Digital Extraction and Quantitative Study of Regional Cultural Elements in Landscape Design

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ABSTRACT Preserving regional cultural identity in landscape design requires systematic approaches capable of transforming cultural characteristics into quantifiable design elements. This study proposes a methodological framework integrating digital extraction, parametric translation, and multidimensional evaluation to support data-driven cultural landscape design. A digital database of regional cultural elements is established using 3D laser scanning, multispectral imaging, and semantic text mining technologies. Extracted cultural parameters are translated into spatial generation rules through a parametric design platform, enabling algorithm-driven landscape creation. Quantitative evaluation combining spatial syntax analysis, behavioral observation, and user perception assessment is then employed to verify design effectiveness. A case study based on a Jiangnan water-town cultural landscape demonstrates that the proposed method significantly improves both spatial integration and cultural identity perception. The study provides a systematic pathway for cultural information modeling and offers methodological references for spatial data analysis, multispectral sensing, and digital landscape generation.

INDEX TERMS regional cultural elements, parametric design, multispectral sensing, spatial data analysis, digital landscape generation

I. INTRODUCTION

As the material carrier and spiritual container for regional culture, landscape space design remains deeply coupled with the translation of local knowledge through the integration of high-performance informatics and intelligent production technologies. These advanced structures serve as functional media for articulating regional identity, transforming traditional spatial logic into a data-driven synthesis of material engineering and cultural expression. However, in terms of the logic of modern buildings, dominated by the idea of efficiency and the use of technology, many landscape projects have fallen into two dilemmas: First, the extraction of regional cultural elements has often degenerated into a mere collage of symbols. For instance, the simple imitation of traditional patterns results in a superficial expression detached from modern functionality. Second, while digital technology is prevalent in engineering implementation, its application in the deconstruction and innovative translation of cultural connotations remains limited. Consequently, the design process still relies heavily on individual intuition, creating a 'black box' that is difficult to trace, verify, and optimize. Throughout this study, the term 'spatial prototypes' is used to refer to these initial algorithmic models, which serve as the conceptual basis for the more detailed 'spatial schemes' evaluated in the final stage.

This "black box" state leaves two important questions hanging: First, how do we, instead of arbitrarily, extract core elements (i.e., "cultural genes") that can be designed and manipulated from complex and multidimensional regional cultural phenomena? Second, such places produced by the transformation of these elements into particular forms of space, can they be effective in stimulating the required humanistic perception and cultural identity? Is there any evidence for evaluating their effectiveness or not? Existing research on the first question is mostly qualitative descriptions or case study, without fixed method on collecting and organizing digital information, and on the second question, is mostly on the level of aesthetics or concepts and have not established quantity correlation model between spatial form variable and cultural perception variable.

Therefore, this study is intended to overcome these bottlenecks by establishing a technical path from cultural cognition to spatial generation and effect feedback, integrating high-performance informatics and intelligent production technologies as the functional media for spatial expression. This systematic approach leverages advanced engineering to translate cultural identity into data-driven material structures, ensuring a rigorous synthesis of regional knowledge and innovative design logic. The core research content is: how to use digital technologies to systematically excavate and organizedly express regional cultural elements; and in the second step, further how to translate regional cultural elements into design rules, which can generate different spatial schemes through the parametric logic; in the third step, how to objectively judge and compare the difference of the spatial performance and the effectiveness of the cultural expression of different translation schemes through the method of quantitative analysis. The importance of this research lay in how it moves the process of cultural translation in landscape design from experience-based to data and algorithm-based, deploying methodology support for the setting of a precise, dialogical, and thus optimizable bridge between technological rationality and cultural expression. The following sections will attempt to first review the research progress and shortcomings in relevant fields, and will then elaborate on the three step method of "digital extraction - parametric translation - multi-dimensional quantification" built in this study, and will demonstrate the entire process and results of the application of this method through empirical cases. Finally, the results of the research and possible future are summarized.

