



## Review Article

# A critical review of processing mechanisms and moderating factors in L2 conceptual metaphor comprehension

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## Abstract

Metaphors are fundamental to human cognition and language but present significant challenges for second language (L2) learners due to the unpredictability of figurative meanings and the cognitive demands required for processing. While much research has focused on metaphor comprehension in first-language contexts, there is still limited understanding of the specific difficulties faced by L2 learners. This review examines the mechanisms and factors that influence L2 metaphor comprehension, emphasizing their limitations in forming a comprehensive picture of how learners' strategies, conceptual transfers, and neural processes interact. Critical issues include processing mechanism inconsistencies and research methodology inadequacies, particularly the lack of cross-linguistic analysis and insufficient data triangulation. Our findings address the need for cross-linguistic interdisciplinary approaches, improved research designs, and methodological triangulation to capture the complexity of L2 metaphor comprehension more accurately. This review offers directions for advancing future research to develop a more comprehensive understanding of how cognitive and linguistic elements interact in L2 metaphor comprehension.

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## Introduction

Metaphor is a pervasive cognitive and linguistic phenomenon that functions as a fundamental mode of cognition, enabling individuals to understand abstract concepts through the mapping of more concrete experiences (Lakoff & Johnson, 1980). For example, in the conceptual metaphor *ARGUMENT IS WAR*,

the structure of physical conflict is used to conceptualize and articulate the abstract domain of argumentation, leading to expressions such as “defend a position” or “attack an argument.” Conceptual metaphors arise from the interaction between embodied experiences and contextual factors, making them fundamental cognitive tools for organizing abstract concepts (Kövecses, 2015).

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In the 1980s, the study of metaphor entered the cognitive category and started to be incorporated into the research of second language or foreign language learning. As Lakoff and Turner (1989) pointed out, metaphors are conventional to native speakers yet may seem novel to second language (L2) learners. They pose specific problems with language learning for all groups of learners due to the unpredictability of the figurative meaning. Compared with native speakers, more cognitive resources will be engaged for L2 learners during processing due to their unfamiliarity with L2 metaphorical expressions. Moreover, L2 learners generally lack the relevant L2 culture and conceptual system, coupled with the limitations of their L2 proficiency and the transfer of first language (L1) culture, leading to challenges for L2 learners to encode conceptual information and interpret L2 metaphors (Danesi, 2000; Deignan et al., 1997). Thus, understanding and processing L2 metaphors requires additional cognitive effort and cultural knowledge, making it a particularly challenging aspect of second language acquisition.

Over the past three decades, research on metaphor processing has become a prominent focus within metaphor studies, leading to the development of several distinct explanatory models. Both *Conceptual Metaphor Theory* (Lakoff & Johnson, 1980) and *Structure Mapping Theory* (Wolff & Gentner, 2011) involve directional projection, where conceptual metaphors are mapped from one domain to another. However, *Conceptual Metaphor Theory* focuses on mappings through embodied experience, while *Structure Mapping Theory* emphasizes the alignment of abstract structural relationships and the alignment of relational patterns rather than sensory grounding. *Relevance Theory* (Sperber & Wilson, 2008) critiques these projection models by arguing that metaphors rely more on contextual inference than fixed mappings, particularly in cases involving nonverbal modalities. For instance, in the metaphor “I felt his glance,” there is no direct physical sensation, yet the metaphor evokes a sensory experience, challenging the notion that all metaphors rely on physical embodiment or structural projection. While *Relevance Theory* posits the role of linguistic and contextual cues in constructing broader, context-specific “ad hoc” concepts beyond the literal meanings, it overlooks creativity and novelty in using metaphors, viewing them mainly as tools for efficiency and relevance.

Another renowned model, the *Class-inclusion Model* (Glucksberg & Keysar, 1990) proposes a symmetric mechanism where metaphors assign source and target domains to a shared category and match their features.

In the example “My job is a jail”, rather than mapping characteristics from “jail” to “job,” the model suggests both are matched within the broader category of “unpleasant, confining situations,” with the metaphor operating through category inclusion rather than direct mapping. By combining mapping and matching mechanisms, the *Career of Metaphor Theory* (Bowdle & Gentner, 2005) proposes that the processing of conventional metaphors is mainly based on the *Class-inclusion Model*, while the processing of novel metaphors is mainly done through structural mapping. The *Graded Salience Hypothesis* (Giora, 1997) claims that matching concepts is not required; instead, the key to interpreting a metaphor lies in the salience degree of the word’s meaning. Regardless of whether the context is appropriate, the salient meaning is automatically extracted and accessed directly in the lexical entries and modified if it does not match the context.

