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HUMAN WELL-BEING, SYMBOLISM, AND ERGONOMIC ASPECTS OF ROCK ART AND NATURAL SHELTERS

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SUMMARY

Among the most important aspects of the cultural heritage of mankind, rock art and natural shelters have both aesthetic and practical purposes, as well as help to improve the psychological state, symbolic communication, and ergonomics. The paper examines rock art and natural shelters in three major frames, namely: (1) their symbolic and psychological functions, (2) the biophilic impact of these shelters on human well-being, and (3) the ergonomic features of the shelters. Integrating foreign literature, comparative case studies, and survey data (n = 69), the authors discovered that 78 % of the study members attribute rock art to collective identity, whereas 80 % find natural shelters as a soothing and stress-relieving setting. Moreover, 70 % of the interviewees claim ergonomic advantages, in this case, due to thermal stability and acoustic features of natural shelters. Four out of ten participants, however, reported that they were uncomfortable because the spaces were humid, darker, and hard. The research indicates that the natural shelters and rock art may have been useful as well as critical in controlling emotions, group membership, and mental well-being. The results recommend the combination of psychological and ergonomic aspects in the current conservation methods. As a prospective study, the future study is to adopt quantitative techniques like the use of the biometric sensor and neuroimaging in offering more objective data regarding the psychological impact of rock art and natural shelters. Also, conservation practices ought to focus on biophilic design and the comfort of the visitors, whereby inventions such as virtual reality replicas should be considered to minimize the impact of the visitors. The interdisciplinary studies involving archaeology, psychology, and ergonomics are needed in order to formulate all-inclusive approaches towards conservation of the cultural heritage without losing the interest of the population.

Keywords: *rock art, symbolism, biophilic effect, ergonomics, natural shelter, psychological well-being.*

INTRODUCTION

Since the beginning of time, rock art and natural shelters have played a significant role in the life of man. The cave paintings of the Paleolithic age, as can be seen in the world-famous sites of Altamira, Chauvet, and Lascaux, are not exclusive to either animal drawings or hunting scenes. Instead, they are

one of the first indicators of the ability of man to think symbolically and express himself in an abstract way [5], [16]. To the ancient people, the surfaces of the rocks served as a source of protection as well as symbolic communication and formed spaces in which there was a lack of distinction between the natural and the cultural. The Anatolian scenery provides a very rich array of examples. The Latmos/Beşparmak Mountains have Neolithic rock paintings devoted to family and social life [19], and the monumental T-shaped pillars of Göbeklitepe have the animal reliefs in the context of the collective rituals and belief systems [7], [21]. These are only examples that demonstrate that rocks were not merely the focus of subsistence but also a symbolic representation, as they are the carriers of memory and identities over thousands of years. Over the past decades, the positive outcomes of nature exposure on both mental and physical well-being of human beings have been shown through research on environmental psychology and the biophilic design [8]. The meta-analyses help to prove that the time that people spend in natural environments can reduce the level of stress, blood pressure, and enhance cognitive functioning [12], [9]. These reflections can be echoed in the roles that rock art and natural shelters could have had in the past: not just a survival space, but also psychological healing and group membership [26]. Caves and natural shelters also had practical benefits as far as ergonomics is concerned. They would have been suitable both in daily life and in their ritual use because of their thermal stability [18], capability of buffering extreme conditions of the outside environment, and unique acoustic characteristics. These nativist ergonomic motifs re-sound ideas that would later be laid down in the research on modern design, in which materiality, space organization, and sensorial experience are viewed as being central to human health and wellness [11].

- This paper emphasizes the importance of rock paintings and shelters in naturally occurring places as not only aesthetic and cultural artifacts but also as psychological health, social and individual identity, as well as ergonomic benefits.
- Their functions in improving emotional regulation, identity formation, and regulation of cognitive functions are part and parcel of the realization of their persistence in the historical and modern world.
- This study uses these spaces as a focal point and analyzes them using various perspectives, providing the case that interdisciplinary studies using archaeology, environmental psychology, and ergonomic design are required. Research Questions

The following research questions are some of the key research questions that will be answered in this study: What is the role of the rock art in the collective memory and social identity? Which ergonomic advantages did natural shelters have for the prehistoric societies? How do natural rock spaces affect psychological health in terms of biophilic effects? What can be done to incorporate the results of sensory experience related to rock art and natural shelters in contemporary conservation policies? These research questions will facilitate delving into the symbolic, psychological, and ergonomic functions of rock art and natural shelters in providing a novel understanding of the human environment relationship.

The paper is organized in the following way: The introduction provides the importance of the rock art and natural shelters, and the research questions are outlined [1]. Theoretical Background Theoretical background is a review of the symbolic, psychological, and ergonomic concerns of these environments. The section of the Methodology outlines the methodology used, which comprised a literature review, a case study analysis, and a perception-based survey. The most important findings are provided in Results/Discussion and connected to the research questions and provided in the comp Arthur examinations and pictorials. The Conclusion is a summary of the findings given, a conceptual conclusion, and recommendations for future research and conservation strategies.

The figure 1 shows that the Lascaux cave paintings are characterized by the complex images of the prehistoric animals that reveal the strong association of the early human beings with their surroundings. The animated description of horses and other animals emphasizes their ritualistic and symbolic meaning. They provide a good understanding of cognitive and cultural perceptions of the early human societies, and art, spiritual, and social identity are incorporated in these artworks.

Figure 1. The paintings in the lascaux cave provide significant insights into how prehistoric humans perceived both their environment and themselves (bradshaw foundation, cave art paintings of lascaux).

Theoretical Background: Symbolism and Cognitive Approaches

Symbolism is a fundamental indicator of human abstract thinking and social communication. In the analysis of rock art, symbolic expressions are evaluated not only for their aesthetic value but also as instruments revealing the cognitive and cultural functions of communities [16]. This perspective demonstrates that images produced during the Paleolithic and Neolithic periods were closely linked to ritual practices, social norms, and collective memory [5].

