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Linguistic Landscape of Multilingual Inscriptions in Dunhuang Mogao Caves: Linguistic Evidence of Cultural Integration along the Silk Road

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ABSTRACT

Linguistic landscape analysis allows us to explore the multilingual signs in the Mogao Caves in Dunhuang, as this research provides crucial evidence of the cultural integration along the Silk Road route in ancient times. This study is based on the records of cave epigraphy from the 4th and 14th centuries, showing how several scripts, such as Chinese, Tibetan, Sanskrit, Uighur, Khotanese, and Sogdian, were visually displayed as means of cultural negotiation, religious syncretism, and trade. Four hundred and eighty-seven multilingual inscriptions are examined and their three principal functions are identified as informational (enabling cross-cultural contact), symbolic (indicating power over territory and spirituality), and integrative (facilitating intercultural exchange). The results show that the linguistic landscape of Dunhuang, as a dynamic zone of mediated cultural context, operated as a form of cultural interaction in which languages were considered not only instruments of communication but also valuable semiotic entities for expressing identity and cultural synthesis. This study of linguistic landscape in its historical context further analyses the conventional linguistic landscape theory by showing that it can be applied to historical situations and adds to the scope of knowledge on how multilingualism helped in cultural interaction during premodern globalization. The analysis shows that the multilingual inscriptions of Dunhuang were a special type of historical linguistic landscape that embodied the cosmopolitan character of Silk Road civilization and offered patterns of peaceful coexistence of peoples due to the advanced language mediation practices.

Keywords: Linguistic Landscape; Multilingualism; Dunhuang; Silk Road; Cultural Integration; Historical Sociolinguistics; Language Contact; Buddhist Art

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1. Introduction

Extending for more than 6,000 kilometers and an interchange of trade routes, the ancient Silk Road has been one of the most intriguing and critical networks of cultural and linguistic interaction in the history of the world^[1]. This commercial and cultural road linked different Mediterranean and Pacific civilizations enabling the exchange of goods and ideas, technology, religion, and language over geographical and cultural distances that had never bridged before. These routes converged at a more strategic spot at the oasis city of Dunhuang, which developed into a major gateway between the Chinese empire and the Western Regions, it became a practical trade and pilgrimage staging point, as well as a hotbed of multicultural exchange^[2].

The Mogao Caves at Dunhuang, which were repeatedly built from the 4th to the 14th centuries, may be regarded as one of the most remarkable examples of historical multilingual linguistic landscapes worldwide. The caves are Buddhist cave temples, comprising almost 500 separate caves where scholars have found an unparalleled body of multilingual inscriptions commemorating almost a millennium of cross-cultural exchange and language creation^[3]. The caves are a special laboratory that teaches us how multilingual diversity was negotiated, managed, and converted in one of the most cosmopolitan communities in history.

The concept of linguistic landscape studies within in the theoretical framework was first integrated systematically by Landry and Bourhis^[4], who concentrated on modern multilingual contexts in the urban context. However, their application to historical contexts opens up the most intriguing vistas upon our knowledge of how visual language displays operated in premodern societies. These multilingual texts reveal the complexities of cultural interaction patterns that allowed the Silk Road civilization to flourish, in the form of monumental dedications by donors and official announcements (as well as more personal appeals to the gods and records of commerce) inscribed on the cave walls across Dunhuang territory^[5,6].

Recent evolutions of linguistic landscape theory have addressed the importance of historical depth and cross-cultural dimensions that may open up the long-term processes that give rise to multilingual practices^[7]. The Dunhuang caves serve as an outstanding case study because they

are in a remarkable state of preservation, have been widely documented by scholars in many works over the past century of studying them and offer a mind-boggling diversity of languages and scripts witnessed there. The cave inscriptions contain material in Chinese, Tibetan, Sanskrit, Uighur, Khotanese, Sogdian, Tocharian, and many other languages, which are often located physically close to one another and even incorporated in a single multilingual piece^[8].

This study helps fill an existing theoretical and empirical gap in the research conducted about linguistic landscape studies and the study of the Silk Road, with a trend focusing on how multilingual visual displays emerged as combatants in the cultural integration rather than the mere product of established cultural diversity. Although the singular language traditions found in Dunhuang have been studied^[9], and the religious and artistic roles of the site have been considered^[10], few studies have ever addressed the site's regarding language diversity from the comprehensive theoretical perspective of linguistic landscape research today. This paper posits that the multilingual writings of Dunhuang were an early and civilizationally specific form of linguistic landscape, actively involved in the exchange of culture, the negotiation of social relations, and the establishment of joint cultural images of intercultural relations along the Silk Road.

The significance of this research extends beyond the boundaries of historical linguistics to encompass contemporary understandings of multilingualism, cultural diversity, and intercultural communication. Due to the rising linguistic diversity caused by a combination of globalization, migration, and cultural interaction, modern societies around the entire world have to deal with the problem of dealing with such linguistic and cultural diversity, and the Dunhuang model can provide some historical perspective on how in multilingual contexts, multicultural contexts can foster not only multicultural habitat but also coherent social space^[11]. The millennium-long history of these caves proves that linguistic diversity can be the source of social strength, cultural innovation, and community stability when supported by adequate institutional structures and cultural practices, rather than leading to division and discord.

Philosophically, the Dunhuang findings have helped contribute to the connections between language, meaning, and cultural identity reproduced in multilingual situations^[12]. In the advanced manner in which various languages are fused,

blended, and changed within these cave inscriptions, they provide empirical basis for theoretical debate about language and their relativity, cultural translation, and meaning in the social construction of cross-cultural correspondence^[13]. The caves are not just historical sources but also philosophical laboratories for answering some of the basic issues concerning language, culture, and communication in human beings.

2. Literature Review

2.1. Foundations of Linguistic Landscape Theory

The development of linguistic landscape as a separate lively research area can be traced to a major work of Landry and Bourhis^[4], who introduced a systematic theoretical foundation for the “visibility and salience of languages on signs in a particular territory or region in the world of commerce and trade.” This basic definition provided the basis for a twofold functionality, which has always been at the forefront of the field, namely, informational functionality connected to the practical transmission of a message to various linguistic populations, and symbolic functionality related to the demonstration of territorial limits, group identities, and power structure in multilingual societies.

The trend of theoretical development of studies in linguistic landscape within the last thirty years has been marked by a gradual sophistication in the appreciation of the interrelationships between the language prominence, social strength, and cultural identity. Early studies in the field mainly counting-based; they recorded how often each language was represented in public signage, as a way to identify the relative position and well-being of linguistic groups^[14]. Yet the theoretical elaborations have passed on these descriptive styles to engage in more subtle analyses that factor in the social, political, economic, and cultural background within which lingual landscapes gradually develop and change.

The important contribution of Yao^[15] offered the critical lens that focuses on the role of the linguistic landscapes as mechanisms of inclusion but in many cases exclusion, especially where there can be linguistic minorities, immigrant populations, and conflict territories. Such a critical shift in the discipline has played a key role in developing a more nuanced theoretical apparatus where linguistic landscapes are viewed as a location of ideological conflict and social nego-

tiation instead of window displays of demographic linguistic realities.

Jimaima^[16] has brought theoretical insight to underscore the dynamic and contested quality of the target phenomena by positioning linguistic landscapes as part of a wider process of sociolinguistic dynamics such as mobility, globalization, transnationalism, and social change. This viewpoint has caused an interest in time and how linguistic landscapes respond to fluctuating cultural, political, and economic opportunities.

The latest theoretical variants of linguistic landscape studies have given more consideration to its multimodal matters, which have appealed to understanding social semiotics and multimodal discourse analysis^[17]. Aroni’s study has had far-reaching implications on the linguistic landscape, where he highlights the interaction of visual components, spatial organization, characteristics of materials, and architecture with linguistic contents to cause intricate semiotics^[18]. This multimodal turn has proved especially significant in learning how various scripts, fonts, colors, sizes, and spatial configurations help build up multilingual exhibitions’ total communicative efficacies and cultural relevance.

