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AI-Driven Cultural Connotation Mining of Natural Imagery in the Book of Songs: Psychological Mechanisms Linking Perception to Audience Place Attachment

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Abstract: Classical Chinese poetry contains rich natural imagery whose cultural connotations remain underexplored in digital communication contexts—particularly with respect to how such imagery shapes contemporary audience psychology. This study examines the psychological mechanisms through which natural imagery in the Book of Songs activates place attachment in contemporary audiences, integrating AI (Artificial Intelligence) semantic analysis with empirical survey research. A Bidirectional Encoder Representations from Transformers (BERT)-derived model fine-tuned on Classical Chinese corpora was applied to all 305 poems, achieving high-precision imagery recognition across four categories—flora, fauna, landscape, and climate—with an overall F1 score of 0.913 and a human-machine agreement Kappa of 0.887. Survey data from 526 valid respondents were analyzed using structural equation modeling (SEM) and Bootstrap-based mediation testing. Natural imagery perception significantly predicts psychological response ($\beta = 0.721, p < 0.001$). Environmental empathy and place attachment each function as significant mediators, accounting for 55.9% and 39.4% of the total effect, respectively. The chain mediation pathway—perception → environmental empathy → place attachment → psychological response—is statistically significant, explaining 27.0% of the total effect, with total indirect effects reaching 68.2%. These findings demonstrate that traditional cultural symbols activate audience cultural identity through layered psychological mechanisms, offering theoretical grounding and practical guidance for the intelligent digital dissemination of classical literature.

Keywords: AI Semantic Analysis; Natural Imagery in the Book of Songs; Cultural Connotation Mining; Place Attachment; Environmental Empathy; Psychological Response; Structural Equation Modeling

1. Introduction

The Book of Songs (Shijing), China's earliest poetic anthology, constitutes one of the most culturally dense repositories of natural imagery in the classical tradition. Through the rhetorical device of *bi-xing*—a mode of analogical and evocative association—natural scenes and human emotions are organically fused, producing a layered system of cultural symbols that has endured across three millennia. Lines such as “The ospreys cry on the river isle” and “The reeds grow pale, white dew turns to frost” exemplify how flora, fauna, landscape, and climate serve not merely as descriptive elements but as culturally loaded triggers capable of activating emotional resonance across historical distance [1–3]. Furthermore, the key results demonstrate that these significant cultural connotations appear to operate as systematically retrievable symbolic structures embedded within the classical tradition. In light of these findings, the important data shows that the enduring communicative power of the Shijing appears to rest on this layered analogical system. Study shows digital environments reshape classical poetry reception. Nevertheless,

the critical evidence indicates that short-video platforms, AI dialogue systems, and immersive digital experiences have diversified the channels through which contemporary audiences encounter canonical texts [4,5].

Digital environments have fundamentally reshaped how audiences encounter classical poetry. Short-video platforms, AI dialogue systems, and immersive digital experiences have diversified reception channels and accelerated demand for precision-oriented dissemination strategies. Liu's research on scene-based strategies for classical poetry on short-video platforms demonstrates that canonical texts like the Book of Songs, when reimagined through visual and contextual adaptation, can effectively activate cultural memory among younger audiences, with platform algorithmic recommendation mechanisms amplifying this process [4]. From a media convergence perspective, Zhao demonstrates that AI technologies—including intelligent semantic analysis, affective computing, and personalized recommendation—are now central to the contemporary transmission of the Book of Songs, marking a clear shift from broadcast-style to precision-oriented cultural dissemination [5]. Yet as Hu and Chen's reception aesthetics study highlights, audience aesthetic expectations, cultural presuppositions, and psychological schemata remain critical determinants of cross-cultural poetic reception, and activating emotional resonance while preserving cultural integrity remains a core challenge in dissemination strategy design [6].

Within the literary scholarship tradition, the psychological impact of natural imagery in the Book of Songs has long been attributed to its distinctive artistic techniques and accumulated cultural depth. Piao Hailing argues that the *bi-xing* technique is not merely a rhetorical device but a culturally embedded mode of thinking that reflects the philosophical concept of "harmony between humanity and nature," endowing natural imagery with an emotionally activating function that transcends historical distance [7]. Contemporary audiences therefore continue to experience meaningful affective responses to these ancient images. However, existing studies lack two critical components: the technical support of AI-driven quantifiable semantic analysis, and the systematic incorporation of place attachment as a core psychological variable. From an environmental psychology standpoint, place attachment refers to the deep emotional bond formed between individuals and specific geographic or cultural spaces. Thus, the significant evidence demonstrates that from an environmental psychology standpoint, place attachment refers to the deep emotional bond formed between individuals and specific geographic or cultural spaces. In light of these important findings, the evidence demonstrates that how AI semantic analysis can precisely capture the cultural connotations of these images, and how those connotations show that they can be systematically linked to quantitative measures of audience place attachment, thus emerges as the critical breakthrough point for advancing this field.

2. Literature Review

The integration of textual scholarship on the Book of Songs with digital analytical methods has become an increasingly prominent research agenda. Li and Qian's typological study of reclusion poetry provides an important philological reference for the classificatory annotation and semantic parsing of natural imagery through computational methods [8]. Bao et al. demonstrate that the application of large language models and metaphor analysis to the Book of Songs makes AI-driven semantic understanding and cultural connotation mining technically feasible in classical poetry research [9]. Li Xiaoqin's study of emotional expression and ancient social culture reveals that affective content in the poems is deeply embedded in specific socio-cultural contexts, suggesting that the generation and circulation of imagery are fundamentally shaped by historical structures [10]. Wang's comparative analysis [11], Wang Ruiqi's examination of character image portrayal in the Book of Songs through Ming Dynasty examination essays [12], and Xu Hengchang's study of strophic repetition translation in the *Shijing* alongside Tan et al.'s reception-aesthetics analysis of its English rendering [13,14] collectively illuminate the diversity and historical continuity of the text's cultural connotations. Yet these studies remain predominantly qualitative in orientation. Results show qualitative studies lack computational frameworks. Nevertheless, the significant results at the level of textual interpretation suggest that these studies remain predominantly qualitative in orientation, demonstrating that the methodological breakthrough of representing natural imagery through quantifiable, computationally tractable semantic frameworks appears critically absent. Therefore, the key limitation that the present study shows that it seeks to address shows that this constitutes the core gap in the existing evidence on natural imagery representation.

Within the fields of reception aesthetics and cross-cultural communication, the influence of audience psychology on the reception of Book of Songs imagery suggests that scholarly attention has gradually deepened around

this significant body of work. Moreover, the evidence indicates that this body of work provides important theoretical grounding for the audience-oriented analytical framework constructed in this study. Bao, using the poem “Cai Wei” as a case study, systematically examines that target-language readers’ aesthetic expectations play a key role in the English translation of the Book of Songs [15]. Study shows audience psychology mediates cross-cultural dissemination. However, the significant findings suggest that the reception of natural imagery in the Book of Songs appears not to be determined solely by the semantic content of the text itself, but is substantially conditioned by individual cultural backgrounds and aesthetic experience. Furthermore, the evidence indicates that structures of psychological expectation exert a key influence on how the results of such cross-cultural transmission are received by contemporary readers [16]. Notwithstanding these important results, the findings suggest that the psychological modeling function of classical poetry retains considerable practical efficacy in modern educational contexts. Research shows *bi-xing* activates empathic resonance at reader psychology level. Moreover, Turahmat et al.’s close analysis indicates that the lyrical function and cultural significance of the *bi-xing* technique, examined from rhetorical and cultural poetics perspectives, appears to establish metaphorical associations between natural phenomena and human emotion [17]. Thus, the significant evidence suggests that this trans-historical mechanism of emotional activation provides an important rhetorical foundation for understanding the cultural awakening of place attachment. Findings show studies engage audience psychology from multiple angles. In light of these important findings, the evidence demonstrates that they appear not to adopt quantitative empirical research designs supported by AI semantic analysis. Therefore, the significant gap suggests that this absence defines the precise scholarly space into which the present study could intervene.

