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L2 exposure intensity modulates the time course of verbal humor comprehension: An ERP study

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Research Article

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Abstract

Understanding verbal humor in a second language (L2) is a hallmark of advanced communicative competence, yet its time course remains unclear. This study investigates the role of L2 exposure intensity in humor comprehension. Forty-two English as a Foreign Language (EFL) learners (Intense vs. Limited Exposure) read jokes in which identical punchlines followed humorous or coherent setups and judged funniness. Behavioral results showed that responses were slower to humorous than to coherent endings, and accuracy was higher in the Intense Exposure group than in the Limited Exposure group. ERPs showed a larger N400 to humorous endings compared to coherent endings. A P600 effect to humorous endings was observed in the Intense Exposure group but not in the Limited Exposure group, suggesting greater engagement of reinterpretation under Intense Exposure. These findings support a conditioned two-stage model of L2 humor in which early detection is broadly preserved, whereas later reinterpretation depends on L2 exposure intensity.

Highlights

- Chinese EFL learners showed an N400, reflecting automatic incongruity detection.
- Only the intense exposure learners showed a P600, suggesting reinterpretation.
- Limited exposure learners showed detection but reduced humor reinterpretation.
- L2 exposure intensity modulates the time course of incongruity resolution.
- The findings support a conditioned two-stage model of L2 humor processing.

1. Introduction

Humor is a multifaceted communicative phenomenon with interpersonal, social, and cognitive functions, yet it is also highly variable (Attardo, 1994; Dynel, 2025; Dynel et al., 2016). In interaction, humor can build affiliation, manage face, reduce tension, and signal group membership, but it can also misfire when the sender and the receiver do not share the linguistic and cultural assumptions needed to "get the joke" (Attardo, 1994, 2001; Martin & Ford, 2018; Vaid et al., 2003).

Within humor research, a common distinction is drawn between nonverbal humor (e.g., visual gags) and verbal humor. Verbal humor makes full use of internal mechanisms of language through rhetorical devices, logical arrangements, and unconventional combinations of words and sentences (Raskin, 1985; Ritchie, 2004, 2018). It often relies on pragmatic inferencing, including implicature and the strategic flouting or exploitation of conversational maxims, which prompts audiences to infer unstated meanings, reinterpret utterances in context, and resolve interpretive incongruities (Dynel, 2008, 2017a, 2017b). Because understanding verbal humor involves managing ambiguity and reinterpreting linguistic and pragmatic information rapidly, it provides a useful test case for models of real-time language comprehension. For neurocognitive research, verbal humor also provides an important methodological advantage. Many joke formats provide a relatively discrete "trigger" point, frequently the final word or punchline, at which an initially plausible interpretation becomes unstable, and an alternative humorous construal becomes available (Bartolo et al., 2006; Li et al., 2025; Schnell et al., 2016; Zheng & Lemhöfer, 2019). This feature makes verbal humor well-suited to event-related potentials (ERPs), which track comprehension with millisecond temporal resolution and can distinguish earlier meaning-access or integration costs from later reinterpretation (Nieuwland & Van Berkum, 2005; Payne et al., 2020).

A widely used cognitive account of verbal humor comprehension is the Incongruity – Resolution Theory (Suls, 1972, 1983). On this view, humor often unfolds in stages. First, the comprehender detects an incongruity between the incoming element (often the punchline) and the interpretation most strongly supported by the preceding context. Second, the comprehender engages in processes that enable reinterpretation so that the utterance becomes coherent under an alternative interpretation, which can then be evaluated as humorous (Yus, 2017). Although

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not all humor necessarily follows this sequence, the framework is influential because it yields predictions about time course and about which stimulus positions should provoke comprehension difficulty (Ku et al., 2017; Vaid et al., 2003).

To investigate the neurocognitive mechanisms of humor interpretation, it is essential to situate Suls's (1972) two-stage Incongruity-Resolution (IR) model within the broader landscape of cognitive accounts, such as the concurrent activation view (Attardo & Raskin, 1991), the three-stage model (Attardo, 1997), and the selective activation theory/graded salience hypothesis (Giora, 1997). These frameworks offer profound insights into the underlying representational and semantic mechanics of jokes. For instance, Attardo and Raskin (1991) emphasize the simultaneous activation and forced switching of opposed semantic scripts, while Giora (1997) highlights how the cognitive system navigates between highly salient and less salient meanings. These representational models are complementary to Suls's (1972) temporal framework. While Attardo's and Giora's theories excel at delineating what semantic operations occur (e.g., script opposition, salience suppression), Suls's model helps specify when these processes occur chronologically. For the current ERP study, Suls's two-stage model provides a macro-level neurocognitive interface for linking humor-related semantic operations to their temporal neural dynamics. Specifically, the first stage involves the concurrent activation of competing scripts and the detection of script opposition (Attardo & Raskin, 1991). The resolution stage then entails the selective activation of the non-salient meaning (Giora, 1997), often through a demanding process of frame-shifting or conceptual blending, which enables the audience to reinterpret the utterance and resolve the incongruity (Coulson & Kutas, 2001; Jabłońska-Hood, 2015).

While this frame-shifting or conceptual blending process during resolution is widely characterized as effortful, the source of this processing demand and its functional payoff remain to be specified. Relevance Theory offers a cognitive-pragmatic account that speaks to this question. According to the theory, comprehension is guided by a search for optimal relevance, an interpretation that yields adequate cognitive effects without unjustifiably high processing effort (Sperber & Wilson, 1996; Wilson & Sperber, 2006). In humorous discourse, the punch line typically renders the initially accessible interpretation inconsistent or insufficient, prompting the comprehender to retrieve additional contextual assumptions and derive an alternative interpretation that restores coherence. Incongruity is thus not itself sufficient to produce humor; it functions as a cue for further inferential processing in the search for rewarding contextual effects (Curcó, 1995; Yus, 2013). When this reinterpretation succeeds, the resulting cognitive effects may offset the additional processing effort invested during resolution and contribute to amusement. This account thus provides a processing-based rationale for the resolution stage posited by Suls's (1972) model: relative to conventional or predictable endings, humorous endings may demand greater inferential effort during resolution and correspondingly longer processing time.

ERP research has been central in operationalizing such staged accounts by mapping these theoretically defined processing stages onto temporally specific neural responses. Coulson and Kutas (2001), for example, reported electrophysiological differences between jokes and nonjokes and argued that humor comprehension involves both an early disruption and later processes consistent with reinterpretation or integration. More broadly, ERP studies frequently report an early processing cost, often discussed in relation to the N400 family and sensitive to semantic integration difficulty and contextual expectancy, followed by later positivities that have been linked to reanalysis or meaning revision (Ku et al., 2020; Kutas & Federmeier, 2011). Nevertheless, the presence, magnitude, and scalp distribution of these effects vary across studies, implying that stimulus structure, baseline design, and task demands shape which sub-processes are most visible in the ERP (Mayerhofer & Schacht, 2015; Vrticka et al., 2013).

