The Mapping between Color-Material-Finish (CMF) and Style Imagery: A Case Study of Neo-Chinese Armchairs

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The mapping relationship was investigated between Color-Material-Finish (CMF) and style imagery, using Neo-Chinese armchairs as the research object. Within a Kansei Engineering (KE) framework, key style imagery features of Neo-Chinese armchairs were extracted by combining the Semantic Differential (SD) method and Principal Component Analysis (PCA), based on evaluations from a panel of design experts. Existing CMF configurations were systematically categorized and coded, with standardized digital samples generated using Rhino 3D and Keyshot software. Quantitative Theory Type I (QTTI) was then employed to establish the CMF-style imagery mapping framework. Results demonstrated that CMF significantly shapes style imagery: Different CMF combinations can shift stylistic perceptions toward "modern" or "traditional," and modulate the intensity of "Zen-inspired" qualities—though they cannot eliminate such attributes entirely. Notably, individual CMF categories may exert contrasting effects on different imagery dimensions. This research addresses two core questions: (1) Which specific CMF components influence the style imagery of Neo-Chinese armchairs, and (2) How do these components operate mechanistically? Furthermore, qualitative CMF design strategies are proposed for Neo-Chinese furniture. The findings provide a theoretical basis for furniture designers to align CMF decisions with user cognitive expectations and a methodological reference for style mapping studies across broader design disciplines.

DOI: 10.15376/biores.21.2.4340-4356

Keywords: CMF; Style imagery mapping; Neo-Chinese furniture; QTTI; Cognitive evaluation

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INTRODUCTION

Traditionally, furniture utility and usability have been primary consumer demands. With the rise of affective consumption, however, consumers' Kansei needs for furniture are gaining significant attention. Consequently, furniture designers strive to decode consumers' cognitive perceptions, such as stylistic imagery, aesthetic preferences, and emotional responses. Neo-Chinese furniture—a design style integrating traditional Chinese cultural elements with contemporary design principles—has emerged as a market-driven aesthetic phenomenon during China's socioeconomic transformation. This evolution strategically reinterprets heritage materials through contemporary Color-Material-Finish (CMF) configurations—where surface finish engineering and chromatic planning collectively encode cultural semantics. The style has thus evolved into a culturally representative furniture paradigm characterized by temporal relevance and heritage continuity. Therefore, stylistic investigation constitutes a critical research dimension in Neo-Chinese furniture design.

Style signifies the proliferation and aggregation of novel forms into a discernible artistic signature (Benjamin 2006), serving as an identifying characteristic that intensifies the inherent artistry of objects. Its evolution stems from material progression and immaterial zeitgeist imperatives, manifesting not merely as physical attributes but as embodiments of intrinsic spiritual qualities. Only by demystifying superficial manifestations is it possible to excavate the ontological essence of style. Furniture design embodies style through explicit features (observable physical attributes: shape, material, color, structure, texture) and implicit features (psychological responses quantifiable *via* perceptual descriptors) (Karina *et al*. 2025). However, most current studies examining such mappings exhibit certain theoretical biases and methodological limitations. For example, Ye *et al*. (2025) proposed a dual-layer optimization approach integrating functional demand refinement and perceptual analysis, achieving a degree of stylistic innovation in shared e-scooter design. Yet, their QTTI regression model relies heavily on morphological elements and fails to systematically incorporate CMF (Color, Material, Finish) as independent variables. Similarly, while Ding and Lee (2013) applied KE to investigate the relationship between design elements and perceptual imagery in electric bicycle charging stations, the study was confined to a morphology-dominated analytical framework, not explaining the systemic role of CMF in shaping style. Although the product imagery decision system developed by Xue *et al*. (2020) validated the effectiveness of form–perception mapping in train seat design, its explanatory power in complex stylistic judgments is limited due to neglecting the synergistic influence of CMF dimensions. Thus, the existing literature demonstrates a distinct "morpho-centric" tendency in stylistic research, overlooking the mediating role of CMF in stylistic expression—particularly its formative influence within established stylistic paradigms. This bias not only weakens the holistic interpretation of style but also leaves design practice without adequate theoretical support in responding to increasingly diverse and emotionally driven consumer demands.

Emerging from the European design discourse around the year 2000, CMF (Color, Material, and Finish) refers to the integrated consideration of chromatic properties, material substrates, and surface treatment techniques. It has since evolved into a conventional professional term, constituting a distinct sub-domain within the field of industrial product form design. As an indispensable semantic carrier in stylistic composition, CMF serves as the primary sensory interface for user experience, enabling users to derive perceptual impressions—such as judgments of superiority, aesthetics, simplicity or complexity, and modernity or tradition—through direct sensory engagement (Song *et al*. 2023). In recent years, dedicated research on CMF has gained momentum in product design. For instance, Huang and Cui (2021) proposed a CMF design method for smart jewelry based on an integrated Kansei Engineering-KANO framework to enhance user experience. Xu and Fang (2022) developed an evaluation system to assess the influence of CMF attributes on subjective impressions in camera design. Meanwhile, He *et al.* (2020) applied fuzzy theory to investigate the relationship between CMF combinations in automotive seats and user preferences. These studies collectively underscore the significance of CMF in shaping emotional responses and user experience in product design. In design practice, however, CMF selection for Neo-Chinese furniture increasingly relies on designers' intuitive judgment, a process that often fails to align with evidence-based perceptual cognition. Given the relative functional fixedness of many furniture typologies, stylistic and affective alignment has become a critical factor for market differentiation. This reality amplifies the urgent need for an evidence-based approach to CMF design in this context.