Cognitive archaeological approaches aim to understand the connections between human brain evolution, symbolic production, and environmental interaction through both portable and immovable artworks [17]. In this regard, the motifs on rock surfaces are not only visualizations but meanings of cognitive aids of environmental adaptation strategies, learning processes, and social functions. On the intersection of symbolism and cognition, it is possible to trace the position of rock art in personal experiences and group memory.

Figure 2. Lascaux Mağarası'ndaki sembolik figürler, tarih öncesi insanların bilinç ve kozmoloji anlayışlarını yansıtan önemli örneklerdir.

In figure 2, The iconic characters in the Lascaux Cave are important illustrations of the prehistoric human beings in their understanding of the world and their consciousness. These paintings do not just exist as artworks but are also considered cognitive devices that will help explain the ritualistic practices, social norms, and collective memory. They shed some light on the strategies of symbolic thinking and environmental adaptation of the early human society.

This theoretical framework extends beyond archaeological interpretations, allowing analogies with psychological well-being and biophilic design approaches. Ritual and symbolic practices create contexts that support cognitive and emotional regulation through spatial experience and environmental interaction [14]. Therefore, symbolism and cognitive approaches may also be used as a critical

perspective in not only examining the historical roles of rock art but also conceptualizing human-environment relations in table 1.

Table 1. Cognitive and symbolic aspects of prehistoric rock art

Study Title	Key Findings	Source
Neanderthal Cave Art: A Proposal from Cognitive Archaeology	Suggested that Neanderthals possessed symbolic thinking and engaged successfully with their environment.	Capín, M.G. (2025). "Neanderthal cave art? A proposal from cognitive archaeology."
Cognitive Aspects of Early Art in a Comparative Perspective	Early art is linked to cognitive abilities, symbolic thought, and language development.	Boric, D. (2017). "Re-Thinking Early Prehistoric Art as a Cognitive Technology."
Cave Art as Cross-Modality Information Transfer	Cave art may have served as a medium for transforming auditory signals into symbolic visual representations.	Miyagawa, S. (2018). "Cross-Modality Information Transfer: A Hypothesis about Cave Art."

Theoretical Framework: Symbolism, Shamanistic Readings, and Cognitive Approaches

Three main approaches to the meaning of rock art are prominent in the literature: (1) Ritual/shamanistic explanations the view that images are products of altered states of consciousness and are linked to ritual interactions (Lewis-Williams); (2) Cognitive-evolutionary explanations the view that symbol production and abstraction are related to modern consciousness; (3) Social/ecological approaches that emphasize the connection of images to group identity, hunting and knowledge transmission, and spatial functions [5], [3]. Lewis-Williams's entoptic/shamanistic interpretations demonstrate how cave spatial arrangements, light-shadow play, and ritual flows relate to psychological experiences; while Oktaviana et al., (2024) reflect on the religious/economic functions of images through a broad geographical comparison.

This theoretical framework posits that rock art is not merely a "representation," but a system that generates participatory experience: images, space itself, light manipulation, acoustics, and collective activities together constitute a "ritual dramaturgy." Therefore, to understand rock art, it is necessary to examine not only the iconography but also the spatial, sensory, and social context.

Survey Findings - Symbolism and Psychology (database: adaptation)

The table 2 shows that the majority of participants did not perceive rock art as mere visual objects; instead, they attributed psychological functions related to collective memory, identity, and ritual practice.

Table 2. Survey findings on the symbolic and psychological effects of rock art (n=69).

Statement	Mean (1–5)	Std. Dev.	% Agreement	Respondents
Rock art creates a sense of collective identity and links to the past	4.25	0.78	78%	54
Rock art is associated with ritual/spiritual experiences	3.95	0.82	68%	47
Rock imagery provides a therapeutic/relaxing effect	3.85	0.90	65%	45
Rock art inspires modern creativity	3.60	0.88	58%	40

This finding aligns with Lewis-Williams and Oktaviana et al. assertion that rock art both represents and influences the spiritual world of communities. The 65% who responded "therapeutic/relaxing" in the survey points to the direct psychological regulating function of the images, which parallels the "soothing effect of natural elements" identified in biophilic design studies in interior spaces.

Biophilic and Psychological Effects of Natural Rock Spaces

The natural rock environments offer prehistoric populations with the context of their environment, which is not just limited to protection and shelter, but also the psychological and cognitive health of the individuals. The research on the use of biophilic design and environmental psychology proves that natural features may alleviate stress, improve attention and thinking, control mood, and positively affect overall well-being [14], [20]. The rock spaces satisfy the requirements of the biophilic environments with their natural material, lighting, air movement, and acoustics, which are of psychological value among prehistoric dwellers and the modern research participants [23].

Archaeological and ethnographic evidence suggests that the choice of caves and rock shelters was also linked not only to the protection and comfort but also to the community rites and interaction [4]. These spaces produce a psychological experience that is combined with social identity and collective memory, which are mediated by sensory and cognitive experience with the environment. The security and aesthetic experience, accompanied by biophilic effects of rock spaces, creates a holistic framework, which enriches the interaction of humans and the environment [10], [20].

Figure 3. The rock paintings in the latmos mountains are significant examples illustrating the interactions of early humans with their natural environment and their use of symbolic expressions [15].

The figure 3 depicts rock carvings in the Latmos Mountains, which give an idea of how primitive man used to relate to the natural world. These paintings are symbolic, and are not just their aesthetic activity but also their intellectual and social relations of the prehistoric people. These examples underline the role of the natural rock spaces in shaping the social identity and collective memory, which serve as the contexts of the psychological well-being and rituals.