Despite progress in first-language (L1) research, time-resolved evidence on second language (L2) verbal humor comprehension remains comparatively limited. Actually, research into L2 verbal humor is significant because humor comprehension can serve as an important indicator of advanced L2 communicative competence (Morain, 1991). However, it remains a major challenge even for proficient learners (Bell, 2009; Davies, 2003; Schmitz, 2002). Failing to grasp L2 humor can lead to social exclusion, embarrassment, and a sense of "reduced personality" in cross-cultural interactions (Bell & Attardo, 2010). This gap also matters because L2 verbal humor is a theoretically informative case of non-literal and pragmatic language processing in a second language, alongside related phenomena such as irony and indirectness (Bell & Pomerantz, 2019; Ellis et al., 2021; Gibbs et al., 2018). In such cases, comprehenders must go beyond literal decoding to recover speaker meaning, manage competing interpretations, and integrate contextual cues into a coherent discourse representation. These demands can be challenging for L2 users, who may show less automatic lexical access, slower semantic integration, and reduced sensitivity to subtle contextual constraints under time pressure (Ellis et al., 2021; Ezrina & Valian, 2023; Kim & Taguchi, 2015; Neff & Dewaele, 2023). Humor comprehension is also time-critical because the punchline typically triggers a rapid shift from an initially coherent "default" interpretation to a competing, humorous one. Verbal humor comprehension therefore depends not only on what learners know, but on how efficiently they can access lexical-semantic information, detect the incongruity, and suppress or revise the initial interpretation to accommodate the intended meaning.

Unlike naturalistic exposure, instructed L2 exposure intensity is characterized not only by the concentration and distribution of instructional hours (Collins & White, 2011) but also by the quality and nature of the input provided within that time frame (Ellis, 2005; Muñoz, 2008). Exposure intensity in classroom contexts should matter for the L2 verbal humor comprehension process. First, intensive exposure may accelerate automatization of lower-level decoding and lexical access, reducing the cognitive cost of constructing the initial interpretation and freeing resources for incongruity detection at the punchline (Segalowitz, 2010). Second, sustained engagement with form-meaning mapping under instructional monitoring may strengthen learners' ability to regulate competition between alternatives (e.g., inhibiting an L1-driven or literal analysis), a control demand that is central to resolving jokes rather than treating them as simple anomalies (Green & Abutalebi, 2013). Thus, intensity is expected to shape the time course of humor processing, not merely overall accuracy, by shifting the balance between early semantic mismatch responses and later reanalysis/integration processes.

From an L2 pragmatics perspective, these challenges are consistent with the view that pragmatic competence is multicomponential and develops through accumulated experience with context-sensitive language use (Gao & Zhang, 2026; Zhang & Aubrey, 2024). Pragmatic competence includes pragmalinguistic knowledge, which means how linguistic forms realize meanings such as implicature, irony, or humorous intent, and sociopragmatic knowledge, referring to norms and expectations about what meanings are appropriate in context (Roever, 2024; Taguchi & Roever,

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2017). Pragmatic performance depends not only on knowledge but also on processing efficiency: learners may possess relevant knowledge yet still struggle to access and integrate cues quickly enough in online comprehension. In this sense, exposure intensity is particularly relevant because it may influence the speed and stability with which learners deploy pragmalinguistic and contextual cues during real-time interpretation, a requirement that is amplified in verbal humor where the intended meaning hinges on rapid reinterpretation.

Behavioral evidence further suggests that L2 humor outcomes are constrained by language experience and language competence (Erdodi & Lajiness-O'Neill, 2012; Ezrina & Valian, 2023). Studies indicate that L2 jokes are often experienced as less funny when they are harder to understand and that individual differences in language experience and comprehension success relate to humor appreciation (Ayçiçegi-Dinn et al., 2018). However, behavioral measures such as accuracy and funniness ratings do not reveal when difficulty arises, whether during early semantic integration, during incongruity detection, during reinterpretation, or during later evaluation. The high temporal resolution of ERPs can help track the time course of language processing stages at the millisecond level to detect neural signatures not reflected in behavioral performance. Therefore, they are well suited to test how L2 learners deploy pragmatic competence during real-time verbal humor comprehension (Moreno et al., 2008).

To examine the time course of L2 verbal humor processing, the present study uses ERPs to investigate English verbal humor comprehension in Chinese EFL learners. We analyze EEG time-locked to the final word, which functions as the critical disambiguating cue. The final word is lexically identical across funny and unfunny conditions, enabling a clean test of context-driven meaning construction (Du et al., 2013). By holding the punchline word constant, ERP differences at the time-lock point can be attributed primarily to how the preceding context constrains interpretation and to the comprehender's revision and integration of meanings at the punchline.

Guided by the incongruity-resolution framework and prior ERP work on humor, we focused on two time windows at the final word: 300–500 ms and 500–900 ms. The 300–500 ms window is intended to capture the stage of incongruity detection, indexed by the N400, a broadly distributed negativity sensitive to semantic expectancy and integration difficulty (Chang et al., 2019; Kutas & Federmeier, 2011). The 500–900 ms window is intended to capture the stage of incongruity resolution, indexed by a P600/late positivity, which has been linked in humor studies to reinterpretation, integration, and discourse updating when comprehenders attempt to integrate the punchline with prior context (Coulson & Kutas, 2001). In addition to these temporal predictions, we tested whether classroom-based exposure intensity may relate to the degree of humor comprehension (Ellis, 2008; Ortega, 2014), in line with the expectation that greater L2 exposure can support more efficient online comprehension of L2 verbal humor.

Based on the above background, the present study addresses the following research questions. (1) What is the time course for Chinese EFL learners' English verbal humor comprehension? Does it reflect a distinct staged model characterized by incongruity detection and incongruity resolution? (2) How does classroom-based exposure intensity, specifically the contrast between Intense Exposure (IE) and Limited Exposure (LE), modulate the cognitive mechanisms underlying English verbal humor comprehension in Chinese EFL learners?

To address these questions, we propose two hypotheses. Hypothesis 1: L2 verbal humor processing is expected to show a two-stage pattern. Incongruity Detection will be indexed by an N400 effect (300–500 ms), where humorous stimuli elicit larger amplitudes than coherent controls. Incongruity Resolution will be indexed by a P600 (500–900 ms), reflecting the cognitive effort of reanalysis. Hypothesis 2: Exposure intensity will modulate L2 verbal humor comprehension, specifically by targeting the cognitive mechanisms of incongruity resolution. Behaviorally, despite the increased reaction time inherent to processing humorous stimuli, the IE group will demonstrate significantly higher accuracy than the LE group. Neurophysiologically, the IE learners will demonstrate a significantly larger or more distinct P600 amplitude relative to LE learners, reflecting greater engagement of later-stage reanalysis or integration processes required for incongruity resolution.

2. Method

2.1. Participants

Forty-two right-handed Chinese learners of English (age range: 19–24 years; 26 female), whose native language was Chinese, were recruited from Jinan University. All participants in our study completed a background questionnaire to collect data such as their age, gender, major, and English learning experience. All participants reported normal or corrected-to-normal vision and no history of neurological disorders. Participants were required to provide informed consent, received verbal and written instructions on all details of the experiment, and were allowed to withdraw at any time. Each participant received compensation for their inconvenience and commute.

The participants were divided into two groups based on the intensity of their L2 exposure. The Intensive Exposure (IE) Group consisted of 21 English majors. These students engaged in a rigorous curriculum involving approximately 12–20 hours of English instruction per week, covering comprehensive skills including linguistics and literature. The Limited Exposure (LE) Group consisted of 21 non-English majors (e.g., engineering, science, etc.). These students followed a standard College English curriculum with approximately 2–4 hours of instruction per week, primarily focused on general proficiency and exam preparation.

