Dynamic Typography Art Design Based on Chinese Character Structural Semantics: An AI-Assisted Approach to Emotional Poster Generation

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Abstract. To address insufficient semantic control in dynamic typographic poster design and the distortion problems of AI-generated results, this study proposes a Chinese character structural-semantic mapping method for AI-assisted emotional poster generation. Structural-semantic features were extracted from public affective lexicons and character structure data, and then mapped to dynamic visual parameters. Based on this process, a collaborative workflow of AI generation and designer refinement was developed. A comparative experiment involving human-designed works, purely AI-generated works, and works generated by the proposed method was conducted. User evaluation and statistical analysis show that the proposed method achieved better semantic communication efficiency, emotional arousal, accuracy, and response time than the pure AI generation group, while maintaining aesthetic tension close to human-designed works. The proposed method offers an interpretable and controllable approach to Chinese dynamic typography design.

Keywords: Chinese character structural semantics; dynamic typography design; emotional posters; artificial intelligence; structural-semantic mapping

1 Introduction

With the evolution of digital media, posters have developed from static graphic outputs into dynamic carriers that integrate temporality, interaction, and emotional communication[1-2]. Compared with Latin letters, Chinese characters combine graphic structure, semantic reference, and cultural symbolism, giving them distinctive potential for dynamic visual design[3-4]. However, existing practice still relies heavily on designers' intuition, and a systematic mechanism linking structural features, semantic meaning, and motion expression remains insufficient[5-6]. Existing studies have mainly examined Chinese character visual design from the perspectives of glyph structure, poster semiotics, and sub-character semantic representation[7-9], while research on dynamic typography, poster generation, and layout design has focused more on motion, deformation, and multimodal visual expression[10-11]. These lines of work have largely developed in parallel, and few studies have established a systematic mapping

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from Chinese character structure to dynamic emotional expression. Although generative AI expands formal possibilities, it still struggles with structural constraints, legibility, and semantic accuracy in Chinese dynamic typography. To address this gap, this study proposes a character-level structural-semantic mapping method that links affective labels and glyph structure to dynamic visual parameters within a human-AI workflow of "AI generation + designer refinement," with multi-character expressions treated compositionally at the poster level.

2 Method

2.1 Structural-Semantic Representation and Dynamic Mapping

This study addresses the core question of how the structural semantics of Chinese characters can be transformed into controllable dynamic visual expression. As shown in Figure 1, the proposed method follows a compact pipeline: emotion word selection, glyph structure analysis, structural-semantic representation, dynamic parameter mapping, AI-assisted draft generation, and designer refinement.

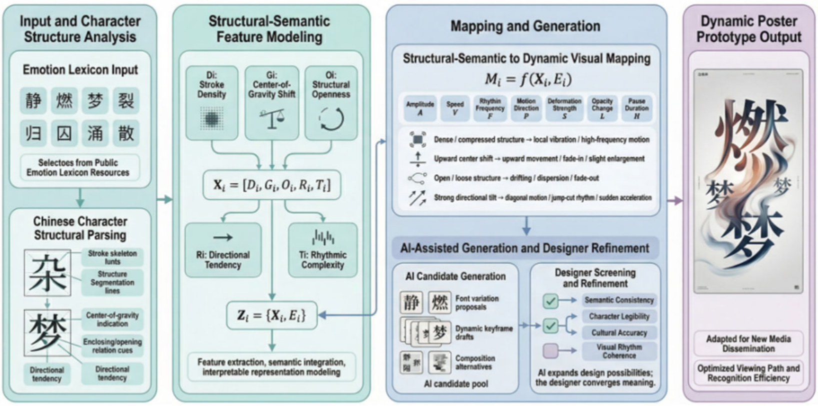

Fig. 1. Overall Research Framework.

Rather than generating final designs directly, the method first constructs an interpretable representation of each target character and then converts it into motion constraints that can guide subsequent visual generation. In this study, each target character is represented by a structural feature vector: $X_i = [D_i, G_i, O_i, R_i, T_i]$, where Di denotes stroke density, Gi denotes centroid shift, Oi denotes structural openness, Ri denotes directionality, and Ti denotes rhythmic complexity. In addition to these structural features, each target character is associated with an emotional semantic label Ei. Here, Ei serves as an initial semantic anchor derived from affective lexical resources rather than a context-free absolute category. Its suitability is further checked in the subsequent designer-refinement stage so as to reduce mismatches between lexicon-based labeling and visual communication context. The structured input can therefore be written as:

$$Z_i = \{X_i, E_i\}$$

where X_i provides the structural basis of the glyph and E_i provides the emotional-semantic constraint.

Structural semantics are mapped to a dynamic parameter set $M_i = f(X_i, E_i)$, including amplitude, speed, rhythmic frequency, displacement direction, and deformation intensity. The mapping is explicit rather than purely end-to-end, with emotional meaning constraining motion tendency and glyph structure constraining feasible visual form; representative correspondences are listed in Table 1.