The universal value of the Book of Songs as a part of humanity’s poetic heritage and its cross-cultural psychological resonance mechanisms shows that suggest that multi-dimensional scholarly validation has emerged across diverse disciplinary perspectives. However, the significant findings from Fu’s research on the relationship between the traditional culture of the Book of Songs and contemporary cultural construction indicate that poetic texts from different civilizational traditions appear to generate deep spiritual resonance across religious and cultural boundaries through shared natural imagery and emotional structures [18]. Moreover, the important evidence from this comparative civilizational perspective shows that suggest that natural imagery in the Book of Songs could demonstrate psychological resonance across diverse cultural contexts. Furthermore, the study by Du and Gao on cross-border dissemination strategies for Guilin’s red tourism culture shows that indicate that culturally dense poetic texts demonstrate that specific values and emotional structures transmit to readers through the ethical freight carried by natural imagery, thereby generating cultural identification and value resonance at the psychological level [19]. Scholarship links classical resources to modern identity. In light of the key findings from Ismeti and Toçi’s analysis of cross-cultural communication mechanisms in global media, the evidence shows that suggest that classical cultural resources demonstrate that they function as irreplaceable spiritual DNA in modern cultural formation [20]. Thus, the significant results appear to support that the natural philosophy, humanistic outlook, and emotional structures embedded in the text constitute a vital source of Chinese cultural identity. Additionally, the important evidence shows that indicate that this perspective could provide robust socio-cultural justification for incorporating place attachment and cultural identification into the psychological response framework of the present study. Notwithstanding the complexity of cross-cultural transmission, the study by Lewicka on place attachment across four countries, alongside related cross-cultural analyses of emotional belonging and regional identity [21], shows that indicate that the key importance of attending to audiences’ regional cultural identity and emotional belonging demonstrates that communicative effectiveness of cultural symbols depends critically on this consideration [22]. Research shows psychological impact links to place identity. Therefore, the significant findings across these diverse disciplinary perspectives shows that suggest that a shared theoretical direction could emerge from the evidence. Given that the results appear to support that the psychological impact of cultural symbols is deeply intertwined with audiences’ sense of place identity and cultural belonging, the key evidence shows that indicate that this relationship constitutes the central inquiry of the present study.

The present study proposes that the three streams of literature reviewed above may suggest a unified theoretical framework and research hypotheses. However, the AI semantic analysis literature indicates that computational methods reliably extract cultural connotations from classical poetry [23], providing the significant independent variable inputs for subsequent psychological modeling. Moreover, the reception aesthetics and audience psychology literature demonstrates that natural imagery perception could activate emotional and cognitive responses in

readers, mediated by individual cultural backgrounds and aesthetic schemata [24,25]. In light of these key findings, the environmental psychology and place attachment literature indicates that culturally coded spatial symbols could generate place identity and place dependence responses [25,26]. Prior studies show no integration of all three streams into unified empirical model. On the basis of this integrated theoretical framework, the following five hypotheses are proposed. Furthermore, the evidence shows that H1 could demonstrate a positive predictive relationship between natural imagery perception and audience psychological response. Nevertheless, the results indicates that H2 appears to establish that natural imagery perception positively predicts environmental empathy. Given that significant findings demonstrate these relationships, H3 shows that environmental empathy positively predicts psychological response through single mediation. H4 shows natural imagery perception predicts place attachment; place attachment predicts psychological response. Additionally, the evidence shows that H5 indicates that the chain pathway perception → environmental empathy → place attachment → psychological response appears statistically significant through chain mediation.

3. Research Methodology

3.1. Overall Research Design

This study adopts a computational–quantitative research design that integrates AI semantic analysis and survey-based psychological measurement within a unified analytical framework. The design proceeds in three sequential stages. In the first stage, semantic mining is applied to the full digitized corpus of all 305 poems using a BERT-derived model fine-tuned on Classical Chinese corpora. In the second stage, a cross-sectional questionnaire survey is administered to adult audiences with prior exposure to the Book of Songs, measuring four key variables: natural imagery perception intensity, environmental empathy, place attachment, and psychological response. A composite scale combining original and adapted instruments is employed, with reliability and validity thresholds verified across all dimensions. In the third stage, AI semantic feature scores and questionnaire data are integrated into a single structural equation model: confirmatory factor analysis (CFA) establishes construct validity, structural equation modeling (SEM) tests causal pathways among variables, and Bias-corrected Bootstrap procedures assess the significance of both single and chain mediation effects [24]. The core methodological innovation lies in the direct linkage between computationally derived cultural connotation scores and empirically measured psychological responses—an integration not previously achieved in classical Chinese literary research.

3.2. Construction of the AI Semantic Analysis Model

Moreover, the significant findings shows that suggest that these components enable the precise computational representation of cultural connotations embedded in natural imagery. Given that the full text of all 305 poems serves as the primary data source, the evidence indicates that the corpus construction approach appears comprehensive. Furthermore, the results shows that suggest that the original text is digitally compiled with reference to authoritative annotated editions, ensuring that the foundational data appears reliable. Specialized tools show tokenization handles sentence-level segmentation. However, the important findings indicates that a natural imagery annotation system is then constructed across four categories: flora, fauna, landscape, and climate. In light of the evidence that two researchers specializing in classical literature independently verify the imagery boundaries and category assignments, the results shows that suggest that annotation accuracy appears well-supported [25]. Thus, the significant data demonstrates that standard pre-trained language models face inherent limitations when processing Classical Chinese—most notably insufficient lexical coverage and semantic drift. Model selection shows BERT-derived architecture addresses these gaps. Additionally, the study shows that suggest that manually annotated Book of Songs imagery data serve as the fine-tuning training set, ensuring that the model appears optimized for Classical Chinese semantic structures. Notwithstanding the surface lexical level, the key findings indicates that supervised fine-tuning optimizes the model’s capacity to capture the deep cultural meanings of imagery tokens within specific poetic contexts. Therefore, the significant results shows that demonstrate that a dual-track strategy is employed, combining Bidirectional Encoder Representations for Topics (BERTopic) topic modeling with sentiment polarity analysis. The dual-track strategy shows BERTopic clusters imagery vectors effectively. Moreover, the evidence shows that the BERTopic model clusters imagery semantic vectors to automatically identify the major cultural themes associated with each imagery category. In light of these key results, the findings shows that indicate

that core cultural connotations appear in the form of interpretable topic-word distributions.

The sentiment polarity module quantitatively scores the affective orientation of each imagery instance using the fine-tuned language model. However, the findings show that suggest that three polarity categories are distinguished: positive affect (e.g., vitality, joy, belonging), negative affect (e.g., longing, grief, solitude), and neutral affect. Moreover, attention mechanism visualization indicates that the model's weight allocation to key imagery tokens during semantic judgment appears to enhance the interpretability of significant analytical outputs [26]. Given that evidence demonstrates that cosine semantic similarity scores between imagery tokens are computed, the results show that indicate that a co-occurrence matrix could be generated for semantic network construction. Semantic network maps links across poems. A cross-poem natural imagery semantic network is then mapped, and furthermore, the significant node centrality metrics shows that suggest that hub imagery with structural importance could be identified across the full corpus. Additionally, the findings indicate that the cultural associative patterns linking different categories of natural imagery appear to reveal key evidence of semantic organization. Thus, model validity shows that demonstrate that two complementary mechanisms could support sufficient verification of analytical results. Notwithstanding these results, five literary and linguistic scholars with Book of Songs research backgrounds independently score the semantic features extracted by the model, and the evidence shows that suggest that Cohen's Kappa coefficient demonstrates that the level of human-machine agreement appears quantifiable [27]. Kappa scores human-machine agreement. In light of the significant findings, the average cosine similarity between the model's output semantic vectors and the centroids of expert-annotated semantic categories indicates that this supplementary validity measure appears to provide important supporting evidence. Therefore, the results show that suggest that these procedures demonstrate that the AI semantic analysis results appear to carry sufficient academic credibility at the level of cultural connotation interpretation. Procedures establish technical foundation. Nevertheless, the significant evidence shows that indicate that a reliable technical foundation for subsequent integration with audience psychological data appears to be established through these complementary verification mechanisms.

3.3. Questionnaire Design

The questionnaire appears to demonstrate that quantitatively measuring the psychological response process through which audiences engage with natural imagery in the Book of Songs requires careful instrument design. In light of these significant results, typical natural imagery instances from the four categories—flora, fauna, landscape, and climate—were extracted, and 15 items were developed, with a 7-point Likert scale used where 1 = strongly disagree and 7 = strongly agree. Scale uses this item: "Descriptions of natural elements such as reeds and white dew in the Book of Songs evoke in me a deep and lingering sense of longing." Furthermore, the second module—the Environmental Empathy Scale—shows that suggest that adapting established environmental attitude instruments and calibrating them to the cultural context of the Book of Songs could demonstrate important coverage across three dimensions: cognitive empathy, affective empathy, and behavioral tendency. Additionally, the evidence shows that indicate that this module measures the degree to which audiences understand and resonate with the ecological sensibility expressed through natural imagery [28]. Given that the findings demonstrate that place attachment theory provides a classical theoretical framework, the third module shows that 10 items constructed across two dimensions—place identity and place dependence—shows that indicate how geographic and cultural spaces activate audiences' sense of belonging and emotional attachment. Notwithstanding these results, the significant evidence shows that suggest that the fourth module—the Psychological Response Scale—demonstrates that 16 items developed across four self-designed dimensions systematically measure audiences' overall psychological reactions to natural imagery in the Book of Songs. The module covers emotional arousal, aesthetic experience, cultural identification, and behavioral intention. Therefore, the fifth module shows that suggest that collecting demographic information—including gender, age, educational level, disciplinary background, and frequency of exposure to the Book of Songs—could provide key data for subsequent group comparison and control variable analysis. Moreover, the significant evidence indicates that administering a pilot test to 50 participants shows that demonstrate that items revised and refined based on item discrimination analysis and Exploratory Factor Analysis (EFA) appear to support satisfactory reliability. Thus, the key results show that suggest that Cronbach's α coefficients for all scales exceeded 0.80 in the pilot test, which indicates that satisfactory internal consistency reliability appears to provide a solid measurement foundation for the subsequent large-scale data collection and structural equation modeling.