To ensure that the observed effects were driven by L2 exposure intensity rather than pre-existing proficiency differences, the participants' English proficiency was assessed using the LexTALE test (Lemhöfer & Broersma, 2012), and their general baseline proficiency was indexed by their National College Entrance Examination (NCEE) English scores. Independent *t*-tests showed no significant differences in LexTALE scores (mean ± SD) between the IE and LE groups (60.71 ± 12.40 and 60.12 ± 7.14, respectively; $t(40) = 0.19$, $p = .85$, Cohen's $d = 0.06$) or NCEE scores (133.05 ± 4.54 and 132.48 ± 5.03, respectively; $t(40) = 0.39$, $p = .70$, Cohen's $d = 0.12$). In addition, we collected participants' self-reported total hours of English exposure (classroom and extracurricular exposure). Total English exposure (mean ± SD) was significantly higher in the IE group than in the LE group (20.00 ± 8.14 vs. 7.05 ± 3.11, $t(40) = 6.81$, $p < .001$, Cohen's $d = 2.10$), indicating a significant group difference in exposure intensity.

2.2. Materials and design

The present study was a mixed design. Manipulation of conditions (Humorous vs. Coherent) served as the within-subject independent variable, while participants' English exposure (Intense vs. Limited) served as a between-subject factor in the comparison of ERP mean

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amplitude elicited in the present study. Behavioral accuracy and reaction time, as well as the mean amplitudes of the N400 and P600 components, were measured to serve as the dependent variables.

English jokes were chosen as the candidate experimental stimuli from various sources, such as joke books, popular magazines, websites, and research articles in humor processing. To avoid too much eye movement and precisely time-lock neural activity, the researcher finally selected and adapted 61 one-liners or funny riddle questions followed by a corresponding concise answer that served as a punchline. One-liners and funny riddles were selected for having a short critical ending eliciting the humorous effect, and could be broadly defined as semantic, i.e., based on an incongruity generated either by lexical-semantic knowledge or world-knowledge (Vrticka et al., 2013). The word in which the incongruity lay was identified by the researcher and was defined as the target word. We then manipulated the setup sentences rather than the punchlines to ensure that the neural activity we observed was not due to differences in the physical attributes of punchlines. We subsequently produced coherent setups for each joke's punchline to serve as non-joke sentences in our set of experimental stimuli. Therefore, two types of stimuli were included within one set that shared the same punchline.

Table 1 shows an example set of our materials, including each of the two types of stimuli, which serves as a demonstration of the characteristics of each type of stimulus. The lengths of the setup sentences were comparable across the two conditions and were constrained to be within 15 words (maximally two lines on the computer screen). In total, 61 sets of experimental stimuli were included in the present study, with each set consisting of two types of stimuli: Humorous and Coherent. Therefore, there were 61 sentences for each condition and 122 experimental sentences in total. All experimental materials are provided in Table A1.

A lexical profile analysis of both types of stimuli was conducted using the VocabProfile tool to determine whether their linguistic complexity was appropriate for the participants' English proficiency level (Cobb, n.d.; Heatley et al., 2002). Results indicated that the lexical demand of all the materials was accessible to our participants, with 89.9% of the words belonging to the 1,000 most frequent English word families (K-1), and cumulatively, 95.4% of the tokens belonged to the 2,000 most frequent word families (K-2). All participants were university students who had completed the National College Entrance Examination, which is aligned with the national senior high school English curriculum, and the English Curriculum Standards for Senior High Schools specify an expected vocabulary range of approximately 3,000–3,500 English words by the end of senior high school. Thus, our participants' vocabulary size exceeded the 95% lexical coverage threshold required for adequate reading comprehension (Nation, 2006), and the lexical demand of the experimental stimuli was considered appropriate for them.

To ensure that the experimental stimuli were comprehensible and that the humorous and coherent stimuli differed as intended in funniness, all experimental sentences were rated by a separate group of 50 participants before the formal ERP experiment. Participants completed an online five-point Likert-scale rating task to evaluate the comprehensibility of the stimuli (1 = most incomprehensible; 5 = most comprehensible) and their funniness (1 = not funny at all; 5 = very funny).The participants who completed this rating task did not take part in the formal ERP experiment. The average rating scores are reported in Table 2. The paired t-tests revealed no significant difference between humorous and coherent stimuli for comprehensibility, t (49) = −1.82, p = .071, while the Humorous stimuli were rated significantly funnier than Coherent stimuli, t (49) = 34.64, p < .001.

In the formal EEG experiment, we randomly divided the 61 sets of experimental stimuli into four blocks. The presentation of experimental stimuli was counterbalanced between subjects.

Table 1. Example of experimental stimuli

Condition	Setup sentence	Punchline	Ending type
Humorous	What can you never eat for breakfast?	Dinner.	Funny
Coherent	*Shall we have a hamburger for lunch or for dinner?*		Unfunny

Table 2. Pretest results of the stimuli

Condition	Comprehensibility	Funniness
Humorous	4.46 (0.22)	3.87 (0.35)
Coherent	4.52 (0.62)	1.83 (0.29)

Note: Data are expressed as mean (standard deviation).

2.3. Experimental procedure

The experiment was programmed and run using E-Prime 2.0 (Psychology Software Tools, Sharpsburg, PA, USA). As shown in Figure 1, each experimental trial began with the presentation of a central fixation (duration = 1,000 ms) to orient the participant to the center of the screen. Then the one-liners or funny riddles were presented without endings. Instead, the endings were replaced by three asterisks at the end of the materials to encourage subjects to activate an expectation about what the possible ending could be (self-paced). Subjects were asked to read silently the setup sentence and press the space key when they felt they understood what they had read; this press made the setup parts disappear (the maximum presentation time was 12 s). A fixation then appeared randomly for 400–600 ms to avoid excessive artifacts of eye movements in reading critical words. Then a humorous ending or a logically coherent ending was presented for 3 s. Participants judged whether each sentence was funny or unfunny by pressing one of the two keys (N or M); the key-to-response mapping was counterbalanced across participants (the maximum time was 3 s). Following an interval of 600–1,000 ms, a new trial appeared. All stimuli were presented centrally and subtended a horizontal visual angle that varied between 1.8° and 5.1°.

The experimental procedure was divided into two parts. First, to familiarize the participants with the procedure and pace of this task, they were trained with 6 trials using the same procedure as in the formal ERP experiment. Then, the formal ERP experiment started. There were four blocks and each one included approximately 30 trials. The different conditions (Humorous/Coherent) in each block were displayed randomly. The participants were seated in a quiet room facing a screen placed approximately 60 cm away from the eyes, and were instructed to respond as fast and accurately as possible by pressing the corresponding key of the keyboard. They were also asked to minimize movements and eye blinks. Each recording session lasted 40 min, including cap electrode preparation. To relieve the participants from weariness, short breaks were provided after each set of trials. Each block lasted approximately 10 min.