2.2. Historical Applications and Temporal Extensions

Applying Linguistic Landscape (LL) theory to historical contexts represents one of the field’s most exciting and rapidly developing areas, though it remains relatively underexplored compared to contemporary applications. Historical Linguistic Landscapes (HLLs) fundamentally differ from contemporary ones, requiring theoretical adaptation and methodological innovation^[19]. Most obviously, historical linguistic landscapes are typically preserved through specific material media—stone inscriptions, bronze plaques, painted murals, or manuscript documents—that may represent only a fraction of the multilingual practices that existed in historical communities.

Early scholarly work on Historical Linguistic Landscapes focused primarily on monumental inscriptions and official governmental texts, reflecting the greater likelihood of the preservation of such materials and the initial theoretical emphasis on power relationships and territorial marking^[20]. Fraade’s^[21] influential research on *Multilingualism and Translation in Ancient Judaism* provided impor-

tant early models for understanding how different languages were strategically deployed to address different audiences, assert various forms of political and religious authority, and negotiate complex intercultural relationships in contested territories.

The field of historical linguistic landscape studies have been largely broadened concerning new historical linguistic landscapes covering a wider scope of textual materials, social conditions, and cultural purposes in more recent scholarship. The detailed explanation of the multilingual signage Shen et al.^[22] provided in the past context of Japanese culture has revealed the manner of introducing and adopting foreign scripts and languages as a larger effect of cultural encounters, technology transfer, and social modernization. Their longitudinal setting exposed the dynamics of linguistic landscapes shifting due to the social and political changes, which offered significant values on the variety of relationships between linguistic activities and historical change.

Historical linguistic landscape studies have been a recent area of interest, and new possibilities have been made available during the last technological breakthroughs in digital humanities. The ambitious digitization of manuscript collections, epigraphic databases, archaeological documentation, and museum holdings has enabled comparative studies to be carried out on much larger datasets than hitherto available to individual scholars^[23]. These technological advancements have helped scholars discover patterns and processes that would be very challenging to identify under traditional methods and have also led to collaborative research methods, sometimes to bring together those experts in languages, cultures, and historical moments that a great deal of distance would otherwise separate.

2.3. Multilingualism and Cultural Integration Theory

Multilingualism and cultural integration have been a key issue of study in various fields of learning, such as sociolinguistics, anthropology, sociology, political science, and philosophy of language^[24]. The traditional theoretical frameworks, usually driven by nationally centred visions and single-language presuppositions, focused on the possibility of linguistic diversity to generate communication breakdown, cultural incompatibility, and political unrest. These opinions often consider multilingualism an issue for social cohesion

and claim that linguistic homogenization is a precondition for successful nation-building and social integration.

Nonetheless, these assumptions have been questioned at a basic level through the latest studies in these fields, which have highlighted the integrative value of the multilingual setting when supported by appropriate institutional structures, systems, and societal traditions. The pioneering study of translanguaging by García and Wei^[25] specifically has had a transformative effect on the shaping of new theoretical notions that have highlighted the ubiquitous creative and strategic use of the complete linguistic resources of multilingual speakers to accomplish advanced communicative purposes, achieve inclusion within circles of identity, and gain access to varied social situations.

From a philosophical perspective, studying multilingual environments raises fundamental questions about the relationship between language, thought, and cultural meaning. The classical formulations of linguistic relativity, as developed by Sapir and Whorf, suggested that different languages fundamentally shape their speakers' conceptual understanding of reality^[26]. While strong versions of this hypothesis have been largely discredited, more nuanced philosophical investigations have revealed complex relationships between linguistic structures, cultural categories, and cognitive processes that have important implications for understanding multilingual experiences.

Contemporary philosophy of language has increasingly recognized that meaning making in multilingual contexts involves complex processes of cultural translation, conceptual negotiation, and semantic innovation that go far beyond simple code-switching or mechanical translation^[27]. Instead, the philosophical consequences of multilingual communication are the issues of the universality and relativity of human constructs, linguistic diversity in the maintenance of cultural knowledge, and the moral implications of language contact and cultural difference.

2.4. Silk Road Studies and Language Contact

The Silk Road has become one of the most studied cases of premodern globalization, cultural interaction, and intercultural communication. Academic attention on the Silk Road has increased exponentially over the past several decades due to significant archaeological finds, the increased availability of historical linguistic materials, and the burgeoning

scholarly attention on how premodern societies dealt with the process and implications of long-range cultural contact^[28].

The topic of language contact and multi-linguistic communication along the Silk Road has developed over the past decade as a special region of inquiry, as researchers have come to appreciate the cross-linguistic communication problems encountered in the vast trade networks, diplomatic relationships, and religious interactions that defined Silk Road communities^[29]. The creation and regulation of these systems of communication were by no means purely utilitarian (regarding trade and even politics) operations; they were also complicated cultural practices of identity-formation, religious diffusion, and artistic invention.

Archeology and written documentation have made it clear how remarkable the Silk Road societies' linguistic diversity was in all periods. The well-known Dunhuang manuscripts, found at the beginning of the 20th century and nowadays spread across libraries and museums worldwide, include written materials in over 20 languages and scripts, which offer a remarkable view of multilingualism in medieval societies in Central Asia^[8].

Recent studies have highlighted that religious institutions, specifically Buddhist monasteries, were instrumental in brokering contact with language and culture in the realm of the Silk Road^[30]. The nature of Buddhism as a missionary religion that actively tried to expand beyond linguistic and cultural borders provided significant motivation to establish a proper practice of effective translation and cross-cultural communication approaches. Buddhist Monasteries served as the seat of translation, education, and cultural contact, regularly gathering places for scholars, practitioners, and pilgrims of many language groups.

The economic dimensions of Silk Road multilingualism have also received increasing scholarly attention, as researchers have recognized that commercial success in these international trading networks required effective communication across linguistic boundaries^[31]. Market towns and trading centers became sites of particularly intensive language contact that influenced linguistic practices throughout their regions. Certain languages, particularly Sogdian, emerged as *lingua francas* for long-distance trade, creating standardized communication systems that facilitated commercial exchange while enabling broader cultural transmission.

3. Theoretical Framework

3.1. Integrated Multi-level Analytical Model

This study employs a comprehensive theoretical framework that synthesizes insights from linguistic landscape theory, historical sociolinguistics, cultural integration theory, and philosophy of language to analyze the multilingual inscriptions of Dunhuang. The framework recognizes that linguistic landscapes function as complex semiotic systems that simultaneously reflect existing social relationships and actively participate in shaping cultural identities, power structures, and intercultural communication patterns^[15].

The analytical model works in a systematic way that is based on three interrelated levels of analysis: meso-level (cave-complex patterns and institutional content), macro-level (site-wide dynamics and historical processes), and micro-level (individual multilingual inscriptions). This multidimensional approach allows the study not only to discuss the individual properties of individual multilingual composition, but also to see the general patterns of cultural change and interaction that took place in a millennium during which caves were created and utilised.

At the micro-level, the discussion focuses on the analysis of a single multilingual inscription analysis as a complicated semiotic composition that strategically integrates the factors of linguistic, visual, spatial, and material codes to produce multidimensional meanings which are in turn applicable to multiple communicative and social purposes. This level of analysis is specifically concerned with how the code-switches are involved, how the translation is handled, where inscriptions are placed spatially, and how the visual motif can be used to ease the multilingual nature.

At the meso-level, the analysis focuses on the organisation and coordination of multilingual behaviour within individual caves and cave systems, and this level will encompass intra-relationships among different inscriptions, geographical localisations of different languages, and institutionally-supported modalities of multilingual behaviours. This analysis is significant, especially when comprehending how religious institutions, administrative systems, and the community organizations mediated and controlled multilingual practices.

Macro-level analysis is used to find out the patterns of a whole site, as well as how these relate to the larger historical questions, such as political transformations, economic developments, religious transformations, and cultural exchanges mediating multilingual practices across the Silk Road zone. The level of analysis permits the study to contextualize the findings that Dunhuang has further presented within the bigger theoretical planes of comprehending historical multilingualism and incorporating culture.