This investigation centers on the mediating role of CMF in Neo-Chinese furniture stylistics, addressing contemporary design practices that predominantly rely on designers' subjective expertise—thereby failing to capture users' perceptual cognition of style and compromising affective resonance. Furthermore, prevailing CMF applications prioritize isolated elements over integrated triadic considerations, neglecting how emotional responses emerge from synergistic design variables. Within the commercialized furniture market, stylistic alignment with affective demands has become a critical evaluation metric for Neo-Chinese furniture—particularly owing to the relative functional fixedness of furnishings, which amplifies stylistic significance. Should quantifiable CMF to style imagery mappings be established, this research will empower designers to generate user-cognitively-aligned Neo-Chinese aesthetics, by simultaneously establishing a theoretical framework for evidence-based CMF design.

EXPERIMENTAL

Framework

This research implements the CMF-style imagery mapping methodology through two integrated phases: (1) Extraction of principal style imagery *via* PCA underpinned by KE theory, employing SD method surveys to capture perceptual cognition of Neo-Chinese aesthetics; and (2) Systematic classification of predominant CMF configurations in Neo-Chinese armchairs to establish representative collocation modes, followed by Rhino 3D-generated standardized specimens evaluated using SD-scale surveys with two principal components as stylistic descriptors—processing response data through Excel and QTTI analysis to establish CMF-style imagery mapping relationships and elucidate sculpting mechanisms of CMF items/categories for stylistic expressions, ensuring methodological consistency through armchair-focused specimen standardization.

Extraction of Neo-Chinese Style Imagery Features

Participants

Given the specialized nature of stylistic cognition research, 41 design practitioners were recruited to mitigate interpretative variances among general consumers, completing perceptual assessments of Neo-Chinese armchair style imagery *via* domain-specific questionnaires—yielding 38 valid responses (male:14; female:24) with a mean completion duration of 30 min/questionnaire after data validation.

Materials

An extensive collection of Neo-Chinese armchair imagery from domestic and international professional furniture websites prioritized mass-produced or custom-manufactured physical furnishings over conceptual renderings, adhering to principles of differentiation, diversity, and representativeness across morphological elements, design techniques, material technologies, price tiers, and brands to ensure validity and comprehensiveness—yielding 90 preliminary specimens that underwent designer evaluation (n=6) for categorization and refinement into 24 representative samples (Fig. 1), which were subsequently processed with background removal, logo elimination, and dimensional standardization while intentionally retaining chromatic variables due to their critical role in stylistic cognition.

Fig. 1. Representative specimens

A systematic compilation of Neo-Chinese furniture documentation from diverse sources (websites, literature, periodicals) yielded 72 perceptual descriptors, which were refined through questionnaire surveys and expert discussions to select style-optimized adjectives, consolidate synonymous high-frequency terms *via* merging and elimination, and ultimately establish 11 antonym-paired lexical dyads.

Employing 24 Neo-Chinese armchair specimens and 11 perceptual lexical dyads, the questionnaire established a 7-point semantic differential scale (Fig. 2) with a rating continuum from -3 (denoting maximal affinity to the left anchor term) through 0 (neutral) to +3 (indicating predominant alignment with the right descriptor), thereby quantifying stylistic proximities through bipolar metric quantification.

Evaluative Dimensions	-3	-2	-1	0	1	2	3
Dignified - Frivolous	○	○	○	○	○	○	○
Modern - Classical	○	○	○	○	○	○	○
Minimalist - Ornate	○	○	○	○	○	○	○
Innovative - Conservative	○	○	○	○	○	○	○
Majestic - Trivial	○	○	○	○	○	○	○
Sober - Lightweight	○	○	○	○	○	○	○
Elegant – Crude	○	○	○	○	○	○	○
Ethnic - Globalized	○	○	○	○	○	○	○
Cultured - Impoverished	○	○	○	○	○	○	○
Exquisite - Inferior	○	○	○	○	○	○	○
Artistic - Kitsch	○	○	○	○	○	○	○

Fig. 2. Questionnaire paradigm for style imagery evaluation

Measurements

Reliability and validity analyses conducted in SPSS yielded a Cronbach's α coefficient of 0.849 (> 0.8 threshold), confirming high internal consistency, while the Kaiser-Meyer-Olkin (KMO) measure of 0.738 (> 0.6 benchmark) and significant Bartlett's test of sphericity ($P < 0.001$) jointly validated robust structural validity of the questionnaire data.

The PCA method—a statistical dimensionality-reduction technique employing orthogonal transformation to convert correlated multivariate data into fewer mutually independent principal components while minimizing information loss (Yohanny *et al.* 2025) —was applied to survey data, yielding eigenvalues and contribution rates of evaluation metrics (Table 1) wherein two components with eigenvalues exceeding 1 demonstrated a cumulative variance contribution of 87.97% (>85% threshold), thereby confirming their sufficiency for encapsulating the 11 perceptual lexical dyads. Table 2 shows the principal component factors: Principal component $\boldsymbol{y}_1$ is summarized as "Modern-Traditional" since it mostly describes the modeling temperament of the Neo-Chinese armchair, including the evaluation index of "x_1", "x_2", "x_3", "x_4", "x_6" and "x_8"; principal component $\boldsymbol{y}_2$ can be summed up as "Zen-inspired-Mundane," since it primarily describes the aesthetic conception and connotation of the Neo-Chinese armchair, including "x_5", "x_7", "x_9", "x_{10}," and "x_{11}".

