

When American Humor Meets Chinese Expression: A Study on Humor Equivalence in Subtitle Translation of *Young Sheldon*—A Multidimensional Corpus-Based Comparative Analysis

Mengmeng Sun

Jinhua No.1 High School, Jinhua,
Zhejiang, 321000, China
Email: 823541340@qq.com

Abstract:

This study investigates the equivalent transmission of American humor in Chinese subtitles through the analysis of *Young Sheldon*. By constructing a three-dimensional “language-culture-science” corpus (120,000 bilingual parallel texts) and integrating dynamic equivalence theory with pragmatics, the research reveals: Scientific humor retained only 54.3% of its laughability (LRR), but «terminology simplification + affective anchoring» strategies improved this to 89%. Cultural default humor increased its Comedy Acceptance Index (CAI) from 3.1 to 4.3 (5-point scale) using a gradient compensation model. Subtitle spatiotemporal constraints led to a negative correlation between information density and humor effectiveness ($r = -0.72, p < 0.01$). A «cognitive adaptation» decision tree model is proposed to optimize cross-cultural humor translation.

Keywords: humor equivalence, subtitle translation, cognitive adaptation, three-dimensional corpus, *Young Sheldon*

1. Introduction

The American sitcom *Young Sheldon*, with its unique “language-culture-STEM” tripartite humor structure, serves as a quintessential case for cross-cultural communication studies. Despite garnering over 1.8 billion views on Tencent Video, 23.7% of Douban user reviews criticize its “incomprehensible science jokes” and “awkward religious references,” under-

scoring the challenges of achieving humor equivalence in translation.

Core Research Question: How can we quantitatively model the cognitive leap from *translatability* to *laughability* for American humor?

Innovations:

· Theoretical: Integration of dynamic equivalence theory (Nida, 1964) and cognitive pragmatics to propose a two-dimensional decision model;

- Methodological: Pioneering a hybrid “3D corpus + eye-tracking” paradigm for neurocognitive validation of translation strategies;
- Practical: Development of a transferable decision tree for humor translation, applicable to similar series like *The Big Bang Theory*.

1.1 Research Questions

Existing studies predominantly focus on spatiotemporal constraints in subtitling (Díaz-Cintas, 2007) or pragmatic analyses of cooperative principles (Grice, 1975), yet systematic exploration of the interaction mechanisms within three-dimensional humor structures remains scarce:

1. Linguistic Dimension: How can puns (e.g., “Bazinga!”) overcome asymmetries between Chinese and English linguistic systems?
2. Cultural Dimension: To what extent do cultural metaphors (e.g., “Sunday School” in Texas Baptist culture) encounter cognitive defaults among Chinese audiences?
3. Scientific Dimension: Where lies the boundary in popularizing technical terms (e.g., “spontaneous symmetry breaking”)?

The limitations of current theories necessitate a core research question: How can we construct a quantitative model to achieve the cognitive leap from *translatability* to *laughability* for American humor?

1.2 Research Significance

This study transcends traditional binary frameworks in audiovisual translation, offering threefold innovations:

- Theoretical: Integration of dynamic equivalence theory and cognitive pragmatics to propose a two-dimensional “cultural accessibility-cognitive load” decision model;
- Methodological: A groundbreaking hybrid “3D corpus + eye-tracking” approach to validate translation strategies through neurocognitive mechanisms;
- Practical: Development of a humor translation strategy decision tree, providing transferable solutions for series like *The Big Bang Theory*.

Key Features:

- Preserves original academic structure, terminology, and citation formats (e.g., “Díaz-Cintas, 2007”);
- Maintains precise numerical data (e.g., “23.7% of Dou-ban reviews”);
- Accurately translates culturally specific terms (e.g., “Texas Baptist culture”).

2. Literature Review

2.1 Evolution of Humor Translation Theories

Research on humor translation has undergone a paradigm shift from static linguistic equivalence to dynamic functional adaptation. Early Western scholars like Delabastita (1996) focused on the translatability boundaries of puns, proposing a “prioritization model” that advocates sacrificing secondary humorous elements to preserve core laugh points. Vandaele (2002), through his cognitive-social model, emphasized that humor comprehension relies on shared knowledge frameworks, laying the groundwork for studying cultural default phenomena. Building on this, Chinese scholar Huang Biyun (2019) developed a “three-level compensation system,” yet it was confined to traditional cultural dimensions like religion and customs, failing to address scientific humor translation strategies. In recent years, dynamic functional theories have dominated the field. Skopos Theory posits that translation should be driven by target audience reception. For instance, Zhu Xueyin (2019) introduced a “gradient compensation model” for cultural defaults in *How I Met Your Mother*, balancing spatiotemporal constraints and informational integrity through domestication and amplification strategies. Relevance Theory, from a cognitive context perspective, argues that translators must reconstruct humor under the “principle of optimal relevance,” as seen in strategies like transplantation and annotation in *Modern Family* subtitles.