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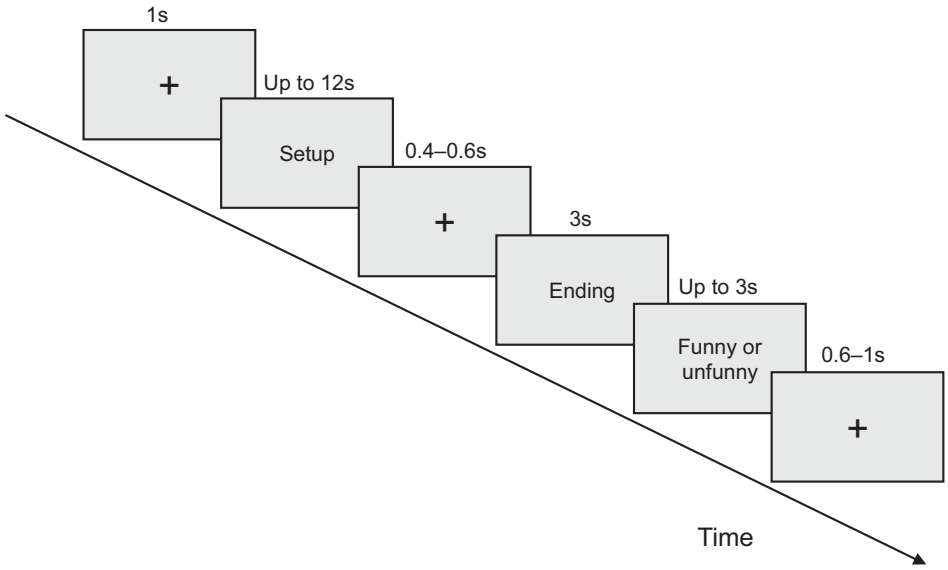


Figure 1. Illustration of the experimental procedure for a single trial. Each trial began with a fixation cross presented for 1 s. Next, the Setup (context sentence) was displayed for a maximum of 12 s (or until the participant pressed a key). After a jitter of 400–600 ms, the Ending was presented for a fixed duration of 3 s. Participants were then asked to judge whether the sentence was funny or unfunny within 3 s. The trial concluded with an inter-trial interval (ITI) ranging from 600 to 1,000 ms.

2.4. Electrophysiological recording and preprocessing

The electroencephalogram (EEG) was acquired at 500 Hz sampling rate using a 64-channel system (Brain Products GmbH, Gilching, Germany). Electrodes were placed according to the 10–20 International System. FCz electrode was used as the online reference electrode, and AFz was the ground electrode. Two electrodes (TP9, TP10) were placed on the mastoids, and one additional electrode monitored eye movements. The electrode impedance was kept below 5 kΩ throughout the recording.

Pre-processing was performed with the MNE-Python toolbox. The continuous data were filtered offline using a band-pass filter from 0.1 to 30 Hz. The filtered data were then re-referenced to the average of the bilateral mastoids. Independent component analysis (ICA) was used to identify and correct ocular artifacts (e.g., blinks and saccades). The data were then segmented into epochs time-locked to the onset of the ending words. Each epoch ranged from −200 ms to 1,000 ms relative to the onset, with the −200 to 0 ms interval serving as the baseline correction. Following previous studies (Bornkessel-Schlesewsky et al., 2020; Qi et al., 2017; Rao et al., 2025), epochs with artifacts exceeding a peak-to-peak amplitude of 150 μV were rejected before averaging. Retained trials and rejection rates are reported in Supplementary Table S1. The main ERP averages included all artifact-free trials, including both correct and incorrect responses.

2.5. Statistical analysis

For the behavioral data, the response time and accuracy were analyzed using a 2 (Condition: Humorous, Coherent) × 2 (Group: Limited, Intense) mixed ANOVA.

For ERP statistical analysis, guided by past humor studies (Coulson & Kutas, 2001; Feng et al., 2014; Ku et al., 2017; Mayerhofer & Schacht, 2015; Shibata et al., 2017), mean amplitudes for the N400 were calculated over the central electrodes (Cz, CPz, Pz) within the 300–500 ms time window, whereas mean amplitudes for the P600 were calculated over the parietal electrodes (CPz, Pz, POz) within the 500–900 ms time window. Data were analyzed using a 2 (Condition: Humorous, Coherent) × 2 (Group: Limited, Intense) mixed ANOVA. The Greenhouse–Geisser correction was applied when sphericity was violated, and post-hoc comparisons were Bonferroni-corrected (alpha = 0.05).

3. Results

3.1. Behavioral results

Mean comprehension accuracy and response time for Coherent and Humorous are reported in Table 3. Statistical analysis of comprehension data revealed a significant main effect of Exposure Intensity in the response accuracy ($F(1, 40) = 4.78$, $p = .035$, $\eta_p^2 = .11$), with the Intense Exposure group showing higher accuracy than the Limited Exposure group. The main effect of Condition was not significant ($F(1, 40) = 0.12$, $p = .73$), and the interaction was not significant, either ($F(1, 40) = 0.001$, $p = .98$). For response time, a significant main effect of Condition was identified ($F(1, 40) = 4.92$, $p = .032$, $\eta_p^2 = .11$), indicating slower responses to Humorous than to Coherent endings in both groups. The main effect of Exposure Intensity was not significant ($F(1, 40) = 0.94$, $p = .338$), and the interaction was not significant ($F(1, 40) = 2.13$, $p = .152$).

3.2. ERP results

For the N400 component, a mixed ANOVA conducted on the mean amplitudes over the central electrodes (Cz, CPz, Pz) in the 300–500 ms time window revealed a significant main effect of Condition ($F(1, 40) = 9.13$, $p = .004$, $\eta_p^2 = .19$). Specifically,

Table 3. Accuracy and reaction time by condition and exposure group

	Accuracy (%)		Reaction time (ms)	
	Coherent	Humorous	Coherent	Humorous
Intense	85.10 (12.22)	86.24 (14.71)	754.41 (189.42)	771.22 (166.82)
Limited	79.62 (14.83)	80.52 (10.18)	781.97 (210.09)	863.64 (271.49)

Note: Data are expressed as mean (standard deviation).

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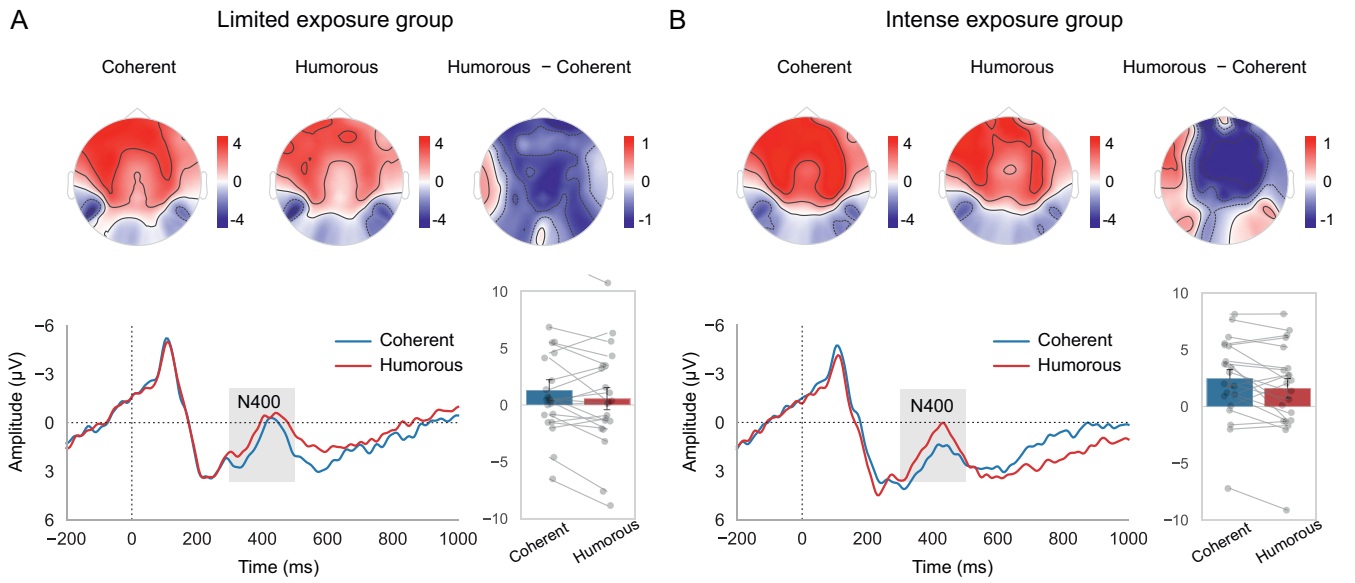


Figure 2. Grand average ERP results for the N400 component. The results are displayed separately for the (A) Limited Exposure group and (B) Intense Exposure group. Top panels: Topographical maps showing the distribution for Coherent and Humorous conditions, as well as the difference (Humorous minus Coherent), averaged within the N400 time window (300–500 ms). Bottom panels: Grand average ERP waveforms elicited by Coherent (blue lines) and Humorous (red lines) endings at the central electrodes (averaged over Cz, CPz, and Pz). The gray shaded area indicates the time window used for statistical analysis (300–500 ms). Bar plots illustrate the mean amplitudes with standard error bars; individual data points represent single-subject means, connected to show within-subject comparisons.