II. RELATED WORK

In the current field of landscape design research, scholars are exploring the deep connection between design elements and human perception, technology application and ecological benefits from a multi-dimensional perspective. Color in landscape design can evoke specific associations for individuals. Eren et al. [1] explored whether there are differences in the degree of recognition of these color associations between professionals and the public. Wang [2] explored the specific application of CAD technology in landscape design, analyzed the role of CAD technology in the landscape design process, and systematically explained its functions and advantages. Faced with increasingly complex urban environments, traditional landscape design methods face challenges in dealing with multi-objective optimization and refined spatial layout. Huang and Liang [3] proposed a landscape design optimization and spatial layout planning method based on AI algorithms. Erdoğan and Aksoy [4] demonstrated through their practice in Mogan Lake that the concept of futurism can be effectively applied to landscape design to create public spaces with strong visual impact and contemporary spirit. Zhu et al. [5] constructed a conceptual framework to show how natural landscape features ultimately affect health outcomes through psychological, physiological and social processes.

Li and Chung[6] explored the application of artificial intelligence in the visual communication of green landscape design in urban and rural integration, providing technical support for the sustainable development of urban and rural areas. Yang et al. [7] proposed a conceptual design framework of "bee botanical garden" that integrates ecological science and social cognition. Under the background of China's rural revitalization strategy, rural landscape construction faces the challenge of how to maintain and highlight local characteristics while improving the living environment and developing the economy. Mao and Lingjun[8] studied and summarized a set of rural landscape design methods based on local characteristics through the design practice of Qili Village. Ren and Chen[9] developed a multimedia interactive landscape design platform based on genetic algorithm. Zhou and Wu[10] discussed the various contradictions existing in contemporary landscape design. The above studies mostly deal with regional cultural elements at the level of qualitative description or symbolic translation, lacking a systematic digital extraction method; the spatial creation effect has not yet established an effective connection between quantitative analysis and cultural expression. This paper explores how to deconstruct cultural genes parametrically and verify the effect of its spatial translation through quantitative methods, in order to establish a more accurate dialogue mechanism between technical rationality and cultural expression.

III. METHODS

A. DIGITAL EXTRACTION AND GENE BANK CONSTRUCTION OF REGIONAL CULTURAL ELEMENTS

Unstructured regional cultural information is transformed into structured data units that can be recognized and processed by computers, namely "cultural genes." The extraction work revolves around three dimensions: material entities, image documents, and intangible records, and adopts corresponding digital technologies.

First, high-precision information collection was carried out on typical material remains of the research object (taking the core area of an ancient town in the Jiangnan water town as an example). Three-dimensional laser scanners were used to obtain point cloud data of key buildings (such as ancient bridges, covered corridors, and wharves) with millimeter-level precision to record their precise geometric shape, scale ratio and spatial relationship. For example, three typical stone bridges (arch bridges, beam bridges and folded bridges) in the area were scanned to accurately obtain key geometric parameters such as the rise-to-span ratio of the arch, the step height-to-width ratio of the bridge deck steps, and the pattern density of the railings. At the same time, multispectral imaging equipment was used to collect and analyze the color and material of building facades, paving and riverbank protection. Not only were the RGB values of visible light color recorded, but the material type and weathering degree were also identified through spectral characteristics, and the hue, brightness range and differences of the "black" color in "white walls and black tiles" were quantified as well as in humid and dry conditions [11-12].

Secondly, digital processing and semantic mining are carried out on image documents such as local chronicles, ancient maps, old photos, and traditional patterns. Image data are obtained by high-resolution scanning or shooting, and the regular morphological elements (such as ice crack pattern paving, tile pattern, and window lattice) contained therein are vectorized and extracted using image processing algorithms (such as edge detection and pattern segmentation), and their composition rules are statistically analyzed, such as the basic unit, repetition cycle, and symmetry of the pattern. For text descriptions in the documents (such as texts recording historical scenes and activities), natural language processing technology is used to extract keywords, count word frequency and cluster themes, and present the core elements, occurrence places and behavioral characteristics of intangible cultural activities in a data-driven way, such as extracting high-frequency related words such as “city river”, “embankment”, “setting up stalls by the water”, and “festival parade” [13].

Finally, the heterogeneous data from different sources were aligned and integrated under a unified geographic information coordinate system to construct a structured digital database of regional cultural genes. This database categorizes cultural elements into “morphological genes” (geometric parameters, topological relationships), “color-material genes” (spectral data, material encoding), “graphic genes” (vector patterns, compositional logic), and “behavioral-event genes” (text keywords, spatiotemporal attributes). Each type of gene is accompanied by its metadata, including source, precision, associated geographic location, and cultural interpretation, providing a rich, accurate, and structured data foundation for the next step of parametric translation.

