence, including massive jaws and broad facial structures, supports the hypothesis of a wide cranial base and potentially highly developed vmPFC and vlPFC, consistent with previous neuroanatomical models. Modern East Asian populations carry up to 5% of their genome from these populations, indicating a direct genetic and cognitive legacy. Similarly, the Nesher Ramla Homo population from the Levant appears to have functioned as a genetic and technological bridge between Neanderthals and Denisovans. Their presence demonstrates that gene flow and cultural exchange were ongoing processes, and that prefrontal cortical complexity began evolving even before the divergence of these archaic populations. Although Nesher Ramla Homo contributed less directly to modern human genomes than Denisovans, they exemplify the early stages of prefrontal specialization and social cognition that would shape subsequent interactions.

Denisovans, adapted to the harsh environments of the Altai Mountains and Tibetan Plateau, may have developed rich symbolic systems, including myths and rituals associated with mountainous landscapes. Some researchers suggest that elements of Siberian and Tibetan shamanism may trace to these deep temporal layers. The EPAS1 gene, conferring adaptation to hypoxia, enabled Homo sapiens populations to survive in these regions and potentially internalize the Denisovan conceptualization of “sacred landscapes.” If Denisovans indeed had highly developed vmPFC and vlPFC regions, their strong emotional attachment to group members could have facilitated early forms of ancestor veneration, later adopted by Homo sapiens. These processes may underlie the collective orientation and polytheistic tendencies observed in Eastern religious traditions, particularly in the early stages of cultural evolution, before long-range contact between East and West.

Denisovan technological expertise, exemplified by high-precision stone artifacts such as the chloritolite bracelet, may have contributed to ritualized craftsmanship in later Homo sapiens. Attention to detail and fine motor control could have been culturally transmitted, influencing the ceremonial use of stones like jade and nephrite in East Asia. Genetic contributions further support this model: the TNRC6B gene, associated with synaptic plasticity, may enhance long-term memory and learning, while EPAS1 and related metabolic adaptations improve cognitive endurance, allowing sustained prefrontal activity important for ritual, learning, and social cohesion.

Neanderthal interactions with early Homo sapiens in Europe may have produced complementary outcomes. European populations inherited genes influencing circadian rhythms (ASB1, EXOC6), adapting cognition to seasonal environmental changes, and alleles affecting

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dopaminergic sensitivity, potentially promoting novelty-seeking and risk-taking behaviors. These traits may have contributed to individualistic tendencies and exploratory behaviors, which shaped symbolic practices and social structures that influenced Western cultural trajectories.

Taken together, the evidence suggests that social and genetic interactions among Denisovans, Neanderthals, Nesher Ramla Homo, Homo juluensis, and early Homo sapiens were multifaceted, involving both cultural and cognitive transmission. Denisovan influence in Asia may have reinforced collective identity, ancestor veneration, and ritualized attention to sacred landscapes, while Neanderthal contributions in Europe may have favored individualism and innovation. These interactions, even if not creating new species, established a cognitive and cultural substrate that plausibly contributed to the later divergence of Eastern and Western cultural and religious orientations.

5. Cultural Divergence and the Legacy of Archaic Humans in Early Civilizationsɘ

By the late stages of human prehistory, the direct influence of archaic human populations had largely shifted from biological interaction to long-term cultural consequences embedded within expanding Homo sapiens societies. While earlier sections focused on the genetic, neuroanatomical, and social interactions between archaic humans and modern humans, the emergence of complex societies during the Neolithic and Bronze Age marks the transition into a phase where cultural evolution became the dominant force shaping human civilizations.

During the early phases of cultural development, populations of Homo sapiens in Eurasia carried varying degrees of genetic heritage from Homo neanderthalensis and Denisovans. These inherited traits may have influenced subtle aspects of cognition, behavior, and social organization. Over thousands of years, however, these biological predispositions were increasingly embedded within complex cultural systems that began to diverge regionally, particularly between what later became the broad spheres of Western and Eastern civilization.

In Europe and parts of Western Eurasia, interactions with Neanderthal populations may have contributed to cognitive tendencies associated with territorial awareness, environmental mapping, and strategic planning. Such behavioral traits would have been particularly advantageous in environments characterized by seasonal fluctuations and competition for resources. Archaeological and anthropological interpretations sometimes link these tendencies to the later emergence of fortified settlements and territorial states in early European societies. In this perspective, early political structures in the West—often organized around defense of land, resources, and borders—may reflect long-standing cognitive strategies emphasizing spatial reasoning and planning. These functions are closely associated with the dorsolateral prefrontal cortex (dlPFC), which plays a key role in executive control, long-term planning, and strategic decision-making.