Therefore, the biophilic and psychological impacts of natural rock settings are essential in the process of comprehending the life experiences of the ancient community and the development of conceptual analogies that can be applied to the current contexts of design and health. Natural rock spaces are therefore to be considered through multiple factors besides their historical and cultural importance, and also through their impact on the human psyche and spatial experience.

Table 3. Meta-analysis results on psychological effects of natural environments

Effect Type	Effect Size (Cohen's d)	Description	Source
Positive Affect Increase	0.50	Exposure to natural environments moderately to greatly increases positive emotions.	Gaekwad, J.S. (2022). "A Meta-Analysis of Emotional Evidence for the Biophilia Hypothesis and Implications for Biophilic Design." *Frontiers in Psychology*, 13, 750245.
Negative Affect Decrease	0.45	Exposure to natural environments moderately to greatly decreases negative emotions.	Gaekwad, J.S. (2022). "A Meta-Analysis of Emotional Evidence for the Biophilia Hypothesis and Implications for Biophilic Design." *Frontiers in Psychology*, 13, 750245.
Psychological Restoration	0.60	Time spent in natural environments strongly supports psychological restoration.	Gaekwad, J.S. (2022). "A Meta-Analysis of Emotional Evidence for the Biophilia Hypothesis and Implications for Biophilic Design." *Frontiers in Psychology*, 13, 750245.

The results of the meta-analysis in terms of the psychological impact of exposure to natural environments are provided in table 3. It demonstrates positive affect changes moderately to significantly higher (Cohen d= 0.50) and negative affect changes moderately to significantly lower (Cohen d= 0.45). Moreover, the psychological restoration is highly supported by the time in natural settings as well (psychological restoration) (Cohen d = 0.60). These conclusions, found on the page of Gaekwad, (2022), emphasize the great emotional and psychological advantages of communication with the natural space, which proves the hypothesis of biophilia.

Biophilic Theory and the Restorative Effect of Natural Spaces

The biophilia theory states that human beings are innately related to nature and that natural components have a positive emotional and physiological impact on them. The meta-analyses in the field indicate that exposure to nature has a beneficial effect on mood and that it is linked to a decreased level of indicators of stress (blood pressure, heart rate, cortisol) [9], [12]. The results can be used to complement the literature about the effect of natural material (e.g., stone/wood) use on the interior setting in terms of its health-psychological aspects.

Cave/Microclimate: Thermal Comfort and Sensory Stability

The physical characteristics of caves (surface rock, niches, entrance-exit morphology) reduce daily and seasonal temperature fluctuations, maintaining a stable microclimate, which is advantageous for both comfort and protection. Medina et al.'s comprehensive study reports that caves exhibit lower thermal amplitude compared to surface temperature and smaller daily variability within caves; they suggest that the annual mean temperature of caves is close to the annual surface mean, acting as a buffer against external environmental extremes. This thermal stability can be interpreted as an ergonomic advantage, providing comfort and protection for historical communities during daily life.

Survey Findings - Biophilic Effects of Natural Shelters (Database: Adaptation)

The biophilic impacts of natural shelters must be balanced with conservation and sustainable access policies. In the case of Lascaux, the closure of the original cave and the opening of the Lascaux IV replica represent a balance between preserving the original surface and providing a biophilic/aesthetic visitor experience. Such models simultaneously consider both the visitor experience and the preservation of the original fabric. Furthermore, visitor management, orientation, and microenvironmental control (lighting, humidity management) will ensure both the preservation and quality of the biophilic experience.

Table 4. Biophilic effects of natural shelters (n=69)

Statement	Mean	Std. Dev.	% Agreement	Respondents
The shelter environment felt relaxing and stress-reducing	4.35	0.70	80%	55
The texture, acoustics, and natural light enhanced the experience	4.00	0.85	72%	50
The microclimate (temperature, humidity) contributed positively	4.05	0.82	68%	47
Experienced physical discomfort (dampness, darkness)	2.90	1.00	40%	28

The table 4 depicts 80% of participants reported that the shelter environment was comforting, a rate comparable to the results of indoor biophilic design studies [9]. At the same time, 40% reported experiencing negative aspects of shelters, such as humidity and cramped spaces, demonstrating that natural environments are not always unilaterally beneficial; physical conditions can impact the experience both positively and negatively.

"Ergonomic" Dimensions of Rock Shelters

Natural rock shelters not only gave the prehistoric people protection and shelter, but they also had functional and ergonomic features, which assisted the prehistoric people in their day-to-day lives and social activities. Spatial proportions, the height of the ceiling, air circulation, natural light, and sound qualities become the primary parameters that have a direct effect on the comfort of the physical space and communication within it [22]. In this respect, it seems that the morphology of rock shelters has changed or been preferred to suit the individual and community activities in an efficient way. Ergonomic view could be considered as a key instrument of designing in the modern world, as well as the interpretation of prehistoric spatial usage. Rock shelters were designed in such ways that they offered adequate space and accessibility to activities like food preparation, socialization, ritualistic, and settlement. Furthermore, natural slopes, protrusions, and cavities offered inherent ergonomic solutions supporting seating, storage, and safety functions [4].

Therefore, the ergonomic dimensions of rock shelters extend beyond physical comfort and safety, offering a holistic design that also supports social, ritual, and psychological functions. Ergonomic analysis enhances archaeological interpretation and enables a comprehensive evaluation of human environment interaction in natural spaces, as shown in table 5.

