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Examining Script Evolution through Language Contact: The Case of Naxi Manuscripts and Chinese Characters

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ABSTRACT

This study explored the impact of language contact on written languages through the case study of Chinese character borrowing in Naxi Manuscripts. Drawing from four primary corpora spanning religious, medical, and divinatory genres, the study identifies 11 frequently borrowed Chinese characters and 301 instances of borrowing through a combination of optical character recognition (OCR) and manual verification. The borrowing is in three types: phonetic, semantic, and graphic borrowing. Through two proposed indicators, "Borrowing Breadth" and "Borrowing Density", the study quantifies the extent of borrowing for different genres. Results show that medical texts exhibit the highest level of Chinese character borrowing, reflecting the extensive interaction between Naxi and Han in this field. In contrast, religious texts display the lowest borrowing rate, possibly due to their earlier composition and limited cross-cultural contact at the time. Phonetic borrowings and semantic borrowings significantly outnumber graphic borrowings, revealing that the functional features of characters were prioritized over their abstract visual forms. This paper not only expands the research on the language contact between Naxi and Han but also shows the important role of genres in linguistic integration and exemplifies how language contact can lead to script evolution.

Keywords: *Language contact; Lexical borrowing; Naxi Manuscripts; Dongba scripts; Geba scripts; Script evolution*

INTRODUCTION

Language contact refers to the phenomenon wherein sustained interactions between speakers of different languages lead to linguistic changes within the languages involved. Such interactions often result in multiple outcomes. Early studies by Uriel Weinreich (1953) and Einar Haugen (1953) shed light on how interference and borrowing occur, mainly due to bilingual speakers. Building on these foundations, Thomason and Kaufman (1988) proposed a broader framework for understanding contact outcomes, where they argued that sustained interaction can also bring about deeper structural changes, including shifts in morphology and syntax. Importantly, these linguistic changes are often associated with the social status of one's language (Sankoff, 2004; Sankoff, 2018; Aikhenvald & Maitz, 2021). Thus, studying these changes provides insights into the sociolinguistic status of minority

languages, especially endangered languages, contributing to efforts aimed at their preservation (O'Shannessy, 2012).

The Naxi people, one of the 55 ethnic minority groups in the People's Republic of China, act as a compelling case study for examining language contact. They have a unique writing system – the Dongba script, employed by Naxi ritual specialists (Dongba) to document religious texts (Li, 2008). The prolonged interactions between the Naxi people and the Han Chinese majority have often been believed to have led to the creation of the Geba manuscript (Li, 2008). The writing system combines elements derived from both the Dongba and Chinese characters.

While much of the literature on language contact has emphasized spoken forms, the role of writing systems has received comparatively less sustained attention. Still, important recent contributions on Sinoxenic and minority writing practices suggest how Chinese characters have been variably borrowed and adapted across minority literature, producing multi-layered orthographic repertoires rather than single, uniform scripts (Poupard, 2022; Mao, 2023). Examining script evolution provides a useful perspective for understanding how writing systems develop and respond to changing cultural circumstances. Scholars have shown that this process is shaped by multiple factors, including internal shifts and external factors (Rogers, 2004; Coulmas, 2003).

This study explores the influence of Chinese characters on Naxi writing systems, with particular attention to the ways in which Chinese characters appear in different genres of Naxi texts. Drawing on a corpus containing medical, divinatory, and religious texts, the study traces instances of Chinese lexical borrowing in Naxi manuscripts and considers how the borrowing varies across genres.

THE NAXI WRITING SYSTEMS.

The Naxi people, one of China's 55 officially recognized minority groups, primarily reside in northwestern Yunnan Province, particularly along the bends of the Yangtze River, with smaller populations in southwestern Sichuan (Friedrich, 2023). Their population exceeds 300,000.