Table 1. Cumulative Factor Contribution

Principal Component	Characteristic Value	Contribution (%)	Accumulative Contribution (%)
1	5.369	48.811	48.811
2	4.308	39.159	87.970

Table 2. Correlation Coefficients between Perceptual Lexical Dyads and Principal Components

Perceptual Lexical Dyads	Principal Component	
	$\boldsymbol{y}_1$	$\boldsymbol{y}_2$
x_1 Dignified - Frivolous	-0.328	0.281
x_2 Modern - Classical	0.412	-0.049
x_3 Minimalist - Ornate	0.295	0.274
x_4 Innovative - Conservative	0.419	-0.039
x_5 Majestic - Trivial	0.110	0.414
x_6 Sober - Lightweight	-0.372	-0.001
x_7 Elegant – Crude	0.093	0.458
x_8 Ethnic - Globalized	-0.403	0.083
x_9 Cultured - Impoverished	-0.285	0.329
x_{10} Exquisite - Inferior	0.002	0.469
x_{11} Artistic - Kitsch	0.242	0.355

Establish the CMF-Style Imagery Mapping Framework

Participants

The authors recruited 55 design professionals (34 females, 21 males; aged 18 to 60 years) with demonstrated expertise in style perception to complete the questionnaire. After receiving standardized instructions prior to participation, all 55 submitted questionnaires were validated as complete and suitable for analysis.

Materials

Given the substantial stylistic diversity of Neo-Chinese armchairs and their corresponding CMF heterogeneity, the classification framework was strategically constrained to mitigate data reliability concerns from categorical overload and multicollinearity risks: (1) Chromatic categorization prioritized dominant hues—excluding material-based descriptors such as metallic/wood tones—and incorporated psycho-physiological hue-response principles alongside Neo-Chinese color characteristics, distilling three tonal categories: high-lightness/low-saturation, low-lightness/low-saturation, and medium-lightness/high-saturation; (2) Material taxonomies differentiated wood, metal, wood-dominant hybrid, and metal-dominant hybrid substrates; (3) Surface treatments excluded substrate modification, focusing solely on surface coating, and surface finishing processes. This systematic consolidation yielded nine mutually exclusive categories subsequently coded for analysis (Table 3).

Table 3. Neo-Chinese Armchair CMF Items and Categories List

Item	Code	Category	Main Types of Description
C (Color)	c_1	High-brightness and low-saturation	Light yellow; yellowish white; yellow; grayish white; light brown; brown; light reddish brown; reddish brown; gold; silver, *etc*.
	c_2	Low-brightness and low-saturation	Dark brown; black, *etc*.
	c_3	Medium-brightness and high-saturation	Big red; orange red; orange yellow; peacock green; ultramarine, *etc*.
M (Material)	m_1	Wood	Rosewood; shark's fin; ash; elm; black walnut; oak; ebony; teak, *etc*.
	m_2	Metal	Copper; stainless steel; carbon steel; aluminum alloy, *etc*.
	m_3	Wood-based mixed materials	Wood and copper; wood and upholstery; wood, copper and upholstery, *etc*.
	m_4	Metal-based mixed materials	Copper and wood; stainless steel and wood; copper and soft cushion; stainless steel and soft cushion, *etc*.
F (Finish)	f_1	Surface coating	Spraying; baking paint; plating; silk-screening, *etc*.
	f_2	Surface finishing	Polishing; sandblasting; brushing, *etc*.

Combinatorial enumeration of CMF categories in Table 4 generated 24 permutations (3 × 4 × 2 configurations, Table 4), which underwent validity screening to eliminate implausible or statistically rare combinations, yielding 13 validated CMF codes (denoted by *). Exemplary configurations were subsequently selected from this subset for isomorphic Neo-Chinese armchair modeling *via* Rhino 3D and KeyShot rendering, producing 13 chromatically distinct yet CMF identical digital prototypes (Fig. 3).

Table 4. 24 Permutations

$c_1m_1f_1$	*$c_1m_1f_2$	$c_1m_2f_1$	$c_1m_2f_2$	$c_1m_3f_1$
*$c_1m_3f_2$	$c_1m_4f_1$	$c_1m_4f_2$	$c_2m_1f_1$	*$c_2m_1f_2$
*$c_2m_2f_1$	*$c_2m_2f_2$	$c_2m_3f_1$	*$c_2m_3f_2$	*$c_2m_4f_1$
*$c_2m_4f_2$	$c_3m_1f_1$	*$c_3m_1f_2$	$c_3m_2f_1$	*$c_3m_2f_2$
$c_3m_3f_1$	*$c_3m_3f_2$	$c_3m_4f_1$	$c_3m_4f_2$	
*Validated CMF codes				

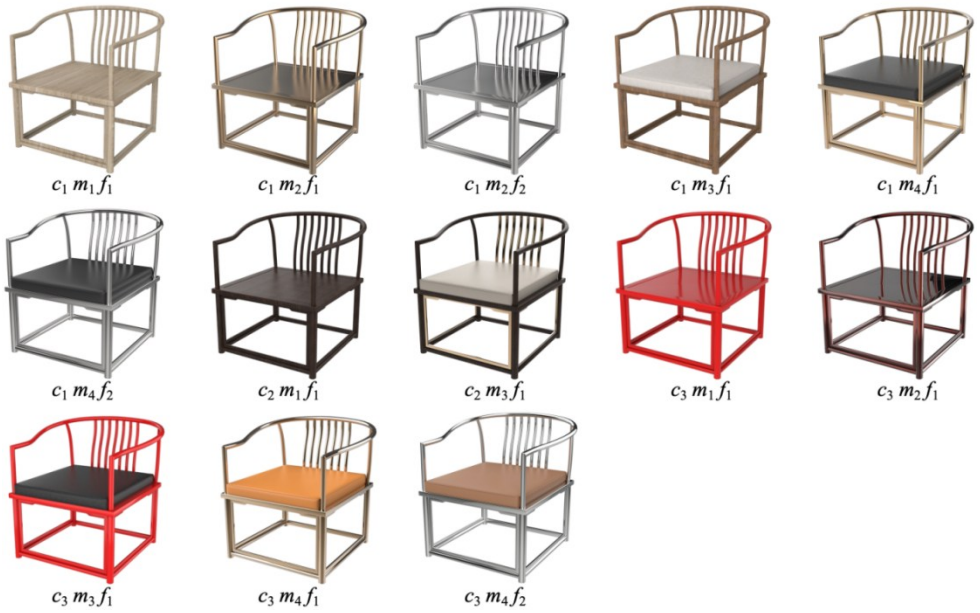

Fig. 3. 13 CMF Digital prototypes

The 13 CMF permutations underwent rigorous refinement prioritizing dual criteria: (1) Comprehensive coverage of all Table 4 categories; (2) Pronounced stylistic imagery differentiation. This selection protocol yielded eight archetypal Neo-Chinese armchair configurations—specifically $c_1m_1f_1$, $c_1m_3f_1$, $c_1m_4f_2$, $c_2m_1f_1$, $c_2m_3f_1$, $c_3m_2f_1$, $c_3m_3f_1$, and $c_3m_4f_1$—which established the standardization framework for final experimental specimens