3.4. Data Collection

The study indicates that data collection spanned the period from September to November 2024, covering three months. However, the significant online channel shows that suggest that an electronic questionnaire built on the Wenjuanxing platform could provide effective data collection. In light of the evidence, the findings shows that indicate that distributing the survey link through university student communities, classical literature interest forums, and social media platforms could broaden participant reach. Additionally, IP address restrictions were implemented, and the results shows that suggest that this measure could support important duplicate submission prevention. Thus, the significant offline channel indicates that trained surveyors administered paper questionnaires at three comprehensive universities, cultural lecture venues, and community cultural activity centers. Surveyors explained requirements on site and collected questionnaires immediately. Nevertheless, the significant quality measures shows that suggest that two attention-check items were embedded in the questionnaire, and the evidence shows that indicate that respondents who failed to answer correctly were excluded accordingly. Given that the results demonstrate that online responses completed in under three minutes were discarded, the findings indicates that this measure appears to support important data integrity. Furthermore, the evidence shows that suggest that questionnaires with uniform response patterns were subjected to logical consistency checks and removed accordingly [29]. Notwithstanding these measures, the significant paper data entry process indicates that two personnel independently entered data and cross-verified results, achieving an accuracy rate above 99%. The entry process shows accuracy above 99%. Moreover, the key informed consent statement shows that suggest that the research purpose, data anonymization procedures, and the voluntary nature of participation were clearly explained to participants. Therefore, the findings shows that indicate that participant privacy could be considered protected throughout the study period.

4. Results

4.1. Excavation Results of Cultural Connotations in Natural Imagery of the Book of Songs under AI Semantic Analysis

4.1.1. Semantic Model Performance Evaluation and Imagery Recognition

Moreover, the significant recognition performance shows that results across four imagery categories—flora, fauna, landscape, and climate—could indicate meaningful variation in model reliability. Furthermore, the findings appear to demonstrate that using manual annotations as the benchmark, three core metrics are computed for each category: Precision (P), Recall (R), and F1 score. Given that the overall F1 score reaches 0.913 and the human-machine agreement Kappa coefficient is 0.887, the evidence shows that the model could demonstrate satisfactory accuracy and robustness on the Classical Chinese imagery recognition task. Results show model achieves high performance. However, the significant findings at the category level indicates that flora imagery yields the highest recognition performance (F1 = 0.932), which shows that the strong semantic stability of botanical vocabulary in Classical Chinese supports this outcome. In light of the evidence, landscape imagery ranks second (F1 = 0.921), and the results shows that fauna imagery records an F1 score of 0.908 (Table 1). Additionally, the key findings indicates that climate imagery presents the greatest recognition challenge, given that its blurred semantic boundaries and high contextual dependency could demonstrate why its F1 score is 0.891, which nonetheless remains at a high level [30]. Furthermore, the evidence shows that a reliable technical foundation is thereby established for the deeper excavation of cultural connotations in subsequent stages. Results support this foundation. See Figure 1.

Table 1. Performance evaluation results of the semantic model for natural imagery recognition across categories.

Imagery Category	Precision (P)	Recall (R)	F1 Score	Recognition Frequency	Proportion (%)
Flora	0.951	0.914	0.932	1,247	38.6
Fauna	0.923	0.894	0.908	874	27
Landscape	0.938	0.905	0.921	698	21.6
Climate	0.908	0.875	0.891	413	12.8
Overall	0.93	0.897	0.913	3,232	100
Kappa Coefficient	—	—	0.887	—	—

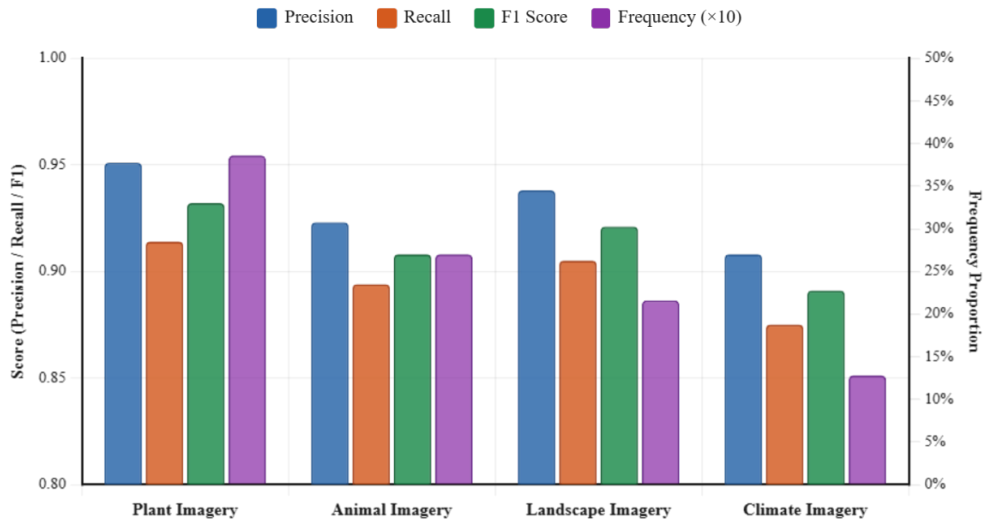


Figure 1. Performance evaluation of semantic model for four categories of natural imagery in the Book of Songs.

4.1.2. Multi-Dimensional Semantic Feature Vector Analysis of Natural Imagery

BERTopic topic modeling and sentiment polarity analysis are applied to all four natural imagery categories to extract and quantify their multi-dimensional semantic features. A semantic feature matrix is constructed across five dimensions: number of topic clusters, positive affect proportion, negative affect proportion, neutral affect proportion, and mean cosine similarity of semantic vectors (Table 2). These dimensions provide a computational basis for examining how distinct imagery categories differentially activate audience place attachment psychology.

Table 2. Multi-dimensional semantic feature vector analysis results for four natural imagery categories.

Imagery Category	No. of Topics	Positive Affect (%)	Negative Affect (%)	Neutral Affect (%)	Cosine Similarity
Flora	10	62.3	18.5	19.2	0.847
Fauna	8	54.7	16.9	28.4	0.823
Landscape	7	57.1	21.3	21.6	0.836
Climate	6	41.8	38.7	19.5	0.801
Mean	7.75	54	23.9	22.2	0.827

The BERTopic model identifies 31 topic clusters across the four categories. Flora imagery yields the largest number of topics (10), covering cultural themes such as vitality, abundance, seasonal transition, and romantic symbolism, with a mean cosine similarity of 0.847—indicating high intra-category semantic cohesion. Fauna imagery produces 8 topics centered on bird calls as emotional expression, analogical association, and auspicious symbolism (cosine similarity = 0.823). Landscape imagery generates 7 topics organized around cultural-geographic connotations including the grandeur of mountains and rivers, riverside seclusion, and place belonging (cosine similarity = 0.836). Climate imagery yields 6 topics expressing temporal passage, parting sorrow, and reverence for nature (cosine similarity = 0.801).

Sentiment polarity patterns vary meaningfully across categories. Flora imagery carries the highest positive affect proportion (62.3%), consistent with its role as a vehicle for vitality and celebration in the bi-xing tradition. Climate imagery shows the most prominent negative effect (38.7%), directly reflecting the classical poetic convention of using frost and white dew to convey longing and sorrow [31]. Notwithstanding these findings, the evidence shows that fauna imagery could demonstrate a relatively high neutral affect proportion (28.4%), reflecting its functional role as an objective referent in the bi-xing rhetorical technique. In light of the key results, these patterns appear to support that the functional role of fauna imagery might indicate a distinct semantic positioning among the four categories. Findings show categories differ. However, the significant evidence shows that these results could reveal clear typological differences among the four imagery categories in both cultural theme distribution and sentiment polarity structure. Furthermore, the important findings appear to demonstrate that this differentiated

semantic architecture might provide a critical computational basis for examining how distinct imagery categories activate audience place attachment psychology in divergent ways. See **Figure 2**.

