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Cross-Linguistic Influence of Image Schema on Chinese EFL Learners' Acquisition of the Spatial Preposition 'in'

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Abstract

English spatial prepositions present challenges for EFL learners due to context dependence, lack of direct equivalence, conceptual differences, and other contributing factors. This study investigates how cross-linguistic similarities and differences in image schema relations between figure and ground (e.g., containment) influence Chinese EFL learners' acquisition of preposition 'in', revealing the cognitive processes underlying conceptual transfer and its pedagogical implications. An explanatory sequential mixed-methods approach was employed, combining quantitative analysis from a picture-based test with qualitative insights from introspective interviews. A total of 150 Chinese university students, selected via a background questionnaire and a vocabulary test, were grouped into three English proficiency levels. The test examined learners' use of 'in' across seven contexts, categorized according to cross-linguistic similarities and differences between 'in' and its Chinese equivalent 'li', based on container categorization and prototype theory. Cross-linguistic similarity and difference served as the independent variable, with proficiency functioning as a moderating factor. Semi-structured interviews explored the cognitive mechanisms underlying L1 conceptual transfer across four key themes. The results indicate that context and proficiency jointly influenced the use of 'in'. Cross-linguistic similarities (e.g., Contexts I, IV, VI, VII) facilitated positive transfer, whereas differences (e.g., Contexts II, III, V) resulted in negative transfer. Although higher proficiency generally increased overall accuracy, Contexts II and III deviated from this pattern because learners were unaware of conceptual errors. The findings suggest that task-based learning, explicit instruction, and VR-enhanced input may help address conceptual transfer

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challenges, emphasizing the value of incorporating conceptual transfer theory into language teaching.

Keywords: Cognitive linguistics, conceptual transfer, education, EFL learners, spatial prepositions.

1. INTRODUCTION

English as a foreign language (EFL) learners often struggle to master English spatial prepositions due to context dependence, the absence of direct equivalents in their first language (L1), and conceptual differences (Alhammad, 2023; Alonso et al., 2016). Cross-linguistic differences in image schemas and family resemblance further complicate the acquisition of these prepositions in a second language (L2) (Taferner & Yamada, 2020). Despite these challenges, English spatial prepositions are crucial for linking sentence elements and expressing spatial relations (Biber et al., 1999).

Given the challenges and importance of spatial prepositions, conceptual transfer offers a valuable perspective on how L1-based concepts influence L2 acquisition. Defined as the cross-linguistic influence arising from language-specific concepts and conceptualization patterns (Jarvis, 2023), conceptual transfer has gained growing attention in recent years (Austen & Jarvis, 2021; Jarvis, 2016). Since the introduction of the Conceptual Transfer Hypothesis (CTH) by Jarvis (1998) and Pavlenko (1998), research on English spatial prepositions has increasingly focused on the conceptual level of language transfer. Closely linked to cognitive processes, this phenomenon involves structural and conceptual differences between languages. Studies across eight cognitive domains (space, time, emotion, object, motion, personhood, gender, and number) have yielded valuable insights into how conceptual transfer shapes EFL learners' understanding and use of linguistic structures (Nghi & Phuc, 2022; Park et al., 2022; Phuc et al., 2023).

In this study, image schema refers to the schematic relations between 'figure' and 'ground,' reflecting fundamental cognitive processes. Talmy (1978) introduced the concepts of Figure and Ground from Gestalt psychology, and Levinson (2003) observed that most spatial descriptions involve these two components. For example, in the expression 'a boy in the tree,' both English and Chinese treat the boy as the figure and the tree as the ground. English uses 'in', implying that the boy is within a containment schema, while Chinese uses *shang* (*zai* tree *shang*), emphasizing a support schema. Linguistic expressions of spatial relations, therefore, convey not only physical configurations but also engage cognitive processes for accurate interpretation. Viewing these relationships through a language acquisition perspective reveals the dynamic interaction between language and thought (Becker & Carroll, 1997), with cross-linguistic influences arising from both linguistic and cognitive factors in L2 acquisition (Jarvis, 2023). This present study specifically examines the cross-linguistic influence of image schema in the spatial domain.