While the previous models differ in whether metaphors are processed through directional projection, symmetric matching, or salience in the mental lexicon, they all assume that metaphors, especially conventional metaphors, are deeply embedded in the mental lexicon, enabling automatic and unconscious processing. However, the background knowledge of embodied experience from a target language could be an additional requirement for L2 learners. Consequently, these models are more applicable to L1 learners but may be less functional with L2 learners, who typically lack common knowledge of necessary source and target domains in the L2.

Based on the implications of existing metaphor processing theories, scholars have recognized the limitations in accounting for L2 metaphor processing. While L1 models of metaphor processing reflect holistic and automated processing, L2 learners often find metaphors, even conventional ones, challenging. This difficulty leads L2 learners to adopt more analytical, non-automated processing modes, which involve breaking metaphors into smaller components. L2 learners can gradually combine the metaphor’s meaning by analysing individual elements and relying on contextual cues. Over the past two decades, L2-specific models have emerged to better account for these challenges. These models focus on the processing mechanisms involved in L2 metaphor comprehension, referring to the concept-encoding processes that L2 learners automatically initiate to attribute semantic features to the tenor of a metaphor (Banaruee et al., 2019). However, these mechanisms are further influenced by various factors, such as L2 proficiency, linguistic and cultural knowledge, and context, which shape the effectiveness of metaphor comprehension.

Despite the emerging L2-specific models, very few studies have comprehensively synthesized and critically evaluated them within the scope of conceptual metaphors. This review aims to examine the mechanisms proposed in these models, examining their strengths, limitations, and practical implications. Additionally, it analyses how moderating factors contribute to the unique challenges faced by L2 learners. By identifying gaps in current research, this paper provides a comprehensive review of existing processing mechanisms and moderating factors, offering implications for future research in L2 figurative language processing and bridging the gap between existing L1 and L2 studies to uncover how cognitive and linguistic processes impact metaphor comprehension.

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## Methodology

This critical study synthesizes findings from an extensive review of research investigating processing mechanisms and key factors in L2 metaphor comprehension. The methodology has been adapted from established procedures in literature review research (Boote & Beile, 2005; Hart, 2025; Tranfield et al., 2003; Webster & Watson, 2002), ensuring a rigorous and systematic approach. These scholars emphasize the importance of conducting a comprehensive and inclusive literature search, applying well-defined selection criteria, and performing both thematic analysis and critical evaluation of the reviewed studies. The following steps were undertaken:

### Step 1: Literature Search

A thorough search was conducted across major academic databases, including Scopus, WOS, and JSTOR, as well as Chinese databases, such as CNKI and Wanfang. Following Hart (2025) guidelines on conducting systematic searches, keywords like “L2 metaphor processing,” “figurative language comprehension,” and “cognitive processes in L2 comprehension” were used to ensure a broad inclusion of both foundational and contemporary studies. This process enabled the identification of diverse, relevant research for analysis, capturing global and regional perspectives essential for thoroughly synthesizing of L2 metaphor comprehension.

### Step 2: Selection Criteria

Boote and Beile (2005) emphasis on defining clear selection criteria guided the division of the literature into two main parts: (1) foundational theories in figurative language processing and (2) more recent studies (within the last 15 years) that contain empirical data

or influential models related explicitly to L2 metaphor comprehension. This selection ensured that only pertinent and high-quality sources were included in the review.

### Step 3: Thematic Analysis

Adapted from Hart (2025) and Webster and Wason (2002) approach to literature synthesis, thematic analysis was conducted to interpret and summarize the primary content and arguments of the selected studies. Critical models in L2 metaphor comprehension were analysed, with patterns and recurring themes identified across the literature. This process enabled a deeper understanding of how these elements contribute to L2 metaphor comprehension, following Boote and Beile (2005) emphasis on synthesizing and integrating theoretical and empirical insights.

### Step 4: Critical Evaluation

In alignment with Boote and Beile (2005) emphasis on evaluating the quality of research, close reading was employed to critically assess the methodologies, findings, and implications of existing research. This included a critical examination of the robustness of study designs, the validity of conclusions drawn, and any potential biases. This method allowed for a nuanced understanding of how different studies approach L2 metaphor comprehension and the cognitive mechanisms involved.

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## Results

Following the literature review of L2 metaphor processing models, recurring themes and patterns were synthesized to identify the core factors and mechanisms revealed in L2 metaphor comprehension.