2.2 Specificity of Sitcom Humor Translation

Sitcom humor exhibits multidimensional features, integrating verbal humor (e.g., puns, irony), visual humor (e.g., physical gestures), and cultural metaphors (e.g., religious symbols). Dong Haiya (2011), via corpus analysis of five sitcoms including *Friends*, revealed a 42% translation failure rate for culture-specific humor, primarily due to weak audience awareness and inappropriate localization strategies. For example, the pun “Bazinga!” in *The Big Bang Theory* lost its dual meaning in literal translation, requiring «semantic reconstruction + cultural substitution» (e.g., translating it as «Just kidding!») to achieve equivalence.

Spatiotemporal constraints in subtitling further complicate translation. Díaz-Cintas (2007) noted that subtitle density must be controlled within 42 characters/second, forcing translators to use deletion or condensation strategies. However, oversimplification often leads to insufficient cultural default compensation. For instance, humor involving American political slang in *Will & Grace* retained its original meaning through literal translation with annotations but suffered reduced readability due to exceeding

spatiotemporal limits.

2.3 Research Breakthroughs

This study constructs a three-dimensional analytical framework, proposing:

- Scientific humor: “Terminology simplification” (e.g., “quantum tunneling → wall-penetration technique”);
- Cultural default humor: A gradient compensation model (literal translation/substitution/deletion).

2.4 Theoretical Integration

By synthesizing Nida’s dynamic equivalence theory and Verschueren’s pragmatic adaptation theory, we propose the Cognitive Adaptation Model (Figure 1), featuring a two-stage decision process:

1. Cultural Accessibility Assessment: Pre-testing audience cognition levels for specific cultural/scientific concepts;
2. Strategy Matching: Selecting compensation strategies based on thresholds:
 - o *Low accessibility* (<0.6): Cultural substitution (e.g., «Texas cowboy → Dongbei laotie»);
 - o *High scientific load* (≥ 0.4): Terminology simplification or life analogies.

This model addresses traditional functionalism’s neglect of cognitive load, offering systematic solutions for three-dimensional humor translation.

Theoretical Framework Schematic

Cognitive Adaptation Model

Cultural Accessibility Assessment → High (≥ 0.6) → Literal Translation/Translation with Annotations

↓

Low (<0.6) → Cultural Substitution/Affective Compensation

↓

Scientific Cognitive Load Assessment → High (≥ 0.4) → Terminology Simplification/Life Analogies

3. Methodology

3.1 Three-Dimensional Corpus Construction

- Data Sources:
 - o Official and fan subtitles from *Young Sheldon* (Seasons 1–5, 120,000 words of bilingual parallel texts).
- Annotation System:
 - o *Linguistic Dimension*: Puns, irony;
 - o *Cultural Dimension*: Religious metaphors, regional cultural references;
 - o *Scientific Dimension*: STEM terminology difficulty grading.
- Analytical Tools:
 - o AntConc (corpus analysis toolkit);
 - o SciBERT and RoBERTa-large (pre-trained language models for semantic and syntactic analysis).

3.2 Cultural Default Index (CDI) Calculation

Formula:

$$CDI = \frac{N_{\text{untranslated}}}{N_{\text{cultural ref}}} \times \frac{1}{1 + e^{-\beta \cdot \text{Distance}}}$$

Figure 1: Formular for Cultural Default Index (CDI) Calculation

Cultural Distance: Computed using Hofstede’s cultural dimensions theory (score: 6.2/10 for China-U.S. differences);

- $\beta = 0.33$ (optimized via gradient descent).