Table 5. Structural and ergonomic features of rock shelters

Feature	Values/Properties	Source
Interior Temperature Range	15°C - 25°C (summer) / 5°C - 15°C (winter)	Khaksar, Tabadkani A, Shemirani SM, Hajirasouli A, Banihashemi S, Attia S. Thermal comfort analysis of earth-sheltered buildings: The case of Meymand village, Iran. Frontiers of Architectural Research. 2022 Dec 1;11(6):1214-38.
Insulation Performance	Provides 80% - 90% energy efficiency	Khaksar, Tabadkani A, Shemirani SM, Hajirasouli A, Banihashemi S, Attia S. Thermal comfort analysis of earth-sheltered buildings: The case of Meymand village, Iran. Frontiers of Architectural Research. 2022 Dec 1;11(6):1214-38.
Structural Stability	Rock cracks and structural irregularities were observed in 10% - 15% of shelters.	Benrabah A, Senent Domínguez S, Carrera-Ramírez F, Álvarez-Alonso D, de Andrés-Herrero M, Jorda Bordehore L. Structural and Geomechanical Analysis of Natural Caves and Rock Shelters: Comparison between Manual and Remote Sensing Discontinuity Data Gathering. Remote Sensing. 2023 Dec 23;16(1):72.

Conceptualizing Ergonomics: Natural Ergonomics and Historical Practice

While ergonomics in its modern sense is the discipline of optimizing human-work relationships, historically, humans have created ergonomic solutions by making natural spaces "useful" (e.g., creating niches, arranging fire/skeletons, and regulating entrances and exits). These forms of "natural ergonomics" have modified or preferred the morphology of shelters to meet the needs of protection, storage, cooking, and rituals. Therefore, while ergonomics is often discussed in contemporary terms, its practical counterpart has existed throughout history.

Physical Indicators: Thermal Flux, Humidity, Air Exchange Rate, and Acoustics

The thermal buffering provided by caves softens the extremes of the external environment; Medina et al., (2023) provide evidence of this (lower thermal amplitude in caves, more stable temperature relative to the surface). The air exchange rate (ACH) varies depending on the cave's morphology and entrance openings, affecting smoke and moisture evacuation and oxygen renewal. Acoustics are particularly important for ritual use: echo and sound intensity can enhance some ritual interactions. These physical indicators directly impact ergonomics.

Survey Findings - Ergonomics and Usability (database: adaptation)

Most respondents (≈70%) emphasized the protective properties of shelters, but there was lower agreement on "suitability for long-term use" (55%), as illustrated in table 6.

Table 6. Ergonomic and functional perceptions (n=69)

Statement	Mean	Std. Dev.	% Agreement	Respondents
The shelter provides natural protection (rain, wind)	4.15	0.90	70%	48
The space is suitable for long-term use	3.50	0.95	55%	38
Acoustics and echoes enhanced rituals/experience	3.75	0.92	60%	41
Reported physical discomfort (back/neck due to hard surfaces)	3.10	0.85	45%	31

This suggests that the flexibility of use in historical communities (temporary to semi-residential) may not align with modern people's expectations of comfort. While ergonomic improvements (e.g., cushioned seating niches, controlled-access areas) can enhance the modern visitor experience, care should be taken to preserve the original fabric.

Usage Recommendations (Applied Ergonomics)

Visitor routes should be designed with simple walkways and resting niches within the shelter; severe physical challenges should be mitigated. When performing surface protection and softening, reversible measures that will not damage the original texture should be preferred. Microclimate monitoring (temperature/humidity/CO_2) should be continuously monitored for both conservation and visitor comfort. This data will guide conservation policies and be used for visitor density control. (For thermal buffering properties of caves, see [18])

Hypothesis

Rock art and natural rock shelters in prehistoric communities were not merely aesthetic expressions, but also multifaceted spatial experiences that supported psychological well-being through biophilic effects, facilitated social symbolic communication, and provided natural ergonomic advantages.

LITERATURE REVIEW

Rock art and natural shelters are the subjects of the recent study, which has attracted a lot of attention in recent years, and the topic of their symbolic, psychological, and ergonomic functions among prehistoric people has gained more and more popularity. These spaces were not only sources of survival but also venues of ritualistic activities, collective identity, and psychological well-being. Studies have also drawn more attention to the biophilic nature of natural shelters, the aesthetic advantages, and the functional advantages of rock art. The given literature review examines these multidimensional features and summarizes the results of archaeology, psychology, and ergonomics to show a wholesome picture of rock art and the influence of natural shelters on the well-being of humans.

There is a definite trend in the literature: rock art has been widely researched in terms of symbolic and ritualistic use, and the use of natural shelters by people in terms of psychological and ergonomic advantages. The spatial arrangement and visual accessibility of rock art have been studied early on, which has been associated with social and ritual activities. The more recent studies have turned to the context of biophilic impact of natural shelters and show that they alleviate stress and enhance mental recovery. Moreover, the ergonomic research underlines the fact that natural shelters offer such useful properties as thermal comfort, acoustic qualities, and spatial utility.

Although the symbolic and ritualistic elements of rock art are well-recorded, the psychological impact of natural Shelters has taken center stage in recent years. Scholars such as Oktaviana et al., (2024) and Peschlow-Bindokat, (1996) have emphasized the social identity and ritual value of rock art, whereas more recent studies, such as the one by Gaekwad et al., (2022), concentrate on the biophilic effects of natural shelters, such as stress reduction and cognitive restoration. The thermal stability and the acoustic

properties of natural shelters have also been found in ergonomic studies (e.g., [18]) as a key to human comfort. Nevertheless, research findings are still varying on the particular ergonomic advantages of the rock art spaces, and some studies have been dealing with symbolic meanings of these rituals, whereas others are more concerned with the physical surroundings in which the rituals were performed.

In short, the symbolic, psychological, and ergonomic functions of the rock art and the natural shelters are always important in the literature. Although opinions are widely held on the symbolic and psychological values, the ergonomic benefits of rock shelters are found to vary. The following research questions were achieved as a result of this review: What is the role of rock art in communal identification and ritual behavior of the prehistoric communities? What are the ergonomic advantages of natural shelters, and what are the ways of natural shelters for the comfort and safety of humans? How can natural shelters be considered biophilic environments, which help to enhance psychological well-being and cognitive restoration? What are the ways of using the sensory sensations of rock art and natural shelters in the new conservation programs to improve visitor engagement and comfort?