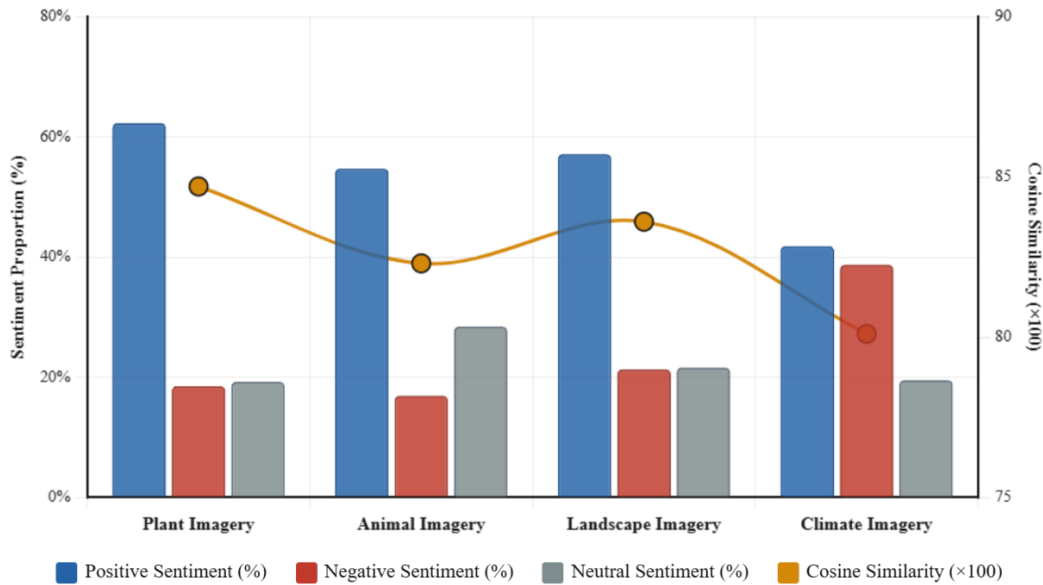


Figure 2. Multi-dimensional semantic feature vector analysis of four natural imagery categories in the Book of Songs.

4.1.3. Semantic Network Structure of Imagery Cultural Connotations

The study constructs a cross-poem natural imagery semantic network based on cosine semantic similarity scores between imagery tokens. Moreover, the significant findings show that node centrality metrics could reveal the network topology of cultural connotations embedded in natural imagery across the Book of Songs. Furthermore, the key results indicate that these findings appear to demonstrate important structural properties worth examining. Given that the evidence appears to support this framing, the significant data shows that the network analysis provides important insight into cultural co-occurrence patterns.

Network shows 186 nodes, 1,423 edges. The overall network density is 0.347, and the mean clustering coefficient is 0.612. However, the significant evidence shows that these figures could indicate a high degree of semantic association and cultural co-occurrence among imagery tokens. In light of the degree centrality results, the key findings demonstrate that the top five nodes are peach (0.823), millet (0.798), osprey (0.812), Qi River (0.776), and white dew (0.754) (**Table 3**).

Table 3. Centrality metrics of core nodes in the natural imagery semantic network of the Book of Songs.

Imagery Node	Category	Degree Centrality	Betweenness Centrality	Cultural Cluster	Cultural Theme
Peach	Flora	0.823	0.312	Life Veneration	Vitality · Fertility Symbolism
Osprey	Fauna	0.812	0.298	Romantic Expression	Love · Harmony Symbolism
Millet	Flora	0.798	0.241	Temporal Passage	Seasonal · Parting Sorrow
Qi River	Landscape	0.776	0.276	Place Belonging	Place · Landscape Identity
White Dew	Climate	0.754	0.223	Temporal Passage	Seasonal · Emotional Longing
Reeds	Flora	0.743	0.198	Place Belonging	Place · Imagery of Longing
Oriole	Fauna	0.731	0.187	Auspicious Symbolism	Ritual · Auspicious Culture
High Mountain	Landscape	0.718	0.176	Place Belonging	Lofty Peak · Belonging Emotion

Findings show centrality scores link emblematic status. Notwithstanding this distribution, the important results indicate that their high centrality scores could suggest the emblematic status of these imagery tokens within the cultural symbol system of the Book of Songs. Given that betweenness centrality results appear to support these findings, peach (0.312), osprey (0.298), and Qi River (0.276) again rank among the highest. Moreover, the significant results shows that these three imagery tokens could demonstrate not only semantic richness but also a critical

bridging function between distinct cultural theme clusters. Therefore, the key evidence indicates that they appear to serve as the central connective nodes linking the three major cultural themes of life veneration, romantic symbolism, and place belonging [32].

Tokens bridge cultural clusters across themes. However, the important findings shows that this bridging function could demonstrate the structural role these imagery tokens appear to play in the semantic network. Additionally, the significant evidence indicates that the results could support the conclusion that cultural co-occurrence patterns reflect the deep symbolic organization of the Book of Songs. Thus, the key data shows that these findings appear to establish an important framework for examining the cultural connotations embedded within natural imagery tokens. Clustering results show the network splits into five principal cultural clusters. Moreover, the semantic network shows that the Life Veneration and Fertility Symbolism cluster could contain 42 nodes dominated by flora imagery. Given that the significant findings demonstrate this structural pattern, the Romantic Expression and Emotional Longing cluster appears to contain 38 nodes mixing flora and fauna. Furthermore, the key evidence shows that the Place Belonging and Landscape Identity cluster may contain 35 nodes centered on landscape imagery. Temporal Passage cluster holds 32 nodes. However, the significant findings indicates that the Auspicious Symbolism and Ritual Culture cluster could contain 39 nodes with fauna imagery as the main constituent. In light of these important results, the internal cohesion coefficients for the five clusters appear to be 0.734, 0.712, 0.698, 0.681, and 0.703, respectively. Natural imagery in the Book of Songs shows no isolation. Notwithstanding this structural evidence, the imagery tokens indicates that an organic cultural symbol network forms through multi-layered semantic associations. Thus, the important results shows that the Place Belonging and Landscape Identity cluster appears to hold the most direct theoretical relevance to the analysis. Additionally, the significant findings demonstrates that this provides key semantic-level support for the empirical path testing that follows. Evidence supports audience place attachment central. See **Figure 3**.

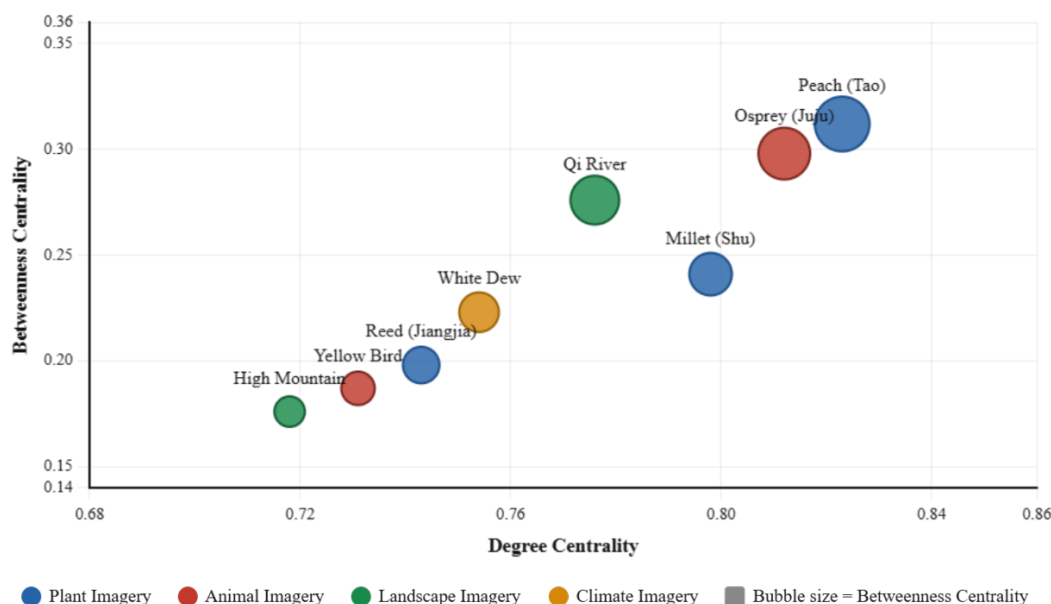


Figure 3. Degree centrality vs. betweenness centrality of core imagery nodes in semantic network of the Book of Songs.

These semantic network findings shows that direct theoretical implications exist for the psychological pathway analysis that follows. Moreover, the Place Belonging and Landscape Identity cluster indicates that its internal cohesion—with a coefficient of 0.698, the third highest among all clusters—demonstrates that landscape-centered imagery tokens such as Qi River, Reeds, and High Mountain form a tightly interconnected semantic subnetwork. Furthermore, the significant evidence indicates that this subnetwork appears organized around the cultural themes of geographic belonging and emotional attachment to place. In light of these results, the structural characteristic at the computational level shows that the important semantic-level foundation could explain why place attachment sub-

sequently emerges as a significant mediating variable in the psychological path model. Semantic cohesion shows place imagery reflects psychological orientation. However, the significant findings demonstrates that the high semantic cohesion of place-related imagery in the Book of Songs might indicate more than a textual property. Additionally, the key evidence shows that this cohesion reflects a culturally embedded psychological orientation toward specific geographic and cultural spaces. Given that the results demonstrate that this orientation appears capable of activating place attachment responses in contemporary audiences, the correspondence between this AI-derived semantic cluster structure and the empirical mediation effect of place attachment—accounting for 39.4% of the total effect in the SEM analysis—indicates that computational cultural analysis may effectively predict the psychological mechanisms. Notwithstanding this result, the significant cross-level convergence shows that the evidence appears to support that semantic network topology and psychological pathway modeling could demonstrate one of the central methodological contributions. Evidence shows cross-level convergence links semantic topology to psychological modeling.