Humorous endings elicited a more negative-going waveform than Coherent endings, as shown in Figure 2. However, neither the main effect of Group ($F(1, 40) = 0.82$, $p = .371$) nor the interaction ($F(1, 40) = 0.05$, $p = .817$) was significant.

For P600 component, a mixed ANOVA conducted on the mean amplitudes over the parietal electrodes (CPz, Pz, POz) in the 500–900 ms time window revealed a significant interaction ($F(1, 40) = 9.00$, $p = .005$, $\eta_p^2 = .18$), whereas the main effects of Condition ($F(1, 40) = 0.60$, $p = .442$) and Group ($F(1, 40) = 0.26$, $p = .610$) were not significant. Further simple effects analysis indicated that in the Intense Exposure group, Humorous endings elicited significantly larger P600 (more positive amplitudes) compared to Coherent endings ($t(20) = 2.39$, $p = .027$). In contrast, for the Limited Exposure group, no significant difference was found between the Humorous and Coherent endings ($t(20) = -1.82$, $p = .084$). See Figure 3 and Table 4 for details.

To evaluate the robustness of the ERP findings, we conducted supplementary sensitivity analyses using stricter peak-to-peak

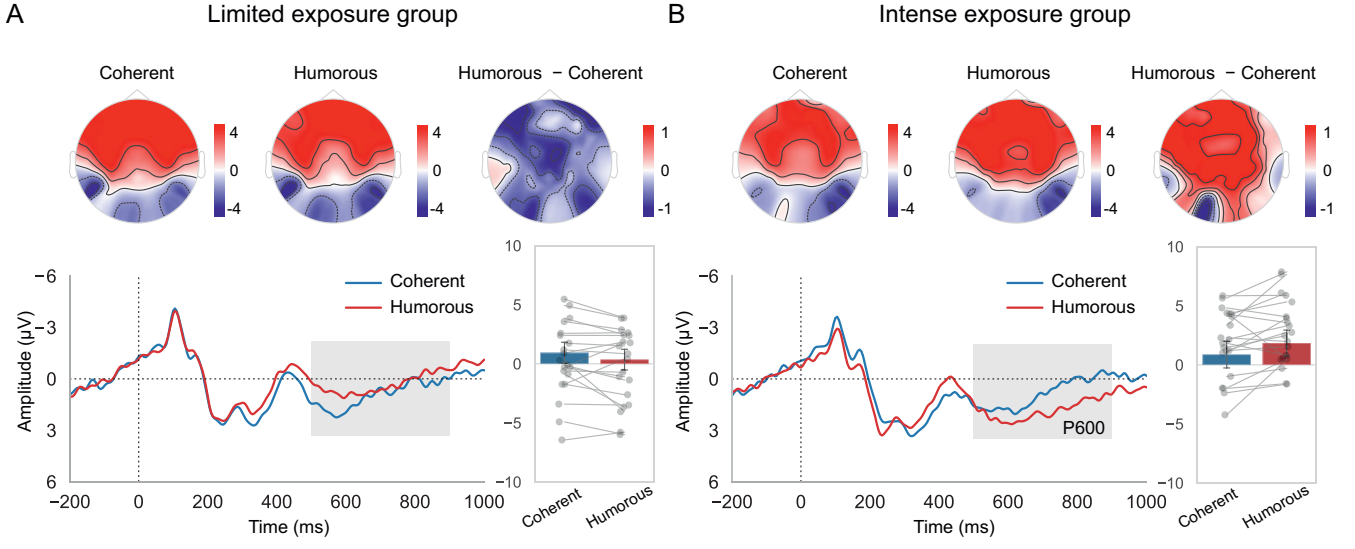


Figure 3. Grand average ERP results for the P600 component. The results are displayed separately for the (A) Limited Exposure group and (B) Intense Exposure group. Top panels: Topographical maps showing the distribution for Coherent and Humorous conditions, as well as the difference (Humorous minus Coherent), averaged within the P600 time window (500–900 ms). Bottom panels: Grand average ERP waveforms elicited by Coherent (blue lines) and Humorous (red lines) endings at the parietal electrodes (averaged over CPz, Pz, and POz). The gray shaded area indicates the time window used for statistical analysis (500–900 ms). Bar plots illustrate the mean amplitudes with standard error bars; individual data points represent single-subject means, connected to show within-subject comparisons.

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Table 4. Mean amplitudes (μV) for the N400 and P600 by condition and exposure group

ERP component	Group	Coherent	Humorous
N400	Limited	1.30 (4.25)	0.56 (4.47)
	Intense	2.47 (3.58)	1.61 (3.91)
P600	Limited	0.93 (4.10)	0.35 (4.01)
	Intense	0.87 (5.19)	1.85 (5.00)

Note: Data are expressed as mean (standard deviation).

artifact-rejection thresholds of 100 μV and 50 μV. Trial retention and rejection rates after artifact rejection are reported in Supplementary Table S1, and the sensitivity analysis results are reported in Supplementary Table S2. Overall, these sensitivity analyses showed a broadly consistent pattern with the main findings, suggesting that the ERP results were not driven by the specific artifact-rejection threshold.

To further examine whether the N400 and P600 effects showed hemispheric lateralization, we conducted supplementary lateralized analyses using a 2 (Group: Limited, Intense) × 2 (Condition: Humorous, Coherent) × 2 (Hemisphere: Left, Right) mixed ANOVA. For the N400, the left region of interest (ROI) included C3, CP3, and P3, and the right ROI included C4, CP4, and P4. For the P600, the left ROI included CP3, P3, and PO3, and the right ROI included CP4, P4, and PO4. Supplementary Figures S1 and S2 show the lateralized ERP waveforms and mean amplitudes for the N400 and P600, respectively, and the corresponding statistical results are reported in Supplementary Table S3. No significant interactions involving Hemisphere were observed, all $ps \geq .353$, suggesting no clear hemispheric lateralization effects.

Since the main analyses included both correct and incorrect behavioral responses, additional ERP analyses restricted to correct trials were conducted. Supplementary Figures S3 and S4 show the N400 and P600 results based on correct trials, respectively. The number of retained correct trials is reported in Supplementary Table S4, and the corresponding statistical results are reported in Supplementary Table S5. As shown in Supplementary Figures S3 and S4, the overall ERP patterns were broadly consistent with those observed in the main analyses (Figures 2 and 3). In the statistical analyses, the N400 condition effect remained significant ($p = .011$), whereas the P600 Group × Condition interaction was reduced and no longer significant ($p = .110$). This may be partly related to the reduced signal-to-noise ratio after restricting the analyses to correct trials. In addition, because the two groups differed in behavioral accuracy, restricting the analyses to correct trials resulted in unequal numbers of trials entering the ERP averages across groups (Supplementary Table S4), which may have reduced the stability and statistical power of the P600 analysis. Moreover, the P600 time window partly overlapped with the response period, and response-related activity may have further affected the stability of the P600 estimates in the correct-trial analysis.

