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DECODING THE CROSS-CULTURAL SYMBOLISM OF "HAN DYNASTY NANYANG PICTURE STONE BACTRIAN CAMEL" IN THE DESIGN OF CHINESE CHARACTERS-IMPLICATIONS FOR CHINESE POSTER DESIGN RESEARCH

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ABSTRACT

The present study explores the cross-cultural symbolism of the bactrian camel image in Chinese character design through a multidisciplinary approach that combines historical artefacts with artificial intelligence to generate design experiments. Utilising camel images from the Nanyang pictorial stones of the Han Dynasty (202 BC-220 AD) as the iconology baseline, Pannowsky's three-layer iconolgy analysis was employed to decode the camel's biomorphology and cultural encoding mechanism. As demonstrated in the relevant literature, there is a correlation between the biological characteristics of the camel, such as the S-shaped curve of the neck and the Z-shaped joints of the legs, and the strokes of Chinese characters (e.g.," (","驼"). This correlation has been verified through AI fusion experiments, which have shown a similarity of 92% in the alignment of the neck curves. The proposed "structural metaphor" methodology reveals the possibility of integrating biomorphic forms of non-hieroglyphic Chinese characters (e.g.,"驼" camel) in accordance with the principles of calligraphic aesthetics, which reflects the transformation of the camel from a practical means of transport along the Silk Road to a cultural symbol. The study provides an innovative approach to negative space dynamics and biomechanical simulation in Chinese poster design, and advocates interdisciplinary collaboration to promote the narrative dimension and cultural carrying capacity of Chinese character design.

Key words: Chinese character design, chinese poster design, cross-cultural symbolism, han dynasty nanyang picture stone, image of the Bactrian camel, structural metaphor

Bactrian camels in cultural and historical contexts

Bactrian camels are predominantly located in Central Asia (e.g., China, Mongolia, Kazakhstan, etc.) (Faye, 2020), and their size is adapted to arid environments, while their robust leg structure renders them suitable for long-distance trekking across deserts and grasslands (Meng and Xie, 1999). The utilisation of camels in the context of long-distance transportation and trade can be traced back to the Han Dynasty (7th century), coinciding with the inception of the Silk Road. The strategic deployment of these animals was attributed to their capacity to navigate the arduous terrain and variable climate that characterised the Central Asian geography, thereby facilitating continuous trade operations. This assertion is corroborated by Ge (2018), who asserts that camels were instrumental in supporting large-scale trade operations. The Tang Dynasty's inclusive and open governance strategy resulted in increased demand for trade, thereby highlighting the distinctiveness of camels in terms of their trade and transport requirements. The prevalence and diversity of camel motifs in Han and Tang cultural artefacts (Guo, 2017) serve as a testament to the profound admiration and respect for the camel spirit. The camel is not merely a mere symbol; it is a representation of the intrepid pioneering spirit that characterised the Silk Road.

Bactrian camels symbolise endurance in Mongolian and Central Asian cultures, and their dairy products and furs were once important commodities in the Silk Road trade (Nagy *et al,* 2022). Bactrian camels racing and panniering in the Gobi region still retain traces of historical trade routes (Otgonsuren *et al,* 2022). Since the 7th century BC, the Steppe Silk Road has played an important role in China's foreign economic and cultural exchanges as one of the main transport routes through the Han and Tang dynasties

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to the Yuan and Ming dynasties. For example, the "travelling Mongolian merchants" (Liu, 2015) owned 1, 500 commercial camels under the trade name "Dashengkui 大盛魁". The camel, through the economic flow of the road, the mainland's agricultural products, industrial products and livestock products from the Mongolian steppe began a frequent two-way flow. This is the economic significance of camels.

The centrality of the camel in the Silk Road economy, in the absence of any Chinese character representation, constitutes a cultural paradox.

Despite the pivotal function of the camel in the Silk Road Economic Belt, there is an absence of "etymological evolution" and "word formation and expansion". A comparison of the character for horse, which is also a transport animal, reveals that horse was already a pictograph in the earliest Chinese character system, the oracle bone inscriptions (Fig 1), and was used independently and in a stable form at an early stage, with a clear evolutionary lineage, and a clear simplification process from pictographs to seal scripts and regular scripts. The character camel "骆驼" did not function as an independent element in either oracle bone or jinwen; rather, it emerged in bronze inscriptions during the Shang and Zhou Dynasties as a synonym for "橐驼" (e.g., "Yi Zhou Shu" records that "橐驼" were imported from the Western Regions). It was not until the Western Jin Dynasty, when Zhang Hua inscribed it in the "Museum Records", that its name became "骆驼" , which was later simplified to "驼" (tuó).