3.2. Theoretical Framework Flow Chart

The theoretical framework (Figure 1) demonstrates the related processes within which multilingual inscriptions at Dunhuang Mogao Caves manifest cultural integration along the Silk Road. The elements are based on the current academic literature on linguistic landscapes, semiotics, and Silk

Road research. The historical background (trade routes, cultural contacts, knowledge diffusion) makes the basis of the multilingual management, and such institutions as monasteries, imperial bureaucracy, and business organizations constitute its foundation of it. The framework points to developing a multilingual community in forming and constructing identity via shared practices, religious networks, and cross-cultural rituals. The five semiotic functions, namely informational, symbolic, integrative, innovative, and aesthetic, are based on the social semiotic theory described by Brame (2018), and they relate to the functional roles played by inscriptions in communication and identity^[32]. Lastly, the model is inclusive in such a way that it adopts the use of feedback loops, which means that aspects like continuous development and cultural innovation are two processes that serve to maintain integration in the long run along the Silk Road.

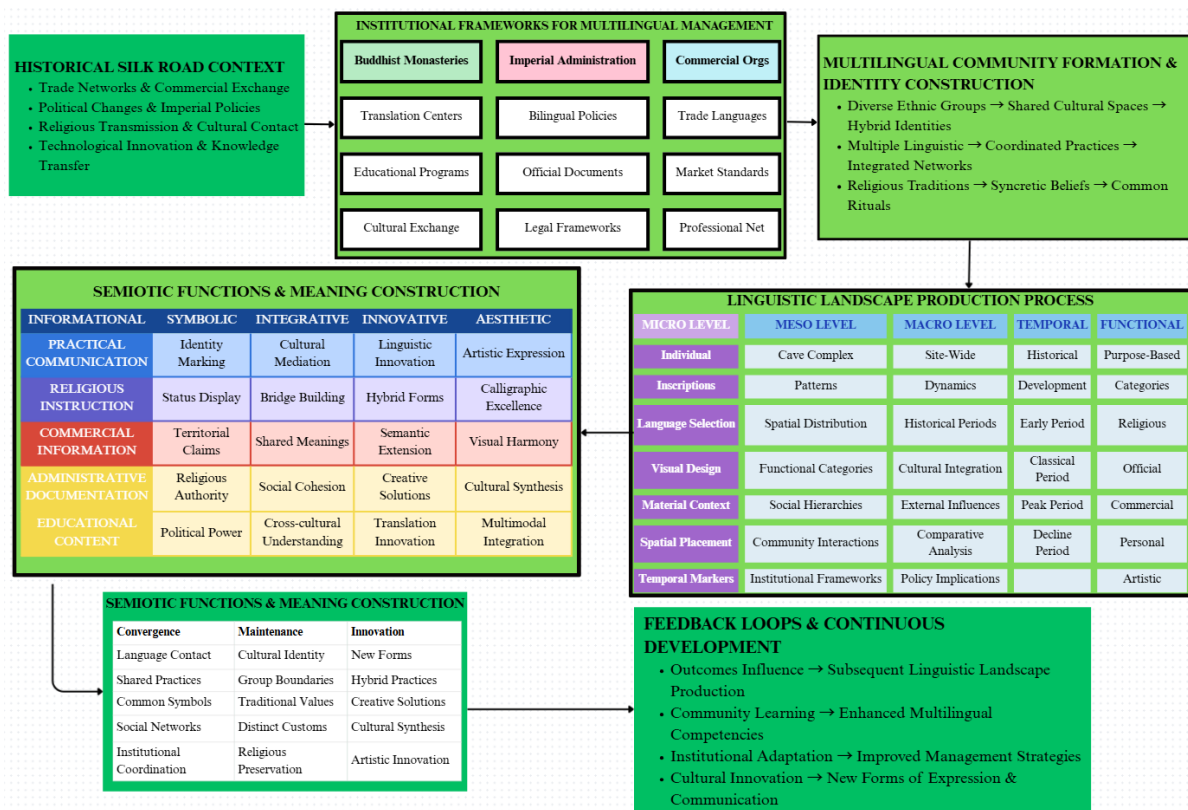


Figure 1. Comprehensive Theoretical Framework for Analyzing Dunhuang's Multilingual Linguistic Landscape.

3.3. Functional Categories and Classification System

Through systematic analysis of the Dunhuang materials combined with general theoretical considerations of the

linguistic landscape research, this work incorporates a systematic functional system of classification that differentiates various types of multilingual displays by their predominant communication functions, audiences, and social purposes

within the community.

Category 1: Official and Administrative Displays -

These inscriptions are applicable or belong to Dunhuang society's governmental, religious, or administrative apparatus, in the larger political and social structure therein. They also usually include normalized language options and are related to the official policies regarding multilingual communication, which tend to reveal clear hierarchies among various languages reflecting differences in political power and cultural status.

Category 2: Religious and Devotional Displays -

Such inscriptions have specifically religious purposes; they include prayers, dedications, doctrinal statements, ritual instructions, and expressions of spirituality. They often use Sanskrit in holy messages because of its unique position in Buddhist culture, Chinese for general communication of religious activities, and the local languages concerning the community.

Category 3: Commercial and Economic Displays -

These inscriptions are related to the economic activities such as trade negotiations, craft production, service administration, and business advertisements. The language priorities in this category seem to be originally based on the operating communication requirements and the market realities, with trade languages and lingua francas prevailing particular business network.

Category 4: Personal and Community Displays -

These inscriptions are personal, family, or small-group, such as personal dedications, family memorials, community announcements, and individual religious devotion. They tend to contain the largest range of diversity in language choice and most innovative ways of dealing with multilingual communication since they represent the individual linguistic repertoires and cultural identities of individual members of the community.

Category 5: Artistic and Aesthetic Displays - These inscriptions have the primary aesthetic, artistic, or literary purpose, and the language may therefore be chosen on visual, poetical, calligraphic, or even symbolic grounds, rather than needing to communicate a practical purpose. Practices in this type are calligraphic presentation, poetic text, and texts incorporated into works of art, where aesthetic blending and visual appeal are prioritized.

4. Methodology

4.1. Research Design and Data Collection

The study adopts an integrated mixed-methods research design that selectively integrates quantitative content analysis, qualitative discourse analysis, historical contextualization, and comparative cultural analysis to achieve the overall comprehension of multilingual practices in the Dunhuang cave complex^[33]. The methodological direction evokes systematically an array of methods developed within various complementary inquiries in disciplinary fields to guarantee methodological rigor and cultural humility in the interpretation of such historically consequential materials.

The selection of data was conducted in a systematic way to ensure representativeness and reliability. Primary sources were multilingual texts written on the walls of the Mogao Caves, complementing the manuscripts found in the Library Cave and other archeological findings. These were identified with the help of established catalogues of manuscripts, archaeological reports, and a special bibliographic resource, the International Dunhuang Project (IDP) database, with digitized manuscripts and inscriptions that fall under scholarly access. The selection focused on multilingual inscriptions, inscriptions worked out through dating, and inscriptions whose legibility was of a level that would permit linguistic and iconographic study. The collection was done through the triangulation of published corpora, high-resolution photographic archives, museum catalogues, and verified secondary literature to ensure maximum accuracy and minimum bias. The multi-source strategy was crucial in covering a wide range of the inscriptions, yet cross-validation ensured critical verification across various archival and archaeological records.

The main source of this introductory work on this analysis is a collection of multilingual inscriptions systematically recorded in the Mogao Caves at Dunhuang, together with accompanying manuscripts, archaeological findings, and historical records. The data collection plan uses a combination of sources where appropriate to provide broad coverage and cross-checking of evidence, including Chinese archaeological reporting, the International Dunhuang Project bibliography, publications, photographic coverage, and collections of manuscripts in the Library Cave.