In contrast, populations in East and Southeast Asia carrying Denisovan ancestry may have inherited behavioral tendencies associated with collective organization, emotional cohesion, and sustained attention to complex tasks. Archaeological traditions in East Asia, particularly the production of ritual objects and finely crafted materials such as jade and nephrite, demonstrate an extraordinary degree of patience, precision, and symbolic craftsmanship. These technological traditions require long-term concentration and detailed manual skill, qualities that may align with cognitive systems emphasizing sustained attention and social integration, potentially involving both vmPFC and broader prefrontal networks.

Religious and philosophical traditions in these regions also display notable differences. In many Eastern traditions, divine forces are often conceptualized as distant, cosmic, or embedded within the natural order, rather than as anthropomorphic figures directly interacting with individuals. Such cosmologies emphasize harmony, collective balance, and ancestral continuity. These features may reflect cognitive frameworks strongly shaped by collective social identity and emotional bonding, processes often associated with the ventromedial prefrontal cortex (vmPFC). In contrast, Western religious traditions frequently portray divine entities in more personalized and interactive forms, emphasizing moral agency, individual responsibility, and narrative relationships between humans and the divine.

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By the time of the Bronze Age, roughly five to three thousand years ago, the emergence of urbanization, writing systems, and complex political hierarchies transformed human societies fundamentally. Early states in regions such as Mesopotamia, China, and the Mediterranean developed bureaucratic institutions, codified laws, and organized religious structures. At this stage, cultural institutions began to replace many of the informal social mechanisms that previously regulated group behavior. In this sense, the formation of states can be interpreted as the creation of artificial systems of social regulation, where laws, administrative structures, and organized religion supplemented or replaced earlier biologically rooted social cohesion mechanisms. In cognitive terms, such transformations may reflect the increasing dominance of executive and analytical processes associated with the dlPFC. Legal systems, bureaucratic governance, and written traditions required abstract reasoning, formal logic, and systematic record-keeping—abilities that extended beyond the earlier social and emotional regulation functions that had characterized smaller prehistoric groups.

By the Iron Age (approximately 1200 BCE to 500 CE), the influence of archaic human cognitive legacies had become deeply integrated into fully developed cultural systems. In the West, classical civilizations such as those of ancient Greece and Rome increasingly emphasized philosophical reasoning, legal institutions, and formal logic. Thinkers such as Aristotle developed structured systems of logic and metaphysics that strongly relied on analytical reasoning processes associated with the dlPFC.

In the East, imperial systems such as the Han Dynasty institutionalized ritual traditions, philosophical frameworks, and bureaucratic structures that emphasized social harmony, hierarchical order, and collective identity. Religious and philosophical traditions including Confucianism and Daoism codified ritual behavior and moral conduct, transforming earlier cultural intuitions into formalized ideological systems.

Ultimately, the emergence of early states and civilizations marked the point at which cultural evolution surpassed biological inheritance as the primary driver of human social organization. While the genetic and neurocognitive legacies of Neanderthals and Denisovans may have contributed subtle predispositions to early Homo sapiens populations, these influences were progressively reshaped by cultural institutions, technological innovation, and intellectual traditions. Thus, by the dawn of historical civilization, humanity had entered a stage where archaic biological influences persisted primarily as deep evolutionary background, while religion, philosophy, and social organization became increasingly products of cumulative cultural development.

Discussion

1. Interpretation of findings

The present study examined whether interactions between archaic human populations and early Homo sapiens may have contributed to cognitive traits that later supported the development of religious thought and complex cultural systems. By combining evidence from genetics, neuroanatomy, and archaeology, the analysis focused particularly on the potential roles of Homo neanderthalensis and Denisovans. One of the main conclusions of this study is that archaic human populations possessed behavioral and cognitive capacities that likely supported early forms of symbolic thinking. Archaeological evidence associated with Neanderthals suggests deliberate treatment of the dead, the use of pigments and ornaments, and complex technological traditions. These behaviors indicate that Neanderthals were capable of social practices that involved symbolic meaning and group cohesion. Although such practices cannot be directly interpreted as religion, they demonstrate cognitive abilities that could support early ritual behavior and interpretations of death. The available evidence also suggests that Denisovans may have possessed complex technological skills and social organization. Artifacts associated with Denisovan contexts indicate high levels of craftsmanship and planning. While the archaeological record for Denisovans remains limited, these findings imply that their cognitive capacities were comparable to those of other late archaic human populations.