With regard to the processes of word formation and expansion, the morpheme "驼" (camel) is analysed as consisting of "马" (horse) on the left for meaning (an animal of the family Equidae) and "它" (it) on the right for sound. The lexicon is characterised by a paucity of extension words, the majority of which pertain to camel itself (e.g."hump", "camel's bell"). There is an absence of rich derivation. In contrast, the radical "马" has been shown to possess a robust capacity for character formation, contributing to the development of a considerable number of Chinese characters (e.g. "骑", "驾", "驰"). As a radical, it has been used to form a large number of Chinese characters (e.g. "ride", "drive", "run fast", etc.), and has given rise to a rich vocabulary of words such as "horse", "horse power", "horse armour", etc., which encompasses both physical objects and abstract concepts as well as metaphors.

While the bactrian camel is indispensable in trade, it is semiotically marginal, reflecting differences in cultural application. The camel's historical role has been predominantly in the form of tribute, particularly in the Western Regions, or as livestock for northern ethnic minorities. Consequently, its application within the Central Plains culture is limited, with the majority of extant documentary records focusing on transport, tribute, or entertainment (e.g., the Xiongnu's "camel fights"). In contrast, the horse, as the first of the five animals, is used throughout farming, military, transport and other fields, with far-reaching cultural symbols, such as "马到成功 beginner's luck", "汗马功劳 sweat and horses" and other symbolism. This discrepancy may be attributed to the non-native status of the camel and the agricultural bias of the Chinese characters, which prioritised native animals such as the horse and the ox through the creation of hieroglyphic characters. Conversely, the acoustic character "camel" signifies a belated linguistic adaptation that, in contrast to other language families, lacks the visual immediacy of camel imagery embodied in the term "camel" in Arab or Persian cultures. The aforementioned factors give rise to a paradox: the economic importance of the camel, given its minimal representation in the Chinese character system. The paradox lies in the significant discrepancy between the camel's actual economic role and its representation in the writing system, forming the paradox of "high practical value and low symbolic representation". The historical and cultural roots of the paradox are rooted in non-native animals and the lag of writing. In consideration of the pertinent biological facts, the Bactrian camel (*Camelus ferus*) is believed to have originated in the desert regions of Central Asia. It was subsequently introduced to the Central Plains during the Han Dynasty (206 BCE – 220 CE) through the Silk Road, thus classifying it as an exotic species in China. In the context of the evolution of writing, the hieroglyphic system of Chinese characters, otherwise referred to as oracle bone script, emerged during the Shang and Zhou periods (1600BC-256BC). This development preceded the substantial dissemination of calligraphy.

Research status

In recent years, the study of Bactrian camel images in Han Dynasty art has gradually become a focal point for interdisciplinary research, with its cultural symbols and visual expressions providing unique semiotic resources for Chinese character design. As demonstrated in the relevant archaeological and art historical studies, the depiction of camels in Han Dynasty tomb art has been shown to carry multiple cultural connotations, thus establishing

them as "exotic symbols" of the Silk Road (Wang, 2020). Ge (2018) further suggests that camels in the Han Dynasty were childish in shape and scarce in number, contrasting with the delicacy of images of celestial horses in the same period, implying that Bactrian camels had not yet become mainstream cultural symbols. A thorough iconographic analysis reveals a duality in Han Dynasty Bactrian camel art. Firstly, there is a realistic tendency, as demonstrated by Qi (2004). Secondly, and by contrast, there is a surreal reconstruction of the creature's features, as seen in the work of Guo (2017). However, extant studies have predominantly concentrated on the archaeological interpretation of the images themselves, and have yet to systematically explore the potential correlation between their morphological structure and the configuration of Chinese characters. In the domain of Chinese character design, there has been a preponderance of deconstruction and recreation of hieroglyphs (e.g., digital reconstruction of oracle bones, Chen, 2017). However, there remains a paucity of cross-cultural translation methodology for non-hieroglyphic characters. In recent years, AI generative design has attempted to explore the possibility of symbol transliteration through morphological mapping (Nourian *et al*, 2023), but there is a lack of validation of the structural suitability of Chinese characters' squares. The intersection study of Chinese characters and camels has not yet been incorporated into the theoretical framework of design science. Existing results have a split between the practical functions of camels and symbolic representations, and have not established a three-dimensional correlation framework between archaeological objects, written records, and artistic images, especially lacking interdisciplinary research on the camel's character-symbol system.