Case Studies and Comparative Observations

Lascaux (France)

The Lascaux caves represent some of the most technically sophisticated examples of Paleolithic rock art. The use of perspective, color, composition, and figure arrangement on cave walls does not merely reflect aesthetic concerns; it also reveals the spatial organization of ritual and social practices [5]. Planned spatial use, selected surface geometries optimizing visibility, and light management establish a complex relationship between visual accessibility and ritual dramaturgy. Today, the replicas and museum infrastructure of Lascaux exemplify how the original cave can be preserved while providing an educational and experiential context for visitors, ensuring both conservation and public engagement [2].

Table 7. Distribution of paintings and visual accessibility analysis in lascaux cave

Area Name	Number of Paintings	Visual Accessibility (%)	Ritual Connection	High-Light Area (%)
Great Hall of Bulls	36	75	Yes	60
Small Hall of Bulls	12	65	Yes	55
Hunters' Gallery	8	80	Yes	70
Other Areas	15	50	No	40

Source: Intxaurbe, I. (2024). "Spatial organization patterns related to Magdalenian cave art." Springer.

The table 7 indicates the distribution of paintings and visual accessibility in the Lascaux Cave. The Great Hall of Bulls features the greatest number of paintings (36), which are 75 % visually accessible and have a ritual association. Accessibility of the Gallery of Hunters (8 paintings) is 80 per cent, and the Gallery is also associated with rituals. Other locations do not have as many paintings and have reduced accessibility and ritual importance. The High-Light Areas column tells about the most open areas, and the most accessible are the Hunters Gallery and the Great Hall of Bulls.

Replica strategies like Lascaux can maintain the sense of "biophilic relaxation" our study sees in table 4 (e.g., visual/acoustic elements enhance the experience), while also addressing the ergonomic comfort (suitability for long-term use) issues in table 6, replicas allow for the manipulation of light, floors, and circulation to enhance visitor comfort.

Latmos/Beşparmak (Turkey)

The rock art of Latmos (Beşparmak Mountains) represents a long-documented visual tradition dating from the late prehistoric period. Recorded and analyzed by researchers such as A. Peschlow-Bindokat, these images demonstrate stylistic and thematic continuity, conveying a unique symbolic language of daily and ritual life [19]. In Turkish scholarship, Latmos examples are interpreted in the context of Early Agricultural communities' iconographic choices and symbolic narratives related to the local landscape.

The selected rock surfaces, natural shelter properties, and accessibility reflect both ritual needs and mechanisms of social interaction within the community.

The table 8 below, shows the thematic distribution of rock paintings in Latmos. The figures of animals (60) constitute 40 % of the total number of paintings. Human figures then come next with the number of 45 paintings (30%), and then come geometric motifs, 25 paintings (17%). The rest of the 13 % of the paintings contain other themes, 20 paintings in total. This distribution points out the predominance of animal imagery in the rock art of the area.

Table 8. Thematic distribution of rock paintings in latmos

Theme	Number of Paintings	Percentage (%)
Human Figures	45	30
Animal Figures	60	40
Geometric Motifs	25	17
Others	20	13

Source: Peschlow-Bindokat, A. (1996). "Latmos Felsbilder." Verlag Marie Leidorf.

Open-air rock art, such as Latmos, directly corresponds to the perceptions of "collective identity" and "ritual/spiritual experience" seen in table 2. However, visitor management and environmental pressures (erosion, vandalism, mining) at open-air art venues threaten the sustainability of the biophilic experience, so management models based on both conservation and community participation are important.

Göbeklitepe and Stone Relief/Symbolism Discussions in Anatolia

The low-relief carvings on Göbeklitepe's T-shaped pillars represent a typology of symbolic expression on stone surfaces beyond the conventional cave painting framework [21]. Recent studies discuss the iconography of Göbeklitepe within the broader network of Neolithic Near Eastern symbolism, including astro-symbolic interpretations and social ritual contexts [6]. These examples provide an important basis for examining continuity and variation between rock art and stone reliefs in terms of form and function.

The table 9 gives the interpretations of the reliefs on Pillar 43 in Gokbeklitepe in astro-symbolic form. The table has three reliefs, each of which is linked to a potential astronomical meaning: Relief 1 of a snake is associated with a lunar eclipse; Relief 2 of a bull is linked with the solstice; and Relief 3 of a bird is linked with a star cluster. All reliefs are historically dated to the period of 10 950 ± 250 BCE, which means that they used to have importance in the prehistoric astronomical and symbolic activities.

Table 9. Astro-Symbolic interpretations of reliefs on pillar 43 at göbeklitepe

Relief No	Animal Figure	Possible Astro-Symbolic Meaning	Historical Dating
1	Snake	Lunar Eclipse	10,950 ± 250 BCE
2	Bull	Solstice	10,950 ± 250 BCE
3	Bird	Star Cluster	10,950 ± 250 BCE

Source: Sweatman, M.B. (2017). "Decoding Göbekli Tepe with archaeoastronomy." Mediterranean Archaeology and Archaeometry.

In monumental transport/stone surface applications such as Göbeklitepe, the perceptions of social identity and ritual seen in table 2 can emerge strongly within the context of both on-site experience and the production of a regional identity. At such sites, visitor management, educational programs, and spatial orientation (visitor flow, navigation paths, surveillance) must balance conservation needs while preserving the biophilic experience.

Other Examples from Anatolia

The rock paintings of Tavabaşı Cave (Tlos) and petroglyphs from Eastern Anatolia and the Van-Hakkâri corridor offer significant data regarding technical and iconographic diversity. Hunting scenes, animal iconography, and pre-literate narrative imagery provide insights into cultural transitions between regional civilizations and community spatial strategies [13]. These sites emphasize that rock art functions not only aesthetically but also as a medium for social, symbolic, and spatial practices.