4. Discussion

4.1. Overview

This study examined the time course of English verbal humor comprehension among Chinese EFL learners using ERPs to characterize the stages of incongruity detection and resolution. By contrasting participants with intensive versus limited English exposure, the research addressed how language exposure intensity might modulate the neural processes underlying figurative comprehension. Consistent with models of humor processing in first language (L1) contexts (Coulson & Kutas, 2001; Shibata et al., 2017), the results demonstrated a two-stage temporal pattern among IE learners but only a partial pattern among learners with limited language exposure. This conditioned two-stage model provides direct evidence that while the detection of incongruity arises automatically in L2 verbal humor comprehension, its resolution depends on exposure-linked cognitive and linguistic resources.

4.2. Behavioral performance of humor comprehension

Reaction time and accuracy results offer a behavioral foundation for interpreting the ERP findings. Both exposure groups responded faster to unfunny, logically coherent endings than to funny ones, reflecting greater cognitive effort required for incongruity resolution. However, IE learners exhibited higher judgment accuracy, suggesting that their broader linguistic knowledge and pragmatic familiarity facilitated access to contextually relevant interpretations.

These behavioral distinctions are consistent with research showing that L2 experience is associated with greater efficiency in pragmatic comprehension, including faster and more accurate use of contextually relevant cues (Taguchi, 2005; Zhang & Aubrey, 2024). The current data indicate that IE learners were able to better isolate relevant contextual information, move beyond literal interpretations, and integrate linguistic and sociocultural cues. Conversely, LE learners responded primarily to surface semantic conflict, with less evidence of fully retrieving or integrating the intended inferential meaning.

The difference between funny and unfunny stimuli also illustrates the role of conventionality in reducing processing cost. As predicted by Relevance Theory (Sperber & Wilson, 1996; Wilson & Sperber, 2006), conventional and predictable utterances require minimal inferential effort, whereas highly unconventional or surprising endings demand greater effort balanced by greater cognitive reward. Longer response times for humorous endings thus may represent the cost of expanded interpretive work that makes resolution and consequently possible amusement.

4.3. Incongruity detection in L2: the N400 effect

In the present study, ERP results revealed a robust N400 effect between 300 and 500 ms post-stimulus onset, with larger negativity elicited by funny than unfunny endings in both exposure groups. The N400 commonly reflects semantic integration difficulty and indexes the mismatch between predicted and actual lexical meaning (Kutas & Hillyard, 1980). Its presence across all participants in our study confirmed that even L2 users could detect violations of contextual expectancy at early stages of processing. These findings accord with previous studies of joke comprehension in L1 speakers, where punchlines elicit enhanced N400 amplitudes due to the mismatch between initial semantic frames and the final, incongruent meaning (Coulson & Kutas, 2001; Du et al., 2013).

Our N400 findings complement behavioral data showing longer processing times for humorous conditions. The detection of incongruity intensifies cognitive demand in both L2 exposure groups. Nevertheless, our results revealed no significant group differences in the N400 component, indicating that the variation in classroom exposure intensity did not modulate the initial stage of incongruity

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detection. This finding aligns with evidence that L2 learners can exhibit similar N400 effects to L1 speakers when they possess sufficient vocabulary proficiency to access lexical-semantic information (Moreno et al., 2008; Moreno & Kutas, 2005). In our study, tightly controlling the lexical properties at the punchline may have further facilitated this by reducing variance in early lexical-semantic access. Even late learners can show N400 effects, and semantic systems often show more plasticity or robustness than syntactic systems (Hahne & Friederici, 2001). Thus, the indistinguishable N400 amplitudes may suggest that both IE and LE learners in our study were equally efficient at accessing the semantic representations required to detect the humor-related conflict, with exposure differences manifesting only during the later resolution stage.

Taken together, our N400 evidence substantiated the first stage of the two-stage model, an early and relatively automatic recognition of semantic conflict driven by lexical – contextual integration rather than by intensity of L2 exposure.

4.4. Incongruity resolution and reinterpretation: the P600 effect

The second stage of L2 humor comprehension emerged as a P600 positivity between approximately 500 and 900 ms after stimulus onset, corresponding to reanalysis and coherence restoration processes. This effect was prominent for humorous endings in IE participants but absent in LE participants.

Although traditionally associated with syntactic reevaluation (Osterhout et al., 1997; Tanner et al., 2013), the P600 has been extended to a wide range of reprocessing phenomena, including discourse integration (Burkhardt, 2007), pragmatic inferences (Regel et al., 2011), and humor comprehension (Canal et al., 2019; Shibata et al., 2017). In the current study, the centro-parietal P600 signals participants' attempts to achieve coherence through frame-shifting, that is, the reorganization of conceptual frames to align initial and alternative interpretations (Coulson & Williams, 2005).

The L2 exposure-based difference in P600 amplitude suggests that only learners with extensive language experience possess sufficient linguistic and pragmatic knowledge to resolve incongruity. While the LE participants detected semantic anomalies (as indexed by the N400) and ultimately achieved high behavioral accuracy in humor comprehension (approximately 80%), their attenuated P600 suggests reduced efficiency and less robust neural engagement during the pragmatic reinterpretation stage compared to the IE group. This neurophysiological pattern indicates that although LE learners can behaviorally resolve the incongruity, their underlying reanalysis process is less automatized and neurocognitively more effortful. In contrast, the intensive L2 exposure in the IE group facilitates a robust and efficient neural integration of hidden implicatures, manifesting as an enhanced P600 effect. This result is consistent with research on L2 pragmatic processing suggesting that limited processing resources may lead learners to rely more heavily on surface-level linguistic cues, making higher-level pragmatic inferences less accessible (Roever, 2024; Taguchi & Roever, 2017).

While semantic conflict recognition is nearly automatic, resolution presupposes the capacity to inhibit earlier interpretations and to construct a new integrated model of meaning, processes that may require intensive exposure and contextual experience. Figurative language processing requires suppressing literal meanings quickly (Ezrina & Valian, 2023; Vaid et al., 2003). In our study, the ERP stimuli were one-liners or funny riddles. One-liners often involve structural or garden-path humor, which requires syntactic processing speed to get the humor under time pressure, while in funny riddles, humor often relies on double meanings of words (polysemy) or similar sounds (homophones), which could test learners' depth of vocabulary and their ability to access literal and non-literal meanings simultaneously and efficiently suppress the initial and salient literal meaning to accept the secondary, funny meaning. This process of comprehension requires cognitive "muscle" built through constant, intensive pressure such as immersion or intensive study, not through occasional practice as in the case of LE participants in our study.

While intensive exposure may not explicitly target humor, it may facilitate the automatization of lower-level syntactic and lexical processing (Morishima, 2013). This reduced cognitive load during the initial parsing phase frees up working memory resources, allowing the L2 learner to allocate attention to the higher-order semantic reanalysis required for humor comprehension. Intensive instructional environments place high demands on inhibitory control, requiring IE learners to constantly suppress L1 interference. This heightened executive control could transfer to figurative language processing, allowing IE learners to more rapidly suppress the salient literal interpretation of a pun or riddle in favor of the contextually appropriate non-literal meaning (Hopp, 2022).