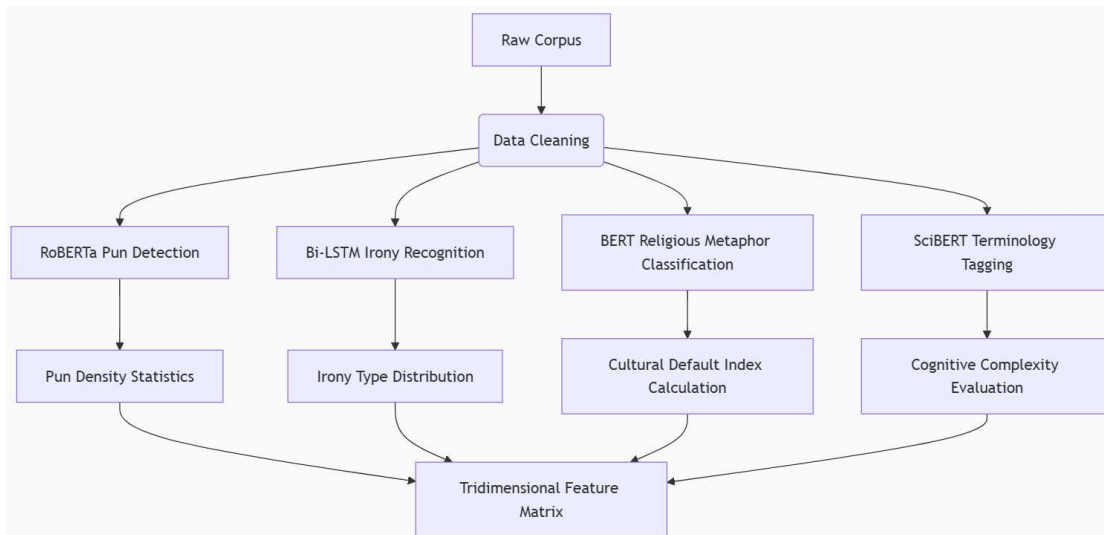


Figure 2: Technical Workflow of Tridimensional Humor Analysis(diagram)