B. SPATIAL TRANSLATION OF CULTURAL ELEMENTS BASED ON PARAMETRIC MODELS

After obtaining structured cultural gene data, this step aims to use a parametric design platform to transform static data into design logic and algorithm rules that can dynamically generate spatial forms, thereby realizing the creative translation from “cultural elements” to “spatial prototypes”.

The core of the translation is to construct a parametric association model. The model takes the key parameters in the cultural gene pool as input variables and the geometric features of the spatial form as output variables, and defines the mapping relationship between them through a series of algorithms. For example, for the core cultural scene of “bridge-water-street”, the following translation logic can be established: “the turning angle and number of turns of the bridge” (from the morphological gene) and “the historical ratio range of the building height and river width of the water street interface” (from literature analysis and point cloud data statistics) are used as core driving parameters. Specifically, high-frequency keywords from semantic mining, such as “market” and “teahouse,” are mapped to spatial occupancy variables; for instance, the word frequency of “market” determines the “node enlargement” coefficient (k) in the algorithm, which mathematically expands the width of the bridge turning platform to accommodate simulated commercial density. In the parametric software, the algorithm script is written so that the change of the “turning angle” parameter and the “market-driven” expansion coefficient (k) can drive the generation of the three-dimensional path of the bridge; the change of the “water street height-width ratio” parameter can automatically adjust the height and advance-retreat relationship of the building blocks along the river [14-15].

By adjusting the values of a few key driving parameters, a series of alternative solutions that share a common core cultural logic but differ in specific spatial forms can be quickly generated. This stage does not pursue a single optimal solution, but rather generates several (e.g., three) significantly different “spatial prototypes” for subsequent quantitative evaluation and comparison. Prototype A may emphasize strict traditional proportions and form reproduction; Prototype B may introduce modern materials and abstract form interpretations while adhering to basic topological relationships (such as the intention of “folding” and waterfront relationships); Prototype C may attempt to extreme a certain parameter (such as compressing the height-to-width ratio of the water street to a historical minimum) to explore the spatial tension under traditional vocabulary. The generation of all prototypes strictly originates from the cultural gene parameters extracted in the first stage, ensuring the traceability and logic of the translation process, rather than unrestrained free creation.

C. MULTI-DIMENSIONAL QUANTITATIVE EVALUATION SYSTEM FOR SPATIAL CREATION EFFECT

To scientific evaluation spatial effectiveness and cultural expression of different parametric translation schemes, this study constructs a dual quantitative evaluation system which consist of objective measurement of spatial performance and subjective evaluation of cultural perception.

Objective measurements essentially measure material properties and possible functional efficiency of the actual spatial prototype. Spatial syntax theory and the tools available for its analysis are used to quantitatively analyse the generated prototype schemes. Core indicators like ‘integration,’ ‘connectivity’ and ‘visual intelligibility’ are computed using a global radius (R=n) for integration to capture town-wide accessibility, and a local topological depth of 3 for connectivity analysis. Integration represents the potential for congestion of human space; connectivity defines accessibility of the space; and visual intelligibility refers to the relative ease by which people visually understand the overall spatial structure of the space. The results from these objective indicators show clearly the differentiated influence of the parameter changes on the spatial structure, e.g. how the number of the path turns may have an influence on the overall accessibility and efficiency of navigation.

Subjective evaluation emphasizes on the psychological feeling and cultural identification of the users. The generated 3D spatial prototype is rendered as an immersive scene of virtual reality or a set of highly-realistic renderings. Participants from different backgrounds (including local residents, tourists and professional designers) are recruited to fill in a structured questionnaire after experiencing the virtual space. The questionnaire is based on a Likert five-point scale in order to measure several dimensions such as for example "perception of the uniqueness of the place culture," "feeling of historical atmosphere," "spatial identification," "degree of exploration desire," and "aesthetic pleasure." While this study utilizes VR to quantify visual and spatial perception, it is acknowledged that "historical atmosphere" is a multi-sensory construct. The current model focuses on visual parameters as a primary driver, yet future iterations should incorporate auditory and tactile variables—such as ambient river sounds or material texture simulation—to fully capture the non-visual dimensions of regional identity. Simultaneously, a basic task of behavioral annotation is established in the virtual environment to record the gaze focus areas and the preferred path selections of the participants using behavioral data to help validate the results from the questionnaire.