Within the Naxi ethnic group, the Dongba script is the most extensively studied Naxi writing system (Li, 2008). Often described as the world's only pictographic script still in active use, it has been called a "living fossil" of human writing (Zhou, 2019; Poupard, 2019). The script is most widespread in western Naxi areas such as Lijiang, Zhongdian, and Weixi in Yunnan. The Dongba script is mainly used by Naxi priests known as Dongba, who use it to record the scriptures of the Dongba religion. Over centuries of use and transmission, these texts have accumulated into a substantial collection—approximately 30,000 manuscripts are now preserved (Yongsheng, 2024). The extensive corpus of Dongba manuscripts plays a crucial role in the cultural identity of the Naxi people and is at the core

of Naxi manuscripts. Based on current research findings, most researchers agree that the Dongba script is a local writing system developed internally by the Naxi people (Li, 2008).

Unlike the internally developed Dongba script, the Geba script arose in a context of intensified contact between the Naxi and the Han Chinese. Historical records suggest that the Naxi people were originally a branch of the Qiang people who lived in the Hehuang Valley (Li, 2008). They then migrated to the Sichuan-Yunnan border area, where they maintained a close relationship with the Han Chinese. This dynamic became especially evident after the implementation of Gaitu Guiliu (the imposition of direct imperial administration) in Lijiang, when Han officials deliberately sought to reshape local customs (Yang & He, 2024). Given the historically dominant position of Han culture, they were more likely to influence the creation and development of neighboring minority ethnic group writing systems. The result of the language interaction is the Geba script, a writing system characterized by its more simplified and abstract symbols compared to the Dongba script. The Geba script integrates Dongba script elements and Chinese characters (Friedrich, 2023).

METHOD

Corpus[1]

The corpus used in this study consists of several datasets, each of which is composed of Naxi Dongba manuscripts in either digitized image form or annotated publication. The study's primary dataset is Dongba1800 (Ma, Li, & Chen, 2024). It includes 1,800 images of Naxi manuscripts from all genres (Ma, Li, Long, et al., 2025). The second dataset is the Book of Medicine, an excerpt from the Annotated collection of Naxi Dongba manuscripts (Editorial Committee, 1999). The book belongs to the medical genre. Another important source is the Naxi Dongba Literature Character Interpretation Collection (Vol. 29) (Yu, 2022). This volume contains two Dongba divination scriptures: *Divining the Fruitfulness and Failure of Crops by Rain, Spring Thunder, Earthquakes, and Eclipses of the Sun and the Moon* (with character interpretations) and *Divination by Bagatu'* (with character interpretations). The former records the Naxi understanding of natural phenomena; the latter describes the trigrams of Bagatu divination. These manuscripts belong to the genre of divination. The fourth dataset is the Book of Genesis (Zhou, R. (Ed.), 1950). It records the Naxi's understanding of the origins of the world and describes the history of their ancestors' migrations and struggles for survival. This belongs to the genre of religion.

This study adopts a combination of manual analysis and code-based analysis to study the influence of Chinese characters on Naxi manuscripts.

[1] It is important to note that although some corpora's names specifically mention "Dongba", they also contain instances of the Geba characters. Moreover, the Chinese characters in the datasets are actually part of the Geba writing system. The overlap of Dongba manuscripts and Geba manuscripts is due to the hybrid nature of many Naxi writings.

To identify potential Chinese character borrowings, an optical character recognition algorithm was employed. Specifically, the Baidu OCR API (Baidu OCR API) was used to scan the corpus for recognizable Chinese characters. Based on the results generated by the OCR, along with previous works identifying Chinese characters in Naxi texts, 11 Chinese characters were selected for further manual analysis (Li, 2008). These 11 characters are: "'上'(Shang)、'下'(Xia)、'五'(Wu)、'方'(Fang)、'犬'(Quan)、'止'(Zhi)、'工'(Gong)、'千'(Qian)、'合'(He)、'六'(Liu)、'光'(Guang)'.

The steps of manual analysis proceeded in several steps. First, the Chinese characters used within the texts were quantified. For each corpus, data were collected on the total number of images, the number of images containing the target Chinese characters, the frequency of occurrences of each character, and the total number of Chinese characters appearing in each corpus. Then, the effect of genre on the number of borrowed words was analyzed. To do so, the study focused on the three corpora with clear genre classifications: *the Book of Medicine* (medicine), *Naxi Dongba Literature Character Interpretation Collection* (divination), and *the Book of Genesis* (religion). Due to the lack of genre identifications in *Dongba1800*, it was excluded from the genre-based comparisons.