Existing research demonstrates the role of conceptual transfer in EFL learners' acquisition of English prepositions. Studies by Nghi and Phuc (2022) and Phuc et al. (2023) showed that Vietnamese EFL learners' understanding and use of English prepositions were shaped by L1 conceptual transfer. Wolter et al. (2020) examined the influence of L1 spatial concepts on Japanese EFL learners' receptive comprehension of English spatial expressions. Similarly, Taferner and Yamada (2020) investigated how cross-linguistic differences in image schema and family resemblance affected Japanese EFL learners' use of 'in' and 'on'. Collectively, these studies reveal that conceptual transfer plays a substantial role in the acquisition of English spatial prepositions. Jarvis (2023) called for further empirical research on the interaction of conceptual transfer in different domains across languages, stressing the need to uncover the cognitive mechanisms involved to inform pedagogical practice.

Chinese EFL learners often struggle with English spatial prepositions. Prepositional errors account for nine percent of all mistakes in the iWrite Baby Chinese Learner English Corpus (J. J. Xu, 2019). Among these, 'in' is particularly prone to misuse, with an error rate of 23.9%. Research on semantic transfer suggests that the semantic scope of 'in' encompasses *li* (the Chinese

equivalent of 'in') and extends beyond it, whereas *shang* (the Chinese equivalent of 'on') covers both 'in' and 'on' (Pan & Hu, 2022). This semantic mismatch contributes to the difficulty Chinese EFL learners face when acquiring 'in.'

Studies on conceptual transfer in Chinese EFL learners' acquisition of 'in' (Li & Liu, 2015; Q. Xu, 2015; Yu & Li, 2017; H. Zhang & Liu, 2013) have yielded inconsistent results. While corpus-based studies (Yu & Li, 2017; H. Zhang & Liu, 2013) found little or no evidence of negative conceptual transfer, experimental studies (Li & Liu, 2015; Q. Xu, 2015) suggest that it caused numerous errors. These discrepancies may be attributed to methodological differences and to the limited scope of the corpora (Yu & Li, 2017). Although corpus-based research provides extensive datasets, thematic mismatches between L1 and L2 corpora constrain direct comparison (Cai & Chang, 2021). Moreover, some studies (e.g., Yu & Li, 2017; H. Zhang & Liu, 2013) have conflated semantic transfer with conceptual transfer, underscoring the need for more rigorous methodologies and more substantial evidence to confirm that transfer originates at the conceptual level (Cai & Chang, 2021). Experimental studies also require tighter control of extraneous variables and incorporate supplementary tasks to substantiate claims of conceptual transfer (Pavlenko & Malt, 2011). Moreover, most prior research examined isolated prepositions rather than collocations, and corpus-based studies have largely overlooked the role of English proficiency. Experimental research exploring its relation to conceptual transfer remains scarce. As a result, the link between Chinese EFL learners' conceptual transfer and their English proficiency is insufficiently understood.

To address these gaps, this study adopted an explanatory sequential mixed-methods approach (Creswell, 2017), combining quantitative analysis of a picture-based preposition test with qualitative insights from introspective interviews. The test generated a comparable learner corpus, while the interviews revealed underlying cognitive processes. A total of 150 participants who met the defined criteria were assigned to three English proficiency groups. This study examined how cross-linguistic similarities and differences in image schema influenced Chinese EFL learners' use of 'in' in preposition–noun collocations, and how these influences varied with proficiency level. Specifically, the study addressed the following research questions:

1. How do cross-linguistic similarities and differences in image schema influence Chinese EFL learners' use of 'in'?
2. How do these influences change with increasing general English proficiency?

2. LITERATURE REVIEW

In constructing the theoretical framework, this literature review addresses six key aspects: (1) the Conceptual Transfer Hypothesis; (2) prior research on conceptual transfer in the L2 acquisition of the English spatial preposition 'in'; (3) a comparison of the English spatial preposition 'in' and the Chinese directional word *li* in expressing spatial relations; (4) a comparison of the image schema of the English spatial preposition 'in' and the Chinese directional word *li*; (5) the classification of seven types of containers based on prototype theory; and (6) the classification of seven context types based on cross-linguistic similarities and differences in image schema.

2.1 The Conceptual Transfer Hypothesis

The Conceptual Transfer Hypothesis (CTH) provides a foundational framework for understanding conceptual transfer in language acquisition. It posits that speakers of different languages develop distinct conceptual patterns that may transfer across languages and influence bilinguals' or L2 learners' use of both L1 and L2 (Bylund & Jarvis, 2011). CTH explains this process through a 'Language → Cognition → Language' model, distinguishing it from both Linguistic Relativity (LR) hypothesis and the Thinking-for-Speaking Hypothesis (TFSH).