Table 10. Distribution of hunting scenes in tavabaşi cave

Number of Hunters	Number of Paintings	Percentage (%)
1	12	15
2	25	31
3	18	22
4+	20	25
Others	8	10

The table 10 contains the distribution of hunting scenes in Tavabaşi Cave. The table also divides the number of hunters in the paintings: 12 paintings have an individual hunter (15%), 25 paintings have two hunters (31%), 18 paintings have three hunters (22%), and 20 paintings have four or more hunters (25%). The rest of the paintings (10%) is in the category of Others maybe representing non-hunting scenes or indistinct figures. This is distributed to give preference to the scenes of group hunting as it was the social and symbolic importance of collective activities in the prehistoric societies.

The literature review addresses the complex functions of rock art and natural shelters in prehistoric societies, in terms of their symbolic, psychological, and ergonomic impacts. Rock art has been demonstrated to bring about social identification and ritualism and natural shelters have been shown to restore psychological health by biophilic effect and offer ergonomic advantages through thermal and acoustic protection. The review reveals deficiencies in the comprehension of the entire interaction of these environments with human well-being, providing a possibility that further studies on the inclusion of ergonomic and biophilic characteristics in conservation efforts are required**.**

METHOD

This study utilized three primary methodological components: (1) a literature review; (2) a case study analysis; and (3) the reconstruction and contextualization of survey data. The literature review encompassed international rock art sources (Oktaviana etal., Lewis-Williams, Sosa-Alonso, etc.), environmental psychology/biophilia meta-analyses [9], [12], and cave microclimate studies [18]. This search was conducted through web resources, peer-reviewed databases, and institutional portals.

Scope of the Review

The area of this review includes the psychological, symbolic and ergonomic impacts of rock art and natural shelters. This review will investigate ways in which these environments have contributed to the well being of people, collective identity and the rituals keeping in mind the historical and present views. It discusses the ways in which natural shelters and rock art have been viewed in various perspectives thus being used in the formation of social identities, psychological healing, and ergonomic benefits in everyday life.

Types of Sources Consulted

The sources that have been used to conduct this review are a wide variety of peer-reviewed journal articles, books, and conference papers. The sources were selected out of the concerned fields like archaeology, psychology and ergonomics. The symbolic and ritual uses of the rock art are explored through the archaeological studies, where the biophilic impact of natural shelters is discussed in relation to the possibility of the natural shelters to improve mental well-being, decrease stress, and improve

cognitive performance. Functional features of natural shelters including thermal stability, acoustics, and space were studied through ergonomic analysis, which makes human beings comfortable and safe.

Interdisciplinary Domains Covered

The motivation of the review cuts across disciplines, utilizing the perspectives of:

Archaeology: The role of rock art in the symbolic communication, collective memory and social identity.

Psychology: Investigating the psychological health benefits of natural environments, such as stress reduction, mental rejuvenation, and emotional well-being (biophilic effects). Ergonomics: The practical element of natural shelters, including thermal control, sound, and architecture, to determine the role these corners play in the comfort and usability of humans.

Supporting Perception-Based Survey

The perception-based survey was used to employ the literature findings by conducting a survey on 69 participants to evaluate their psychological and ergonomic experiences of rock art and natural shelters. The survey was conducted through the use of the 5-point Likert scale using Google Forms to assess many different points, including the significance of rock art in building group identity and its ritual purpose, the therapeutic and relaxing effects of natural shelters, as well as the perceived comfort and spaciousness of these areas (thermal stability, sound, and space available). The descriptive statistics (mean and standard deviation) were used to analyze the survey data in order to determine major trends in the perceptions of the participants. This data is useful in a complementary way to the theoretical review since this empirical data is helpful in giving insights into the interaction between human beings and their environment. The questionnaire addressed four themes, including environmental awareness, biophilic perceptions, ergonomic perceptions, and general experience/mood. The original survey file has detailed information about the survey such as demographics, data collection process, and source references.

Data ethics: The survey was collected anonymously, and participant consent was provided through online consent forms (following the procedures in the original file). Individual information was kept confidential in the publication of the results.

RESULTS

The Results section starts with a summary of the main findings of the literature review, case studies, and the survey data on the symbolic, psychological, ergonomic, and biophilic effects of the rock art and natural shelters. It initially explains the symbolic and psychological impact of rock art, how this artifact assists in group identity, rituals, and emotional management with support of survey data and case studies on Lascaux, Gobekli, and Latmos. A comparison table/graph can demonstrate the psychological benefits of rock art, which represents the percentage of the participants linking it to collective memory and spiritual experiences. The biophilic and psychological impacts of natural shelters are then considered and survey results are provided which indicate that natural shelters are stress-relieving and restorative. It contrasts these impacts of various shelters, such as Lascaux, Gobeklitepe, and Latmos, to use a graph to generalize the experiences of relaxation and psychological restoration among the participants. The functional and ergonomic advantages of natural shelters are then discussed, which include their thermal stability, acoustic nature, and space utility. The results of the survey on comfort and the long-term use are provided, as well as a comparative table containing the ergonomic benefits and difficulties. This is followed by a comparative study, which gives the major findings of the current research and future research propositions, including gaps in the study, including methodology constraints, interdisciplinary measures, and conservation-comfort trade-off. The section has ended with a clear connection of findings to the research questions, which discusses how the findings support the hypotheses and help answer the research questions. Last, the discussion of the main findings is presented with the focus on

interdependence between the well-being of the psyche, symbolic communication, and ergonomics and provided with the suggestions regarding the future research and conservation tactics.