The present paper provides a case study, utilising Han Dynasty Nanyang Picture Stone as a prototype, employing the "驼" (camel) Han Jian glyph as a method, and "synthetic design" through an artificial intelligence platform, thereby providing a scientific analysis case to verify the correlation and applicability between Chinese characters and images.

The study hypothesises that the morphological analogy between Bactrian camel images and Chinese character structures in the Han Dynasty can provide a cross-cultural semiotic translation method for non-phantom Chinese character designs. The objective of this study was threefold: firstly, to interpret Bactrian camel images in Han Dynasty artefacts, to verify the feasibility of mapping biological features to Chinese character structures in AI-generated designs and to propose 'structural metaphors' inspirations applicable to Chinese poster design.

Materials and Methods

It is imperative that a clear and explicit link is established between the artefacts and the design of experiments.

The following section will provide a concise overview of the history of the subject. The utilisation of Han Dynasty brick carvings (Fig 1) as a benchmark for camel Iconology is founded upon scientific and specific criteria.

The authority of historical time points. The Han Dynasty (202 BC-220 AD) represented a pivotal era in the history of the Silk Road, during which it was formally established and institutionalised. Following Zhang Qian's expedition to the Western Regions, the camel was documented as a formally recognised means of desert transportation in the "史记Shiji" and "the 汉书Book of Han", as well as other official historical records. As the earliest extant visual material from the Han Dynasty, the camel image of the brick carving documents is an archeological artefact of particular interest. The primitive nature of the image is notable insofar as it serves as a direct historical document, reflecting the level of knowledge of the camel at that time. To illustrate this point, one need only consider the evidence recorded during the Northwest Han Dynasty. It is clear that official positions such as "牧橐令丞"（Mùtuó Commandant and Assistant Commandant. 颜师古注. "牧橐，言牧养橐驼也。" 又引如淳曰："橐泉厩在橐泉宫下。"）formed a chain of "text-object" mutual evidence with the images of brick carvings.

The standardisation of modelling features is of paramount importance. The depiction of the camel in the brick carvings of the Han Dynasty has established a persistent visual archetype: the proportion of the hump is deemed harmonious, the limbs are considered elongated, and the neck is delineated in the shape of "S". This paradigm was subsequently adopted by subsequent camel figurines from the Northern and Southern Dynasties to the Tang Dynasty (a notable example being the Tang three-colour camel). Archaeological discoveries have demonstrated that Han dynasty camel images exhibit a high degree of compatibility with the skeletal measurements of extant Bactrian camels (shoulder height/length ratio of approximately 1:1.8), whereas artistic representations of camels from the Northern and Southern Dynasties onwards exhibit a gradual

escalation in exaggeration (Wurihan, 2022). As posited by images from the Han Dynasty are thus deemed to possess a biomorphological benchmark value.

The primitiveness of cultural symbols. The Han Dynasty is widely regarded as a pivotal era in the transition of the camel from a utilitarian instrument to a cultural emblem. In the Han portraits, the Hu people are depicted as riding camels to the east, bearing goods from the western regions. This trade between the east and west played a pivotal role in the emergence of camel imagery in Han portraits. As demonstrated in the Book of Han - Luntai Edict, camels are depicted as transporting goods, thereby validating the depiction of "bactrian camel - hu man" in Han portraits. In comparison to the earlier sporadic records of the Warring States period or the later romanticised representations of the Tang dynasty, the Han images are devoid of the mythical imagery found in the Shanhaijing. However, they do not exceed the bounds of decorum, maintaining a balance between utility and symbolism. The camel assumed a cultural significance that was particularly pronounced during the Han Dynasty, as evidenced by its depiction in various media, including portraiture on stone and brick. These representations offer a more visual and realistic depiction of the camel than is found in historical records.