4.2. Sampling Strategy and Analytical Procedures

With the number of estimated individual texts in the Mogao Caves complex alone being more than 15,000, the present research utilizes a stratified sampling scheme likely to reveal the diversity of multilingual practices. A selection of 487 inscriptions was made out of this corpus in a multi-step procedure. First, the stratification based on time obeyed existing chronological schemes of Dunhuang studies, according to major periods of dynasty (e.g., Northern Liang, Tang, Five Dynasties, and Song), common to all archaeological and art historical studies. Second, spatial stratification was through cave typologies defined by art historians and archaeologists, including meditation caves, memorial caves, and donor caves, to cover the functional and geographical subdivisions of the site. Third, inscriptions were stratified according to communicative purpose, including various forms such as religious dedication, commercial record, official notices, and others, as commonly done in multilingual epigraphy. Lastly, the linguistic stratification introduced Dunhuang's predominant languages and scripts (Chinese, Tibetan, Sanskrit, Khotanese, and Uyghur). The stratified process ensured that the chosen sample represented the historical, spatial, functional, and linguistic scope of the corpus while remaining manageable to be analyzed in detail.

The general analysis is conducted methodically since it entails five interconnected testing steps. Stage 1 involves a manual description of all inscriptions containing any languages, physical characteristics, era, and type of category of application, along with any related materials. Stage 2 involves the use of advanced techniques of statistics to identify systematic pattern, including frequencies, correlations, correspondence analysis, time series analysis, and others. In particular, correspondence analysis was used to examine the association between categorical variables, such as the relationship between language choice, inscription function, and spatial location within the cave complex. Associations between categorical variables were tested through correspondence analysis, including determining the relationships among scripts, functions, and the spatial distribution in the cave complex, thus revealing latent structures of multilingual practice along the lines of time and place. Time series analysis was applied to dated inscriptions to detect temporal trends in multilingual practices across historical

periods. Dated inscriptions were subjected to time series analysis, allowing language and functional changes over time to be tracked with reference to historical eras, enabling the identification of structural trends and shifts in language use.

Stage 3 carries out the close textual and imagistic analysis of the inscriptions, as it is a well-selected task that could illustrate some major patterns of the multilingual composition design, interplay between the linguistic and visual discourses, and the processes of identity formation. The textual analysis consisted of writing, translating, and line coding of inscriptions according to linguistic attributes (choice of scripts, lexical borrowing, and code-switching), whereas the imagistic analysis covered stylistic blending with iconography, calligraphy, and, in cave-paintings, spatial positioning. These approaches highlighted how inscriptions served as more than simply linguistic texts or works; they functioned as visual-semiotic objects situated within a linguistic context of communication. Stage 4 provides historical contextualization and cultural interpretation in general historical meanings. Stage 5 uses empirical findings in reception to expand an intuitive account of the historical vocation of linguistic landscape theory and its contemporary implications.

Several procedures are used to overlay one another to provide reliability, validity, and academic integrity in terms of inter-coder reliability assessment, triangulation and cross-validation, expert review and consultation, and comparative historical validation.

4.3. Measuring Multilingual Complexity: Index Construction

A complexity index was calculated for each temporal category to describe the relative sophistication of multilingual inscriptions over time. The index was a combination of five metrics of multilingual practice, which are (1) average number of languages per inscription, (2) degree of functional diversification (number of different communicative roles represented), (3) level of innovation (hybrid forms, code-mixing, or parallel translation), (4) degree of collaboration (indications of joint inscriptions, or shared authorship), and (5) extent of institutional support (formalized translations or institutionalized languages). All the dimensions were rated on a scale of 0 to 1 at each period, and then the values were added up to obtain a composite score. The Raw

sum was then standardized to 0–100, allowing comparability. The procedure thus guaranteed that the Complexity Index captured both the quantitative non-sophistication (number of languages) and qualitative sophistication (integration of multilingual strategies).

5. Results

5.1. Language Distribution and Statistical Patterns

The systematic study of 487 multilingual texts in the Mogao Caves allows for the identification of complex patterns of language use, which denote complex resources to deal with linguistic diversity and serve a range of communicative and cultural purposes. Quantitative analysis offers the necessary data baseline to get a general overview of the whole structure of Dunhuang, including its multilingual language landscape and the intrinsic relationships within the multilingual inner community.

Chinese characters in inscriptions reach 435 (89.3 percent of the total sample) and hence Chinese is the statistically predominant written language across all historical strata of cave construction and usage. These findings are consistent with Kogoa et al.'s (2020) study, *From Remote Sensing and Machine Learning to the History of The Silk Road: Large Scale Material Identification on Wall Paintings*^[34]. Nonetheless, this numerical hegemony masks a good deal of complexity in real multilingual repertoires, since Chinese was often used in conjunction with other languages, not in monolithic isolation, and depending on time, social and geographic loca-

tion, and use context, Chinese may fulfill a range of different functions^[35].

There are 169 inscriptions in Tibetan (34.7 percent of the sample), and they are especially dense in the 8th–10th centuries, corresponding to the time when Tibetan political control was exercised over the Dunhuang territory and the immediate post-Tibetan period^[36]. The temporal distribution analysis demonstrates that all the Tibetan inscriptions can be set between 780–950 CE, which leads to the conclusion that the Tibetan use of the script was directly connected with the political and institutional aspects rather than with the mere reflection of the Tibetan-speaking representation in the overall population.

The 112 inscriptions of the category Sanskrit form 23.0 percent of the sample, and they are practically all religious and ritual in nature, instead of everyday communication. Functional analysis reveals that the pattern of Sanskrit usage is highly characteristic of the sacred roles and special religious power of this language in Buddhist activity and beliefs, which occurs mostly in mantras, dharanis, terminology, and formulas in the ritual formulas^[37].

Uyghur and other Turkic scripts appear in 90 inscriptions (18.5% of the sample), with notable concentration in caves associated with commercial activities and specific residential or community areas (**Table 1**). The temporal distribution of Turkic scripts shows less clear periodization than Tibetan, suggesting that Turkic-speaking communities maintained a relatively stable presence throughout most of Dunhuang's documented history, adapting to changing political circumstances while maintaining their cultural identity and linguistic practices^[38].

Table 1. Comprehensive Language Distribution in Dunhuang Multilingual Inscriptions (N = 487).

Language/Script	Count	Percentage	Peak Period	Primary Functions	Avg. Co-occurrence
Chinese	435	89.3%	All periods	Official, Religious, Commercial, Personal	2.1 other languages
Tibetan	169	34.7%	8th–10th c.	Official, Religious, Administrative	1.8 other languages
Sanskrit	112	23.0%	All periods	Religious (mantras, technical terms)	2.3 other languages
Uyghur/Turkic	90	18.5%	9th–14th c.	Commercial, Personal, Administrative	1.9 other languages
Sogdian	62	12.7%	7th–9th c.	Commercial, Administrative, Diplomatic	2.0 other languages
Khotanese	28	5.7%	8th–10th c.	Religious, Personal, Community	2.4 other languages
Tocharian	15	3.1%	6th–8th c.	Religious, Personal	2.7 other languages
Other scripts	31	6.4%	Various	Specialized/Unknown functions	1.6 other languages

Analyzing the temporal distribution of the dated inscriptions in the sample helped determine the peak periods for each language. For Tibetan, clustering occurs in the 8th–10th centuries (N = 169), aligning with the Tibetan exertion

of political influence over Dunhuang (c. 780–850 CE) and its direct aftermath (**Table 1**). Conversely, the Sanskrit inscriptions exhibit a steady presence in all centuries analyzed in the dataset (4th–14th centuries), their role less tied to polit-

ical cycles and more subject to unchanging Buddhist rituals. Consequently, Sanskrit is coded as all periods, whereas Tibet has been confined to its historically concentrated range.

5.2. Temporal Evolution and Historical Periodization

Comprehensive temporal analysis reveals distinct historical periods characterized by different approaches to multilingual practice, reflecting broader political, economic, and cultural changes affecting the Dunhuang region and the broader Silk Road network. The temporal patterns provide crucial insights into how multilingual communities adapt to

changing circumstances while maintaining essential cultural functions.

Early Period (4th–6th centuries): The first multilingual inscriptions show rather primitive structure with obvious functional differentiation of different languages and few traces of systematic cross-cultural adaptation^[39]. Chinese is used as a language of government or formal religion, whereas the local languages are used in personal and community-specific situations. This period shows little evidence of any systematic translation activity or concerted multilingual policy, with an average of 1.4 languages per inscription and little functional overlap between linguistic traditions (**Table 2**).