Linguistic Relativity (LR), also known as the Sapir–Whorf Hypothesis, explores how language shapes cognition. Although interest declined with the rise of Chomsky's Universal

Grammar, Neo-Whorfism revived the discussion by providing empirical evidence, especially in studies of spatial and temporal cognition among monolingual speakers (Levinson, 2003). Building on this foundation, CTH extends the language-thought relationship to bilingual contexts, proposing that conceptual patterns are reshaped during L2 acquisition and may influence both L1 and L2. For example, Chinese EFL learners may apply L1-based conceptual patterns when using 'in' in English (L1 → L2), and newly acquired English concepts may also influence their thinking in Chinese (L2 → L1). The Thinking-for-Speaking Hypothesis (TFSH), introduced by Slobin (1991), further explains how language affects cognition during speech production, particularly in the context of motion events. It emphasizes language-specific patterns of "thinking for speaking" and complements the CTH framework by accounting for online conceptualization during linguistic performance.

While LR focuses on how language shapes cognition, and TFSH examines how language influences cognitive patterns during speech production, CTH integrates both perspectives to explore cognitive processes and cross-linguistic influence in L2 acquisition. Additionally, CTH draws on Vygotsky's sociocultural theory (Jarvis & Pavlenko, 2008), which views concepts as dynamically developing through social interaction and linguistic experience. From this perspective, cognitive structures such as categorization and reasoning evolve across the lifespan and are continuously reshaped through engagement with multiple languages.

Building on CTH, Jarvis (2023) further elaborates how L1 conceptual frameworks influence L2 use and comprehension during L2 acquisition. Conceptual transfer, as a subset of language transfer, includes two dimensions: concept transfer and conceptualization transfer. It may occur in three directions: forward (L1 → L2), reverse (L2 → L1), and bidirectional (mutual influence between L1 and L2). Depending on the outcome, conceptual transfer may be positive or negative. The present study investigates forward transfer (L1 → L2), including both positive and negative transfer.

2.2 Prior Research on Conceptual Transfer in the L2 Acquisition of the English Spatial Preposition 'in'

Prior research on conceptual transfer in the L2 acquisition of the English spatial preposition 'in' has revealed that when L1 spatial concepts and patterns of conceptualization differ from those of the L2, negative conceptual transfer is likely to occur (Alonso et al., 2016; Taferner & Yamada, 2020). Alonso et al. (2016) demonstrated that conventions for construing spatial configurations differ among Danish, Spanish, and English, leading Danish and Spanish L2 learners to rely on their L1 spatial frameworks when using English prepositions such as 'in', 'on', and 'at'. Their study employed two data-elicitation tasks: a picture-description task involving ten images and a sentence-completion task requiring preposition selection to examine learners' conceptual representations. Similarly, Taferner and Yamada (2020) investigated mismatches in image schemas and family resemblance between Japanese and English using preposition fill-in tasks, picture-drawing tasks, and picture-description tasks. Both studies employed multiple visual tasks to generate rich data on how conceptual transfer functions across languages.

Research on Chinese EFL learners demonstrates comparable cross-linguistic influences. Studies examining conceptual transfer in the acquisition of the English spatial preposition 'in' have shown that positive transfer facilitates acquisition, whereas negative transfer leads to systematic errors (Li & Liu, 2015; Q. Xu, 2015; Yu & Li, 2017). Q. Xu (2015) noted that the cognitive factors influencing the use of 'in' are complex and multifaceted, suggesting the need for further investigation. Yu and Li (2017) emphasized that cross-linguistic mismatches between English and Chinese require clarification, highlighting the importance of contrastive analysis. Furthermore, Yu and Li (2017) recommended that English preposition instruction should address spatial cognitive differences, raise learners' awareness of prototypical meanings, and reduce reliance on direct translation. Building on this work, Cai and Chang (2021) proposed a framework outlining the causes, manifestations, and influencing factors of conceptual transfer, advocating for systematic cross-linguistic comparisons of target structures and their underlying cognitive systems to identify similarities and differences. Such comparisons are essential not only for

deepening theoretical understanding but also for informing the design of pedagogical tasks that integrate linguistic and visual representations to elicit richer conceptual data.

2.3 A Comparison of the English Spatial Preposition 'in' and the Chinese Directional Word *li* in Expressing Spatial Relations

Describing spatial relations requires establishing a spatial reference frame. Cognitive science suggests that perceiving spatial relations involves determining the position of one object relative to another, a process grounded in the Figure-Ground principle. A spatial reference frame consists of a figure, a ground, and the spatial relation between them (Evans, 2007). Notably, such reference frames are not inherent properties of the objective world but are subjective constructs shaped by the observer's cognition (Yu & Li, 2017).