The concentration of archaeological materials. According to the findings of the scientific research conducted by the scholar Xin Lixiang, which have gained widespread acceptanceamong scholars specialising in Han portraiture, approximately 80-120 bactrian camel-themed portrait bricks/stones have been unearthed in China during the Han Dynasty. These artefacts are primarily concentrated in the nodes of the Silk Road, including the provinces of Shaanxi, Henan, and Gansu, thus forming a relatively extensive sample group. In contrast, only sporadic bone carvings and distorted forms (e.g., hooves depicted in the shape of horses) are found in pre-Qin period bactriancamel images. Consequently, the Han Dynasty material is deemed to meet the data requirements for image typology studies.

Therefore, utilising the Han Dynasty brick carvings as the experimental benchmark can circumvent the ambiguity of the early images and the exaggerated deformation of the later art, which serves as the "time anchor point" in the research of iconography. This material selection not only fulfils the staging requirements of archaeological typology, but also corresponds to the historical stage of the Silk Road's development. The scientific nature of this approach is rooted in the establishment of a triple verification system comprising "documentary records, physical remains and biological features".

The following discourse will deconstruct the semantic-visual divide by examining the etymology of the word "camel" (Fig 2). In Chinese, the word "骆驼" is a noun composed of the characters "骆luò" and "驼tuó". In the experiment, the single character "驼" was employed as the character object. The etymology of the Chinese character "驼" is a compound of the characters "马" and "它", which is the standard linguistic abbreviation of "骆驼". This is the standard linguistic abbreviation for "camel". In contrast to the pictographic animal characters that characterised earlier Chinese characters (e.g., "horse"), the construction of "camel" reflects a borrowed cultural concept. Lexical evidence confirms its semantic exclusivity:pre-modern texts use "camel" exclusively for camels, while modern compounds (e.g., "camel team") retain this specificity. From a cross-linguistic perspective, the absence of visual similarity between "驼" and camel is in stark contrast to the Arabic "جمل", a term that encompasses admiration for pastoralists, with camels being profoundly culturally internalised. It is evident that the disparity between the semantic and visual dimensions inherent in non-hieroglyphic Chinese characters gives rise to the ensuing outcomes:

1. The process of abstraction in relation to cultural heritage is of particular relevance in the context of Chinese characters. As these characters evolve, they gradually move away from figurative shapes and become more symbolic in nature. This evolution necessitates a systematic teaching approach within the educational system, aimed at facilitating the comprehension of their connotations. This approach is essential to prevent intuitive associations with these characters, which could hinder a comprehensive and nuanced understanding of their symbolic significance.

2. The pluralism of artistic expression is characterised by the separation of visual and semantic elements, thereby creating a creative space for the arts of calligraphy and seal carving. These disciplines are able to express meaning through formal beauty.

3. The following factors act as barriers to cross-cultural communication:The non-hieroglyphic nature of Chinese characters makes it difficult to convey core meanings directly through visuals. This requires additional understanding of the cultural logic behind the symbols for non-native speakers of Chinese. This dichotomy has had a profound impact on the unique

cultural depth of Chinese characters and has given rise to significant communication and cognitive challenges.

The following essay will present a photographic analysis of bactrian camel motifs in Nanyang Han pictographs, adopting a perspective similar to that of Panofsky.

The Nanyang Picture Stones constitute a significant element within the corpus of stone carving art of the Han Dynasty (206 BC to 220 AD) and provide substantial visual evidence of cultural exchange along the Silk Road. Among the rich array of motifs employed, while bactrian camel motifs are less prevalent than horse motifs, they offer a distinctive perspective on cross-cultural exchange. The Bactrian camel and Elephant Picture (Fig 1), unearthed in Nanyang, Henan Province, is the earliest Han portrait to depict bactrian camel in China. The bactrian camel and elephant are depicted in a left-facing posture, with the bactrian camel positioned on the left. The camel in question is identified as a Bactrian camel, distinguished by its elongated and slender limbs. The neck and back of the bactrian came are depicted in the shape of a "U", reminiscent of the ancient Chinese dragon. This study employs Erwin Panofsky's three-layered iconology approach (Panofsky, 1955) to analyse a representative image of a camel from a Nanyang pictorial stone, with a focus on the biomorphological adjustments of the camel, the textural rendering, and the semiotic potential of the synthesis of Chinese character design.