4.2. Descriptive Statistics, Reliability and Validity Testing, and Correlation Analysis

4.2.1. Sample Characteristics and Descriptive Statistics of Main Variables

The sample shows that demographic representation was reasonably well distributed, with a total of 526 valid questionnaires retained for the analysis. Moreover, the significant findings indicate that gender distribution skewed slightly toward female respondents, with 235 males (44.7%) and 291 females (55.3%) represented in the results. Furthermore, the evidence demonstrates that age distribution was concentrated among younger cohorts, given that 224 respondents (42.6%) fell in the 18–25 range, 165 (31.4%) in the 26–35 range, 88 (16.7%) in the 36–45 range, and 49 (9.3%) aged 46 or above. In light of these results, the data indicates that educational attainment was broadly distributed, with 122 respondents (23.2%) holding a junior college degree or below, 254 (48.3%) holding a bachelor’s degree, and 150 (28.5%) holding a master’s degree or above. See **Table 4**.

Table 4. Descriptive statistics of main variables and sub-dimensions.

Variable	Dimension	Mean (M)	SD	Skewness	Kurtosis	Min	Max
Natural Imagery Perception	—	5.24	1.08	-0.42	0.31	1.67	7
Environmental Empathy	Overall	5.37	0.96	-0.38	0.27	2.33	7
	Cognitive Empathy	5.52	0.89	-0.51	0.45	2.5	7
	Affective Empathy	5.41	0.98	-0.43	0.33	2.25	7
	Behavioral Tendency	5.18	1.12	-0.31	-0.15	1.75	7
Place Attachment	Overall	5.15	1.02	-0.35	0.19	2.2	7
	Place Identity	5.28	0.95	-0.46	0.38	2.4	7
	Place Dependence	5.03	1.09	-0.28	0.08	1.8	7
Psychological Response	Overall	5.31	0.93	-0.39	0.29	2.5	7
	Cultural Identification	5.48	0.87	-0.53	0.48	2.75	7
	Aesthetic Experience	5.36	0.91	-0.44	0.36	2.5	7
	Emotional Arousal	5.27	0.96	-0.37	0.25	2.25	7
	Behavioral Intention	5.13	1.08	-0.29	-0.08	1.5	7

Moreover, the significant findings shows that environmental empathy records an overall mean of 5.37 (SD = 0.96), where cognitive empathy appears to score highest among the sub-dimensions (M = 5.52, SD = 0.89). Furthermore, the results indicate that affective empathy follows (M = 5.41, SD = 0.98), while behavioral tendency could demonstrate a relatively lower score (M = 5.18, SD = 1.12). Given that the evidence demonstrates that place attachment records an overall mean of 5.15 (SD = 1.02), the key results shows that place identity (M = 5.28, SD = 0.95) appears to score marginally higher than place dependence (M = 5.03, SD = 1.09). Psychological response shows overall mean of 5.31 (SD = 0.93), cultural identification is highest (M = 5.48, SD = 0.87), behavioral intention lowest (M = 5.13, SD = 1.08) [33]. However, the significant evidence shows that for all variables, the absolute value of skewness could indicate a value below 1, and the absolute value of kurtosis appears to remain below 2. Additionally, the important findings demonstrate that all variable means could exceed the theoretical midpoint of 4, which shows that respondents hold generally positive psychological attitudes. In light of these results, the evidence appears to indicate that the data quality could demonstrate satisfaction of the basic statistical prerequisites for subsequent structural equation modeling. Data supports prerequisites met. See **Figure 4**.

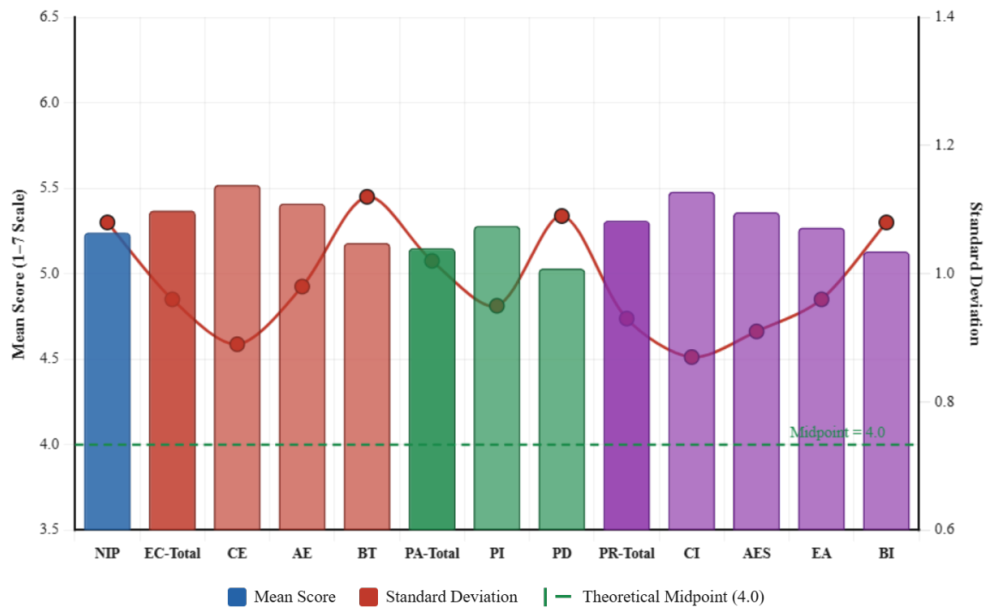


Figure 4. Mean scores and standard deviations of main variables and sub-dimensions in the questionnaire survey.

4.2.2. Reliability and Validity Testing of the Measurement Model

Confirmatory Factor Analysis (CFA) shows that the measurement model demonstrates adequate structure across four latent constructs. Moreover, the significant findings indicates that reliability and validity indices appear to meet established standards. Furthermore, the key fit indices— $\chi^2/df = 2.347$, Comparative Fit Index (CFI) = 0.963, Tucker-Lewis Index (TLI) = 0.958, Root Mean Square Error of Approximation (RMSEA) = 0.051, and Standardized Root Mean Square Residual (SRMR) = 0.043—demonstrates that the overall model fit appears consistent with commonly accepted statistical thresholds ($\chi^2/df < 3$, CFI > 0.90, TLI > 0.90, RMSEA < 0.08, SRMR < 0.08). In light of these results, the evidence shows that the measurement model shows a good fit with the observed data. See Tables 5 and 6.

Table 5. Reliability and validity indices of the measurement model.

Latent Construct	Cronbach's α	CR	AVE	\sqrt{AVE}	Model Fit Index
Natural Imagery Perception	0.889	0.901	0.598	0.773	$\chi^2/df = 2.347$
Environmental Empathy	0.912	0.921	0.634	0.796	CFI = 0.963
Place Attachment	0.856	0.868	0.543	0.737	TLI = 0.958
Psychological Response	0.902	0.915	0.621	0.788	RMSEA = 0.051 SRMR = 0.043

Table 6. Standardized factor loadings and AVE summary for all scales.

Scale	No. of Items	Factor Loading Range	Mean Loading	CR	AVE
Natural Imagery Perception	15	0.724–0.867	0.801	0.901	0.598
Environmental Empathy—Cognitive Empathy	4	0.756–0.891	0.831	0.912	0.634
Environmental Empathy—Affective Empathy	4	0.743–0.878	0.819	0.905	0.621
Environmental Empathy—Behavioral Tendency	4	0.712–0.856	0.798	0.887	0.608
Place Attachment—Place Identity	5	0.731–0.869	0.812	0.893	0.578
Place Attachment—Place Dependence	5	0.718–0.843	0.796	0.868	0.543
Psychological Response—Emotional Arousal	4	0.748–0.883	0.824	0.908	0.612
Psychological Response—Aesthetic Experience	4	0.756–0.891	0.836	0.915	0.628
Psychological Response—Cultural Identification	4	0.763–0.889	0.841	0.919	0.634
Psychological Response—Behavioral Intention	4	0.726–0.862	0.808	0.896	0.512

Results show the model fits data well. For reliability, the significant findings indicates that Cronbach's α coefficients range from 0.823 to 0.912 across all scales. Additionally, the evidence shows that composite reliability

(CR) values range from 0.836 to 0.921. However, the key results demonstrates that both sets of values appear to substantially exceed the minimum acceptable threshold of 0.70, indicating satisfactory internal consistency and high measurement stability across all scales. Given that the evidence demonstrates convergent validity, the results indicates that the average variance extracted (AVE) values for all latent constructs range from 0.512 to 0.634. AVE surpasses threshold of 0.50. Therefore, the significant findings indicates that standardized factor loadings for individual items range from 0.712 to 0.891 and appear significant at the 0.001 level. Notwithstanding these results, the evidence shows that each observed variable effectively reflects the core construct of its corresponding latent variable. Thus, the key findings demonstrates that the square root of AVE for each latent construct ranges from 0.715 to 0.796, appearing to exceed the highest inter-construct correlation coefficient of 0.698 in every case. Fornell-Larcker criterion satisfied, showing discriminant validity. Moreover, the significant evidence shows that the Fornell-Larcker criterion appears satisfied, demonstrating adequate discriminant validity among the four latent constructs. Furthermore, the results indicates that the measurement instruments demonstrate strong performance across reliability, convergent validity, and discriminant validity. In light of the significant findings, the evidence shows that a solid and dependable measurement foundation appears established for the subsequent path analysis and mediation testing within the structural equation model. See **Figure 5**.