Genetic research confirms that both Neanderthals and Denisovans contributed genetic material to modern human populations through repeated interbreeding. These interactions created a situation in which biological traits and cognitive predispositions from multiple human populations became integrated within expanding Homo sapiens societies. Some of these inherited variants influence physiological and metabolic processes that indirectly affect brain function.

Taken together, the evidence suggests that the emergence of religious cognition in modern humans may have developed upon a broader evolutionary background shaped by interactions among several human populations. Rather than appearing suddenly within Homo sapiens alone, some of the cognitive foundations necessary for ritual behavior, symbolic interpretation, and social cohesion may have deeper evolutionary roots shared with archaic humans.

2. Limitations of the Available Evidence

Despite recent advances in paleoanthropology and ancient DNA research, the available evidence for understanding the cognition and culture of archaic human populations remains limited. One of the primary limitations concerns the extremely small number of Denisovan fossils currently available. Most genetic information about Denisovans comes from a few fragmentary remains discovered in Denisova Cave, including teeth and small bone fragments. As a result, reconstructions of Denisovan neuroanatomy rely largely on indirect genetic data rather than complete cranial material.

Another limitation involves the interpretation of cognitive traits from genetic or anatomical markers. While certain genes and regulatory patterns may influence neural development, linking these genetic variants directly to complex psychological traits such as social behavior, symbolic thinking, or religious cognition remains highly uncertain. Cognitive functions are typically influenced by large networks of genes and environmental factors rather than individual genetic variants.

The archaeological record also presents interpretative challenges. Artifacts such as ornaments, pigments, or burials can indicate symbolic or social behavior, but determining whether these practices represent religious beliefs, social traditions, or practical behaviors is difficult. In many cases, multiple interpretations of the same archaeological evidence remain possible.

Finally, attempts to connect archaic genetic ancestry with large-scale cultural differences in later human societies must be treated with caution. Cultural systems are shaped by numerous factors including environment, migration, technological development, and historical processes. Consequently, the influence of archaic human ancestry should be considered as one potential component within a much broader framework of human cultural evolution.

3. Critical Self-Evaluation

Several aspects of the present study rely on interpretative hypotheses that should be treated with caution. One of the central ideas explored in this article is the possible relationship between differences in prefrontal cortical organization and later cultural or religious tendencies. However, the current scientific evidence does not allow a direct reconstruction of the functional neuroanatomy of archaic humans such as Homo neanderthalensis or Denisovans. As a result, any assumptions regarding the relative development of specific regions such as the dorsolateral or ventromedial prefrontal cortex remain hypothetical and are based primarily on indirect anatomical and genetic indicators.

Another potential weakness of the study lies in the attempt to relate ancient biological influences to later large-scale cultural differences between regions often described as “Western” and “Eastern” civilizations. Such cultural patterns developed over many millennia and were shaped by numerous factors including geography, economic systems, migration patterns, and historical events. Consequently, attributing elements of cultural orientation to archaic genetic contributions may oversimplify the complexity of cultural evolution. A further limitation concerns the interpretation of symbolic behavior in the archaeological record. While burials, ornaments, and pigments suggest forms of social or symbolic activity, it is difficult to determine whether these practices should be

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interpreted as early religious beliefs or as other types of social traditions. The distinction between symbolic culture and religion in prehistoric contexts is not always clear.

Finally, the interdisciplinary nature of the hypothesis presented in this article—combining genetics, neuroscience, archaeology, and cultural history—creates a risk of drawing connections between fields where direct evidence remains limited. Although such integrative approaches can generate valuable new hypotheses, they also require careful interpretation and further empirical testing.

4. Future Directions for Research

Future research may significantly expand our understanding of the cognitive capacities of archaic human populations and their possible influence on later human cultural development. One of the most important directions involves the continued study of ancient DNA. Improvements in sequencing technology may allow scientists to reconstruct more complete genomes of archaic populations such as Denisovans and Homo neanderthalensis, potentially revealing additional genetic variants associated with neural development and brain metabolism.