According to QTTI, the total number of samples (n) in the questionnaire should be maximized based on a fixed number of categories (p) to enhance model prediction precision, typically satisfying the condition $n \geqslant 2p$ (Zhou *et al*. 1979). To mitigate the influence of the "form" variable under a single-form condition and prevent the visual fatigue effect during questionnaire completion, three distinct Neo-Chinese armchair forms were selected (Fig. 4), each assigned eight standardized CMF configurations, yielding a total of 24 samples (3 × 8). Subsequently, Neo-Chinese armchair models were constructed and rendered using Rhino 3D and Keyshot to produce standardized sample images. Each image employed an identical viewpoint and resolution to ensure visual consistency, thereby enabling the investigation of the impact of diverse CMF combinations on the overall style imagery perception of the Neo-Chinese armchair under constant form conditions. The final sample images and their corresponding numbering are presented in Fig. 5.

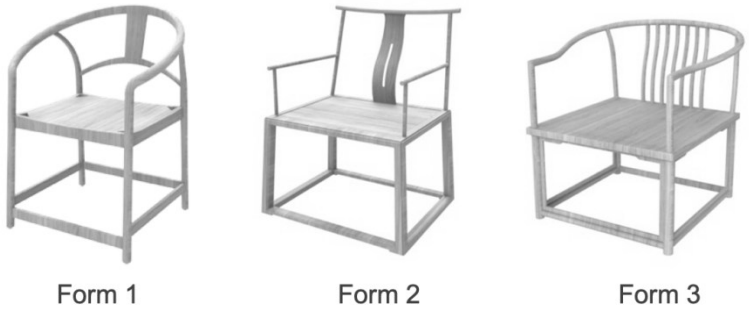

Fig. 4. Sample forms

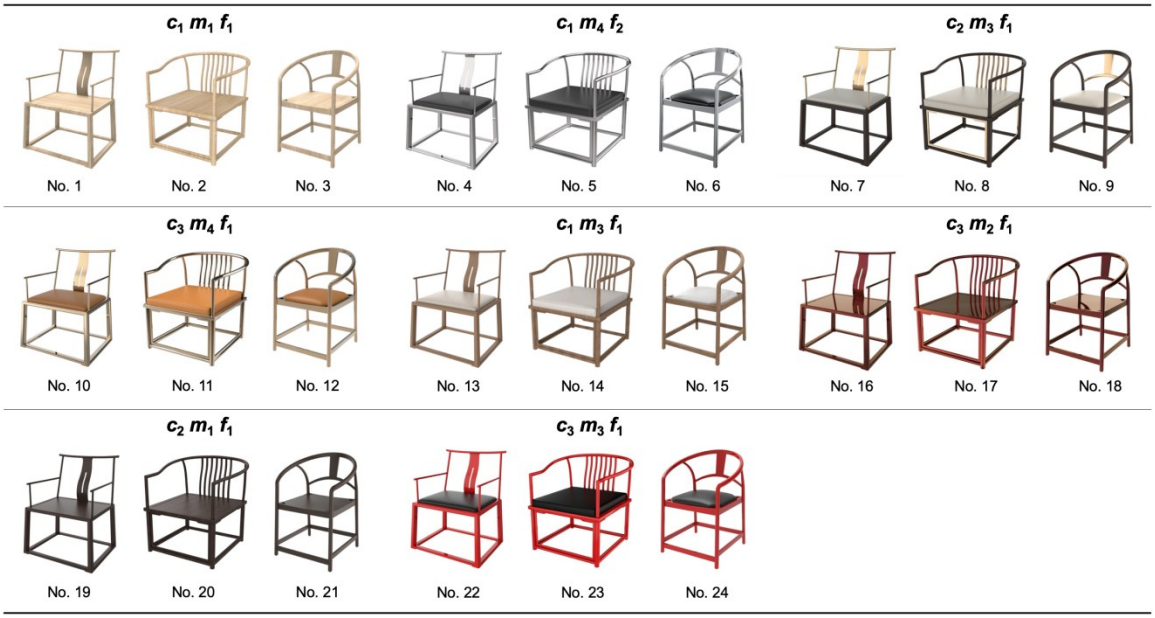

Fig. 5. Standardized sample images and numbering

Measurements

Utilizing the two principal components ("modern-traditional" and "Zen-inspired-mundane") extracted from prior analysis as evaluative dimensions, with the 24 samples in Fig. 5 serving as assessment targets, a questionnaire was developed employing the SD method and a 7-point Likert scale (Fig. 6). Respondents evaluated each sample's stylistic imagery on a graduated scale ranging from -3 to 3, where for the "modern-traditional" dimension: -3 corresponds to "very modern", -2 to "moderately modern", -1 to "modern", 0 indicates "neutral/no evident tendency", +1 to "traditional", +2 to "moderately traditional", and +3 denotes "very traditional".