Finally, correlation analysis and cross-comparison are performed between objective measuring indicators and scores of subjective evaluation. For example, the influences of the following aspects are analyzed: whether there is a significant positive correlation between the objective value of spatial integration and the "exploration desire" score in the questionnaire; compare which prototype achieves the best balance between objective connection efficiency and subjective cultural identity. Through multi-dimensional data evaluation, not only can the scheme with better overall performance be picked, more important is that, it is possible to go backward and trace the role of more important cultural gene parameters (such as changing the aspect ratio of the water street or the topology of the bridge), thus resulting in positive or negative changes in specific evaluation dimensions, establishing the quantitative causal chain "parameter adjustment → spatial morphological change → effectiveness / perception change", thereby completing the methodological loop.

IV. RESULTS AND DISCUSSION

A. RESULTS AND STRUCTURED CHARACTERIZATION OF DIGITAL EXTRACTION OF CULTURAL GENES

The systematic digital extraction of the target ancient water towns in Jiangnan yielded a rich, multi-layered dataset of cultural genes. These specific samples were selected based on a preliminary typological survey of the Jiangnan region, ensuring that the 7 bridges cover the three primary structural types—arch, beam, and folded—that define the regional architectural vernacular. Although the dataset is focused on a specific ancient town, these samples serve as high-fidelity "anchor points" that embody the most prevalent geometric logic found across the broader Jiangnan water town gene pool. After processing and analysis, 23 key morphological parameters were extracted. In image document processing, 14 basic pattern units were identified and vectorized from 87 historical drawings and patterns using algorithms. Semantic text analysis processed over 150,000 words of local chronicles and travelogues. Keyword co-occurrence network analysis clearly showed that "bridge," "river wharf," "market," "boat," and "teahouse" constituted the core association clusters, revealing a traditional spatial behavior pattern integrating "transportation nodes, commercial activities, and social life." All data were integrated into a database, and Table 1 shows the digital extraction results of some core "morphological genes."

TABLE 1. Examples of Gene Extraction Results for Core Material Culture Forms

Cultural elements category	Specific object	Extracted key morphological parameters	Parameter value range/features	Data source
Traffic structures	Single-arch stone bridge	Sag (f) / Span (s) ratio	0.20 - 0.22	3D laser scanning
	Beam-type flat bridge	Bridge deck length-to-width ratio	3.5:1 - 5:1	3D laser scanning
	Folded bridge (covered bridge)	Number of turning points / Turning angle of a single segment	2-3 times / 15°-30°	3D laser scanning + historical map
Interface and paving	Stone revetment for river channel	Cross-sectional taper ratio (top width/bottom width)	0.6 - 0.7	3D laser scanning
	The old street is paved with stone slabs.	The aspect ratio of the unit stone	John 3:1	Photogrammetry and Image Analysis
	Courtyard paving pattern	The inner corner of the dominant pattern (ice crack pattern) unit	90°-120°	Image vectorization analysis
Building components	eaves of the corridor	Projection depth (D) / Eave height (H)	D/H ≈ 0.4 - 0.5	3D laser scanning

The results of digital extraction reveal significant parametric characteristics of regional culture at the material level. The "span-to-rise ratio" of bridges and the "bow-to-recession ratio" of revetments are not arbitrary values, but rather stable within specific ranges, reflecting the wisdom gained through long-term adaptation to the geographical environment, material properties, and mechanical laws. Making these implicit "rules" explicit and precise through digital means provides a reliable and abundant initial driving force for subsequent parametric design. The establishment of a structured gene bank transforms cultural elements from vague images into a series of data objects that can be directly invoked, combined, and adjusted.

B. DIFFERENTIATED SPATIAL PROTOTYPES GENERATED BY PARAMETERIZED TRANSLATION

Based on the aforementioned gene pool, this study focuses on the "bridge-water-street" node space, selecting "bridge turning logic," "water-street interface height-to-width ratio (H/W)," and "waterfront building receding rhythm" as core driving parameters to generate three differentiated spatial prototypes. The generation of all prototypes is controlled by the same set of parameterized algorithm scripts, and the morphological variation is achieved only by adjusting the values of the input parameters.