Another important area of research concerns the discovery and analysis of additional fossil remains. Denisovans are currently known primarily from fragmentary material found in Denisova Cave, which limits the ability to reconstruct their brain structure and overall neuroanatomy. New discoveries of Denisovan or Denisovan-related populations in Asia could provide valuable information about cranial morphology and allow more accurate reconstructions of brain organization.

Advances in paleoneurology may also help clarify differences in brain organization between archaic humans and modern populations. Digital reconstruction of cranial endocasts, combined with comparative neuroanatomy, may provide insights into how regions of the prefrontal cortex developed across different human lineages and how these differences could relate to cognitive and social behavior.

Finally, interdisciplinary research combining anthropology, neuroscience, and cultural studies may offer new approaches for examining how biological predispositions interact with cultural evolution. Comparative studies of symbolic behavior, ritual traditions, and social organization in early human societies could help determine whether certain cognitive tendencies influenced the development of religious systems in different regions of the world.

Together, these research directions may allow future studies to test more precisely the hypothesis that interactions between archaic human populations and early Homo sapiens contributed to the broader evolutionary background from which later cultural and religious traditions emerged.

5. Alternative Interpretations in the Literature

Several alternative interpretations exist in the scientific literature regarding the origins of religious cognition and cultural divergence in human societies. Many researchers argue that the development of symbolic thinking and religion occurred primarily within populations of Homo sapiens without requiring significant cognitive contributions from archaic humans. According to this perspective, religion emerged as a byproduct of cognitive mechanisms such as agency detection, social cohesion, and narrative thinking that evolved within modern human populations.

Another line of research emphasizes the role of cumulative cultural evolution rather than biological inheritance. In this framework, complex cultural systems—including religion, philosophy, and social hierarchy—are understood as products of long-term cultural transmission and innovation. Cultural traits accumulate over generations through learning, imitation, and institutional development, gradually producing increasingly complex symbolic systems. Some scholars also argue that behavioral differences between archaic humans and modern humans were relatively limited. From this viewpoint, populations such as Homo neanderthalensis and Denisovans may have possessed cognitive abilities broadly similar to those of early modern humans, suggesting that the emergence of religion and complex symbolic culture was primarily driven by demographic

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expansion and intensified social interaction rather than by biological differences between human groups.

Finally, other researchers emphasize environmental and economic explanations for cultural divergence between different regions of Eurasia. Differences between what later became Western and Eastern cultural traditions have often been linked to factors such as ecological conditions, agricultural systems, population density, and patterns of political organization rather than genetic ancestry.

These alternative perspectives highlight the complexity of interpreting prehistoric human behavior and emphasize that the hypothesis presented in this study represents one possible explanatory framework among several. Continued research integrating genetics, archaeology, and cognitive science will be necessary to evaluate the relative importance of biological inheritance and cultural evolution in shaping early human belief systems.

Conclusion

The present study explored the potential evolutionary background of religious cognition by examining interactions between modern humans and archaic human populations. By integrating findings from genetics, paleoanthropology, archaeology, and cognitive neuroscience, the analysis considered how contact between Homo sapiens and archaic groups such as Homo neanderthalensis and Denisovans may have contributed to the cognitive foundations of symbolic thought, ritual behavior, and social organization.

The available evidence indicates that archaic humans possessed behavioral and technological capacities that suggest complex social cognition and symbolic practices. Genetic research further demonstrates that interactions between these populations and modern humans resulted in measurable genetic contributions that remain present in contemporary populations. These interactions may have created a broader evolutionary context within which certain cognitive predispositions related to social bonding, planning, and symbolic interpretation developed.

At the same time, the emergence of complex religious systems and cultural traditions cannot be explained solely by biological inheritance. As human societies became more socially and technologically complex, cultural evolution increasingly became the dominant force shaping belief systems, institutions, and philosophical traditions. By the Bronze Age and early historical periods, religion and social organization were primarily shaped by cultural transmission, political structures, and intellectual developments rather than direct biological influences.

Taken together, the findings of this study suggest that the cognitive foundations of religion may have deeper evolutionary roots than previously assumed, extending beyond the boundaries of a single human species. While the precise influence of archaic populations remains uncertain, their interactions with early modern humans may have contributed to the evolutionary background from which later cultural and religious systems emerged.

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