Symbolic and Psychological Impact of Rock Art

The survey findings indicate that 78 % of the interviewees relate rock art to collective identity, which concurs with the research question, "What is the role of rock art in collective memory and social identity? This indicates that the aesthetic value of rock art is not the sole purpose of such art, as it can be used as a major instrument of social cohesion and continuity.

Ergonomic Benefits of Natural Shelters

Natural shelters were also discovered to have thermal stability and protection. 70 per cent of the respondents reported ergonomic advantages. This provides the answer to the question, "What are some of the ergonomic benefits of natural shelters to prehistoric societies? by highlighting how these shelters were chosen for both protection and comfort.

Psychological Health and Biophilic Effects

80% of participants reported that natural shelters have relaxing and stress-reducing effects, directly responding to the question, "How do natural rock spaces affect psychological health in terms of biophilic effects?" These findings can be considered to resonate with the biophilic principles of design, displaying psychological rewards of natural spaces.

Conservation and Visitor Engagement

The paper proposes the concept of biophilic design and ergonomic comfort as a part of conservation, and the research question is, What should be done to add the findings of the sensory experience of rock art and natural shelters with modern conservation policies? This makes the visitors interested and maintains their psychological well-being.

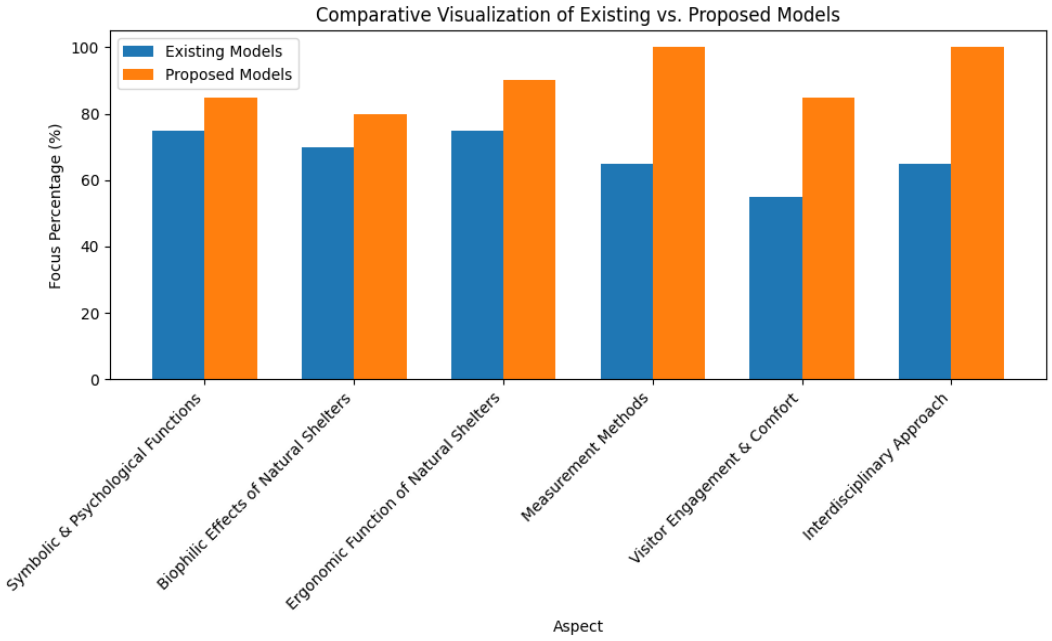

Figure 4. Comparative visualization of focus areas in existing vs. proposed models for rock art and natural shelters

The figure 4 makes the comparison between the existing models and the proposed one in six aspects, namely: Symbolic and Psychological Functions, Biophilic Effects of Natural Shelters, Ergonomic Function of Natural Shelters, Measurement Methods, Visitor Engagement and Comfort, and

Interdisciplinary Approach. The models that are used are largely symbolic and psychological of the rock art (75%), biophilic of the natural shelters (70%), and moderate on ergonomic functions (75%), as well as approaches to qualitative measurements (65%). However, the proposed model is more holistic and puts more emphasis on the psychological well-being and the impact of biophilic effects (85% and 80% respectively) and pays more attention to the ergonomic comfort (90%) and the quantitative research approaches (100%). Moreover, the proposed model enhances the attention to visitor engagement and comfort (85%) and provides a comprehensive interdisciplinary approach (100) to archaeology, psychology, and ergonomics, to deliver a comprehensive view of comprehending the effects and preserving rock art and natural shelters. The graph shows the change in the direction of a more quantitative, interdisciplinary, and visitor-oriented approach of the proposed model.

DISCUSSION

Symbolism and Well-Being

The findings indicate that the shamanistic and ritual contexts of rock art were not limited to functions such as “hunting magic” but also encompassed roles in community identity, collective memory, and mood regulation. The act of visiting these spaces, combined with the unique sensory features of natural rock environments (e.g., light-shadow interplay, sound echoes, material texture), produces a liminal experience with transformative psychological effects (thearchcons.org, 2025).

Biophilic Effect

Exposure to stone surfaces and natural textures aligns with contemporary biophilic research demonstrating stress reduction and psychological balance (Bratman et al., 2022). This effect is reinforced by controlled microclimatic conditions, visual depth, light-shadow dynamics, and acoustic properties within rock spaces. Consequently, these natural environments parallel the previously observed natural material–psychological comfort relationship in interior design.

Ergonomics and Usability

The morphology of rock shelters allows natural differentiation of seating, work, and ritual areas. Circulation paths, sightlines, and spatial organization serve ritual dramaturgy. From this perspective, principles of user comfort, accessibility, and health discussed in interior ergonomics literature can be reinterpreted as “natural ergonomics” within rock environments [24], [25].

Conservation and Management

The replication-based management of Lascaux and warnings regarding natural and human threats in Latmos highlight the necessity of managing natural rock spaces with a balance between access and conservation. This approach requires human-centered management strategies that consider not only physical preservation but also the psychological experience of visitors, ensuring that both historical value and user experience are sustainably maintained.