### *Factors Moderating L2 Metaphor Comprehension*

One of the major criticisms of *Conceptual Metaphor Theory* (Lakoff & Johnson, 1980) is its limited consideration of context in metaphor comprehension. While *Conceptual Metaphor Theory* emphasizes pre-stored, universal mappings between source and target domains, critics argue that metaphors are dynamically shaped by the immediate discourse and broader situational context (Kövecses, 2015). Early research on L2 metaphor comprehension has extensively examined the factors moderating L2 learners' comprehension, with context consistently identified as a pivotal factor. Metaphor processing involves inference-making based on boarder context and semantic analysis, aligning with *Semantic-context Effects*

(Tulving & Gold, 1963). Context helps disambiguate metaphors by promoting the perception of contextually congruent words and inhibiting incongruent ones. Even minimal context supports the correct interpretation of figurative expressions through necessary semantic information (Gildea & Glucksberg, 1983). Relevant context facilitates the differentiation of figurative and literal meanings, enhancing comprehension, particularly for unfamiliar phrases. With sufficient context, metaphors can be processed as quickly as literal statements (Bowdle & Gentner, 2005). Additionally, Türker (2016) demonstrates that the effects of L1 conceptual/linguistic knowledge and L1 frequency vary with context. Consequently, most studies (Xu, 2014; Wu et al., 2021) consider the role of context, embedding metaphorical expressions in a one- or two-sentence context as research instruments. Regarding the configuration of context in facilitating comprehension, Shu (2000) suggests that metaphor comprehension begins with identifying metaphors through explicit signals or semantic-contextual conflicts, followed by inferring meaning based on the tenor and vehicle, with the quantity and quality of contextual information and the listener's knowledge structure significantly influencing the process.

Carrol and Littlemore (2020) argue that while context aids sensory selection, transparency is crucial for generating new senses. High transparency enhances memory retention of figurative language, improving L2 comprehension (Hubers et al., 2020). While transparent figurative languages are generally viewed as more decomposable, transparency and decomposability are distinct concepts, facilitating L2 figurative language comprehension (Carrol & Littlemore, 2020). Decomposability refers to the extent to which individual components independently contribute to the overall figurative interpretation (Gibbs et al., 1989). Higher decomposability improves meaning identification (Carrol & Littlemore, 2020). For example, in the Chinese metaphor 耳边风 (ěr biān fēng, “a puff of wind past the ear”), the components — 耳 (ěr, “ear”), 边 (biān, “beside”), and 风 (fēng, “wind”) independently contribute to its figurative meaning of unheeded advice, making the metaphor more decomposable and earlier to interpret.

Familiarity, or conventionality, is a crucial predictor in measuring the frequency of figurative expressions (Thibodeau & Durgin, 2011). Bowdle and Gentner (2005) note that novel metaphors require comparison and analysis, while conventional metaphors are categorized. High familiarity leads to rapid metaphor processing, aided by prior experience, which reduces viable

interpretations and strengthens semantic connections (Blasko & Connine, 1993). Consequently, conventional, high-familiar metaphors are processed more quickly and easily than novel ones (Giora, 1997). Therefore, familiarity is included in the screening criteria for developing experimental stimuli (Wang, 2018). Additionally, aptness also plays a crucial role in determining the speed and ease of metaphor processing, with research showing conflicting results. Damerall and Kellogg (2016) argue that familiarity alone drives metaphor processing, while Blasko and Connine (1993) find that high-familiarity metaphors are less affected by aptness than less familiar ones. Thibodeau and Durgin (2011) demonstrate that conventionalizing a metaphor speeds processing, whereas differently priming it reduces its aptness rating. Aptness, describing how well a metaphor's vehicle captures its tenor, influences metaphor-sentence quality but primarily measures perceived processing fluency (Tourangeau & Sternberg, 1981).

To summarize, sentence context, transparency, decomposability, familiarity, and aptness have been empirically identified to affect L2 metaphor comprehension. With the roles of context and familiarity being addressed in developing experimental stimuli, other dimensions have not been comprehensively elucidated in the screening criteria or incorporated as moderator variables in metaphor processing studies. This oversight threatens the external validity and generalizability of existing findings. For example, in Wu et al. (2021) study, the metaphor — 火热 (huǒ rè, “fiery, intense”) — was given to both Thai and Malay learners of Chinese. However, it might be understood differently by Thai and Malay learners of Chinese due to differences in direct translations and cultural connotations. In Thai, 火热 translates to ร้อนแรง (ron raeng, “fiery, intense”), which retains a similar metaphorical meaning, while in Malay, the direct translation *hangat* (warm) or *bersemangat* (full of energy) may not fully capture the same nuance. To address these discrepancies, a transparency rating test should be conducted when developing stimuli to ensure metaphorical expressions are appropriately understood across different linguistic and cultural backgrounds.