Two core indicators were used to measure the extent of borrowing: Borrowing Breadth and Borrowing Density:

a. Borrowing Breadth refers to the percentage of images or pages containing Chinese characters among all images or pages in the manuscripts, and the formula is:

   Borrowing Breadth (%) = (number of images with borrowed Chinese characters ÷ total number of images/pages) × 100%.

This indicator reflects how widely the Chinese characters are distributed throughout the text, revealing whether Chinese characters appear in a small number of texts or appear extensively in the whole corpus.

b. Borrowing Density measures the frequency of borrowed Chinese characters relative to the size of the corpus, and is calculated as follows:

   Borrowing Density = (total number of borrowed Chinese characters ÷ total number of images/pages) × 10

This indicator shows how many Chinese characters appear in every 10 images or pages of Naxi texts on average.

To avoid statistical bias caused by differences in the total number of images or pages across the corpus, this paper adopts a relative ratio by calculating the number of Chinese characters in each 10-image subset, rather than the absolute number, to ensure data comparability. Additionally, to assess whether the observed variation in borrowing across genres was statistically significant, a Chi-square (χ^2) test of independence was conducted. The test was chosen because it is suitable for comparing frequency data across categories, like genres in our paper. A standard significance threshold of $p < .05$ was adopted.

Finally, the 11 Chinese characters were classified into three categories based on the classification proposed in *Perspectives on the etymological research of Geba script: A review of Research on the origin and development of Naxi Geba script* (Yu, 2005) and the table *Comparison of the synonyms of Geba and Chinese characters* in *A comparative study of the four writing systems of the Naxi people* (Li, 2008). The three categories are: phonetic borrowing, where characters are adopted primarily for their sound rather than meaning; semantic borrowing, where characters are adopted primarily for their meaning rather than sound; and graphic borrowing[2], where characters are adopted primarily for their visual form rather than for phonetic or semantic value.

During the actual analysis process, we found that many examples exhibit overlapping features. For example, in both semantic and phonetic borrowing, the visual features (such as radicals and structure) of Chinese characters often play a supportive role to assist recognition. This observation aligns with findings in reading research. Rayner et al. (2012) emphasize that word recognition depends on the concurrent integration of orthographic, phonological, and semantic information. Likewise, Heine and Kuteva (2005) note that borrowing is rarely a straightforward transfer; it frequently involves complex interactions among form and sound. Therefore, although this study adopted a three-category method for analytical purposes, we are aware that the three types of borrowing are not distinctly separate in real language use but form a continuum with blurred boundaries. To manage these overlaps, this study adopts the "dominant-feature classification approach," whereby borrowings are categorized according to the feature that plays the most significant role. For example, even if graphic or semantic elements play a secondary role, if a character is primarily used for its phonetic similarity to a Naxi word, it is classified as phonetic borrowing.

These theoretical considerations provide the foundation for the following analysis. In the next section, we examine how these three types of borrowing appear in different genres of Naxi manuscripts.

FINDINGS AND DISCUSSION

This section presents the results obtained by following the procedures outlined in Section 3. It is divided into three parts: the first examines how borrowing patterns vary across different genres using quantitative metrics; the second provides qualitative examples

[2] Suppose a character is adopted mainly because its shape is the most distinctive and recognizable, while its pronunciation or original meaning plays only a secondary or auxiliary role in its usage. In that case, it can be considered a graphic borrowing. It is typically identified in the following scenarios: 1. The character's form is highly similar to the original Chinese character in visual structure; even if rotated or simplified, it remains recognizable. 2. In the Naxi context, the pronunciation of the character differs significantly from its original Mandarin pronunciation. 3. In the specific context, the meaning expressed by the character has deviated significantly from its original Chinese meaning or is difficult to establish a direct connection with.

of the three types of borrowing found in the corpus; and the third summarizes the overall distribution and classification of Chinese character borrowings across the corpus.