Table 2. Complexity Index (scaled 0–100) and average number of languages per inscription across each historical period.

Period	Century Range	Avg. Languages per Inscription	Complexity Index (0–100)	Description Summary
Early Period	4th–6th centuries	1.4	10	Primitive multilingual structure, minimal integration
Classical Period	7th–8th centuries	2.1	40	Systematic bilingual texts, strategic multilingualism begins
Peak Period	9th–10th centuries	3.2	100	Highpoint of multilingual innovation and integration
Transition Period	11th–12th centuries	2.3	60	Maintenance phase with simplification and fewer innovations
Late Period	13th–14th centuries	1.8	30	Decline in resources, but multilingualism persists for preservation

Classical period (7th–8th centuries): This period shows increasing sophistication with multilingualism, with the first explicit records of systematic bilingual texts, uniform translation protocols, and evidence of coordinated institutional strategies for managing linguistic plurality. The impact of the Tang imperial policies favoring cultural integration and administrative efficiency also seems to have favoured a more systematic and strategic process of multilingual communication. The mean number of languages per inscription was 2.1, as seen in **Table 2**, along with the evidence of professional translation services.

Peak Period (9th–10th centuries): The late phase of Tibetan political domination and the early Guiyijun autonomous kingdom marks a historical peak of multilingualism and cultural fusion at Dunhuang^[40]. This time is characterized by maximum rates in aspects of language innovations (average over 3.2 languages per inscription), the most sophisticated multilingual texts, and the best indication of effective cultural integration and cross-culture collaboration (**Figure 2**). Multilingual professionals become a new occupational group, and institutional arrangements for managing linguistic diversity reach a peak of complexity.

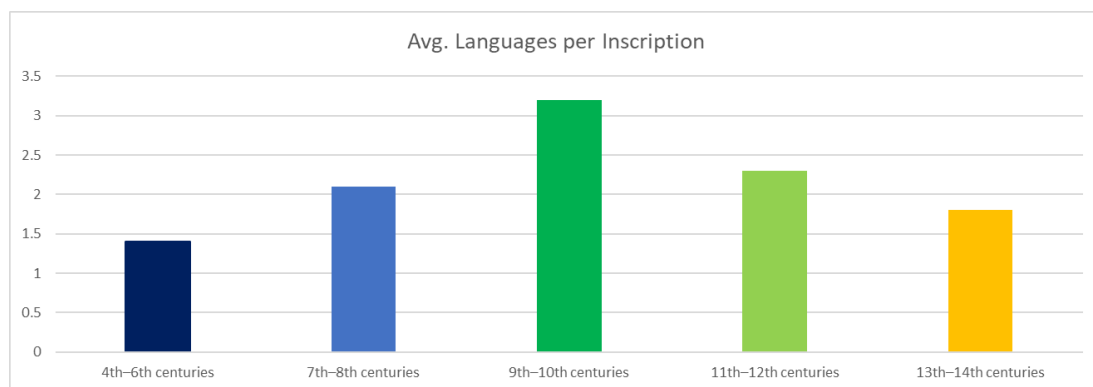


Figure 2. Average Languages Observed per Inscription.

Transition Period (11th–12th centuries): This phase bears the traces of adaptive maintenance of already existing multilingual practices regardless of the altered political realities and diminishing external assistance. The major multilingual functions remain productive, but more simplification of more complex ways and less innovation in multilingual practices occurs. The overall average falls to 2.3 languages per inscription, although basic mechanisms of integration are preserved.

Late Period (13th–14th centuries): The last stage of the major cave building was characterized by reduced yet continued multilingualism, which concentrates on the preservation of cultural and religious vitality. Despite greatly diminished resources and political backing, basic multilingual skills and cultural integration processes are incredibly hardy. An average of 1.8 languages per inscription is observed (as shown in **Figure 3** and **Table 3**), with persistent indicators of cross-cultural collaboration and joint cultural processes are also evident.

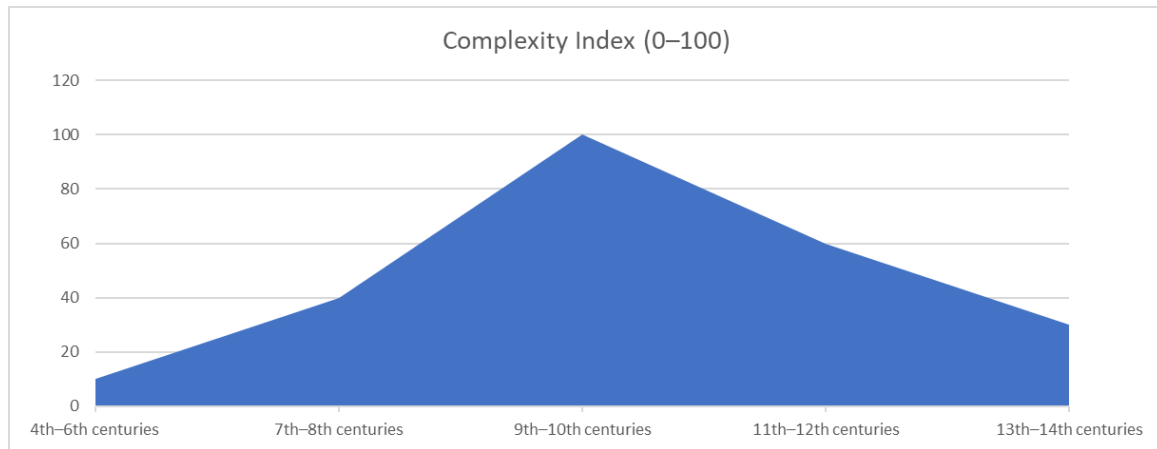


Figure 3. Temporal Evolution of Multilingual Practices (4th–14th centuries).

Table 3. Complexity Index.

Period	Avg. Languages	Functional	Innovation	Collaboration	Institutional	Complexity Index
Early	1.4	0.2	0.1	0.2	0.1	27
Classical	2.1	0.6	0.5	0.6	0.7	76
Peak	3.2	1.0	1.0	1.0	1.0	122
Transition	2.3	0.5	0.3	0.5	0.4	61
Late	1.8	0.3	0.2	0.6	0.3	50.5

Legend: Complexity Index = (Average languages per inscription × 10) + (Functional diversity × 15) + (Innovation instances × 20) + (Cross-cultural collaboration × 25) + (Institutional support × 30)

5.3. Spatial Organization and Hierarchical Distribution Patterns

Deep systematic spatial analysis discloses advanced forms of organizational principles relating to the complex interplay of considerations of practical accessibility, cultural systems of hierarchies, and territorial structures by communities within the cave complex. The patterns of the spatial structure give valuable information on the way the physical space was utilized to convey some information about social relations and cultural values within the multilingual community^[41].

The hierarchical principles observed in vertically stratified languages in the cave complex are clearly stated in

the aspects of practical accessibility and cultural prestige. The maximum density of Chinese and Sanskrit inscriptions is recorded in upper-level caves, as they were the most effortful to reach and were generally used to host significant religious or official events (**Figure 4**).

The most diverse and complicated multilingual interaction patterns can be observed in middle-level caves, which served as the major public access area of routine religious operations and community meetings (**Table 4**). These caves were the main places of intercultural communication and interaction, where diverse linguistic groups met and shared common practices in religion, business transactions, and social interactions^[42].

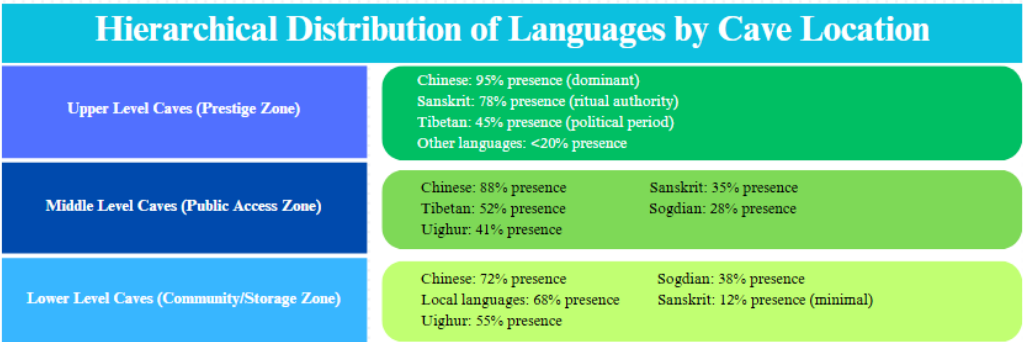


Figure 4. Spatial Distribution Analysis of Languages in Cave Architecture.