Based on extensive cross-linguistic research, Levinson (2003) identified three primary types of spatial reference frames used across languages: intrinsic, relative, and absolute. Both English and Chinese employ relative and absolute frames and share similarities in Figure-Ground identification (Yu & Li, 2017). For example, in the sentence 'The bike stood near the house', the bike functions as the figure and the house as the ground in both English and Chinese, reflecting shared cognitive patterns between the two languages. However, linguistic encoding of spatial relations differs, particularly with respect to spatial dimensions (e.g., point, line, surface, area, volume). English uses prepositions to express these relations, which are categorized into three types based on the spatial dimensions of the ground relative to the figure (Quirk et al., 1985). Type-0 prepositions include 'at', 'to', and 'from'; Type-1/2 prepositions consist of 'on', 'onto', and 'off'; and Type-2/3 prepositions encompass 'in' 'into' and 'out of'. For instance, in the sentence 'The cows are in the field', the field represents a Type-2 area, while in 'There are only two beds in the cottage', the cottage is viewed as a Type-3 volume. Thus, 'in' can function as both Type-2 (area) and Type-3 (volume), depending on context.

In contrast, Chinese encodes spatial relations in a structurally different manner. Wu and Wei (2007) found that the Chinese directional word *li* corresponds to 'in' when expressing containment. Whereas English typically marks containment solely through the preposition 'in' (e.g., in the drawer), Chinese often combines *zai* with *li* to convey dimensional information (e.g., *zai* drawer *li*). In some cases, *zai* can be omitted, leaving a noun followed by *li* (e.g., drawer *li*). Alternatively, *li* can be omitted, with *zai* alone indicating spatial relation (e.g., *zai* drawer) (Zhou, 2011).

These linguistic differences reflect broader cognitive and cultural distinctions in spatial conceptualization. Chinese speakers tend to prioritize simplicity over precision when describing spatial relations (Yu & Li, 2017). Y. Zhang et al. (2011) argued that Chinese categorizes spatial scope into inner, upper, and outer configurations, providing a more intuitive framework than English's abstract geometric concepts of point, line, surface, area, and volume. While Chinese speakers assess dimensional features in spatial relations, their judgments are often made more intuitively and less constrained by rigid dimensional criteria. For instance, in the preposition test, Item 26 (There is a car ___ the square), when the ground denotes an area (see Figure 1), English uses 'in', emphasizing that the car is contained within the square. In contrast, Chinese tends to prefer *shang* (*zai* square *shang*), stressing the car's position on the upper surface of the square. Consequently, 34% of Chinese EFL learners chose 'on', compared to only 22.7% who selected 'in'. These findings suggest that differences in spatial conceptualization may be deeply rooted in culturally shaped cognitive patterns.

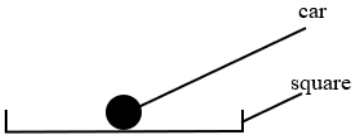

Figure 1. The image schema of *in* and *shang*.

2.4 A Comparison of the Image Schema of the English Spatial Preposition 'in' and the Chinese Directional Word *li*

Image schema consists of three essential components: trajectory, landmark, and path. According to Langacker (1987), the trajectory (TR) represents the focal element in a spatial relationship and represents the moving or located object (figure). Landmark (LM) serves as the reference point (ground), providing spatial context for the trajectory. The path refers to the route or area along which the trajectory moves or is positioned, indicating both direction and distance. Together, these components constitute the conceptual foundation for understanding spatial relations.

The image schema of *in* (see Figure 2) involves the trajectory being fully or partially enclosed by the landmark, without requiring complete enclosure on all sides. The trajectory can be moving or static (H. Zhang & Liu, 2013). Similarly, the image schema of *li* (see Figure 3) involves the trajectory being located within a container-like landmark, which may be either open or closed. The trajectory can also be moving or static (H. Zhang & Liu, 2013).

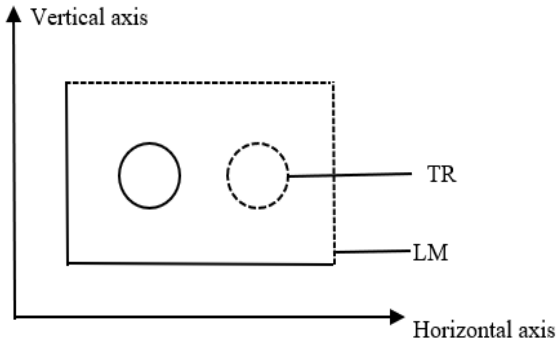

Figure 2. The image schema of 'in'.