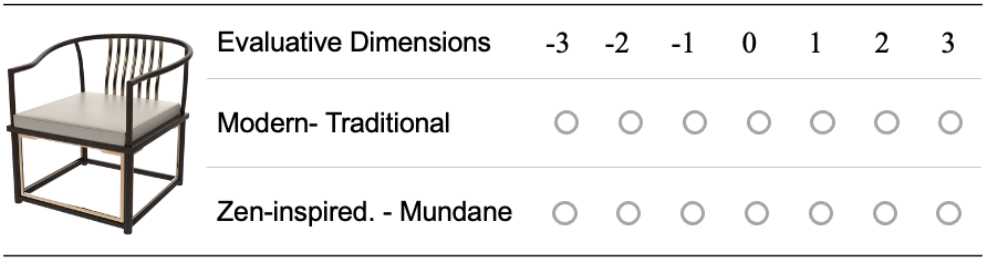

Fig. 6. Questionnaire paradigm of CMF samples

Preliminary processing of the questionnaire data was conducted using Excel, tabulating the mean style imagery ratings for three armchair models across eight CMF configurations (Table 5), with corresponding radar charts generated (Fig. 7). In the radar chart for principal component $\boldsymbol{y}_1$ ("Modern-Traditional"), pronounced disparities in style imagery scores among the eight CMF conditions indicated substantial CMF-driven variations, where configurations $c_1m_4f_2$, $c_3m_4f_1$, and $c_2m_3f_1$ exhibited the strongest modern characteristics, while $c_1m_1f_1$, $c_1m_3f_1$, and $c_2m_1f_1$ demonstrated the most traditional attributes. Conversely, the $\boldsymbol{y}_2$ ("Zen-inspired-Mundane") radar chart showed minimal angular deviation across all four curves and closely clustered scores among CMF configurations, suggesting limited CMF influence on this stylistic dimension.

Table 5. Mean Style Imagery Ratings Across CMF Configurations

Code		$c_1m_1f_1$	$c_1m_4f_2$	$c_2m_3f_1$	$c_3m_4f_1$	$c_1m_3f_1$	$c_3m_2f_1$	$c_2m_1f_1$	$c_3m_3f_1$
$\boldsymbol{y}_1$	Form 1	.709	-1.691	-1.564	-1.891	-0.127	-.400	-.309	-1.109
	Form 2	1.218	-1.727	-1.327	-1.527	.418	-.236	.255	-1.000
	Form 3	.382	-1.782	-1.127	-1.473	.364	-.600	-.109	-1.036
Mean Value		.770	-1.733	-1.339	-1.630	.218	-.412	-.055	-1.048
$\boldsymbol{y}_2$	Form 1	-1.309	-.291	-.764	-.891	-1.255	-.800	-1.236	-.636
	Form 2	-1.109	-.127	-1.127	-.564	-1.600	-.818	-1.345	-.618
	Form 3	-.727	.273	-.709	-.327	-1.182	-.455	-.764	-.200
Mean Value		-1.048	-.048	-.867	-.594	-1.345	-.691	-1.115	-.485

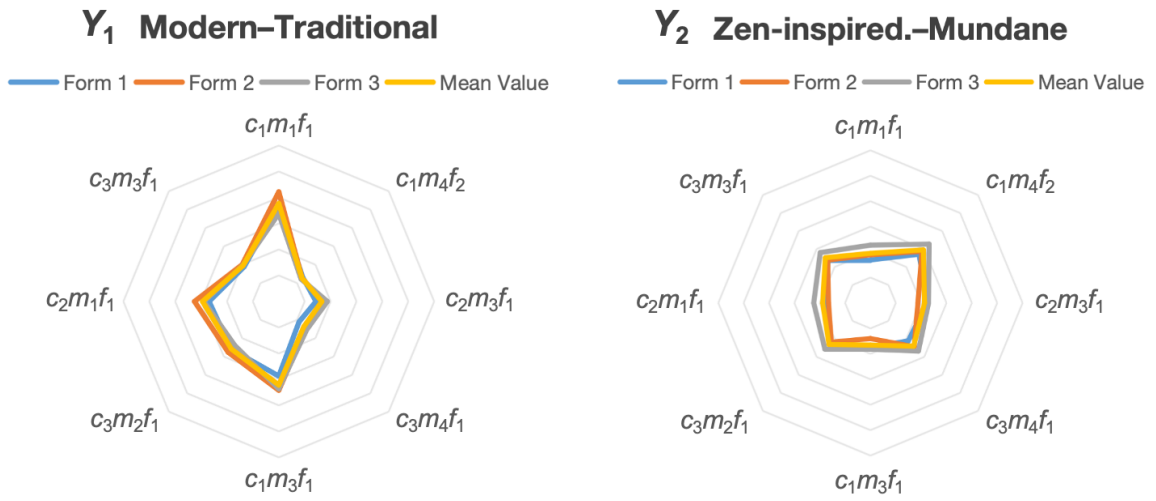

Fig. 7. Radar charts of mean style imagery across CMF configurations

Using the mean values of $\boldsymbol{y}_1$ from Table 5 as the x-axis coordinates and the mean values of $\boldsymbol{y}_2$ as the y-axis coordinates, a scatter plot was generated in Excel. Taking the samples of shape 3 as an example, the 8 CMF samples were placed into the corresponding coordinate points on the scatter plot using Adobe Photoshop to create a style imagery scale map for the Neo-Chinese armchair under the 8 CMF conditions, as shown in Fig. 8. All 8

CMF samples were positioned below the horizontal axis, distributed in the third and fourth quadrants, indicating that different CMF configurations can change the style imagery to "modern" or "traditional". For example, the third quadrant contains CMF samples combined with metal, spraying, and other contemporary materials, which are more oriented toward a modern feel, while the fourth quadrant contains all the wood samples with high lightness and low saturation color, which are more oriented toward the traditional feel. However, CMF samples with soft cushions appear in both the third and fourth quadrants, indicating that despite being a modern material, soft cushions have no obvious impact on this style imagery. Additionally, varied CMF configurations can reduce or strengthen the "Zen-inspired" imagery, but cannot remove it, indicating that "Zen-inspired" is a basic feature of the Neo-Chinese armchair.