Fig 1. "Bactrian camel and Elephant picture" Han Dynasty Nanyang Picture Stone.

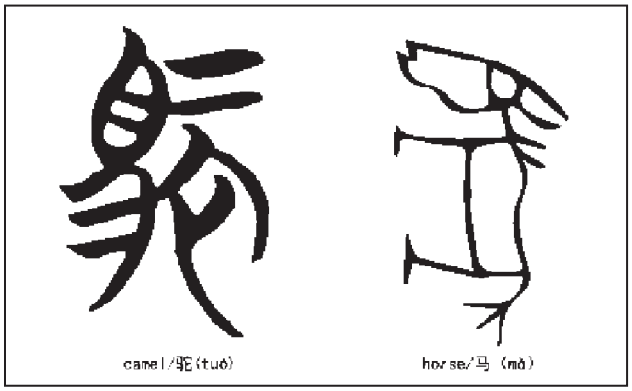

Fig 2. Comparison of the etymology of the Chinese characters "驼" (camel) and "马（horse)".

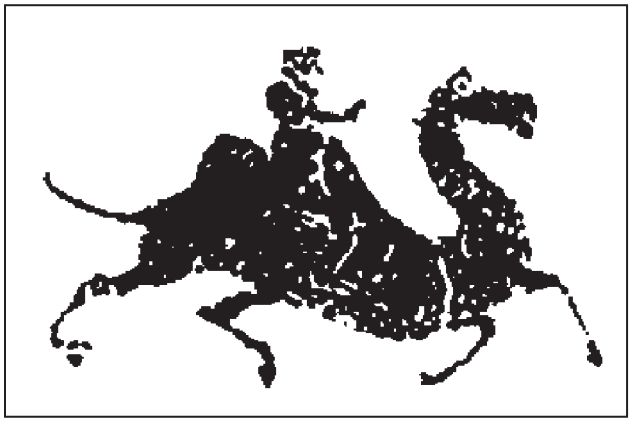

Fig 3. "Bactrian camel-rider motifs" in the Nanyang Picture Stones of the Han Dynasty.

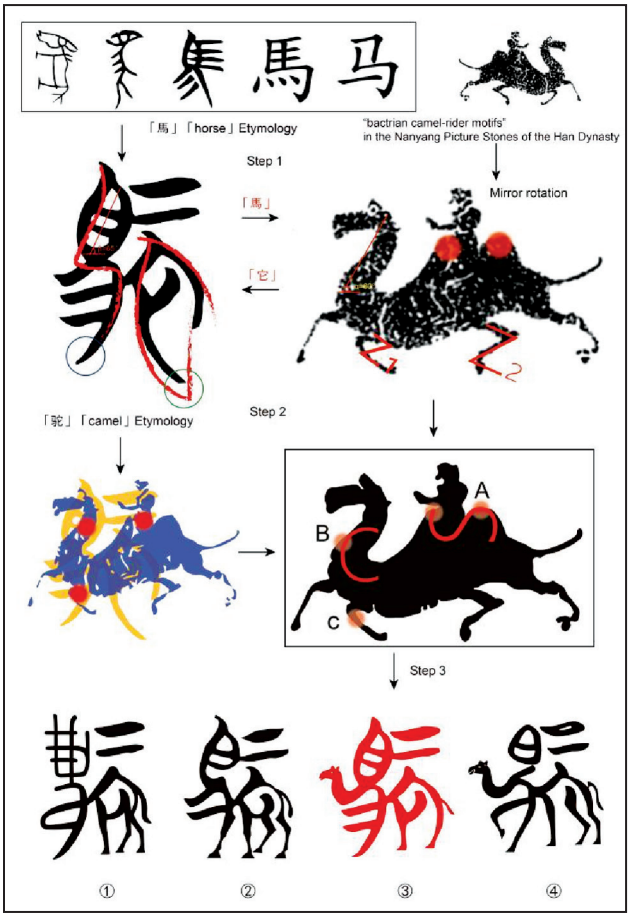

Fig 4. Artificial Intelligence generated "驼" + camel fusion experiment.