### *Mechanisms Revealed from L2 Metaphor Comprehension*

The processing mechanisms involved in L2 metaphor comprehension encompass interconnected cognitive and linguistic processes that collectively facilitate comprehension. In this review, strategy use, conceptual transfer, and neurological activity emerge as integral components of the broader mechanism driving L2

metaphor comprehension. Strategy use refers to the methods learners adopt for interpreting metaphors, while conceptual transfer involves the application of L1 knowledge to L2 metaphor understanding. Neurological activity provides insight into the real-time cognitive processes underlying metaphor comprehension.

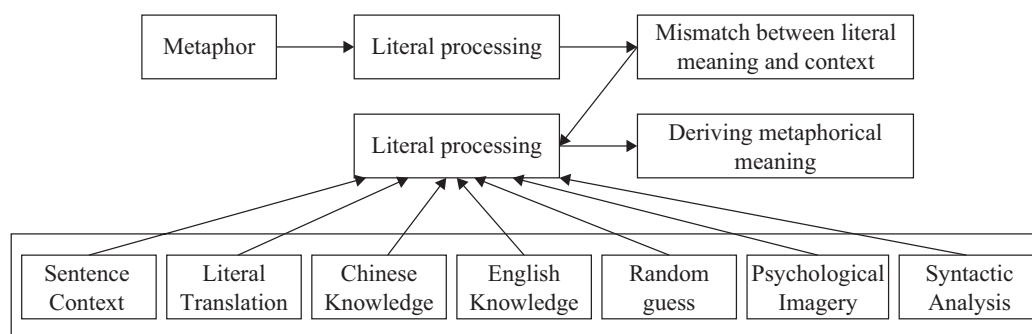
#### *Strategy use in L2 metaphor comprehension*

Strategy use plays a crucial role in L2 metaphor comprehension, providing learners with cognitive tools to navigate the complexities of metaphor interpretation. Specifically, sentence context and literal meaning assist learners in deciphering metaphorical meaning by drawing on contextual cues or translating metaphors directly from L2 to L1 (Wu et al., 2021; Xu, 2014). While sentence context helps infer metaphorical meaning through surrounding text, literal translation can lead to misinterpretation when metaphorical meanings significantly diverge from their literal counterparts. Linguistic and cultural knowledge from both L1 and L2 serve as essential knowledge resources for learners in metaphor comprehension, referred to as L1 and L2 knowledge. In studies exploring strategy use in L2 metaphor comprehension, learners commonly draw on these knowledge sources, though their effectiveness and frequency of use vary. Su and Chen (2020) found that while L1 knowledge is a secondary strategy, it remains effective in aiding metaphor comprehension. Xu (2014) observed that higher-proficiency learners rely more on L2 knowledge, whereas lower-proficiency learners often depend on L1 knowledge, albeit with less accuracy. Similarly, Wu et al. (2021) demonstrated that although using L1 and L2 knowledge resulted in 100 percent accuracy, the low frequency of their use limited the validation of these strategies' overall effectiveness.

Strategies do more than just aid in processing; they directly impact metaphor comprehension by enabling learners to handle linguistic and conceptual challenges. For example, when learners encounter unfamiliar metaphors,

they may rely on strategies like psychological imagery, syntactic analysis, or random guessing to compensate for knowledge gaps and low L2 proficiency (Li et al., 2019; Wu et al., 2021). Moreover, lexical interpretation strategies, particularly for Chinese L2 learners, allow learners to access metaphorical meaning, through the semantic components of Chinese characters (Wu et al., 2021). These strategies help learners move beyond literal interpretation, facilitating deeper comprehension of metaphorical expressions.

Despite extensive research on strategy use, few studies have established a comprehensive model for L2 metaphor comprehension. Xu and Wang (2014) examined metaphor comprehension strategies employed by Chinese EFL learners, who provided written explanations of their reasoning. The study identified several strategies: sentence context, literal translation, Chinese knowledge, English knowledge, random guess, psychological imagery, and syntactic analysis. The strategies revealed a multi-stage cognitive process in L2 metaphor comprehension: (1) initial literal interpretation based on the L2 lexical form, (2) recognition of a mismatch between literal meaning and sentence context, (3) association with L1 culture concepts, (4) projection of L1 concept onto L2 context, and (5) facilitation or hindrance of comprehension depending on concept alignment. Although learners start with literal processing, strategies are activated only when a conflict between literal meaning and context arises, prompting a shift to more analytical strategies to resolve the metaphorical meaning. This analytical approach led to the development of the *Analytical Model for Metaphor Comprehension* (See Figure 1), pioneeringly reflecting the role of literal processing, sentence context, and strategy uses. However, the written response format oversimplifies documentation of strategy patterns, such as a sequence of strategy deployment, and without tracking processing pathways, it fails to capture how these strategies interact to achieve L2 metaphor comprehension.