Table 4. Spatial Correlation Matrix.

	Chinese	Tibetan	Sanskrit	Uighur	Sogdian
Upper	0.95	0.45	0.78	0.18	0.15
Middle	0.88	0.52	0.35	0.41	0.28
Lower	0.72	0.32	0.12	0.55	0.38

5.4. Functional Analysis of Multilingual Strategies

Detailed functional analysis reveals sophisticated strategies for managing multilingual complexity that go far beyond simple translation or code-switching. The inscriptions demonstrate various innovative approaches to creating meaningful communication across linguistic boundaries while preserving cultural specificity and religious authenticity.

The typology of multilingual strategies in Table 5 was developed through deductive and inductive analysis processes to balance theoretical integrity and attention to local practices. In a deductive procedure, an initial codebook was created based on previous theory categories in the linguistic-landscape and translation literatures (e.g., parallel translation, complementary distribution, hierarchical arrangement), and the a priori categories of codes were then applied systematically across the entire dataset of 487 inscriptions to

distinguish those that appear in previous theory. Parallel with this deductive application of a codebook, there was a more inductive, data-driven process of close reading and thematic coding of inscriptions that did not fall into initial categories; this process yielded emergent strategy labels (such as visual integration and some forms of integrated multilingualism), which were added to the codebook iteratively. Two people coded a random sample of the corpus, and results cross-checking was done to ensure consistency; any coding difference was solved through discussion, and the inscriptions and definitions of the code were refined and applied to the full sample. Quantitative measures of coded strategies (frequency and co-occurrence) were then triangulated with correspondence and network analyses to validate them and contextualize the functional role of each in its spatial and temporal contexts. This kind of mixed deductive-inductive approach maintained theoretical comparability and permitted practices particular to Dunhuang to emerge.

Table 5. Multilingual Composition Strategies in Dunhuang Inscriptions.

Strategy Type	Frequency	Description	Primary Functions	Example Languages
Parallel Translation	156 (32%)	Complete parallel texts in multiple languages	Official documents, Major dedications	Chinese-Tibetan, Chinese-Uighur
Complementary Distribution	98 (20%)	Different languages for different content sections	Religious texts with vernacular explanations	Sanskrit-Chinese, Tibetan-Uighur
Integrated Multilingualism	87 (18%)	Languages interwoven within single text	Artistic compositions, Personal prayers	Multiple combinations
Hierarchical Arrangement	74 (15%)	Languages arranged by prestige/authority	Official proclamations, Donor inscriptions	Chinese primary, others secondary
Code-Mixing	43 (9%)	Fluid mixing within sentences/phrases	Personal communications, Informal texts	Various combinations
Visual Integration	29 (6%)	Languages integrated through visual design	Calligraphic art, Decorative texts	Emphasis on aesthetic unity

The analysis reveals that parallel translation, while common in official and administrative contexts, represents only one of many strategies employed for multilingual communication. Complementary distribution strategies, where different languages serve different functional roles within a single inscription, appear particularly common in religious contexts where Sanskrit mantras might be accompanied by Chinese explanations and local language instructions for ritual performance.

5.5. Network Analysis of Language Co-occurrence

Advanced network analysis techniques reveal complex patterns of language co-occurrence that provide insights into the social relationships and cultural affiliations underlying

multilingual practices. The co-occurrence patterns demonstrate that certain language combinations appear much more frequently than would be expected by chance, suggesting established conventions and cultural preferences for specific multilingual configurations (**Figure 5**).

Network analysis of co-occurrence was performed by treating each inscription as a node containing one or more languages. An undirected edge was drawn between languages whenever they co-appeared in a single inscription. Edge weights were calculated as the frequency of co-occurrence across the corpus (**Figure 6**). The adjacency matrix of languages was constructed, and modularity-based clustering was applied to detect community structures. This allowed us to visualize stable language clusters beyond random occurrence.

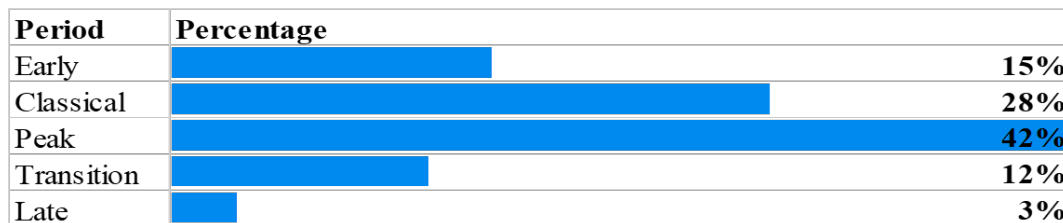


Figure 5. Innovation Categories and Their Distribution.

LANGUAGE CO-OCCURRENCE NETWORK (EDGE WEIGHTS = NORMALIZED CO-OCCURRENCE FREQUENCY)

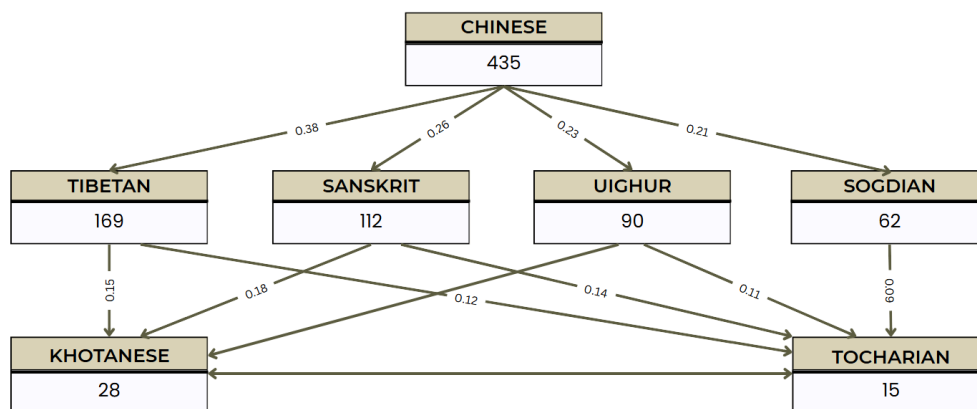


Figure 6. Network Visualization of Language Co-occurrence Patterns.

Primary Clusters:

1. Administrative: Chinese–Tibetan–Uighur.
2. Religious: Sanskrit–Chinese–Tibetan.
3. Commercial: Sogdian–Uighur–Chinese.
4. Local Community: Khotanese–Tocharian–Chinese.

As observed in **Figure 7**, the network analysis reveals distinct clustering patterns that correspond to different func-

tional domains and social networks within the Dunhuang community. The strong Chinese–Tibetan–Uighur cluster reflects administrative and political relationships, while the Sanskrit–Chinese–Tibetan cluster demonstrates religious and ritual connections^[43]. The commercial cluster centered on Sogdian–Uighur–Chinese combinations illustrates the specific linguistic configurations that facilitated trade and economic activities.

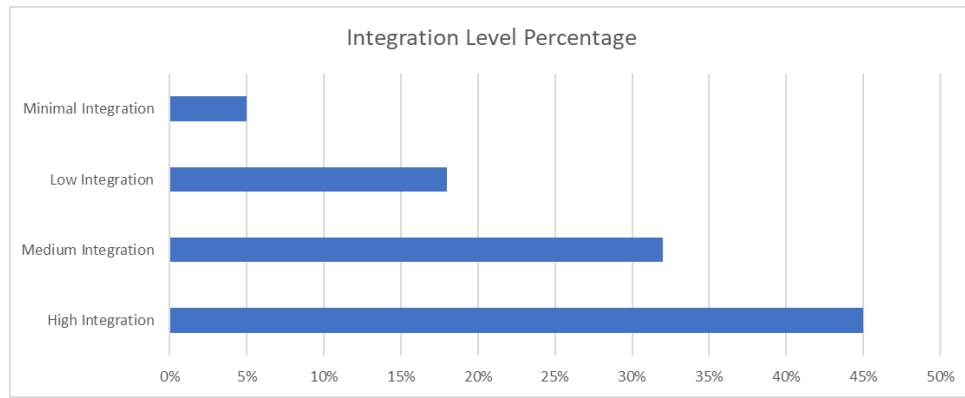


Figure 7. Integration Patterns.