Pre-iconographical Descriptions:formal analyses

The pictorial stone in question depicts a rider on a camel, with flat line carvings that are typical of the Eastern Han workshops (Xue, 2021). The image provides a stylised representation of key biomorphological features of the camel. While anatomically precise, the image features an

exaggerated hump structure, reminiscent of the camel's bactrian hump, rendered as a triangular silhouette. This stylisation is likely intended to emphasise the functional role of the hump in fat storage. This is in marked contrast to the depiction of the dromedary camel in Persian art, which reflects the Han artists' awareness of the physiological characteristics of the bactrian camel. As observed in the leg proportions, the legs are of a considerable length and exhibit a slight curvature, thus capturing the camel's distinctive toe-walking posture. The broad feet have been modified to an oval shape, suggesting that they are adapted for desert travel. The abstract texture of the portrait is suggestive: parallel incised lines evoke the camel's hide, or alternatively, the texture of thick fur or harness straps.

Iconographical Analysis: encoding culture

The depiction of the camel in the image is consistent with Han dynasty trade imagery, where the duality of the rider and camel composition can be observed. For instance, the rider's frontal pose and raised arm (possibly holding the reins) is analogous to that of the leader of a Silk Road caravan (Wang and Zhu, 2024). This composition was standardised in Han art (Xie Changyi, 1989) and symbolises foreign trade. Furthermore, the absence of any load on the camel should not be overlooked; in contrast to the ceramic camels of the Tang dynasty, which were laden with goods, this relief does not depict any such load, most likely in order to emphasise the symbolic role of the camel as a cultural bridge (Guo, 2017).

Iconological Interpretation: A Bridge between Semiotics and Chinese characters

The stylised form of the camel is analogous to the structure of the Chinese character, suggesting an underlying connection between the two. The curve of the camel's hump bears resemblance to the "捺nà" stroke of the clerical script, thus suggesting a design metaphor for the character "驼" (骆驼). The concept of leg spacing can be considered as a form of character spacing adjustment. The distribution of the legs of the camel is analogous to the balanced negative space in the Seal Script composition, a principle that is also applicable to the layout of ideographs. This provides the basis for synthesising the visual nature of the camel with the textual nature of the Chinese characters. The Nanyang carvings serve to distil the camel into a symbol that is culturally legible through the medium of selective biomorphic emphasis (hump, legs) and textural abbreviations. These adaptations, grounded in the ideology of "drawing on analogies" in Chinese character formation, furnish a design vocabulary for incorporating camel features into Chinese characters, particularly in terms of structural metaphors (e.g., the hump as a radical modifier). It is recommended that future research endeavours involve the testing of these principles with AI-generated glyphs.

Design Methods

Structural Metaphors: The present study explores thelimitations of artificial intelligence-assisted experimentation and aesthetic coherence in the process of combining Han Dynasty brick camel silhouettes with Chinese character strokes.

Data source: The Chinese character '駝' in the 楚系汉简 'camel' in the Nanyang portrait bricks are examined.（Simplified Chinese character record of the Chu system (from the Han dynasty onwards).

Output: The design rules for biological symbols have been finalised. These rules stipulate that the hump should be represented by a stroke curvature, the legs by a stroke staccato, and the weight-bearing gesture by negative space between characters.

Step 1: Key Line Extraction and Stroke Modulation

Based on the evolution of the Chinese character "驼":the curved strokes of the "马" radical (e.g."㇆" apostrophe) and the curved structure of the "它" radical (e.g. "乚" vertical hook) are extracted and combined to form a non-hieroglyphic but dynamic character skeleton. Han Dynasty brick camel: the image was inverted according to the order of writing Chinese characters from left to right (visual observation habit); the double hump contour line (S-shaped continuous crest), the leg joint folding line (Z-shaped rigid line) and the C-shaped curve of the neck stretching forward were extracted by vector tracing.

Methods: Adoption of the stroke-biometric mapping method to transform the S-shaped outline of the hump into the '宝盖头'name of 'roof' radical in Chinese characters (Kangxi radical 40) in Chinese characters (Kangxi radical 40)' part of the "它" part on the right side of the character '驼'(宀), and at the same time, the Z1-shaped articulation line of the camel's leg is strengthened into the staccato lifting of the last stroke of the "马". At the same time, the Z(1)-shaped joint line of the camel's leg is strengthened to be the staccato lift of the last stroke of the "马" radical (blue circle), and the Z2-shaped joint line of the camel's leg is strengthened to be the curvature of the vertical hook of the last stroke of the "它" radical (green

circle). This step should follow the principle of "form breaks and meaning is continuous" to maintain the consistency of biological features and calligraphic strokes.