**Figure 1** The analytical model for metaphor comprehension (Xu & Wang, 2014)

Conceptual transfer in metaphor processing

In cognitive linguistics, conceptual transfers are the main focus in studies of L2 metaphor processing. This section primarily focuses on conceptual transfer in L2 processing, exploring how pre-existing metaphorical schemas in L1 influence the acquisition and comprehension of metaphors in L2. *Conceptual Transfer Theory*, first proposed by Odlin (1989), posits that language acquisition influences cognition, affecting the understanding and use of new languages, with L1 impacting L2 at cognitive and linguistic intersections (Jarvis & Pavlenko, 2007).

Metaphorical transfer is the application of *Conceptual Transfer Theory* to L2 metaphor processing, highlighting how pre-existing metaphorical schemas in L1 affect the acquisition and use of metaphors in L2 (Jarvis & Pavlenko, 2007). During the metaphorical transfer, information is translated between the source and target domains, involving complexity due to the asynchronous levels of the conceptual basis (CB) and linguistic form (LF) (Charteris-Black, 2002). Cross-cultural differences in conceptual systems lead to varying comprehension of conceptual metaphors (Lakoff & Johnson, 1980), reflected in the differences in LFs. Thus, metaphorical transfer entails correspondence between LF and CB. Danesi (2000) proposed three transfer modes: (1) The L1 concept results in positive transfer when the LF and CB of L1 and L2 are equivalent; (2) the L1 concept produces negative transfer when L1 and L2 share the equivalent LF but different CB; and (3) the transfer has a dual effect when the LF of L1 and L2 partly overlap.

Metaphorical transfer is analysed through metaphorical tests, which serve as primary stimuli for eliciting L2 learners' reports on metaphor processing. However, studies (Li et al., 2019; Wu et al., 2021) typically lack systematic classification criteria for the correspondence between learners' native language and the target language in stimuli selection, affecting test validity. Deignan et al. (1997) contrastive analysis model provides valuable insights by combining contrastive and cognitive-linguistic approaches. This model identifies four possible correspondences in L2 learners' metaphorical transfer: (1)

equivalent CB and equivalent LF, (2) equivalent CB and different LFs, (3) different CBs, and (4) equivalent LF but different metaphorical meaning. Charteris-Black (2002) refined this model by addressing cultural individuality and generality, providing a more precise model for analysing metaphorical transfer across languages (see Table 1). However, assessing cultural generality based on whether the knowledge basis is culturally neutral lacks specificity and may be perceived as subjective and biased, particularly when comparing languages with many commonalities.

Charteris-Black (2002) categorized figurative expressions into six types based on their relationships in English and Malay and used a multiple-choice test to examine L2 learners' metaphor comprehension difficulties. The results indicated that metaphors with equivalent CB and LF between L1 and L2 were easiest to comprehend, while those with equivalent LF but different CB were most difficult. Additionally, metaphors with transparent cultural references were more accessible to comprehend than those with opaque cultural meanings. Charteris-Black's revised contrastive model was applied to design metaphorical items to measure metaphoricity proficiency. Similarly, Zibin (2016) adopted a multiple-choice test to assess Jordanian EFL learners' metaphor comprehension by applying all six types of the contrastive model to compare English and Arabic metaphors, supporting Charteris-Black's findings. Xu (2014) also used contrastive models to classify English metaphors and assessed Chinese learners' comprehension, examining how proficiency influenced their strategy use, with participants providing written explanations of their interpretations. Using both isolated and contextualized metaphors, Türker (2016) explored how L1 conceptual and linguistic knowledge and context influence L2 figurative expression comprehension, finding that learners performed better when L1 and L2 were conceptually and linguistically analogous in minimal or no context situations. However, both Xu and Türker used only the first four types of the contrastive model, overlooking cultural contrasts between native language and target language.