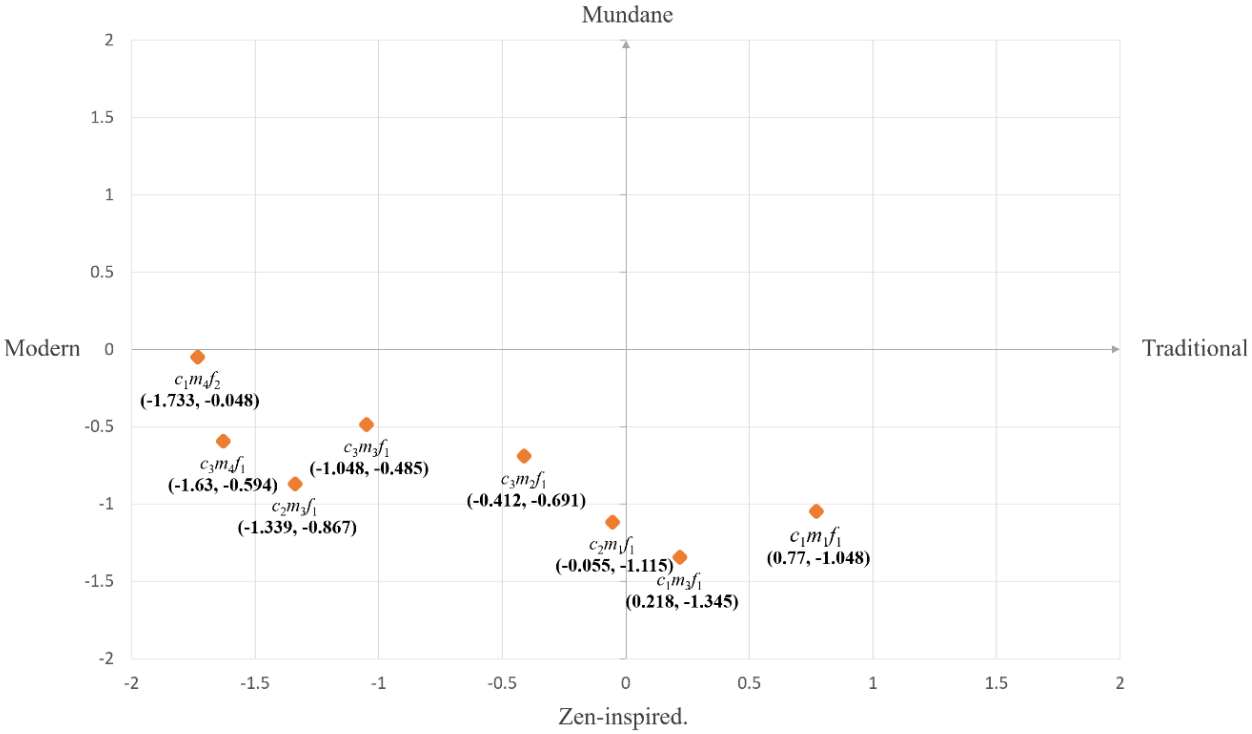

Fig. 8. The style imagery scale map of the 8 CMF configurations

QTTI-based statistical analysis

Chikio Hayashi proposed the QTTI method for quantitatively analyzing qualitative data (Yu *et al*. 2024). QTTI aims to investigate the relationships between random variables and convert qualitative information into computable data. Qualitative variables are termed items, their possible values are called categories, and the variable to be predicted is the dependent variable (Lin *et al*. 2023). When the independent variable is qualitative and the dependent variable is quantitative, QTTI analyzes how the independent variable influences the dependent variable. This allows for predicting the dependent variable, assessing the strength of this influence, and uncovering underlying patterns. QTTI effectively integrates qualitative and quantitative variables, transforming hard-to-quantify elements into useful parameters.

According to the QTTI, suppose there are m items in a prediction problem, and study their effects on the benchmark variable y, so as to achieve the purpose of predicting y. Where the number of categories is j, the number of samples is n, and the category of the

i^{th} item is x_i, then $\delta_t(i, j)$ (i=1,2,⋯, m; j=1,2,⋯, x_i; t=1,2,⋯, n) signifies the response of the n^{th} sample under the i^{th} item and the j^{th} category. When sample n is the j^{th} category beneath the i^{th} item, the value of $\delta_t(i, j)$ is 1, and 0 otherwise.

$$\delta_t(i,j) = \begin{cases} 1 & (\text{sample } t \text{ is the } j\text{th category beneath the } i\text{th item}) \\ 0 & (\text{otherwise}) \end{cases} \quad (1)$$

In this way, the reaction matrix consisting of all δ_t (i, j), denoted as C, is obtained, and

$$C = \begin{bmatrix} \delta_1(1,\ 1) & \cdots & \delta_1(1,\ x_1) & \cdots & \delta_1(m,\ 1) & \cdots & \delta_1(m,\ x_i) \\ \delta_2(1,\ 1) & \cdots & \delta_2(1,\ x_1) & \cdots & \delta_2(m,\ 1) & \cdots & \delta_2(m,\ x_i) \\ \vdots & & \vdots & & \vdots & & \vdots \\ \delta_n(1,\ 1) & \cdots & \delta_n(1,\ x_1) & \cdots & \delta_n(m,\ 1) & \cdots & \delta_n(m,\ x_i) \end{bmatrix} \quad (2)$$

Using color (C), material (M), and surface treatment process (F) as items and CMF subordinate classification as categories, the 24 Neo -Chinese armchair samples were coded according to Eqs. 1 and 2. The CMF items were quantified into calculable values ("1" for presence and "0" for absence of category characteristics). In the questionnaire, samples with identical CMF were placed adjacently, resulting in identical category codes for every three adjacent samples. Subsequently, the matching matrix was created by incorporating the style imagery scores from Table 5, as illustrated in Table 6.