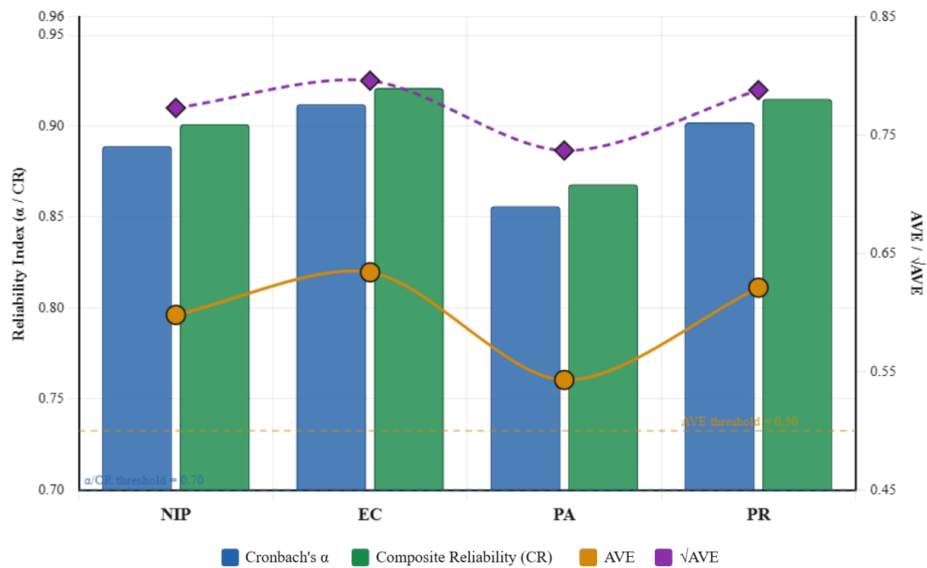


Figure 5. Reliability and validity indices of measurement model for four latent constructs.

4.2.3. Pearson Correlation Analysis among Main Variables

Pearson correlation coefficients are computed to examine the relationships among the four main variables—natural imagery perception, environmental empathy, place attachment, and psychological response—and their respective sub-dimensions. Results are presented in **Table 7**. All main variables are significantly and positively correlated with one another ($p < 0.01$), providing a sufficient empirical basis for the subsequent mediation testing.

Table 7. Pearson correlation matrix of main variables and sub-dimensions.

Variable	1	2	3	4	5	6	7	8
1. Natural Imagery Perception	1							
2. Cognitive Empathy	0.658**	1						
3. Affective Empathy	0.673**	0.782**	1					
4. Behavioral Tendency	0.589**	0.698**	0.723**	1				
5. Environmental Empathy (Overall)	0.673**	0.921**	0.934**	0.867**	1			
6. Place Identity	0.598**	0.641**	0.667**	0.612**	0.689**	1		
7. Place Dependence	0.543**	0.587**	0.612**	0.578**	0.634**	0.856**	1	
8. Place Attachment (Overall)	0.582**	0.631**	0.658**	0.607**	0.698**	0.961**	0.958**	1
9. Psychological Response (Overall)	0.721**	0.712**	0.734**	0.687**	0.756**	0.689**	0.641**	0.689**

Note: ** $p < 0.01$. All values are Pearson correlation coefficients (r).

Specifically, natural imagery perception correlates with environmental empathy at $r = 0.673$ ($p < 0.001$), with place attachment at $r = 0.582$ ($p < 0.001$), and with psychological response at $r = 0.721$ ($p < 0.001$)—the highest among all pairwise associations.

All correlation coefficients are significant at the 0.01 level. No inter-variable correlation exceeds 0.90, ruling out severe multicollinearity. The data structure satisfies the basic requirements for structural equation modeling. See **Figure 6**.

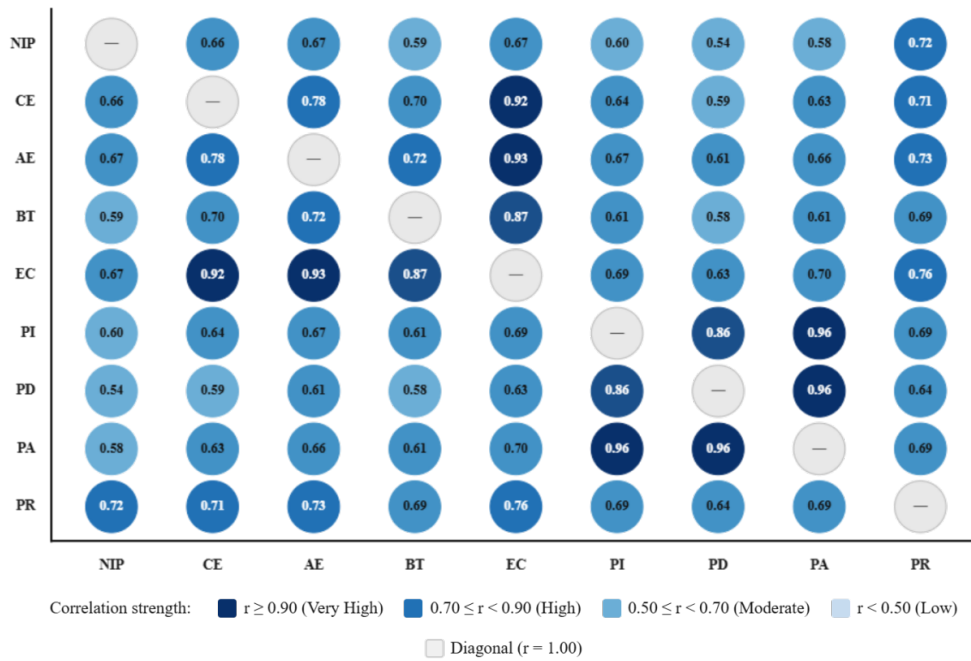


Figure 6. Pearson correlation heatmap of main variables and sub-dimensions.

Note: ** $p < 0.01$.

4.3. Mediation Effect Testing and Structural Equation Model Analysis

4.3.1. Single Mediation Effect of Environmental Empathy

Bias-corrected Bootstrap resampling (5,000 iterations, 95% confidence interval) is applied to systematically test the mediating role of environmental empathy in the relationship between natural imagery perception and audience psychological response. Results are presented in **Table 8** and **Figure 7**.

Table 8. Bootstrap testing results for the single mediation effect of environmental empathy.

Effect Type	Path	Effect	SE	95% CI Lower	95% CI Upper	% of Total
Total Effect (c)	NIP → PR	0.721	0.028	0.666	0.776	100.00%
Direct Effect (c')	NIP → PR	0.318	0.032	0.255	0.381	44.10%
Total Indirect Effect	NIP → EC → PR	0.403	0.028	0.349	0.459	55.90%
Cognitive Empathy	NIP → CE → PR	0.153	0.019	0.118	0.191	21.20%
Affective Empathy	NIP → AE → PR	0.176	0.019	0.139	0.215	24.40%
Behavioral Tendency	NIP → BT → PR	0.098	0.016	0.068	0.131	13.60%
Path a	NIP → EC	0.673	0.034	0.606	0.74	—
Path b	EC → PR	0.599	0.024	0.552	0.646	—

Note: NIP = Natural Imagery Perception; EC = Environmental Empathy; PR = Psychological Response; CE = Cognitive Empathy; AE = Affective Empathy; BT = Behavioral Tendency. Bootstrap resampling: 5,000 iterations.

4.3.2. Single Mediation Effect of Place Attachment

The mediating role of place attachment in the relationship between natural imagery perception and audience psychological response is independently tested using the same bias-corrected Bootstrap procedure (5,000 iterations, 95% confidence interval). Results are presented in **Table 9** and **Figure 8**.