Table 1 Contrastive model of figurative units (Charteris-Black, 2002)

|        | Category                                                           | Linguistic form | Conceptual basis |
|--------|--------------------------------------------------------------------|-----------------|------------------|
| Type 1 | ones with an equivalent CB and an equivalent LF                    | =               | =                |
| Type 2 | ones with an equivalent CB and a similar LF                        | ~               | =                |
| Type 3 | ones with a different CB but an equivalent LF                      | =               | #                |
| Type 4 | ones with an equivalent CB but a different LF                      | #               | =                |
| Type 5 | ones with a different CB (cultural-transparent) and a different LF | #               | #+transparent    |
| Type 6 | ones with a different CB (cultural-opaque) and a different LF      | #               | #+opaque         |

Note: \* = equivalent; # different; ~ similar

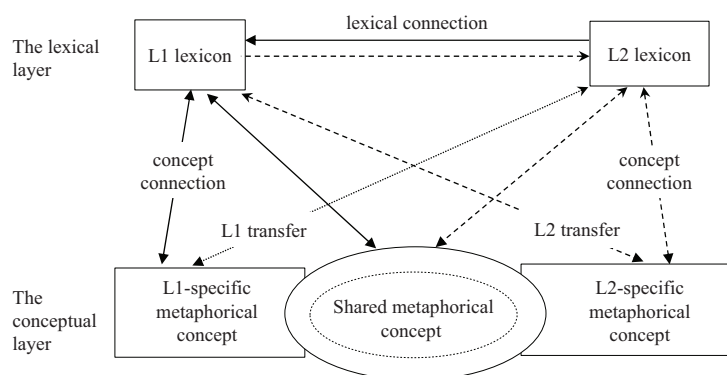
Building on previous models of bilingual conceptual representation models with findings on types of metaphorical concept representation schemas, Xu (2014) proposed the *Developmental Model of Metaphorical-conceptual Representation*, which explains the relationship between the development of metaphorical-conceptual representations and the improvement of learners' foreign language proficiency.

As shown in Figure 2, the *Developmental Model of Metaphorical-conceptual Representation* posits two input channels for bilinguals: L1 and L2. For low-proficiency L2 learners, lexical connections between the L1 and L2 are predominant. The L1 lexicon strongly connects to L1-specific and shared metaphorical concepts, while the L2 lexicon weakly connects to L2-specific concepts. L1 transfer occurs when the L2 lexicon maps to L1-specific concepts, leading to L1 positive transfer with shared concepts. Similarly, L2 transfer occurs when the L1 lexicon maps to L2-specific concepts, contributing to the L2 positive transfer when mapped to shared metaphorical concepts. However, due to the low proficiency of L2 learners, the positive transfer is relatively weak, while the negative transfer effect is more significant. As language proficiency improves, L2 learners restructure concepts, strengthening L2 lexicon connections and increasing L2 positive transfers. L1-L2 lexical connections always exist, with L1 to L2 connections being stronger. This model depicts conceptual transfers in L2 metaphor processing by highlighting the connections between L1 and L2 lexicons and metaphorical concepts. However, it fails to account for the interplay of multiple factors such as context, cultural familiarity, and individual cognitive strategies, lacking the comprehensive detail needed to fully explain the complexity of L2 metaphor processing.

### Neurological activity in L2 metaphor comprehension

With advancements in science and technology, substantial psycholinguistics research has explored neural activities underlying L2 metaphor processing over the last decade. This section delves into electrophysiological evidence on cognitive load and hemispheric engagement in L2 learners during metaphor processing, using various advanced techniques. Methods such as eye-tracking, event-related potentials (ERPs), which measure brain activity with high temporal precision, and functional magnetic resonance imaging (fMRI), which tracks brain activity by measuring changes in blood flow, have been widely employed. In particular, ERPs help assess violations of semantic expectancies – the brain's prediction of upcoming words or meanings.

Different types of metaphors influence cognitive load in distinct ways. Conventional metaphors, being familiar and frequently used expressions, demand less cognitive effort, whereas novel metaphors, which are new or unfamiliar, require more cognitive resources due to their complex conceptual mappings (Abraham et al., 2021; Blasko & Connine, 1993). Scientific metaphors, often found in technical domains, necessitate both metaphorical understanding and specialized domain knowledge (Shen et al., 2022). Empirical studies provide insight into these cognitive demands. Studies on conventional metaphor comprehension (Li et al., 2019; Wang, 2018; Zhu et al., 2022) indicate that L2 metaphors elicit higher cognitive load and engage both hemispheres differently compared to L1 metaphors and literal sentences. Additionally, higher L2 proficiency leads to greater accuracy and cognitive resource usage. Research on novel and scientific metaphors has revealed even greater cognitive demands. Studies incorporating novel metaphors or scientific metaphors (Abraham et al., 2021; Shen et al., 2022)



**Figure 2** The developmental model of metaphorical-conceptual representation (Xu, 2014)

indicate that novel metaphors require higher cognitive effort and greater right-hemisphere engagement due to their unfamiliarity and complex conceptual mappings, while scientific metaphors exhibit high cognitive load due to their dual-contextual nature, necessitating the need for scientific inference and knowledge integration.