Unlike naturalistic exposure, which prioritizes communicative fluency, intensive L2 exposure fosters acute metalinguistic awareness that may prime IE learners to detect the phonological or syntactic ambiguities central to verbal humor, treating the joke as a linguistic puzzle to be solved. Although the target jokes were not explicitly taught, the IE learners' more intensive instruction (12–20 hours per week), frequent peer interaction, and motivation to become language professionals may have afforded them denser exposure to English in use than the LE learners, despite no significant between-group difference in general proficiency. This account is consistent with evidence that denser L2 exposure enhances the accuracy of implicit meaning comprehension (Taguchi, 2011), and that intensified L2 contact predicts gains in pragmalinguistic development (Zhang et al., 2026). However, as the online allocation of contextual and pragmatic resources was not directly measured in the present study, this remains a plausible rather than an established interpretation of the ERP findings.

4.5. The conditioned two-stage model of L2 humor processing

Synthesizing these findings, the present study advances a Conditioned Two-Stage Model of L2 humor comprehension, adapting Suls' (1972) classic Incongruity – Resolution framework to bilingual contexts. The first stage is Incongruity Detection. In this stage, universal and largely automatic processing detects a mismatch between the predicted and the actual meaning. Chinese EFL learners with both intense and limited English exposure demonstrated this stage. In the second stage of Incongruity Resolution, however, only controlled, L2 exposure-dependent reanalysis enabled reinterpretation and humor comprehension. Completion of this stage depends on linguistic fluency and pragmatic knowledge sufficient for frame-shifting, which is more likely to be achieved through intensive L2 exposure in a language learning environment depending on classroom instruction.

Our model captures the partial success experienced by many L2 learners: they can perceive incongruity but not necessarily resolve it to derive humor. Such conditionality reflects cognitive resource allocation in L2 comprehension (Morishima, 2013; Roever, 2024). As L2 exposure increases, learners may gradually automatize

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lower-level processes and can redirect cognitive capacity toward inferential integration. The model therefore bridges neurocognitive and pragmatic theories by linking observable ERP components to levels of communicative competence. It further supports the view that pragmatic comprehension constitutes a continuum of processing depth rather than a categorical dichotomy between "understanding" and "not understanding" humor (Bell & Pomerantz, 2019).

Pragmatic comprehension in a second language requires the rapid coordination of multiple knowledge sources. At a minimum, comprehenders must integrate linguistic meaning with contextual inference and pragmatic cue knowledge, and performance varies systematically as a function of cue type and its attendant processing demands (Prichard & Rucynski, 2022). This cue-sensitivity is particularly relevant for humor and irony, where the intended meaning often diverges from the literal meaning and must be recovered by combining what is said with what is implied (Dynel, 2008; Ellis et al., 2021). In this sense, humor comprehension depends not only on what learners know about vocabulary, grammar, and sociocultural conventions, but also on how efficiently these sources can be brought to bear in real time.

Against this background, our results may inform ongoing discussions on L2 pragmatic comprehension by suggesting a dynamic relationship between early interpretation and later integrative repair. The biphasic N400–P600 pattern observed here is consistent with a two-stage account in which learners first attempted lexico-semantic integration (indexed by the N400) and then engaged in later reanalysis, inference, or coherence-building operations (indexed by the P600). In our study, the N400 effect was observed for humorous stimuli in both groups, indicating that participants detected a semantic mismatch at the punchline. The absence of an IE – LE group difference at this stage suggested that classroom-based exposure intensity did not substantially influence early lexical – semantic activation or incongruity detection. Nevertheless, the group difference that emerged in late positivities revealed that, for IE learners, the initial N400 detection signal triggered a reanalysis process. The P600 here reflects the cognitive work of suppressing the literal interpretation and restructuring the discourse model into correct humor comprehension. Conversely, the LE group, despite showing a similar N400, displayed a significantly reduced P600 and lower accuracy in the funny/unfunny judgment test. This pattern suggests that while they recognized something was wrong (N400), they lacked the intensity of training to carry out the subsequent repair (P600). Simply put, the LE learners detected the joke, but could not resolve it.

Several limitations of the present study should be acknowledged. First, the stimulus set focused primarily on one-liners and riddles, and future studies could examine whether the two-stage pattern generalizes beyond these stimulus types. Cultural familiarity ratings should also be collected to disentangle linguistic difficulty from socio-cultural unfamiliarity. Second, although our study focused on individual differences within the L2 population, the absence of a native speaker baseline remains a limitation. To fully understand these findings, future research needs an L1 control group to compare these L2 neural responses directly with those of native speakers. Thirdly, although LexTALE is a generally reliable proxy for global language proficiency, it may miss the deeper semantic and pragmatic skills required for humor comprehension. Future research should incorporate discourse-level proficiency assessments. Finally, the study employed sensor-space ERP analysis without source localization. Coupling ERPs with methods such as sLORETA or fMRI would enable localization of the cortical networks supporting L2 humor comprehension, such as the temporo-parietal and prefrontal areas implicated in theory-of-mind and inference construction (Feng et al., 2014; Shibata et al., 2017).

5. Conclusion

This study provides converging behavioral and neurophysiological evidence that L2 verbal humor comprehension involves two temporally distinct stages: early semantic incongruity detection, indexed by the N400, and later reanalysis for coherence restoration, indexed by the P600. The findings show that only L2 learners with intensive exposure (the IE group) fully engaged both stages and achieved humor appreciation, suggesting that general L2 proficiency may provide the lexical basis for comprehension, whereas intensive exposure facilitates the higher-order pragmatic integration required for humor resolution. Extending Suls' (1972) Incongruity – Resolution model to bilingual contexts, these results support the proposed Conditioned Two-Stage Model and indicate that L2 exposure modulates the efficiency and time course of incongruity resolution in L2 humor comprehension.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S1366728926101850.

Data availability statement. Anonymized data, preprocessing scripts, and analysis code will be made available upon reasonable request to the corresponding author.

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Author contribution. F.P.: the design of the work, the acquisition and analysis of data for the work, the interpretation of data for the work, funding acquisition, drafting and revising the article, and final approval of the version to be published. R.Z.: the conception of the work, revising the article, and final approval of the version to be published. M.X.: the experiment design, analysis of data, revising the work, and final approval of the version to be published.

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Competing interests. The authors declare none.