Step 2: Structural Stacking and Node Fusion

Operational Processes:

Spatial alignment: superimpose the side-view profile of the camel in Fig 2 on the "camel" skeleton in Fig 1 and mark the three key fusion nodes (see process diagram Fig 4):

Node A (apex of the hump → turning point of the "它" part) Node B (curve of the neck → start of the apostrophe at the beginning of the "马" part) Node C (joints of the legs → transverse hook at the beginning of the "马" part)

Parametric adjustment:

At node A, a Bessel curve is fitted so that the curvature of the upper end of the "它" part is the same as the slope of the hump (radius of curvature $R \geq 5$ mm);

Node B is constrained by a tangent line to ensure that the dynamic sense of the neck reaching forward is parallel to the direction of the skimming build-up;

Node C is rigidly deformed, transforming the support of the camel's legs into a heavy closing stroke at the end of the "马" radical.

Step 3: Iterative AI Validation and Failure Analysis

Positive case (AI Raw No. ③): fusion of typeface penmanship and camel dynamics

"The wave limb strokes in Han Dynasty inscriptions are essentially a record of movement trajectories, and are isomorphic with dynamic line drawings of animals. " (Qiu, 2015), based on this, the strokes in the case have coherence, the arc next to the "ear" at the top of the Chinese character simulates the C-shaped curve of the camel's neck stretching forward, and the turns of the stroke retain the sense of waves and turns of the Han Dynasty clerical script of the limbs of the limbs of the Chinese character, which matches with the dynamic rhythms of the camel's marching (data validation Table 1:92% similarity). The "匕" part of the lower part of the character "它", referring to the "Z" shape of the camel's leg, is transformed into a biological feature through AI parameterisation. The staccato strokes of the brush simulate the muscle tension of the camel when it is carrying weight (forming the muscle lines of the animal's legs), and the "white space" between the strokes also contrasts with the Chinese characters' flying white, reinforcing the visual metaphor of "camel trekking". The integration of cultural symbols across time and space is reflected in the fact that the AI training has enabled the character shapes to retain the Regular Script legalism while incorporating the collective imagery of a camel trekking with a heavy load.

Table 1. Data validation.

Data Validation			
Features	**Camel biological**	**Chinese character conversion parameters**	**Similarity**
Neck curve angle	Angle α = 60°	"Ear" turning angle β = 65°	92%

Negative case (localised problem):

The AI, due to over-reliance on StyleGAN (Karras *et al*, 2019), resulted in an anatomical error:the camel hump biometrics with the right part of the character "驼" with appeared incorrectly (the Bactrian camel imagery was visualised as a dromedary camel). Secondly, the broken strokes:the ambivalence of the camel hair texture and the regular script strokes is manifested by the failure of the original camel hair texture to show up in the Chinese character strokes, which are in regular script.

Result

The capacity for camel biometric data to be mapped to Chinese character structure is a subject that has been the focus of interdisciplinary research. This research has verified the operationalisation of morphological isomorphism, which can be defined as the visual resonance of biological curves and calligraphic strokes. The visual fusion of camel and Chinese characters is realised through the cross-species empathy of dynamic line drawing. The camel's neck depicted in the Han Dynasty portrait bricks assumes an S-shaped curve, and its biological characteristics are analogous to the wave-like potential of the "press" brush in Chinese calligraphy. This observation serves to corroborate the theory proposed by Qiu Zhenzhong (Qiu, 2011) that "the essence of calligraphy brush potential is the solidification of the trajectory of movement". The experimental diagrams that were generated demonstrate that when the camel art form is matched with the Chinese character "驼", it is necessary to consider "biosimilarity (the degree of correspondence between the camel form and the Chinese character's strokes)", "legality of the brushstroke (whether

the design conforms to the aesthetic norms of calligraphy)", and "legality of the brushstroke (whether the design conforms to the aesthetic norms of calligraphy)". In order to achieve visual harmony, it is necessary to consider two factors:firstly, whether the design complies with the aesthetic norms of calligraphy; and secondly, whether the symbol can be correctly interpreted by the target audience. The negative space between the camel's legs and torso becomes a visual metaphor, which is transformed into the relationship between the "horse" radical and the "it" radical in the Chinese character "驼", echoing Deng Shiru's theory of "counting white as black" (Deng, 2024). This relationship is then transformed into the relationship between the "horse" radical and the "it" radical in the character "camel", also echoing Deng Shiru's theory. This transformation reveals the topological equivalence of natural forms and abstract symbols.