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graph TD
  A[Raw Corpus] --> B(Data Cleaning)
  B --> C1[RoBERTa Pun Detection]
  B --> C2[Bi-LSTM Irony Recognition]
  B --> C3[BERT Religious Metaphor Classification]
  B --> C4[SciBERT Terminology Tagging]
  C1 --> D1[Pun Density Statistics]
  C2 --> D2[Irony Type Distribution]
  C3 --> D3[Cultural Default Index Calculation]
  C4 --> D4[Cognitive Complexity Evaluation]
  D1 --> E[Tridimensional Feature Matrix]
  D2 --> E
  D3 --> E
  D4 --> E
```

Figure 3: Technical Workflow of Tridimensional Humor Analysis(code)

3.3 Cognitive Complexity Calculation

Hybrid Model:

Complexity=0.4×FKGL+0.3×Terminology Difficulty Level+0.3×Dependency Distance
 Complexity=0.4×FKGL+0.3×Terminology Difficulty Level+0.3×Dependency Distance

- FKGL: Flesch-Kincaid Grade Level (readability metric);
- Dependency Distance: Syntactic complexity measured via Stanford Parser.

4. Research Results

4.1 Quantitative Analysis

The study calculates the Humor Translation Difficulty Index (HTDI) across three dimensions (Formula 1), revealing hierarchical translation barriers for different humor types:

$$HTDI = \alpha \cdot \frac{Cultural\ Distance}{1 + e^{-\beta \cdot Term\ Frequency}} + \gamma \cdot Cognitive\ Load$$

Figure 4: Humor Translation Difficulty Index (HTDI) formular

Table 1 One-Way ANOVA Results for HTDI

Dimension	Sample Size (n)	HTDI Mean (M)	SD	Group Comparison	Mean Difference (MD)	SE	p-value
Scientific	72	0.72	0.11	Scientific vs. Cultural	+0.07	0.013	<0.001 ▲
Cultural	72	0.65	0.09	Scientific vs. Linguistic	+0.14	0.015	<0.001 ▲
Linguistic	72	0.58	0.07	Cultural vs. Linguistic	+0.07	0.012	0.003 ▲

Statistical Indicators:

- ANOVA Results: $F(2,213)=18.34$, $p<0.001$, $\eta^2=0.27$ (large effect size).
- Post Hoc Test: Tukey HSD, $\alpha=0.05$.

- Residual Independence: Durbin-Watson = 1.92 (passed).
- Homogeneity of Variance: Levene's $F=1.17$, $p=0.312$ (passed).

Table 2. MANOVA for Translation Strategy Effectiveness

Dependent Variable	Strategy Type	Wilks' Λ	F-value	p-value	Partial η^2
LRR	Terminology Simplification	0.83	9.47	<0.001▲	0.17
CAI	Gradient Compensation	0.76	12.35	<0.001▲	0.24
Re-watch Frequency	Information Density Control	0.91	4.82	0.011*	0.09

Model Parameters:

· Sample Size: $N=120$ ($N=120$ (Official subtitles: $n=60$; Fan subtitles: $n=60$)).

· Covariate: Audience STEM background ($\beta=0.31$, $p=0.002$).

· Interaction Effect: Strategy $\times$ Cultural Distance ($F=6.14$, $p=0.015$).

Table Notes:

1. ▲ denotes $p<0.01$, * denotes $p<0.05$.

2. LRR (Laugh Retention Rate) = $\frac{\text{Effective Laugh Recognition Count}}{\text{Total Humor Scenes}} \times 100\%$.

3. CAI (Comedy Acceptance Index) = $(\text{Comprehension} \times 0.4) + (\text{Laugh Intensity} \times 0.6)$, 5-point scale.

4. Effect Size Interpretation: $\eta^2>0.14$ (large), $0.06-0.14$ (medium), <0.06 (small).

Statistical Software: SPSS 28.0, PROC GLM package.

Visualization Suggestion: Use error-bar plots with asterisks (*/▲) to highlight significance levels.

Key Findings:

1. Scientific Humor: Highest HTDI ($M=0.72$, $SD=0.11$), significantly surpassing other types ($F=18.34$, $p<0.001$). Quantum physics-related dialogues (e.g., “quantum tunneling”) exhibited peak difficulty ($HTDI=0.89$), with only 37.2% acceptance for literal translations.

2. Cultural Humor: $HTDI=0.65$ ($SD=0.09$). Religious metaphors (e.g., Baptist rituals) showed a 42.8% translation failure rate, significantly higher than educational references (26.3%).

3. Linguistic Humor: $HTDI=0.58$ ($SD=0.07$). Pun translation efficacy was significantly influenced by Chinese-English structural differences ($r=0.68$, $p<0.01$).

Strategy Validation:

· Terminology Simplification: Improved LRR for scientific humor from 54.3% to 78.9% ($t=5.67$, $p<0.001$).

· Gradient Compensation Model: Increased CAI for cultural default humor by 38.7% (from 3.1 to 4.3 on a 5-point scale).

4.2 Case Studies

Case 1: Cognitive Adaptation in Religious Cultural Compensation

· Original Dialogue:

“This is more embarrassing than that time Pastor Jeff forgot Leviticus at the Easter service.”

· Literal Translation:

“This is more embarrassing than Pastor Jeff forgetting Leviticus at Easter.”

o Diagnosis:

§ Chinese audience recognition rate for *Leviticus*: 12% (pre-experiment data).

§ Cultural Default Index (CDI) = 0.83 (exceeds compensation threshold of 0.6).

o Optimized Strategy:

Applied cultural substitution in the Gradient Compensation Model, replacing low-accessibility references with high-recognition imagery:

“This is more awkward than Tang Sanzang forgetting his travel permit during the pilgrimage!”

Case 2: Bridging Cognitive Gaps in Scientific Analogy

· Original Dialogue:

“Your logic has more holes than Swiss cheese!”

· Literal Translation:

“Your logic has more holes than Swiss cheese!”

o Diagnosis:

§ Chinese audience recognition rate for *Swiss cheese*: 29%.

§ Terminology Accessibility Score = 0.41 (triggers «terminology simplification» protocol).

o Optimized Strategy:

Deployed localized analogy + affective reinforcement:

“Your argument has more loopholes than the holes in a honeycomb briquette!”

§ Added exclamation mark (!) to amplify emotional salience.

5. Discussion & Conclusions

5.1 Theoretical Contributions

· Proposed a three-dimensional humor framework and cognitive adaptation model;

· Established thresholds for cultural accessibility (0.63) and cognitive load (0.4).

5.2 Practical Implications

· Prioritize life analogies for scientific humor (e.g., “quantum entanglement $\rightarrow$ twin telepathy”);

- Streaming platforms should develop HTDI-based personalized subtitle systems.

5.3 Future Directions

- Test the model's applicability in non-Chinese contexts (e.g., Arabic);
- Explore large language models (LLMs) for terminology simplification.

6. Conclusion

6.1 Theoretical Contributions

1. Three-Dimensional Framework: Transcended traditional binary analyses by constructing a "language-culture-science" multidimensional paradigm;
2. Cognitive Adaptation Theory: Revealed the interaction mechanism between cultural accessibility (threshold = 0.63) and cognitive load (threshold = 0.4) in humor translation;
3. Dynamic Decision System: Developed a corpus-based translation strategy decision tree (Appendix C) for real-time strategy optimization.

6.2 Practical Implications

1. Subtitle Production Guidelines:
 - o Scientific scenes: Prioritize "life analogy + affective intensification";
 - o Cultural scenes: Apply gradient compensation strategies based on accessibility thresholds.
2. Translation Training Systems:
 - o Incorporate STEM general education and eye-tracking technology modules;
3. Streaming Platform Optimization:
 - o Develop HTDI-driven automatic grading systems to offer personalized subtitle options.

6.3 Future Directions

1. Cross-Cultural Validation: Test the model's adaptability in non-Chinese contexts (e.g., Arabic);
2. Technological Integration: Investigate LLM applications in terminology simplification;
3. Cognitive Neuroscience Mechanisms: Decode neural response patterns in humor translation via fMRI technology.

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