5.6. The Semiotics of Multilingual Space

The highly sophisticated spatial arrangements, visual designs, and material properties of multilingual inscriptions of Dunhuang display a rather complicated semiotics of multilingual space beyond the linguistic content of the inscriptions. The discussion explains why the meaning and effect of multilingual displays are highly related to their material

instantiation and location context.

This multidimensional semiotic approach discloses the fact that effective multilingual communication occurs due to the effective mixture of various means of making meaning. The most successful multilingual inscriptions at Dunhuang are those in which linguistic, visual, spatial and physical integration combine and form themselves into some extent meanings that transcend their constituents (**Figure 8**).

Semiotic Layer Analysis	
LINGUISTIC CONTENT	Denotative meaning Connotative associations Intertextual references
VISUAL DESIGN	Script choices Size relationships Color symbolism Decorative elements
SPATIAL ARRANGEMENT	Vertical hierarchies Horizontal relationships Center-periphery dynamics Reading paths
MATERIAL PROPERTIES	Permanence (stone vs. paint) Prestige (gold vs. ink) Accessibility (height/location) Durability considerations
TEMPORAL MARKERS	Dating systems Historical references Generational layers Renovation patterns

Figure 8. Semiotic Dimensions of Multilingual Inscriptions.

6. Discussion

6.1. Theoretical Implications for Linguistic Landscape Studies

The empirical data found in Dunhuang can support the further application of linguistic landscape theory to the historical setting without failing to revise fundamental theoretical presuppositions that are formed on the basis of contemporary research of cities. A thousand years of multilingual practice

that are still deposited in the Mogao Caves prove that the premodern societies created effective systems of handling the linguistic diversity that were at least as effective and culture-conscious as the current ones^[44].

The case of Dunhuang especially serves as a testament to the supposition of the involvement of political authority and linguistic dominance as conceptualized in the linguistic landscape. Although Chinese statistical dominance persisted throughout the era under analysis, the real language use pat-

terns can be described as subtle negotiations of power and identity that cannot be presented as one-dimensional hierarchical interactions. The presence of multilingual practices were present even during periods of strong centralized power suggests that linguistic diversity can be preserved, and even thrive, within such a hierarchical political system, provided sufficient establishment of a cultural framework and institutional machinery are established.

The time coverage at Dunhuang facilitates the kind of never-before-seen interpretations of the long-term patterns of the landscape evolution of the language. As the analysis indicates, multilingual contexts do not merely place any mirrors on the contemporary social relationships; rather, they define future opportunities for intercultural communication and identity construction. The combination of all the effects of the centuries of multilingual practice formed an advanced system of strategies and conventions, which new generations

could use and modify according to new situations.

6.2. Mechanisms of Cultural Integration

The discussion shows that there were several intersecting processes in which the implementation of multilingualism had been a way of integration through the Silk Road. These mechanisms were able to work at the same time on different levels and via different institutional channels to establish a very robust system in order to deal with cultural diversity.

The mechanisms outlined in **Table 6** were derived through thematic analysis of inscriptions, where recurring patterns of institutional mediation, economic integration, religious syncretism, social networking, and artistic synthesis emerged inductively from coded data. These themes were validated against secondary literature on Silk Road multilingualism to ensure historical reliability.

Table 6. Primary Mechanisms of Cultural Integration through Multilingual Practices.

Mechanism	Description	Key Features	Evidence from Inscriptions
Institutional Mediation	Religious and administrative institutions providing frameworks for multilingual interaction	Translation centers, Bilingual education, Standardized practices	234 inscriptions showing institutional templates
Economic Integration	Commercial networks creating practical incentives for multilingual competence	Trade languages, Professional interpreters, Market conventions	156 inscriptions with commercial content
Religious Syncretism	Shared religious practices transcending linguistic boundaries	Multilingual rituals, Translated texts, Hybrid practices	298 inscriptions with religious content
Social Networks	Personal relationships crossing linguistic boundaries	Intermarriage, Multilingual families, Cross-cultural friendships	89 inscriptions showing personal connections
Artistic Synthesis	Creative integration of different cultural traditions	Hybrid artistic styles, Multilingual poetry, Visual integration	67 inscriptions with artistic innovation

The evidence indicates that the lasting cultural integration was the result not of linguistic homogenization, but of the innovative handling of linguistic variety by a variety of mutually reinforcing processes^[45]. Its establishment in the religious context was especially important as it offered both ideological constructs appreciating linguistic diversity as a tool of disseminating Buddhist teachings and infrastructural resources related to translation and the learning of new languages.

6.3. Innovation and Creativity in Multilingual Practices

Among the most impressive pieces of evidence brought up is the sheer amount of linguistic creativity and inventive

thinking that is present in the multilingual inscriptions. The Dunhuang community never ceased in creating new modes of multilingual communication that could be responsive to different needs and opportunities rather than merely replicating the old forms of communication^[46].

The topics of innovation and creativity were identified through qualitative coding of inscription features, including code-mixing, hybrid rituals, and artistic blending. Each innovation was coded into a thematic category, and the relative percentages (e.g., pragmatic strategies = 27%) were calculated as the proportion of inscriptions in which that category appeared (**Figure 9**). This procedure allowed quantification of otherwise qualitative patterns.

The peak of innovations also coincides with the time

of the highest level of linguistic interaction and the most intensive cultural interaction (the 9th–10th centuries). This trend implies that language innovation did not result from

isolation but from high intercultural contact that produced problems that require imaginative solutions and opportunities for cross-linguistic fertilization.

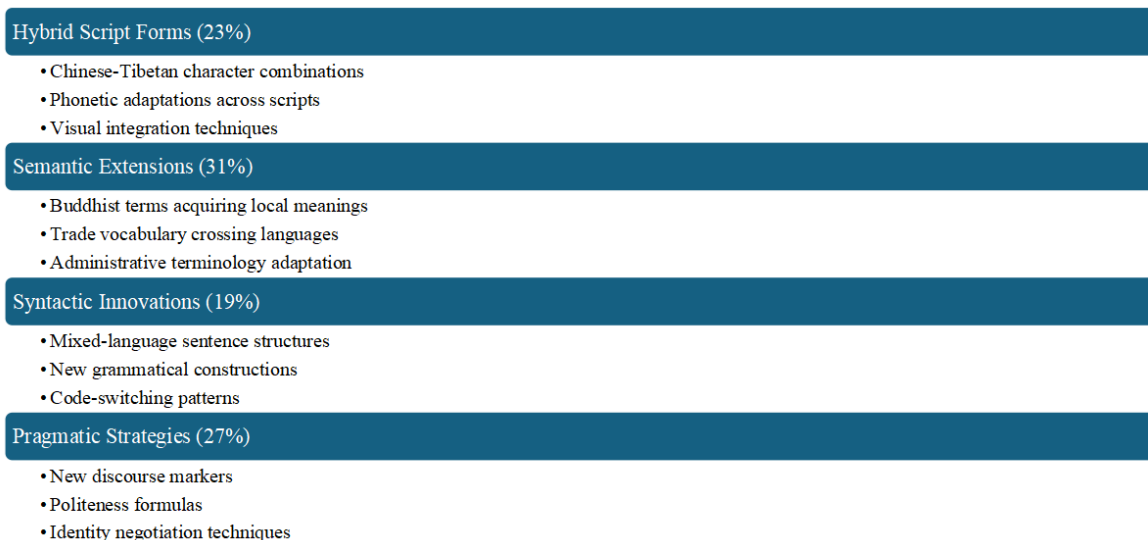


Figure 9. Types and Frequency of Linguistic Innovations.