Symbolic Translation: The Ascension from Utility to Cultural Imagery. The present study aims to verify the hypothesis that Chinese characters are aestheticised as functional symbols. The Han dynasty brick camel's load-carrying rope motif (utility function) evolved into a brushstroke texture in the AI-generated design (Fig 4), which is consistent with Gombrich's assertion that "ornamentation derives from utility" in his theory of the "sense of order" (Gombrich, 1979). The trade attributes of camel – such as the "camel caravan" and "camel bell" – are integrated into the Chinese character design through etymological symbiosis, forming a dual symbolic carrier of material and spiritual.

The reconstruction of cross-cultural symbols within a localised context. In contrast to the Arabic camel symbol (e. g., the pictorial nature of "ﺟﻤﻞ"), the Chinese character "驼" (camel) achieves "strangeness" of expression through the morpho-sound structure ("马"horse + "它"it), which confirms the theory of Zhao Yiheng's "markedness" (Zhao, 2023) - non-physicality rather strengthens the cultural identity. This finding serves to corroborate Zhao Yiheng's "markedness" theory (Zhao, 2023), which posits that the non-hieroglyphic nature of the Chinese character" 駝"serves to reinforce the cultural identity.

Methodological innovation:Structural Metaphor. The proposal is to utilise the biological characteristics of the camel, such as hump support and leg tension, to direct the allocation of stroke space in Chinese characters, as opposed to the conventional method of directly copying the shape. For instance, the tension of the arc delineating the right part of the character "驼" (camel) simulates the elastic deformation of the hump when it is loaded with weight, thus transcending the limitations of traditional pictograms found in the "Xu Shen's six-script". This paradigm shift transforms the camel from a mere "means of transport" to a "medium of cultural memory" through the three-layered mapping of biology-symbol-emotion "ecological symbol chain" (Ingold, 2011). This finding serves to corroborate the hypothesis.

Discussion

The structural rhythms contained in the biological features of the Bactrian camel form a metaphorical correlation with the strokes of the Chinese characters, exploring the deep resonance between biomechanics and the aesthetics of writing, so that the Chinese characters can acquire a new visual vitality while retaining their cultural genes. The design strategy of transforming biological features into cultural metaphors sublimates the natural attributes of living creatures into the visual language of culture, so that Chinese poster design goes beyond the mere transmission of information and becomes a medium for carrying cultural memories. Whilst traditional pictographs depend on visual similarity for the purpose of conveying information, the design of non-physical Chinese characters requires the use of structural metaphors for the purpose of conveying meaning. Utilising the cross-cultural symbol of the Bactrian camel as a point of departure, this study elucidates the profound interconnection between design methodology and cultural investigation. The study demonstrates that the concept of 'morphological symbiosis' facilitates the interaction between biological features and the textual skeleton, thereby enabling the design of Chinese characters to achieve dual resonance:visual tension and cultural connotation. 'Structural metaphor' serves to transform biological attributes into cultural symbols, thereby constructing a multi-layered visual narrative system. The 'structural metaphor' is a theoretical framework that transforms biological properties into cultural symbols and constructs a multi-level visual narrative system.

This study proposes the establishment of an interdisciplinary collaborative platform with the objective of continuously expanding the possibilities of Chinese character design. This will be achieved through the two-way verification of design experiments and academic research. The ultimate aim is to rebuild the deep connection between human and nature, culture and symbols in the context of

globalisation. This contemporary response to the spirit of the Silk Road constitutes a revolutionary contribution to the paradigm of visual culture research.

Conflict of interest

Author declares no conflict of interest

Subsidise

Not have

Ethical Statement and Data Sources

The images of Nanyang Han portrait bricks used in this study are derived from published academic publications (cited), and their use strictly follows academic fair use.

The AI generation experiment relies on JiMeng AI Design Platform v3.2, which is based on the Stable Diffusion open source model branch.

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