Prototype A (Traditional Continuation): Parameter settings strictly adhere to the average values of historical data. The folded bridge has two turns, each with a turn angle of 22.5 degrees; the water street's H/W ratio is a historically common value of 0.65; the architectural rhythm is completely reproduced according to the existing patterns recorded in the scan. This prototype "restores" the traditional spatial texture and scale to the greatest extent possible.

Prototype B (Logical Translation): Retains the "turning" topological relationship of the folded bridge, but increases the turn angle to 30 degrees and expands the platform at the turning point to form a viewing and resting point; the water street's H/W ratio is slightly adjusted to 0.8, moderately increasing the sense of enclosure; the architectural rhythm is simplified and modularized based on the original rhythm. This prototype aims to abstract and strengthen traditional spatial logic and integrate the needs of contemporary public activities.

Prototype C (Extreme Exploration): Extremely pushes a certain parameter to test the boundaries. While increasing the number of turns on the zigzag bridge to four significantly lengthens the tour route for experiential purposes, it is recognized that such a configuration may introduce functional inefficiencies by obstructing direct pedestrian flow. This extreme parameter setting was intentionally selected to test the trade-off between "efficient transit" and "scenic immersion," allowing the model to quantify the point at which spatial complexity ceases to be a cultural asset and becomes a functional liability. At the same time, the water street's height-to-width ratio was reduced to a historical low of 0.5, creating a more open waterfront view, but weakening the sense of enclosure of the streets and alleys.

The digital models of the three prototypes are clearly distinguishable in form. Table 2 compares their key parameter settings and the main features of the generated spatial forms.

TABLE 2. Comparison of core driving parameters and morphological features of three parametric translation space prototypes

Space Prototype	Core driver parameter settings	Description of the main features of the generated spatial morphology
Prototype A (Traditional Continuation)	1. Bridge bend: 2 times, 22.5°/time 2. Water street H/W: 0.65 3. Advancing and retreating rhythm: Historical pattern reproduction	Its form is highly consistent with traditional style. The bridge is gently sloping, the street and alley scale is intimate and enclosed, and the spatial sequence is familiar and stable.
Prototype B (Logical Translation)	1. Bridge bends: 2 times, 30°/time, node enlargement. 2. Water street H/W: 0.80 3. Advancing and retreating rhythm: Simplified modularization.	The bridge's form exudes strength, with turning points becoming focal points. The sense of enclosure within the streets and alleys is enhanced, and the spatial interface is more concise, modern, and logically clear.
Prototype C (Extreme Exploration Type)	1. Bridge bends: 4 times, 20°/time 2. Water street H/W: 0.50 3. Advancing and retreating rhythm: weakened	The bridge's structure is complex and offers a strong experiential element. The waterfront area is very open, with a weak sense of street or alleyway, making it feel more like a waterfront promenade with a prominent sense of spatial tension.

Parametric translation successfully transforms static cultural gene data into a design engine that can be dynamically adjusted and generate diverse solutions. Results show that by adjusting only a few key cultural parameters (such as transition angle and aspect ratio), solutions with drastically different spatial character and experience can be derived. This confirms the feasibility and efficiency of parametric operations based on cultural genes. Prototype A demonstrates the path to cultural "authenticity," prototype B explores the possibility of combining cultural "translation" with contemporary relevance, and prototype C serves as a "boundary stress test" for the parametric model. The objective of Prototype C is not to propose a final design, but to use "extreme exploration" to identify the quantitative thresholds at which cultural identity collapses. By intentionally pushing parameters beyond traditional limits, the study establishes a "negative control group" that scientifically defines the geometric range within which local identity is preserved versus where it is lost. This generative approach shifts the design process from finding a "single correct answer" to exploring a "spectrum of possibilities under a specific cultural logic."

C. COMPREHENSIVE FINDINGS AND CORRELATION ANALYSIS OF MULTI-DIMENSIONAL QUANTITATIVE ASSESSMENT

After conducting objective spatial syntax analysis and a subjective VR experience questionnaire survey on the three spatial prototypes, systematic quantitative evaluation data was obtained. Objective analysis shows that prototype B has the highest spatial integration (measuring the potential for crowd gathering), outperforming prototypes A (1.28) and C (1.15). Prototype B, through a moderate increase in the height-to-width ratio and clear rhythmic progression, creates more potential small spaces for dwelling and interaction while maintaining path connectivity. In terms of visual comprehensibility, prototype A has the highest due to its traditional and familiar layout, while prototype C has the lowest due to its overly complex paths.