The Influence of Genre on the Frequency of Loanwords

Table 1. Frequency and Distribution of Chinese Loanwords in the Naxi Manuscript Corpus Across Genres

Name of the Book	Genre	Total Number of Images	Number of Images with Chinese Characters	Number of Occurrences of Chinese Characters	Borrowing Breadth	Borrowing Density
The Book of Genesis	Religious	37	1	1	2.70%	0.27
Naxi Dongba Literature Character Interpretation Collection	Divination	46	10	17	21.70%	3.69
The Book of Medicine	Medical	20	8	10	40.00%	5.00

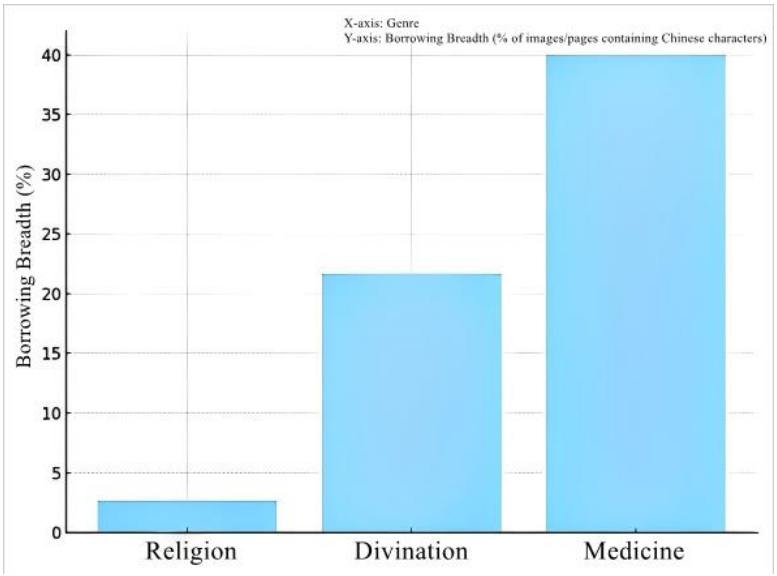

Figure 1. Borrowing Breadth by Genre

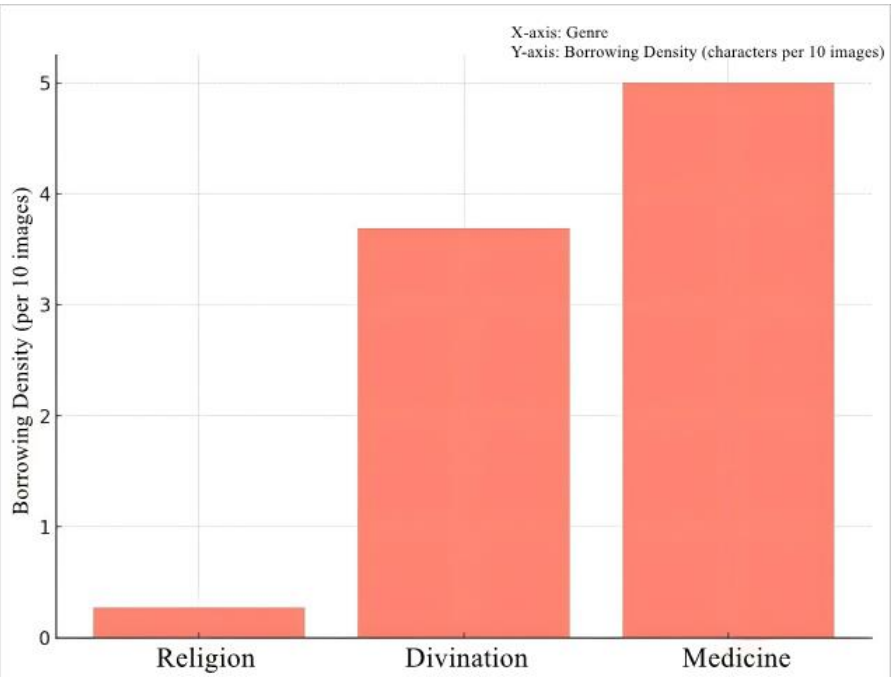

Figure 2. Borrowing Density by Genre

As can be seen from Table 1&Figure 1, the Borrowing Breadth varies significantly among different types of genres. The religious genre (The Book of Genesis, Zhou, 1950) has a low percentage of Chinese characters borrowed, only 2.70%, indicating that the coverage of Chinese characters in this genre is very limited. The divination genre (Naxi Dongba Literature Character Interpretation Collection (Vol. 29), Yu, 2022) is at a medium level. In contrast, the medical text (The Book of Medicine (Editorial Committee, 1999)) has the highest Borrowing Breadth, reaching 40.00%, indicating a wider distribution of loaned Chinese characters in this genre. In terms of Borrowing Density, as can be seen from Table 1&Figure 2, the medical genre has a borrowing density of 5.00, meaning that every 10 images contains an average of 5 Chinese characters, which is 18.5 times higher than that of the religious genre (0.27) and 1.35 times higher than that of the divination genre (3.69). The findings indicate that the medical genre exhibits the highest level of borrowing in both breadth and density, followed by the divination genre, with the religious genre showing the lowest degree of borrowing. This pattern aligns with findings from other studies of genre-driven contact, which show that technical and medical registers are particularly prone to cross-linguistic borrowing due to the demands of knowledge transfer (Meletis & Dürscheid, 2022; Hemelstrand & Inoue, 2025).

The Chi-squared test confirmed a statistically significant association between genre and the incidence of character borrowing, with $\chi^2(2, N = 103) = 10.33$. For this test with 2 degrees of freedom at a 0.05 significance level, the critical value is 5.99. Because the calculated χ^2 exceeds this threshold, we can confidently reject the idea that the differences 、

in borrowing across the genres are due to random chance, and the results suggest that genre exerts a meaningful influence on character borrowing.