Table 6. CMF Category and Style Imagery Coding Matrix

Code	CMF									Style Imagery Scores	
Item	*C*			*M*				*F*		$\boldsymbol{y}_1$	$\boldsymbol{y}_2$
Category	c_1	c_2	c_3	m_1	m_2	m_3	m_4	f_1	f_2		
No.1	1	0	0	1	0	0	0	1	0	.709	-1.309
No.2	1	0	0	1	0	0	0	1	0	1.218	-1.109
No.3	1	0	0	1	0	0	0	1	0	.382	-.727
No.4	1	0	0	0	0	0	1	0	1	-1.691	-.291
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
No.21	0	1	0	1	0	0	0	1	0	-.109	-.764
No.22	0	0	1	0	0	1	0	1	0	-1.109	-.636
No.23	0	0	1	0	0	1	0	1	0	-1.000	-.618
No.24	0	0	1	0	0	1	0	1	0	-1.036	-2.000

RESULTS AND DISCUSSION

According to QTTI, with the categories in Table 6 as the independent variable and the style imagery value as the dependent variable, the constants, multiple correlation coefficient R, coefficient of determination R^2, partial correlation coefficient (PCC), and category scores (CS) for the two sets of style imagery ($\boldsymbol{y}_1$ and $\boldsymbol{y}_2$) were calculated using a Matlab function, with the results presented in Tables 7 and 8. R^2 reflects the model's accuracy; the closer R^2 is to 1, the stronger the linear correlation between the independent and dependent variables. Generally, an R^2 value above 0.7 indicates high credibility of the QTTI analysis results. PCC values range between -1 and 1, with higher absolute values

signifying greater item contributions to the style imagery. The magnitude of the category score indicates the correlation between each category and the style imagery, with positive values representing positive correlations and negative values representing negative correlations. Categories with |PCC| ≥ 0.4 and items with |CS| ≥ 0.2, marked with an asterisk (*), are identified as key factors.

Table 7. Calculation Results of CMF Correlation y_1 (Modern - Traditional)

Item	Category	|PCC|	Category Score: Modern - Traditional	
			Negative Correlation	Positive Correlation
C(color)	c_1 High brightness & low saturation	0.890*		0.354*
	c_2 Low brightness & low saturation		-0.028	
	c_3 Medium brightness & high saturation		-0.329*	
M(material)	m_1 Wood	0.895*		0.659*
	m_2 Metal			0.103
	m_3 Wood-based mixed materials		-0.061	
	m_4 Metal-based mixed materials		-0.670*	
F(finish)	f_1 Surface coating	0.774*		0.461*
	f_2 Surface finishing		-0.461*	
C=-0.238; R=0.963; R^2=0.927; * the key factor.				

Table 8. Calculation Results of CMF Correlation y_2 (Zen-inspired - Mundane)

Item	Category	|PCC|	Category Score: Zen-inspired. - Mundane	
			Negative Correlation	Positive Correlation
C(color)	c_1 High brightness & low saturation	0.654*	-0.070	
	c_2 Low brightness & low saturation		-0.285*	
	c_3 Medium brightness & high saturation			0.325*
M(material)	m_1 Wood	0.282	-0.404*	
	m_2 Metal			0.072
	m_3 Wood-based mixed materials		-0.220*	
	m_4 Metal-based mixed materials			0.595*
F(finish)	f_1 Surface coating	0.702*	-0.625*	
	f_2 Surface finishing			0.625*
C=-0.979; R=0.845; R^2=0.714; * the key factor.				

The results demonstrate that CMF significantly shapes both stylistic dimensions where individual elements may exert either congruent or divergent influences across dimensions—empirical support for these findings will be presented in subsequent sections.

CMF and the "Modern-Traditional"

As tabulated in Table 7, the coefficient of determination ($R^2 = 0.927$) substantially exceeded the 0.7 reliability threshold, confirming high predictive validity in this QTTI analysis. For the "modern-traditional" stylistic dimension ($\boldsymbol{y}_1$), material exhibited the

highest absolute partial correlation coefficient (|PCC| = 0.895), followed by color (|PCC| = 0.890) and finish (|PCC| = 0.774), with all coefficients exceeding 0.4 - establishing these CMF elements as primary determinants. Particularly pronounced material and color influences (|PCC|≈0.9) demonstrate their visual dominance; high-brightness/high-saturation red or metallic integrations enhance modernity, whereas high-brightness/low-saturation wood finishes (*e.g.*, light-toned wood) reinforce traditionalism. Category score (CS) analysis further revealed: m_1 (0.659), f_1 (0.461), and c_1 (0.354) significantly promote traditional imagery (all |CS| ≥ 0.2), while m_4 (-0.670), f_2 (-0.461), and c_3 (-0.329) conversely enhance modernity, corroborating the PCC-based findings.

CMF and the "Zen-inspired-Mundane"

Table 8 reports a coefficient of determination (R^2 = 0.714) exceeding the 0.7 reliability threshold, confirming moderate predictive validity for this analysis. Regarding the "Zen-inspired-mundane" stylistic dimension (y_2), finish exhibited the highest absolute partial correlation coefficient (|PCC| = 0.702), followed by color (|PCC| = 0.654), both exceeding 0.4 and thus constituting primary determinants. Material demonstrated minimal influence (|PCC| = 0.282 < 0.4), suggesting that form attributes (*e.g.*, silhouette, joinery, ornamentation) predominantly govern this imagery, while finish and color function as modulating agents. CS analysis further indicates that f_2 (0.625), m_4 (0.595), and c_3 (0.325) diminish Zen-inspired manifestations (all |CS| ⩾ 0.2), whereas f_1 (-0.625), m_1 (0.404), c_2 (0.285), and m_3 (-0.220) enhance this style imagery, corroborating the PCC-based hierarchical relationships.