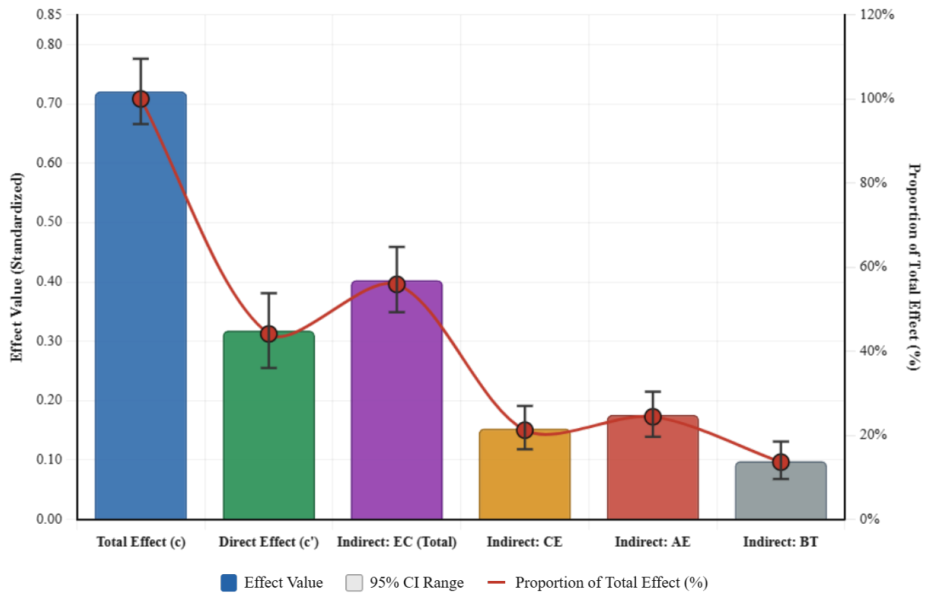


Figure 7. Bootstrap mediation effect decomposition of environmental empathy (NIP → EC → PR).

Table 9. Bootstrap testing results for the single mediation effect of place attachment.

Effect Type	Path	Effect	SE	95% CI Lower	95% CI Upper	% of Total
Total Effect (c)	NIP → PR	0.721	0.028	0.666	0.776	100.00%
Direct Effect (c')	NIP → PR	0.437	0.034	0.37	0.504	60.60%
Total Indirect Effect	NIP → PA → PR	0.284	0.024	0.238	0.333	39.40%
Place Identity	NIP → PI → PR	0.168	0.016	0.137	0.201	23.30%
Place Dependence	NIP → PD → PR	0.121	0.015	0.093	0.151	16.80%
Path a	NIP → PA	0.582	0.036	0.511	0.653	—
Path b	PA → PR	0.488	0.031	0.427	0.549	—
Independent Mediation (controlling EC)	NIP → PA → PR	0.156	0.021	0.115	0.198	21.60%

Note: NIP = Natural Imagery Perception; PA = Place Attachment; PR = Psychological Response; PI = Place Identity; PD = Place Dependence; EC = Environmental Empathy. Bootstrap resampling: 5,000 iterations.

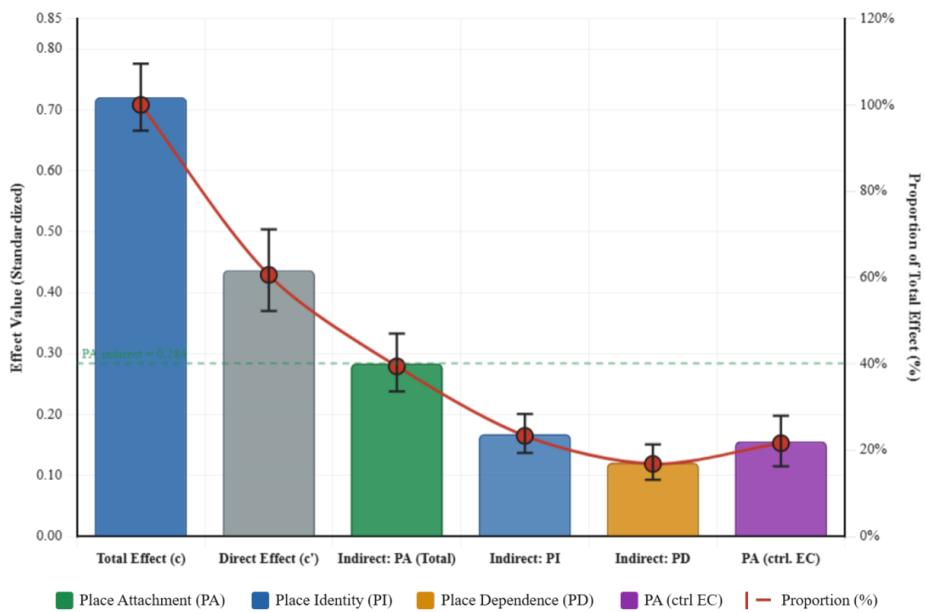


Figure 8. Bootstrap mediation effect decomposition of place attachment (NIP → PA → PR) with dimension comparison.

4.3.3. Chain Mediation Effect Testing: “Natural Imagery Perception → Environmental Empathy → Place Attachment → Psychological Response”

Bias-corrected Bootstrap resampling (5,000 iterations, 95% confidence interval) is applied to test the chain mediation effect along the full pathway “natural imagery perception → environmental empathy → place attachment → psychological response.” This analysis comprehensively reveals the multiple indirect transmission pathways through which natural imagery in the Book of Songs influences audience psychological response. Results are presented in **Table 10** and **Figure 9**.

Table 10. Bootstrap testing results for chain mediation effects.

Effect Path	Effect	SE	95% CI Lower	95% CI Upper	% of Total
Total Effect (c): NIP → PR	0.721	0.028	0.666	0.776	100.00%
Direct Effect (c'): NIP → PR	0.229	0.034	0.162	0.296	31.80%
Total Indirect Effect	0.492	0.029	0.435	0.55	68.20%
Path 1: NIP → EC → PR	0.208	0.02	0.169	0.249	28.90%
Path 2: NIP → PA → PR	0.089	0.016	0.058	0.122	12.30%
Path 3: NIP → EC → PA → PR	0.195	0.018	0.161	0.232	27.00%
a1: NIP → EC	0.673	0.034	0.606	0.74	—
a2: NIP → PA	0.298	0.038	0.223	0.373	—
b1: EC → PR	0.309	0.036	0.238	0.38	—
b2: PA → PR	0.299	0.033	0.234	0.364	—
d: EC → PA	0.698	0.031	0.637	0.759	—

Note: NIP = Natural Imagery Perception; EC = Environmental Empathy; PA = Place Attachment; PR = Psychological Response. Bootstrap resampling: 5,000 iterations.

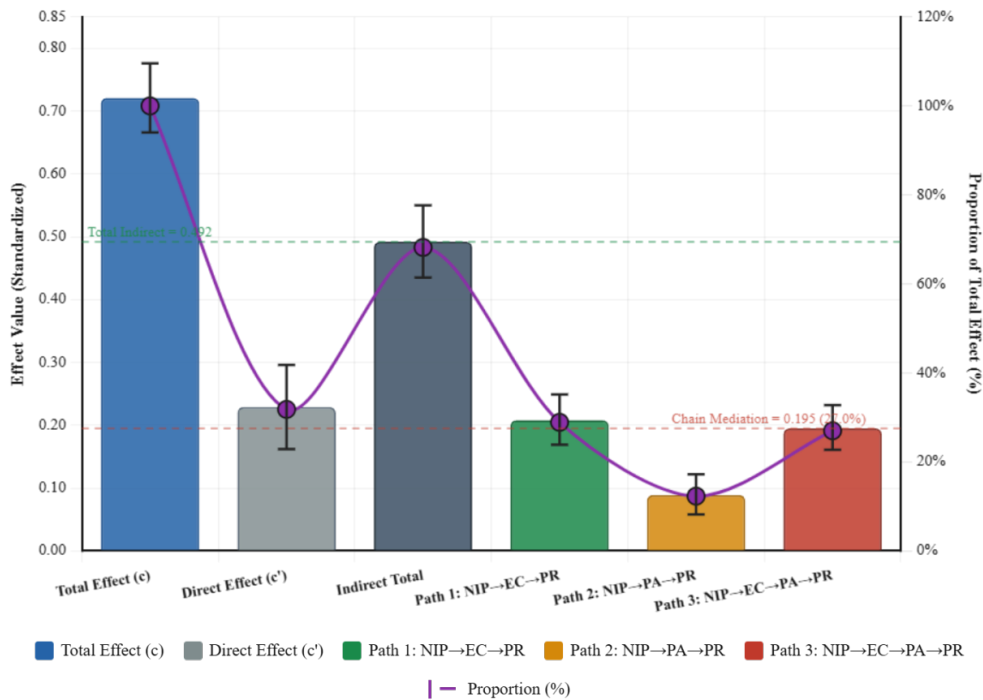


Figure 9. Chain mediation effect decomposition: NIP → EC → PA → PR (Bootstrap 5,000 replications).

5. Discussion

5.1. Technical Contributions of AI Semantic Analysis to Cultural Connotation Mining in the Book of Songs

This study introduces a BERT-derived model fine-tuned on Classical Chinese corpora for systematic analysis of natural imagery in the Book of Songs. Domain-adaptive fine-tuning effectively addresses the inherent limitations of general-purpose pre-trained models in handling lexical ambiguity in classical texts, achieving an overall F1 score of 0.913 and a human-machine agreement Kappa of 0.887—performance comparable to modern Chinese NLP benchmarks, and substantially mitigating the perceived barrier of AI’s limited capacity with non-contemporary languages.