Case Studies of the Three Types of Borrowing

This section presents one example for each of the three borrowing categories to illustrate how Chinese characters are incorporated differently in Naxi texts.

Example 1: Phonetic Borrowing

Figure 3. Example of Phonetic Borrowing

This example (Figure 3) is taken from the Naxi Dongba Literature Character Interpretation Collection (Vol. 29) (Yu, 2022), containing the Chinese character '上 Shang'. The meaning of the picture is: 'Wheat will have rust disease, which is bad. Black frost will fall on the villages. Quarrels and fights will occur in the direction of the West and the Dog's Abode (NW)' (Yu, 2022). In this context, '上' does not carry its standard Chinese character meaning of 'above', but rather means 'say' in the Naxi manuscript, and appears in conjunction with the word 'quarrel'. It is pronounced as: $ʂə^{55}$ $ʂə^{33}$, similar to the Mandarin pronunciation /ʂɑŋ^{51}/. Because the meaning has diverged completely from its origin while the phonetic value has been retained, the instance is an example of phonetic borrowing (Yu, 2005).

Example 2: Semantic Borrowing

Figure 4. Example of Semantic Borrowing

This example (Figure 4) is also from the Naxi Dongba Literature Character Interpretation Collection (Vol. 29) (Yu, 2022), including the Chinese character'犬 Quan'.

The meaning of this excerpt is: 'When someone's year turns in the direction of the dog's abode (NW) in Baghdad' (Yu, 2022). In this case, the character retains the Chinese character's original meaning "dog", but has a new pronunciation khw^{33}, different from the Mandarin pronunciation /t͡ɕʰyan^{214}/. The perseverance of the semantic meaning and shift in phonology show that the case is an example of semantic borrowing.

Example 3: Graphic Borrowing

Figure 5. Example of Graphic Borrowing

This example (Figure 5) is taken from image 82 of the Dongba1800 dataset (Ma, Li, & Chen, 2024), containing the Chinese character '工 Gong'. Although the character is rotated 90 degrees clockwise here, it is still clearly recognizable. According to the table *Comparison of the synonyms of Geba and Chinese characters* in *A comparative study of the four writing systems of the Naxi people* (Li, 2008), '工 Gong' here means 'link', and is pronounced as: pu^{33}. However, in Mandarin, the meaning of '工 Gong' is 'productive enterprise', and its pronunciation of is /kʊŋ^{55}/. '工 Gong' diverges from its original meaning both semantically and phonetically, and thus is an example of graphic borrowing.