Though ERP studies provide valuable empirical evidence for bilingual mechanisms, they are limited by controlled experimental settings that may only partially capture natural language processing. A notable methodology limitation is the exclusive use of “X is Y” sentences to maintain consistency in sentence length and complexity, which restricts the generalizability of the results given the diversity of metaphorical structures. Additionally, electrophysiological studies have a limited role in depicting specific cognitive processes underlying the observed neural responses, failing to determine if the increased cognitive load for L2 metaphors is due to rejecting literal meanings or transferring explicit L2 knowledge. These ambiguities restrict the explanatory power to draw definitive conclusions about the mechanisms involved in L2 metaphor comprehension.

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## Discussion

Previous empirical investigations have revealed processing mechanisms and moderating factors that shape L2 metaphor comprehension across linguistic domains. However, controversies in existing mechanisms and methodological inadequacies require further attention to capture the multifaceted nature of linguistic and cognitive processes. This chapter critically reflects on the existing limitations and future implications from the perspectives of theoretical foundations, research focus, and methodology.

Regarding theoretical foundation, existing models for L2 metaphor comprehension have yet to establish a unified processing mechanism. Over the past three decades, academic debates have focused on two core approaches: rationale processing and contextual referencing. Rationale processing, a bottom-up approach, emphasizes the logical connection between the tenor and the vehicle of a metaphor, forming a pathway of “tenor - rationale - vehicle” (Wang et al., 2022). This approach primarily represents the fundamental perspective of mapping and matching mechanisms, where L1 or L2 concepts provide the rationale for linking the tenor and vehicle. Conversely, contextual referencing, a top-down approach, highlights the role of contextual information in inferring the vehicle of

the metaphor. Kövecses (2015) notion of context-induced creativity further elaborates this perspective, arguing that metaphors arise dynamically from specific contextual pressures, such as cultural, social, and physical environments. Context allows L2 learners to interpret or create metaphors creatively, integrating semantic cues like literal meanings and contextual information. This aligns with the *Graded Salience Hypothesis* (Giora, 1997), which posits that salient word meanings are accessed first in the mental lexicon but are adjusted when mismatched with the surrounding context, as well as the *Semantic-context Effects* (Tulving & Gold, 1963), which highlight the role of context in word perception. The key difference between these approaches is that rationale processing focuses on the inherent structure of metaphors, while contextual referencing relies heavily on external cues from the surrounding environment to derive metaphorical meaning.

However, rather than adhering to one of the two pathways in models explaining L1 metaphor processing, a thorough review reveals that both rationale processing and contextual referencing are involved in L2 metaphor comprehension. For example, the *Analytical Model for Metaphor Comprehension* (Xu & Wang, 2014) demonstrated that L2 learners first engage in rationale processing on literal translation before utilizing contextual referencing to reconcile the mismatch between literal and metaphorical meanings. Similarly, in Xu (2014) *Developmental Model of Metaphorical-conceptual Representation*, learners initially conduct rationale processing by relying on L1 conceptual transfer but increasingly integrate L2-specific metaphorical concepts as their proficiency improves, illustrating a gradual shift towards more contextually guided metaphor comprehension. These L2 models reflect how both pathways – initial rationale processing and later contextual referencing – interact, with L1 transfer serving as a starting point before contextual clues guide deeper metaphorical understanding. Future research should focus on identifying specific conditions under which these two pathways converge, and how their integration influences metaphor comprehension across varying proficiency levels and cultural contexts, thereby developing insight into a unified processing mechanism for L2 metaphor comprehension.

Furthermore, the limited scope and scale of existing studies often confine research to a single linguistic discipline, making reliance on current data inadequate for developing comprehensive processing models, thus leading to inconsistencies and disputes across different disciplines. For example, controversial

views have been presented on whether rejecting literal meaning is necessary for L2 metaphor comprehension, leaving it uncertain if L2 learners can directly access metaphorical meaning. Though conceptual knowledge of metaphors can facilitate rapid access to metaphorical meaning, existing evidence cannot deny the necessity of literal meaning activation and rejection. To resolve this controversy, future studies should consider cross-linguistic interdisciplinary research by integrating theoretical frameworks from neurolinguistics, cognitive and applied linguistics. Addressing the potential brevity of response times in electrophysiological measurements, and findings from concurrent and retrospective verbal reports and references from previous L2 processing models can provide triangulated evidence to resolve existing disputes on L2 metaphor processing mechanisms. This triangulation method, which incorporates references to existing models, quantitative data support, and qualitative data interpretation, can facilitate a thorough analysis and refinement of the processing patterns indicated by current research data.