A total of 153 valid samples were collected from the subjective questionnaire. Prototype A scored highest in "perception of cultural uniqueness" and "feeling of historical atmosphere" (4.15 and 4.20 respectively), as expected. However, Prototype B achieved the highest scores in the two comprehensive dimensions of "overall spatial identity" and "degree of stimulation of exploration desire" (4.32

and 4.05 respectively). All eligible participants signed an informed consent form. Behavioral annotation data showed that participants spent significantly more time looking at the magnified section of the folded bridge in Prototype B than in other areas. Table 3 summarizes the quantitative results of the core assessment dimensions.

TABLE 3. Summary of Multidimensional Quantitative Evaluation Results of the Three Spatial Prototypes

Evaluation Dimensions	Specific indicators/issues	Prototype A Score/Value	Prototype B Score/Value	Prototype C Score/Value	Notes
Objective space performance	Spatial integration (HH)	1.28	1.52	1.15	The higher the value, the stronger the potential for crowd gathering.
Objective space performance	Visual intelligibility (R^2)	0.81	0.76	0.68	The higher the value, the easier the spatial structure is to understand visually.
Subjective cultural perception	Perception of cultural uniqueness	4.15	3.98	3.60	Likert 5-point scale, mean
Subjective cultural perception	Historical atmosphere	4.20	3.90	3.25	Likert 5-point scale, mean
Subjective cultural perception	Spatial identity	3.88	4.32	3.40	Likert 5-point scale, mean
Subjective cultural perception	Degree of exploration stimulated	3.50	4.05	3.75	Likert 5-point scale, mean
Subjective cultural perception	Aesthetic pleasure	3.95	4.18	3.82	Likert 5-point scale, mean

The comprehensive evaluation data revealed several key and insightful findings. First, while simply replicating historical forms (Prototype A) led in the perception of "historical atmosphere," it did not achieve the highest ratings in "spatial identity" and "desire for exploration," indicating that contemporary users' needs for cultural spaces transcend mere nostalgia. Second, Prototype B demonstrated balanced and outstanding performance across multiple core indicators, with its spatial integration improved by approximately 18.75% compared to Prototype A, while simultaneously achieving the highest spatial identity and aesthetic pleasure. Crucially, this improvement in integration is interpreted not as a guarantee of cultural success, but as a facilitator of the "market" and "social" behaviors identified in the semantic mining stage. High integration in Prototype B correlates with higher "desire for exploration" because the spatial logic provides the necessary physical vitality for cultural activities without reaching the threshold of detrimental overcrowding, thereby balancing functional performance with cultural expression. Finally, the evaluation of Prototype C indicates that excessively drastic changes to certain key parameters (such as too many turns leading to complex flow lines, and an excessively low H/W ratio weakening the sense of territory), while potentially creating a unique visual impact, can damage the space's comprehensibility and the foundation of cultural identity. The quantitative assessment clearly establishes a chain of correlation: "parameter adjustment (such as H/W ratio increasing from 0.65 to 0.80) $\rightarrow$ change in objective spatial attributes (increased integration) $\rightarrow$ change in subjective perception response (enhanced sense of identity and desire for exploration)," providing traceable and verifiable data support for design decisions.

V. CONCLUSION

This study addresses the issues of superficiality and subjective evaluation in the application of regional cultural elements by proposing a research methodology that integrates digital extraction and parametric translation through high-performance informatics and intelligent production technologies. By applying multi-dimensional quantification to these advanced structures, the framework validates a precise technical path for embedding cultural identity into functional material engineering and landscape design. Through empirical application in a case study of an ancient water town in the Jiangnan region, the methodology demonstrates its systematic, operable, and scientific value. Future research could explore more complex multi-gene synergistic driving models by incorporating high-performance informatics and intelligent production technologies to optimize material parameter combinations through machine learning algorithms. Extending this evaluation system to the post-occupancy stage of the built environment will facilitate the continuous iteration of data-driven engineering and its widespread application in functional spatial design.

AUTHOR CONTRIBUTIONS

Conceptualization –Yiduo Ha and Hongqi Zhou; methodology – Yiduo Ha and Hongqi Zhou; investigation – Yiduo Ha and Hongqi Zhou; writing-original draft preparation – Yiduo Ha and Hongqi Zhou. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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