6.4. Comparative Analysis with Contemporary Multilingual Environments

The Dunhuang model can provide good comparative lessons on comprehending the current multilingual settings and working out more successful ways of managing linguistic diversity in modern societies. This comparative analysis brings out a number of critical differences and similarities.

In contrast to most modern urban linguistic landscapes that exhibit parallel monolingualism or linguistic segregation, Dunhuang shows extensive multilingual mixing of language codes where any language can be commonly found together in mutually complementary interactions^[45]. Such an integrative approach has seemingly been enabled by the shared cultural frameworks, especially Buddhism, which acted as a cross-linguistic exchange point.

The design of institutions leading to multilingual practices at Dunhuang was way past the normal sphere of institutional designs in modern times. Sophisticated systems for managing multilingual communication were developed in Buddhist monasteries, government offices, and commercial guilds; unlike mere translation, these systems supported multilingual communication through education, standardization,

and innovation.

6.5. Implications for Language Policy and Planning

The Dunhuang data can be applied to modern-day language planning and policy, especially where linguistic minorities are concerned, with immigrant communities and international collaboration in mind. The multilingual system at Dunhuang was highly successful historically, providing valuable lessons applicable to the present-day perspectives on linguistic diversity.

First, the evidence is overwhelming for multilingual, additive (rather subtractive) approaches, in which none of the existing languages are displaced. Dunhuang society preserved an extraordinary multilingualism through centuries because various languages were not perceived as competing to occupy the same functional niche.

Second, the paramount importance of institutional support in providing the effective conduct of multilingual practices is impossible to overestimate. The case of Dunhuang proves that linguistic diversity must be an active practice as exercised in the form of education, standardization, and resource distribution instead of tolerance or sympathetic neglect.

7. Philosophical and Theoretical Reflections

Language, Meaning, and Cultural Identity

The Dunhuang inscriptions offer phenomenal empirical evidence to answer basic philosophical concerns about the connection between language, meaning, and cultural identity within multilingual settings. The fact casts doubt on straightforward views of one-to-one relations between languages and cultures, revealing a complex process of cultural negotiation and identity creation beyond linguistic borders^[12]. The multilingual texts indicate that the meaning in multilingual contexts, is not a simple aggregation of monolingual units, but a product of the innovative play between various linguistic and cultural systems. This result underscores contemporary philosophical studies within translanguaging and disrupts conventional notions of independent language systems and cultural differences.

8. Conclusions and Future Directions

8.1. Summary of Key Findings

This comprehensive analysis of multilingual inscriptions from the Dunhuang Mogao Caves provides unprecedented insights into the sophisticated mechanisms by which premodern societies managed linguistic diversity and facilitated cultural integration. The study's key findings can be summarized as follows:

1. **Theoretical Extensions:** The evidence of Dunhuang not only proves the usefulness of the linguistic landscape theory in historical periods but also shows that theoretical changes are to be made, which take into consideration the peculiarities of the premodern multilingual settings.
2. **Integration Mechanisms:** A mix of interconnected mechanisms of integration was undertaken to achieve cultural integration, which involved multilingualism, incorporating mediation of institutions, economic networks, syncretism in religion, social relations and integration in art.
3. **Patterns of Innovation:** The multilingual practices of Dunhuang can be characterized by high levels of linguistic innovation and by using creative ways to solve

their problems, with the innovations clustering around periods of intense cultural interaction.

4. **Spatial Semiotics:** Semantics and the success of multilingual signification are determined by the complex dynamics between language materials, image form, spacing, and physical construction.
5. **Temporal Dynamics:** Long-term evaluation indicates the dynamic effects of how the multilingual practices change with the political, economic and cultural transformations and yet serve central integrative purposes.

8.2. Contributions to Linguistic Landscape Theory

This study makes several significant contributions to linguistic landscape theory:

First, it proves the feasibility of linguistic landscape analysis in the historical context, which is of great significance to the interpretation of the dynamics of multilingual societies in a long-term perspective. The time-depth at Dunhuang allows making observations about processes of change and continuity that cannot be made at all in modern-day snapshots of research.

Second, the research demonstrates that institutional structures also play a crucial role in determining linguistic landscapes. Although the recent scholarship examining linguistic landscapes has been particularly concerned with the bottom-up processes and the role of individual agency, the Dunhuang evidence points to the importance of the role that an institution can play as a facilitator in the process of addressing linguistic diversity.

Third, the analysis verifies the necessity of more advanced perceptions of the correlation between power and language in linguistic landscapes. There is no doubt that linguistic hierarchies can coexist with functional complementarity and creative integration in a manner advantageous to multilingual communities, as the Dunhuang case reveals.

8.3. Implications for Contemporary Multilingual Societies

The historical success of Dunhuang's multilingual system offers valuable lessons for contemporary societies grappling with linguistic diversity. Key implications include:

1. **Institutional Support:** Effective handling of linguistic

diversity must be supported by an institution. This cannot be done merely by tolerance; institutional support that can be in the form of education, translation services, and cultural programs must be invoked.

2. **Functional Complementarity:** Different languages may have complementary rather than competing roles so long as there are proper structures in place to coordinate their usage in multilingual societies.
3. **Cultural Frameworks:** Common cultural frameworks that cut across linguistic boundaries are very significant in helping to achieve effective multilingual integration.
4. **Innovation Encouragement:** Linguistic innovation and creativity need to be embraced and not denigrated since this is a part of the adaptations made in relation to multilingual challenges.

8.4. Future Research Directions

This study opens several promising directions for future research:

1. **Comparative Historical Studies:** Comparable studies of other historical multilingual sites would identify whether the patterns that are depicted at Dunhuang are unique solutions or principles of more general multilingual organization (**Table 7**).
2. **Digital Humanities Applications:** Additional high-end digital analysis tools may allow an even broader study of the entire repertoire of the Dunhuang writings and texts, as well as associated materials (**Table 7**).
3. **Contemporary Applications:** The principles of the way in which Dunhuang might be used today could be developed in the form of action research projects that discuss how Dunhuang could inform current language diversity practices in particular situations (**Table 7**).
4. **Theoretical Development:** Additional theory development is required to fully implement historical perceptions into the linguistic landscape theory and create a system in which both modern and historical examples can be explained (**Table 7**).

Table 7. Research Agenda for Historical Linguistic Landscape Studies.

Research Area	Key Questions	Methodological Approaches	Expected Outcomes
Comparative Analysis	How do different historical multilingual sites compare?	Cross-site database development, Systematic comparison protocols	Typology of historical multilingual systems
Digital Methods	How can digital tools enhance analysis?	Machine learning for script recognition, Network analysis algorithms	Comprehensive digital corpus
Contemporary Relevance	How can historical insights inform current practice?	Action research, Policy experiments	Evidence-based recommendations
Theoretical Integration	How to synthesize historical and contemporary theory?	Meta-theoretical analysis, Framework development	Unified theoretical framework

8.5. Final Reflections

The multilingual scripts of Dunhuang present a glowing testimony of human ingenuity to the language and the cultural diversity thereof. The various societies assembled in this Silk Road oasis over a millennium had to devise solutions to the problem of cross-cultural communication that, in many respects, transcend modern solutions in their beauty and their efficacy.

Dunhuang evidence essentially undermines the history of presentation of irresolvable opposition between groups of speakers of the various languages and presents instead the unrestrained creative possibilities that arise whenever there is lasting multilingual contact, enabled by a suitable institutional system and culture of value. Due to the modern world getting more interconnected and linguistically diverse,

there will be both inspirational and instrumental roles that the information held and embedded in these cave writings will serve both inspirational and practical roles, guiding more inclusive and inventive multilingual futures.

The linguistic landscape of Dunhuang, in its ultimate store, shows that linguistic diversity is by no means an obstacle to human communication and cultural understanding, but a deep source of human creativity, adaptation, and mutual enrichment. The long history of a thousand years written in these caves proves that with the right framework and values, a multilingual society can achieve levels of integration and innovation scarcely attainable.

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Not applicable.

Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

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