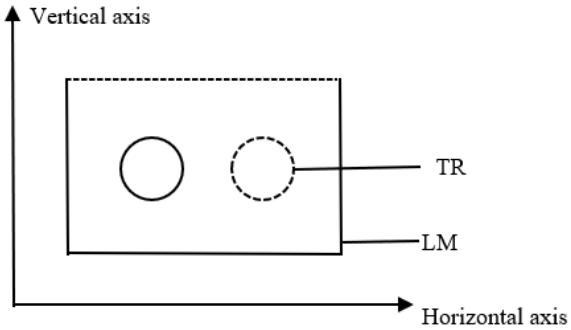

Figure 3. The image schema of *li.*

The image schema of 'in' and *li* share the feature of a container-like landmark enclosing the trajectory, whether in a static or dynamic state (H. Zhang & Liu, 2013). A container-like landmark represents a typical spatial category in English and Chinese (Q. Xu, 2015). However, the key difference lies in the degree of enclosure: *li* requires enclosure by a container-like landmark on all relevant sides, whereas 'in' permits either complete or partial enclosure. For example, in the preposition test, Item 46 (There is a boy ___ the tree), the picture shows a boy is partially enclosed by the tree. Despite the structure, 'a boy in the tree' being repeatedly taught in middle school English, only 8.7% of Chinese EFL learners chose 'in'. This outcome suggests that merely explaining prepositional meanings is insufficient; instead, teachers should highlight the cognitive differences between Chinese and English to address these errors. Q. Xu's (2015) classification of containers provides a valuable framework for understanding these cross-linguistic differences.

2.5 The Classification of Seven Types of Containers Based on Prototype Theory

Prototype theory, proposed by Rosch (1978), posits that categories are organized around prototypes, which represent the most typical examples or conceptual cores of a category. According to this theory, category membership is not an all-or-nothing matter but involves varying degrees of typicality (Ungerer & Schmid, 2013). The prototype exemplifies the category by sharing the greatest number of attributes with other members and the fewest with members of contrasting categories. As a result, category membership is graded, with greater similarity to the prototype indicating a more central status within the category (Taylor, 2002).

Family resemblance is a key principle that governs the formation of category prototypes and the gradient of category membership (Ungerer & Schmid, 2013). As defined by Rosch and Mervis (1975), this principle suggests that category members are connected through overlapping features rather than by sharing a single, defining set of attributes. Cognitive factors, such as Gestalt principles, conceptual projection across domains, topological characterization, and cultural influences, all contribute to family resemblance among category members.

Building on prototype theory and previous research by Cuyckens (1993), Hottenroth (1993), and Q. Xu (2015) applied a geometric-functional approach to categorize objects based on the schematic landmark represented by 'in', arranged along a prototypicality continuum. The preposition 'in' denotes containment, indicating that a located object is within an interior space defined by a reference object (Becker & Carroll, 1997). Q. Xu (2015) identified seven types of containers (see Table 1) along a prototypicality continuum from Type I (most prototypical) to Type VII (least prototypical).

Table 1. Seven types of containers.

Type	Dimensionality	Hollowness	Closeness	Discreteness
I	Three	Hollow	Fully close	Discrete, bounded
II	Three	Hollow	Partially close	Discrete, bounded
III	Three	Solid	Fully close	Discrete, bounded
IV	Three	Hollow/Solid	—	Indiscrete, vaguely bounded, or unbounded
V	Two	—	—	Discrete, bounded
VI	Two	—	—	Indiscrete, vaguely bounded, or unbounded
VII	One	—	—	—

Note. the dash '—' means absence of a specific attribute.

Q. Xu (2015) found that for monolingual English speakers, the use of 'in' correlates with container prototypicality, with its frequency increasing as the container becomes more prototypical. However, this pattern did not apply to Chinese EFL learners, as the frequency of their responses did not decline linearly as prototypicality decreased. Specifically, 'in' was used most frequently with Type I containers (e.g., car, classroom) and least frequently with Type II containers (e.g., penholder, stirrup). Further analysis showed that the effect of prototypicality was moderated by cross-linguistic equivalence in container categorization, but Q. Xu (2015) did not explain in detail how this influence operates. These findings suggest that cross-linguistic similarities and differences in container categorization influence learners' use of 'in.'