Ethical standard. All participants provided informed consent. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Appendix

Table A1. Experimental stimuli used in the ERP experiment

Item	Humorous setup	Coherent setup	Critical ending
1	Which is faster, hot or cold? Hot. Because you can catch a ***	Is December a good time to visit Beijing? No. It's too ***	cold
2	My wallet is like an onion. When I open it, it makes me ***	Newborns can only express their feelings or needs by ***	cry
3	What color is the wind? ***	What is the past tense of "blow"? ***	blew
4	My girlfriend told me to go out and get something that makes her look sexy. So I got ***	I went to a nightclub with my friends and met a sexy bartender there. So I got ***	drunk
5	A naked woman robbed a bank. Nobody could remember her ***	If a woman is forced to be naked in public, it will make her lose ***	face
6	Why did the physics teacher break up with the biology teacher? There was no ***	Marie Curie was the woman behind great changes in the science of ***	chemistry
7	A new study found that humans eat more bananas than monkeys. I cannot remember the last time I ate a ***	What animal lives in hot countries, has a long tail, climbs trees, and likes eating bananas? ***	monkey
8	Why does not the sun go to college? It already has a million ***	What's the temperature today? The weather forecast says 30 ***	degrees
9	I want to die in my sleep like grandpa, but not screaming like his ***	The capacity of the bus is 60 persons, but now it only carries 20 ***	passengers
10	How do celebrities stay cool? They have many ***	The winners of the game were loudly cheered by their ***	fans
11	I'm so good at sleeping. I can do it with my eyes ***	After the accident, all the shops and cinemas here have been ***	closed
12	My wife and I were happy for twenty years. Then we ***	I have waited for my wife at the airport for 3 hours before we ***	met
13	Time waits for no man. Time is obviously a ***	Our chief of police is a woman, and our mayor is also a ***	woman
14	Child's experience: if a mother is laughing at the father's jokes, it means they have ***	Child's experience: if a mother is cleaning the house, it means they have ***	guests
15	The road to success is always under ***	The road in front of my office is under ***	construction
16	Light travels faster than sound. This is why some people appear bright until you hear them ***	Action speaks louder than words. So you'd better do something rather than ***	speak
17	I gave up my seat to a blind person on the bus. That is how I lost my job as a bus ***	He was charged with endangering public security because, in a moving bus, he hit the ***	driver
18	A good wife always forgives her husband when she's ***	A good husband always finds excuses for his wife when she's ***	wrong
19	You're not fat, you are just…easier to ***	Please blacken the key words to make them easier to ***	see
20	Money is not everything, but it sure keeps you in touch with your ***	The divorced couple refused to get in touch with their ***	children
21	My New Year's resolution is to help all my friends gain ten pounds, so I look ***	My New Year's resolution is to lose ten pounds, so I look ***	skinnier
22	Why did the bee get married? Because he found his ***	Why does the apple mixture taste so good? Because it is sweetened with ***	honey
23	What did the big chimney say to the little chimney? "You're too young to ***	What did the shopkeeper say to the young child? "You are too young to ***	smoke
24	Where there's a will, there's a ***	The children are being cared for by a ***	relative
25	Talk is cheap until you hire a ***	If you are unsure of your legal rights, check with a ***	lawyer
26	What did the spider do on the computer? Made a ***	Do you want to know more about our conference? Visit our ***	website
27	Why did the tomato turn red? Because he saw the salad ***	Apple jam can be used as a dessert, snack, baby food, or salad ***	dressing
28	On what kind of ships do students study? ***	On what did the poor student complete his education? ***	scholarships
29	I'm not a complete idiot…Some parts are still ***	The robbers have been caught, but the jewelry is still ***	missing

(*Continued*)

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Table A1. (*Continued*)

Item	Humorous setup	Coherent setup	Critical ending
30	Have you ever tried to eat a clock? It is very ***	The operation is rather complicated and ***	time-consuming
31	What do computers eat for a snack? ***	What could be inserted under a pet's skin in case it gets lost? ***	microchips
32	What can you never eat for breakfast? ***	Shall we have hamburger for lunch or for dinner? ***	dinner
33	How do you turn white chocolate into dark chocolate? Turn off the ***	It's getting dark, and I cannot read. Please turn on the ***	light
34	I am nobody. Nobody is perfect. Therefore I am ***	I'm not a talent, so I practice every day. I believe Practice makes ***	perfect
35	What do you call a bee that comes from America? ***	What device do you use to store the data? ***	USB
36	What's red and bad for your teeth? ***	What is a rectangular block of hard material used for building walls? ***	a brick
37	Give a man a gun, and he'll rob a bank. Give a man a bank, and he'll rob ***	Get to the end of the line and wait your turn, just like ***	everyone
38	The number one cause of death is too many ***	The happiest moments of my childhood were my ***	birthdays
39	Why do ants not get sick? They have ***	The purpose of vaccination is to make people produce ***	anti-bodies
40	Teacher: Why is your paper in blank? Student: Sometimes the best answer is ***	When I'm recording the music, the background must be in absolute ***	silence
41	What did the green grape say to the purple grape? ***	What does the yoga teacher often say to you during practice? ***	breathe
42	Time flies like an arrow; fruit flies like ***	When I was young, my favorite fruit was ***	banana
43	Apparently, I snore so loudly that it scares everyone in the car I'm ***	Do not look at your mobile phone while you are ***	driving
44	A doctor tells a woman she can no longer touch anything alcoholic. So she gets a ***	The man told her wife that he fell in love with his secretary. So they got a ***	divorce
45	Money talks…but all mine ever says is ***	As the bus left, she turned around and waved ***	goodbye
46	Last Christmas, my wife told me, "Nothing would make her happier than a diamond necklace." So I bought her ***	"I bought my wife a diamond necklace for Christmas. What did you buy for your wife? "I bought her ***	nothing
47	What do you call somebody with no body and no nose? ***	What do you think will happen to the abandoned factory? ***	Nobody knows
48	"No, thanks. I'm a vegetarian." is a fun thing to say when someone hands you their ***	"No, thanks. My hands are occupied." is not a fun thing to say when your wife hands you your ***	baby
49	The reward for a job well done is more ***	He worked overtime yesterday, but today he was assigned more ***	work
50	A man walks into a lawyer's office and asks, "How much do you charge?" The lawyer says, "$5,000 for three ***	After the lecture, the speaker said to the audience: "Thank you for listening. Now please ask me ***	questions
51	The doctor told me to walk three miles a day to get fit. It's been two weeks and I do not know how to get ***	In order to lose weight and get fit, I decided not to drive after work. Instead, I chose to walk ***	home
52	How do you rob a snowman? With a ***	How do you dry your hair quickly? With a ***	hairdryer
53	My doctor told me to watch my drinking. Now I drink in front of a ***	My daughter is addicted to makeup. Today she is sitting 3 hours in front of the ***	mirror
54	Husbands are the best people to share secrets with. They'll never tell anyone, because they aren't even ***	When someone wants to share secrets with you, the best thing to do is to pretend you aren't ***	listening
55	Teamwork is important; it helps to put the blame on ***	Teamwork is important. When something goes wrong, do not try to put the blame on ***	others
56	Wife: "I look fat. Can you say something nice to make me happy?" Husband: "You have perfect ***	Son: "Can I play computer games for one more hour?" Mom: "No. It will damage your ***	eyesight
57	A man says to his friend: "My wife is an angel." His friend answers: "You're lucky. Mine's still ***	"My wife is lucky," a man says. "When she was rescued from the ruins of the earthquake, she is still ***	alive
58	My dog used to chase people on a bike a lot. It got so bad, so finally I had to take away its ***	I wasn't at home when you called me. My youngest child was learning to ride ***	bike

(*Continued*)

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Table A1. (*Continued*)

Item	Humorous setup	Coherent setup	Critical ending
59	My sister told me she loves a man in uniform, so she cannot wait to start working at ***	When my son was young, he always invited his friends and held a birthday party at ***	McDonalds
60	Son: Dad, what is it like to have a handsome son? Dad: I do not know; ask your ***	Son: Dad, what is the grandma's favorite food? Dad: I do not know; ask your ***	grandpa
61	Although the destruction of this earthquake is terrible, there's still hope. I found a man's ***	A man called 110 and said a robber had threatened him with a gun and taken his ***	wallet

Note: Each item included a humorous and a coherent version. The two versions shared the same critical ending, and the preceding setup sentence was manipulated to create either a humorous or coherent interpretation. The asterisks indicate the position at which the critical ending appeared. ERP epochs were time-locked to the onset of the critical ending.

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