Concerning the focus of research, much attention has been given to the strategy use and the association between learners' L2 proficiency levels and comprehension performance. Nevertheless, most studies rely on written reports, which emphasize cognitive resources but often overlook metacognitive strategies, posing a potential oversight. Subsequent research should address this limitation by incorporating both cognitive and metacognitive strategies to develop for a comprehensive model of L2 metaphor processing. Additionally, there have been controversial findings regarding the effect of L2 proficiency level on comprehension. Li et al. (2019) report a significant correlation between higher proficiency and better metaphor comprehension, while Yao (2019) suggests that this correlation is inconsistent across different proficiency levels. These discrepancies may arise from varying standards for grading levels and confounding variables such as learners' age of exposure to the L2 and length of exposure. Further investigation should examine the interplay between L2 proficiency levels and metaphor comprehension by employing longitudinal designs and controlling for confounding variables.

Regarding research methods, metaphorical tests are typically employed as stimuli in empirical studies, yet the selection of metaphorical expressions often lacks systematical screening criteria. Beyond basic categorization (i.e., conventional/novel, noun/verb), key factors moderating metaphor processing, such as transparency, decomposability, and familiarity,

should be clarified to ensure test validity and reliability. Additionally, these tests often use electrophysiological or self-report methods. While electrophysiological research provides neurological evidence, it may not capture the complexities of real-world language use and the dynamic interplay of cognitive, contextual, and cultural factors in L2 metaphor processing. Self-report methods, which present questions as multiple-choice (Wu et al., 2021; Zibin, 2016) and open-ended responses (Xu, 2014), require participants to select answers or provide written/verbal reports. Despite their widespread use, multiple-choice formats can serve as cues for unfamiliar metaphors, and written reports may fail to capture learners' immediate, online processing. Think-aloud protocols offer in-depth data through real-time verbal reports, but are limited by time and resource demands, and the challenge of having participants verbalize in their L2. To address that, incorporating a mix of multiple-choice formats, open-ended responses, and think-aloud protocols can offer deeper insights into learners' online processing. Besides, using L1 in verbal reports can help them articulate their thoughts more effectively, improving the quality of qualitative data collected.

As for research subjects, previous studies primarily target EFL learners, with scarce attention given to L2 learners of other languages, resulting in a lack of comparative analysis of strategy and resource use across languages. English, as an alphabet script, allows L2 learners to prioritize phonetic decoding without requiring logographic recognition. In contrast, ideographic languages, such as Chinese, require learners to recognize logographic characters, which consist of both semantic and phonetic radicals. Some studies have shown that Chinese, as a hieroglyphic language, engages bilateral activation during semantic processing (Wang, 2018; Zhu et al., 2022). These differences suggest that L2 learners of ideographic languages exhibit unique patterns in metaphor processing. Significant emphasis should be directed towards learners with an alphabetic L1 and an ideographic L2, as their processing of ideographic characters can provide a holistic understanding of L2 metaphor comprehension.

In sum, the existing models have been effective in explaining some aspects of metaphor comprehension, but they do not fully address the cognitive complexities unique to L2 learners. Many of these models lack the integration of cross-linguistic data, which limits their applicability to global L2 contexts. Future research must incorporate interdisciplinary approaches and propose novel frameworks that take into account these limitations.

## Conclusion

This review critically explored the processing mechanisms and moderating factors involved in L2 conceptual metaphor comprehension. While considerable progress has been made in understanding how L1 learners process metaphors, the complexities faced by L2 learners require more nuanced approaches. Many of the existing models, while insightful, fail to fully capture the cross-linguistic and cognitive challenges unique to L2 metaphor comprehension. This gap highlights the need for more comprehensive models that integrate insights from cognitive linguistics, neurolinguistics, and second language acquisition research.

Moreover, the review emphasized the importance of context and cultural knowledge in shaping how L2 learners interpret metaphors. The role of strategies like sentence context and lexical interpretation in resolving metaphorical meaning for L2 learners cannot be overstated. However, empirical evidence suggests that these strategies are often applied differently by L2 learners depending on their language proficiency and cultural familiarity. Future research should prioritize interdisciplinary and cross-linguistic studies to develop models that account for these complexities. Additionally, methodological improvements, such as integrating data triangulation and longitudinal studies, are essential to providing a more holistic understanding of L2 metaphor processing. By addressing these gaps, future studies can offer more effective pedagogical tools to support L2 learners in mastering metaphorical language. In sum, this review serves as a stepping stone for advancing research in L2 metaphor comprehension, offering practical directions for future studies that aim to capture the intricate interplay of cognitive, linguistic, and cultural factors in second language learning.

## Conflict of Interest

The authors declare that there is no conflict of interest.

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