General Analysis

The correlation data between CMF items/categories and the two groups of style imagery were separately analyzed using comparative bar charts (Figs. 9 and 10), revealing that the CMF project exerts a substantial influence on the "modern-traditional" style imagery but relatively minor influence on the "Zen-inspired-mundane" imagery; as a mood factor, "Zen-inspired" is more significantly impacted by surface finish and color, since these factors provide more intuitive tactile and visual sensations that readily evoke spiritual-level emotions.

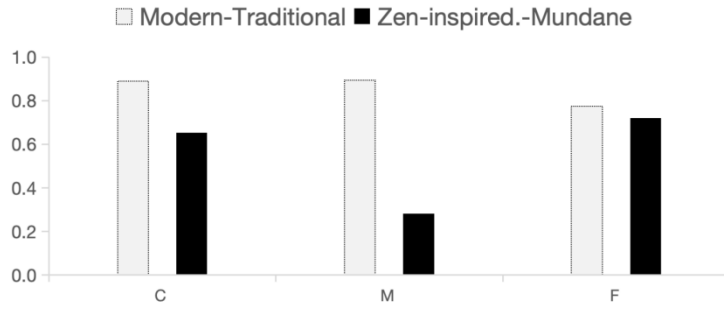

Fig. 9. Comparison of |PCC| values of CMF items and two groups of style imagery

Figure 10 illustrates the influence characteristics of CMF categories on these style imagery sets: Categories c_2 and m_3 (dark, wood-dominant mixed materials) simultaneously enhance both modern and Zen-inspired qualities, while categories m_1, f_1, and c_1 (transparent-coated light-colored wood) concurrently accentuate traditional and Zen-inspired characteristics—though this does not imply exclusivity of these categories for

designing such imagery. It should be noted that a single CMF category may exert consistent (positive or negative) or even opposing influences on a given stylistic dimension. Furthermore, category combinations may exhibit synergistic or counteractive effects on stylistic perception, necessitating flexible application informed by these findings.

Fig. 10. Comparison of CS values of CMF categories and two groups of style imagery

Fig. 11. The $c_1m_3f_1$ chair in a traditionally-styled Chinese living environment

Based on the aforementioned analytical findings and design strategies, while integrating considerations of practical manufacturing processes and design aesthetics, this study developed two furniture visualization renderings: one featuring a traditionally-oriented configuration ($c_1m_3f_1$) and the other a modern-oriented configuration ($c_3m_4f_2$).

These were respectively contextualized within traditionally-styled Chinese (Fig. 11) and modern Chinese (Fig. 12) living environments. Through this visual comparison, the harmonious integration between furniture and its stylistically consistent domestic setting can be intuitively perceived.

Fig. 12. The $c_3m_4f_2$ chair in a contemporary Chinese living environment

CONCLUSIONS

1. Through Kansei Engineering, this study operationalized Neo-Chinese style into two cognitively validated dimensions: "modern-traditional" (capturing perceptions of form, structure, and ornamentation) and "Zen-inspired-mundane" (reflecting spiritual and atmospheric aesthetics), supported by robust psychometric data (Cronbach's $\alpha = 0.849$, cumulative variance explained = 87.97%). Expert panel input further ensured methodological rigor in sample selection and perceptual lexicon development.
2. Building upon this stylistic framework, the study extended explicit stylistic characteristics to the CMF dimension, establishing a demonstrable mapping relationship between tangible CMF attributes and implicit stylistic perceptions in Neo-Chinese furniture design.
3. A novel methodology employing standardized CMF samples resolves qualitative variable coding limitations inherent in QTTI analysis, enhancing rigor in design research parameterization.

4. Extraction and analysis of stylistic imagery features from the Neo-Chinese armchair deliver a concrete operational definition, clarifying the conceptual boundaries and semantic connotations of "Neo-Chinese" as a distinct design style.
5. Qualitatively derived CMF design strategies for the Neo-Chinese armchair provide designers with a theoretically grounded framework to align material-finish-color implementations with consumer perceptions of target aesthetics, applicable across furniture typologies.
6. For furniture manufacturing professionals, the study establishes specific correspondences between CMF configurations and stylistic outcomes, providing an evidence-based framework for CMF selection that mitigates reliance on subjective intuition and reduces stylistic deviations in production.
7. For vendors and cultural communicators, the quantified influence of CMF on style imagery offers a tangible framework for consumer education, enabling the clear demonstration of how CMF choices convey specific affective and cultural narratives in furniture design.

Limitations and Future Work

It should be noted that the CMF-style imagery mapping established in this study is primarily based on data collected from design professionals. While this approach facilitates the construction of a semantically coherent analytical framework, the findings largely reflect a professional perspective. Future research incorporating comparisons with end-user perceptions would enhance the generalizability and practical relevance of the conclusions.

Furthermore, this study focuses specifically on CMF applications in Neo-Chinese armchairs. In practice, functionally diverse Neo-Chinese furniture (*e.g.*, beds, tables, cabinets) often employs more heterogeneous and complex CMF combinations, which may correspond to distinct stylistic associations. Moreover, ongoing advancements in materials and finishing technologies will continue to introduce novel CMF variants, necessitating further investigation into the dynamic relationships between evolving CMF configurations and stylistic perceptions.

ACKNOWLEDGMENTS

The author is grateful for the Zhongshan Polytechnic Curriculum Ideology and Politics Teaching Research and Reform Project（JYSZ202403）.

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Article submitted: July 5, 2025; Peer review completed: October 4, 2025; Revised version received: January 3, 2026; Accepted: January 5, 2026; Published: March 31, 2026.
DOI: 10.15376/biores.21.2.4340-4356