Summary of Loaned-Chinese Distribution and Classification

Table 2. Number of Occurrences of Chinese Loanwords in Naxi Manuscripts Corpus

Name of the Dataset	Genre	Total Number of Images	Chinese Character	Types of Borrowing	Number of Images with Chinese Characters	Number of Occurrences	Total Occurrence
Dongba 1800	/	1800	上 Shang	phonetic	70	134	273
			下 Xia	semantic	28	97	
			光 Guang	phonetic	1	1	
			犬 Quan	semantic	1	1	
			止 Zhi	phonetic	10	17	
			工 Gong	graphic	2	2	
			千 Qian	semantic	1	1	
			合 He	semantic	12	19	
			六 Liu	semantic	1	1	
Naxi Dongba Literature Character	Divination	46	上 Shang	phonetic	5	11	17
			犬 Quan	semantic	6	6	

Interpretation Collection							
The Book of Medicine	Medical	20	上 Shang	phonetic	2	2	10
			止 Zhi	graphic	4	4	
			方 Fang	phonetic	1	1	
			光 Guang	phonetic	2	3	
The Book of Genesis	Religious	37	上 Shang	phonetic	1	1	1

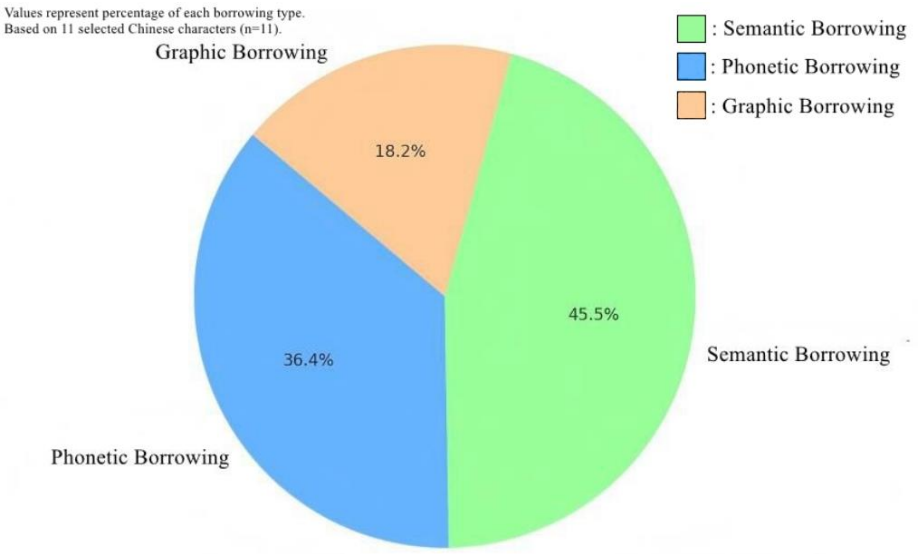

Figure 6. Proportion of Borrowing Types in Naxi Manuscripts (n=11)

As shown in Table 2, a total of 301 cases of loaned Chinese characters were found in the Naxi manuscripts, covering three types of borrowing. The distribution presented in Figure 6 shows that there are more phonetic and semantic borrowings than graphic borrowings, indicating that the Naxi writing systems tend to incorporate Chinese characters more for their sound and meaning rather than pure visual form. This is also consistent with Yu's argument in 'Perspectives on the etymological research of Geba script: A review of Research on the origin and development of Naxi Geba script' (Yu, 2005). Overall, the high frequency of Chinese characters and diverse forms of Chinese character borrowing in Naxi manuscripts provides evidence of linguistic contact leading to significant influence on the Naxi writing systems.

DISCUSSIONS

Through the in-depth analysis of the Chinese character-borrowing phenomenon in Naxi manuscripts, this study reveals key ideas of linguistic evolution demonstrated by the Naxi and Han in the process of language contact.