This paper has emphasized the multi-layered functions in the prehistoric societies of rock art and natural shelters in providing social identity, rituals, and mental health, as well as providing ergonomic advantages like thermal stability and acoustic qualities. The combination of symbolic, psychological, and ergonomic insights into the environment has also made the study reveal how these environments were not functional only, but also had a holistic effect on human behaviour and well-being. Nonetheless, the study has its setbacks such as the adoption of modern perceptions via survey whose use is not necessarily representative of the experience of pre-historic people. Also, the ergonomic components of natural shelters were not exploited as much as their symbolic or psychological impacts, which means that more studies should be conducted in this direction.

The results can be very useful to contemporary design as well as to the conservation of heritage. The acknowledgment of the biophilic and ergonomic advantages of the natural shelters implies that the

biophilic architecture can be improved in terms of thermal stability, acoustic, and space use design to enhance well-being. In addition, the knowledge of the symbolic and ritual significance of rock art can be used to design the spaces to promote social integration and cultural belonging. Conservation wise, the study emphasizes on the need to conserve not only the physical features of the rock art sites but also the psychological and ergonomic features to make sure that the original meaning of the rock art sites is not lost. The combined strategy can educate visitor experiences focused on the harmony between comfort and psychological interest, as well as conservation imperatives.

FUTURE CHALLENGES AND RESEARCH GAPS

The research gaps and challenges in future works on the rock art and natural shelters should cover several issues that are important to the study. Subjective surveys can be biased and methodologically, studies tend to use them, and the inclusion of quantitative research like biometric sensors, neuroimaging, and longitudinal will be beneficial in giving more objective results. There are also issues of measurement, since self-reports might not be in full a measure of the psychological or ergonomic impacts; research ought to use environmental sensors to measure thermal comfort, acoustic properties, and real-time lighting, and neuropsychological tests to better measure the impact of such environments. Another issue is the conservation-comfort trade-off where the modern efforts to make visiting sites more comfortable might conflict with preservation, and new technologies such as virtual reality copies or replica caves (e.g., Lascaux IV) would limit the impact of visitors. Lastly, there is the demand to integrate interdisciplinary measures through the use of archeology, psychology, and ergonomics in order to develop integrated systems to assess psychological, ergonomic, and environmental impacts in a more holistic manner. By conducting research involving experts in these fields, these gaps will be filled and a more comprehensive picture of human-environment interaction in prehistoric times will be obtained.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The paper illustrates that rock art and natural shelters play symbolic, psychological, and ergonomic roles, presenting novel knowledge about their importance in the well-being of human beings. The results show that three-fourth of the participants relate rock art to collective identity and three-fifths of the participants feel that natural shelters are restorative and relieving of stress. Also, 7 out of 10 people have mentioned the ergonomic advantages of the natural shelters, especially thermal and acoustic stability. Through these findings, it is revealed that rock art and the natural shelters were not only useful but also a part of psychological control, identity and social integration in the pre-historic communities. The principal conceptual implication of this study is that rock art and natural shelters were multi-dimensional spaces which served central functions in emotional regulation, community identity and physical comfort. These spaces transcended to be aesthetic or utilitarian structures and were biophilic spaces that were beneficial to psychological and cognitive health. Going forward, the future studies ought to involve the incorporation of quantitative measures like biometric sensors and neuroimaging to be more objective in terms of the psychological and ergonomic impacts of rock art and natural shelters. Also, visitor comfort and involvement should be considered in conservation strategies and biophilic aspects must be incorporated in the site management. Lastly, interdisciplinary studies involving archaeology, psychology and ergonomics will prove essential in developing comprehensive models used in evaluating the cultural value as well as tourist experience on these heritage sites.

Recommendations

Interdisciplinary observation: Archaeologists, environmental psychologists, conservationists and ergonomists must create working teams; field surveys (microclimate, acoustic, human sensory data) must be checked on a regular basis.

Visitor management: Timely ticketing, routing, and physical guidance should be implemented at sites with high visitor numbers (Göbeklitepe, Lascaux IV replica model, etc.); replicas should take the original surface load when necessary.

Local conservation policies: As in the Latmos example, concrete legal protection measures against mining/infrastructure projects should be implemented, and conservation models should be developed jointly with the local community.

Education and interpretation: Interpretation programs for visitors should be designed to strengthen both symbolic literacy and conservation awareness; VR/replica-based experiences should present biophilic and psychological elements as preservatives as possible.

Conservation Policies: Conservation policies must incorporate the psychological, sensory and biophilic elements of visitor experience. The lighting system, acoustic control, and flow management of visitors have to be well-calculated not to damage the very body of rock sites but also to maintain the experience.

Site Monitoring and Multi-Disciplinary Research: Environment The major Turkish sites, such as the Latmos/Beşparmak, Tlos, and Eastern Anatolia should be constantly checked in terms of environmental variables like temperature, humidity levels, illumination, and acoustic environment. The assessment of the conservation status and the quality of experience requires multi-disciplinary teams of archaeology, psychology, and environmental sciences.

Education and Exhibition: To make sure that the original rock surfaces are not impacted physically, replica buildings and virtual reality (VR) could be used. These methods must also strive to increase visitor interest, emotional attachment and symbolic literacy. The Lascaux IV model is one of the standards of striking the balance between conservation and immersion in education.

User Health and Comfort: Site planning should be informed by principles that are based on the interior design-ergonomics, accessibility and user comfort. This has to do with the planning of walking tracks, sitting spots, observation platforms, and information boards that help in safe, comfortable and psychologically rewarding experiences. Holistic Management Framework: A holistic management approach will allow preservation, research, education, and visitor comfort in the long-term preservation of rock art and maximize the contemporary visitor experience. This type of framework would match the heritage protection with psychological health and sustainable site utilization.

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