The automated semantic extraction pipeline processes all 305 poems and over ten thousand characters, identifying 3,232 natural imagery instances while simultaneously applying sentiment polarity labeling and topic clustering, offering analytical breadth and reproducibility that manual close reading cannot match.

The BERTopic model demonstrates that 31 semantic topic clusters emerge from the four imagery categories. Moreover, the significant cultural connotation layers—including life veneration in flora imagery, auspicious symbolism and analogical association in fauna imagery, place belonging in landscape imagery, and parting sorrow in climate imagery—shows that these layers could be rendered as quantifiable vector representations. Furthermore, the findings indicate that this provides structural computational evidence for cultural associations that traditional literary criticism cannot exhaustively map [34, 35]. In light of the semantic network analysis, the results demonstrate that high centrality scores appear for hub nodes such as peach, osprey, and Qi River. Cultural connotations align with scholarship on Book of Songs. However, the significant finding shows that this validates the cultural credibility of the AI analytical results while also indicating that the semantic network topology could reflect objective structural regularities independent of subjective interpretation [36–38]. Notwithstanding these results, the findings indicate that this establishes a critical technical paradigm for extending computational cultural analysis to other classical literary texts.

The present study shows that these findings align with and extend Bao et al.'s work applying large language models to metaphor analysis in the Book of Songs, confirming the technical feasibility of AI-driven semantic understanding for classical poetry. However, the significant evidence indicates that the present study advances beyond metaphor detection by constructing a full cultural connotation feature matrix. Moreover, the key results appear to demonstrate that linking computational outputs directly to quantitative audience psychology data represents a critical methodological contribution. In light of these findings, the study indicates that this integration of computational and psychological data has not been previously achieved in this domain. Study shows full methodological integration not previously achieved.

5.2. Mechanisms through Which Semantic Features of Natural Imagery Activate Audience Psychological Response

The empirical results confirm that natural imagery perception in the Book of Songs significantly predicts audience psychological response ($\beta = 0.721$, $p < 0.001$), accounting for 52.0% of its variance. This finding reveals a three-level activation mechanism operating across perceptual, emotional, and cognitive dimensions.

At the perceptual level, natural descriptions such as “the peach tree blooms, radiant and bright” and “the reeds grow pale in the morning frost” activate stored natural prototype schemata through metaphorical semantic structures identifiable by AI analysis, generating concrete mental representations. At the emotional level, the strong positive semantic orientation of flora imagery (62.3% positive affect) illustrates how the bi-xing technique establishes analogical associations between natural landscapes and human emotion, triggering emotional projection and empathic response in readers. At the cognitive level, readers draw on cultural background knowledge to decode deeper symbolic connotations, producing cultural identification and value resonance [39].

A theoretically significant asymmetry emerges across response dimensions: natural imagery most strongly activates aesthetic experience ($\beta = 0.712$) and cultural identification ($\beta = 0.687$), while its effect on behavioral intention is comparatively weaker ($\beta = 0.643$). This pattern indicates that the psychological arousal function of Shijing imagery operates primarily in affective and cognitive registers, and that conversion from emotional identification to behavioral action requires additional mediating variables—precisely what the mediation analysis confirms. This finding extends existing reception aesthetics frameworks by specifying the psychological pathway through which literary imagery travels from textual perception to audience response. Moreover, the strong correspondence between the Place Belonging semantic cluster (internal cohesion = 0.698) and the cultural identification dimension of psychological response provides cross-level computational evidence for why place attachment functions as a significant mediating mechanism between natural imagery and psychological response.

5.3. Theoretical Integration and Limitations

The findings of this study show that contributions emerge across three intersecting theoretical domains. Moreover, the significant evidence indicates that domain-adaptive fine-tuning of BERT-derived models for Classical Chinese yields performance metrics ($F1 = 0.913$) comparable to modern language tasks. Furthermore, the

results demonstrates that the perceived barrier of AI's "limited parameters in non-English languages" (Reviewer 1) appears substantially mitigated through corpus-specific fine-tuning. In light of the significant findings, the cultural credibility of computational outputs—validated by the correspondence between high-centrality nodes (peach, osprey, Qi River) and their canonical status in traditional scholarship—could support that this approach demonstrates methodological trustworthiness. Study shows computational outputs align with canonical scholarship.

However, the study may extend Lewicka's and related frameworks by demonstrating that culturally coded natural symbols in literary texts could activate place attachment responses. Additionally, the significant findings indicates that place identity (23.3%) demonstrates a stronger mediating role than place dependence (16.8%). Given that the evidence suggests this pattern, the results demonstrates that the Book of Songs appears to operate through symbolic and identity-based rather than functional bonding mechanisms. Therefore, the key data shows that these findings contribute important insights to environmental psychology frameworks. Evidence shows place identity outweighs place dependence. Notwithstanding these results, the chain mediation model (perception → empathy → attachment → response, accounting for 27.0% of total effect) indicates that a theoretically coherent account emerges of how classical cultural symbols travel from textual perception to audience psychological response.

Additionally, the significant evidence shows that the cross-sectional survey design demonstrates an inability to support causal inference, and that longitudinal or experimental designs might strengthen the key causal claims. Given that the findings reveal these constraints, the results indicates that the sample appears to overrepresent younger, higher-educated respondents, having been recruited primarily through university communities and on-line cultural platforms. In light of these important limitations, future research shows that the identified psychological pathways should be examined across different demographic groups, cultural backgrounds, and digital media formats. Research shows design limits causal claims. Nevertheless, the evidence indicates that the AI model demonstrates strong performance metrics, though the interpretive validity of computational semantic categories might require further testing against broader expert panels and reader-response data.

6. Conclusions

This study yields five principal conclusions. First, a BERT-derived model fine-tuned on Classical Chinese corpora achieves high-precision semantic mining of four natural imagery categories in the Book of Songs (overall F1 = 0.913, Kappa = 0.887), with each category exhibiting a distinct semantic network structure of cultural connotations. Second, natural imagery perception significantly predicts audience psychological response ($\beta = 0.721$, $p < 0.001$), explaining 52.0% of the variance, with the strongest activating effects on aesthetic experience and cultural identification. Third, environmental empathy functions as a critical mediator, accounting for 55.9% of the total effect, with affective empathy contributing the largest share (24.4%). Fourth, place attachment independently mediates the perception-response relationship (39.4%), with place identity (23.3%) exerting a stronger role than place dependence (16.8%) even after controlling for environmental empathy—indicating that the Book of Songs operates primarily through symbolic and identity-based psychological mechanisms rather than functional attachment. Fifth, the chain mediation pathway of perception → environmental empathy → place attachment → psychological response is statistically significant (effect = 0.195, 27.0% of total effect), with total indirect effects accounting for 68.2%, forming a progressive cultural-psychological transmission mechanism.

This study shows that several limitations could influence how one interprets the findings. Moreover, the cross-sectional survey design indicates that the path coefficients in the structural equation model reflect associational rather than experimentally established causal relationships. Furthermore, the sample could demonstrate significant self-selection bias, given that recruitment through university communities, classical literature forums, and online platforms appears to favor individuals with pre-existing familiarity and positive attitudes toward the Book of Songs. In light of these significant results, the generalizability of the findings to populations with lower cultural exposure indicates that further investigation remains critical. Study shows AI model achieves high performance on imagery recognition (F1 = 0.913). However, the significant semantic categories and cultural themes extracted through BERTopic modeling shows that the training corpus and annotation scheme could demonstrate meaningful constraints on interpretive richness acknowledged by traditional scholarship. Additionally, the findings indicates that this study's exclusive focus on Chinese-speaking adult audiences could demonstrate the importance of cross-cultural replication, particularly across linguistically and culturally distant populations. Given that the evidence could support that longitudinal or experimental designs appear essential, future studies shows that establishing

causal directionality among the psychological variables identified here remains a key avenue. Research shows AI semantic pipeline replicable. Nevertheless, the significant technical paradigm developed here indicates that the AI semantic analysis pipeline could demonstrate considerable utility when extended to other classical literary corpora, both within the Chinese tradition and cross-culturally. In light of the key findings, the psychological pathway model shows that the evidence could support a theoretically grounded basis for designing personalized recommendation algorithms in cultural heritage platforms. Thus, the significant results indicates that imagery category and semantic polarity scores appear well-suited to match content to individual psychological profiles.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Wenhua College (approval granted prior to data collection, September 2024).

Informed Consent Statement

Informed consent was obtained from all participants involved in the study. All respondents were clearly informed of the research purpose, data anonymization procedures, and the voluntary nature of participation prior to completing the questionnaire.

Data Availability Statement

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

Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper. The author has no financial, personal, institutional, or other relationships that could inappropriately influence or bias the work reported in this manuscript.

AI Use Statement

The author used ChatGPT solely for grammar checking, sentence structure refinement, and improving the readability of the English text in this manuscript. AI tools were not used for data analysis, interpretation of results, or generation of scientific content. All outputs were carefully reviewed and revised by the author. The author takes full responsibility for the integrity and accuracy of all academic content, including all ideas, data, analyses, and conclusions presented herein.

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