Firstly, language contact not only facilitates change in spoken languages but also in written languages. When communities that speak different languages interact over extended periods, their writing systems may evolve through the borrowing of other languages'

characters. In the case of Naxi and Han Chinese, this study has shown how the Naxi writing system is significantly influenced by the Chinese characters, with 11 examples of borrowed characters and 301 occurrences of these characters.

Secondly, text genre proves to be an important factor influencing the frequency of borrowed characters. The breadth and density of Chinese character borrowing in medical texts are significantly higher than in other genres, showing close communication and knowledge sharing between Naxi and Han in the medical field. In contrast, the religious texts were written earlier, when there was less contact between Naxi and Han, so the frequency of Chinese character borrowing is lower. This pattern aligns with research indicating that genre influences linguistic features because of differing communicative demands and audience expectations (Biber, 1991; Lysanets & Bieliaieva, 2023). Further, for the distribution of borrowing types, the frequency of phonetic and semantic borrowing is significantly higher than that of graphic borrowing. This suggests that in the process of borrowing, Naxi people preferred to retain the semantic or phonological core of the Chinese characters. Studies on Chinese character recognition lend support to this pattern: phonetic components (phonetic radicals) reliably facilitate recognition, making phonetic borrowing cognitively efficient and thus more likely in contact situations (Liu et al., 2020). Similar evidence comes from semantic processing. Experimental work shows that semantic radicals can facilitate character recognition when their meaning closely corresponds to the character containing them (Tong et al., 2021), and recent studies further demonstrate that semantic accessibility enhances recognition speed and accuracy (Jiang et al., 2025). Taken together, these findings provide a cognitive explanation for why phonetic and semantic borrowings dominate over purely graphic borrowing in the Dongba corpus. Strikingly, this preference mirrors other Sinoxenic traditions where script adaptations consistently foregrounded sound and meaning over visual form (Poupard, 2022; Zhou, 2019; Zisk, 2025).

However, the study still has several limitations. Although the dataset is comprehensive, it is constrained by the accuracy of OCR and human resources. Due to the difficulty of proofreading all of the recognized characters one by one, there may be minor inaccuracies in certain results. Future work should employ larger-scale computational methods to map borrowings alongside codicological and paleographic evidence in order to establish their provenance and date their emergence (Petersen, 2023; Yang & He, 2024). At the same time, the human dimension could be investigated through psycholinguistic experiments examining how these hybrid scripts are cognitively processed (Tong et al., 2021).

CONCLUSION

This study investigates Chinese character borrowing in Naxi manuscripts. The scarcity of pure graphic borrowing suggests that the Naxi people were more inclined to adopt either the phonetic or the semantic meanings of Chinese characters. This reflects the adaptive evolutionary mechanism of the writing system as the Naxi people interact with dominant

cultural influences, where functional components were privileged over abstract form. The comparative analysis of texts across genres further underscores the trend: medical texts show the greatest degree of Chinese character integration, suggesting a stronger level of convergence in the fields that require technical knowledge. Moreover, the findings show that language contact between the Naxi and Han has become increasingly deepened over time. This is particularly evident in the growing presence of Chinese elements in more recent texts.

Importantly, this study contributes to the broader field of language contact by showing how written languages respond to external influences. As discussed in Yu's analysis of the Geba script, the development of Geba represents a product of this cultural fusion (Yu, 2005). By documenting 301 instances of Chinese character borrowing, the research provides empirical evidence for the impact of linguistic contact on written languages.

Looking ahead, future research could delve deeper into other dimensions of the impact of language contact. While the present study focuses on lexical borrowing in texts, other linguistic features, such as syntactic or morphological adaptations, may need further attention. Expanding the corpus, generating more data using ethnographic methods, and including more genres may also show the impact of language contact more comprehensively. Furthermore, research could be expanded to examine the modern evolution of the script.

Overall, this study helps to reveal how Chinese characters entered the Naxi writing systems through the analysis of specific texts. It also provides an analytical framework and theoretical grounding for the study of language contact for written languages and the integration of cross-cultural writing systems.

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Antong Dai and Ziqing Lin contributed equally to this work and should be considered co-first authors.

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