Table 1. Correspondence between structural-semantic features of Chinese characters and dynamic design rules

Structural-semantic condition	Dynamic parameter setting	Main expressive effect
Dense, compressed, rhythmic	local vibration; high frequency; slow expansion	tension, pressure
Upward-centered, rising	upward motion; gradual appearance; slight enlargement	hope, growth
Open, loose	drifting; dispersal; fade-out	distance, dissipation
Tilted, directional	diagonal motion; broken rhythm; sudden acceleration	conflict, rupture
Stable, symmetrical	micro-motion; even rhythm; long pause	calmness, order
Enclosed, constrained	inward contraction; boundary shrinkage; occlusion	confinement, suppression

2.2 AI-Assisted Generation and Prototype Refinement

In the generation stage, the method adopts "AI-driven divergence + designer-led convergence" rather than end-to-end automation. Structural-semantic cues, motion constraints, and legibility requirements are integrated as generation conditions to produce candidate drafts, which are then screened and refined according to semantic consistency, glyph legibility, cultural appropriateness, and visual rhythm. Thus, AI expands formal alternatives, while the designer removes semantically weak or visually inappropriate results and develops the selected outputs into poster prototypes.The workflow and representative case examples are illustrated in Figure 2.

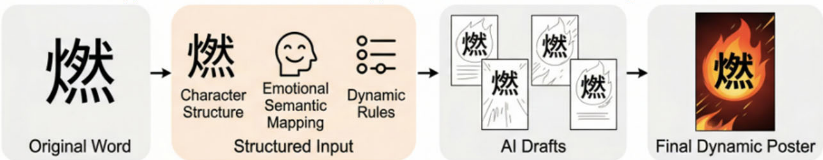

Fig. 2. AI-Assisted Dynamic Poster Generation Workflow and Case Examples.

3 Experiments and Analysis

3.1 Sample Construction and Experimental Setup

To ensure emotional coverage and structural comparability, 24 target characters were selected from a public Chinese affective lexicon and divided into six semantic groups (calmness, activation, oppression, alienation, return, and eruption), with four characters per group. The current experiment focuses on a controlled target set for character-level dynamic poster generation rather than claiming full lexical coverage. Accordingly, the present evaluation is intended to test the feasibility and interpretability of the proposed mapping under controlled conditions, while broader extension to rarer characters and simplified/traditional variants remains for future work. To verify the proposed method, three versions were prepared for each target character: Group A (Manual Design), created by professional designers; Group B (Pure AI Generation), based solely on affective meanings and lacking structural-semantic rules and human refinement; and Group C (Proposed Method), a human-AI collaborative approach combining structural-semantic mapping, AI generation, and designer refinement. Therefore, the stimulus set contained 72 dynamic samples in total. A total of 42 participants with normal/corrected-to-normal vision viewed these samples in randomized order under unified conditions. The evaluation included subjective metrics (7-point Likert scale), namely aesthetic tension, semantic communication efficiency, and emotional arousal, as well as behavioral metrics, namely semantic judgment accuracy and recognition reaction time.

3.2 Results and Discussion

One-way ANOVA was used to analyze the data (Table 2). Significant intergroup differences were observed across all measures ($p < 0.001$), with Group C demonstrating the best overall performance.

The results indicate two main findings:

1.Superior Communication and Arousal: Group C significantly outperformed Groups A and B in semantic communication efficiency and emotional arousal. This confirms that structural-semantic rules align motion patterns and glyph structures with emotional meanings effectively. Furthermore, Group C's subjective ratings of aesthetic tension matched or slightly exceeded Group A's, indicating that the rule-based constraints preserved visual appeal while reducing semantic drift. Because the present study emphasizes user-side communication outcomes, this conclusion is limited to perceptual evaluation rather than objective computational aesthetics metrics.

2.Faster and More Accurate Recognition: Behaviorally, Group C achieved the highest accuracy and shortest reaction time, facilitating more efficient emotional recognition.

Overall, while experience-driven design (Group A) outperforms pure AI (Group B), it lacks the consistency and reusability of the rule-constrained human-AI collaborative framework (Group C).

Table 2. User evaluation and statistical analysis results.

	Subjective Evaluation Metrics			Behavioral Metrics	
Group	Aesthetic Tension	Semantic Communication Efficiency	Emotional Arousal	Accuracy (%)	Reaction Time (s)
Group A: Manual Design	5.86 ± 0.62	5.71 ± 0.58	5.54 ± 0.64	82.3 ± 8.7	2.31 ± 0.42
Group B: Pure AI Generation	5.12 ± 0.73	4.68 ± 0.71	4.75 ± 0.69	71.4 ± 9.5	2.89 ± 0.51
Group C: Proposed Method	6.02 ± 0.57	6.18 ± 0.49	6.01 ± 0.55	88.9 ± 7.2	2.03 ± 0.37
Between-Group Comparison	10.84	28.31	19.76	16.42	14.95

*Values in the last row are F statistics; all $p < 0.001$.

4 Conclusion

This study proposes a dynamic typography design method based on Chinese character structural-semantic mapping. By translating structural features into dynamic visual parameters, the method links glyph structure, emotional semantics, and visual motion within a collaborative workflow of rule-based control, AI-assisted generation, and designer refinement.

Experimental results show that the proposed method outperforms pure AI generation in semantic communication efficiency, emotional arousal, accuracy, and recognition response time, while obtaining subjective aesthetic-tension ratings comparable to or slightly better than human design. These results support the effectiveness of the proposed human-AI collaborative approach in controlled character-level poster generation, although broader lexical coverage and objective aesthetic assessment remain to be further developed.

Overall, the study provides an interpretable and controllable framework for dynamic typography design. Future research will further expand semantic coverage, refine motion parameters, and improve evaluation under more complex communication conditions.

Disclosure of Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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