2.6 The Classification of Seven Contexts Based on Cross-linguistic Similarities and Differences in Image Schema

Building on Q. Xu (2015)'s findings, this study identifies seven contexts based on cross-linguistic similarities and differences in container categorization, specifically the image schema between 'in' and its Chinese equivalent *li*.

1. Context I refers to the shared image schema in which the located object (figure) is either fully or partially enclosed by a three-dimensional, hollow, container-like reference object (ground). These prototypical containers with clear and salient boundaries include Type I containers (e.g., car, cage, telephone box, and classroom) and some Type II containers with one open side (e.g., toothpick box, penholder). In this context, the strong perceptual salience of enclosure

facilitates a high degree of conceptual overlap between English 'in' and Chinese *li*, thereby promoting positive conceptual transfer.

2. Context II involves divergence in conceptualization. In English Type II containers with multiple openings or partial enclosure (e.g., 'highchair', 'stirrup', 'fork of a tree', 'pulpit', and 'tree') are construed as containers due to mental closure, based on Gestalt principles (e.g., proximity, similarity, closure, and continuity). In contrast, Chinese does not interpret mental closure as sufficient evidence of containment, reflecting the L1-based reliance on direct visual intuition rather than inferred enclosure.
3. Context III shows differing schemas. In English, Type III containers (e.g., 'wall', 'ice', 'tablecloth', 'cup', and 'road') are construed through a static embedding schema, whereby containment is projected from hollowness onto solidity, and the figure is conceptualized as embedded within a solid reference object. In contrast, Chinese typically interprets these configurations as supporting surfaces, reflecting the absence of such conceptual projection.
4. Context IV represents a shared understanding. Type IV containers (e.g., 'rain', 'light', 'water', and 'sunshine') are mass objects that lack clearly defined boundaries and function as continuous, indivisible environment with potential for unlimited expansion. In both English and Chinese, 'in' and *li* are used to express the spatial relation of an object being surrounded by such an environment.
5. Context V deals with perspectival variation. Type V containers (e.g., 'square', 'mirror', 'margin', and 'field') can be viewed either as containers or as supporting surfaces, depending on the conceptual perspective adopted. In English, 'field' is perceived as a bounded container in the phrase 'the cow in the field', but as a supporting surface in 'players on the field'. Chinese, by contrast, tend to interpret these entities as supporting surfaces, reflecting culture-specific perspectives.
6. Context VI presents partial convergence. In English, Type VI containers (e.g., 'sky', 'universe', 'continent', and 'desert') are conceptualized as containers due to their expansive, enclosing nature. Chinese aligns with similar visual experiences of spatial enclosure; however, the conceptualization of these spaces as containers may be less prominent.
7. Context VII highlights an abstract similarity. Through conceptual projection, English enables Type VII containers (e.g., 'circle', 'queue', 'row' and 'line') to be construed as containers despite the absence of physical enclosure. In Chinese, attention is directed more toward individual entities within the collection, but *li* is still employed to express part-whole relations.

Taferner and Yamada (2020) found that only 6% of Japanese college students correctly selected 'in' for 'birds in the tree'. Picture-drawing and description tasks revealed that most students perceived the tree solely as a trunk and branches, making it difficult to distinguish between 'in' and 'on'. Since Chinese learners face similar challenges, incorporating spatial visual tasks may help clarify conceptual mismatches between 'in' and *li* and guide the development of targeted instructional strategies, such as task-based learning, explicit instruction, and VR-enhanced input. Therefore, this study examines Chinese EFL learners' use of 'in' across seven contexts, providing empirical support for cross-linguistic differences and informing pedagogical practice.

3. METHODS

This study employed an explanatory sequential mixed-methods approach (Creswell, 2017), integrating quantitative analysis to identify patterns of conceptual transfer with qualitative data to explore learners' cognitive processes, thereby offering a comprehensive understanding of the phenomenon. Based on Cai and Chang's (2021) theoretical framework of conceptual transfer and container categorization (Q. Xu, 2015), grounded in prototype theory, the conceptual framework in this study (see Figure 4) illustrates the relationships among the independent, mediating, moderating, and dependent variables. Quantitative analysis of a prepositional test examined how cross-linguistic similarities and differences in image schema affected Chinese EFL learners' use of 'in' and how these influences varied with increasing English proficiency. Qualitative analysis,

through introspective interviews, provided further insights into the cognitive mechanisms underlying L1 spatial conceptual transfer.

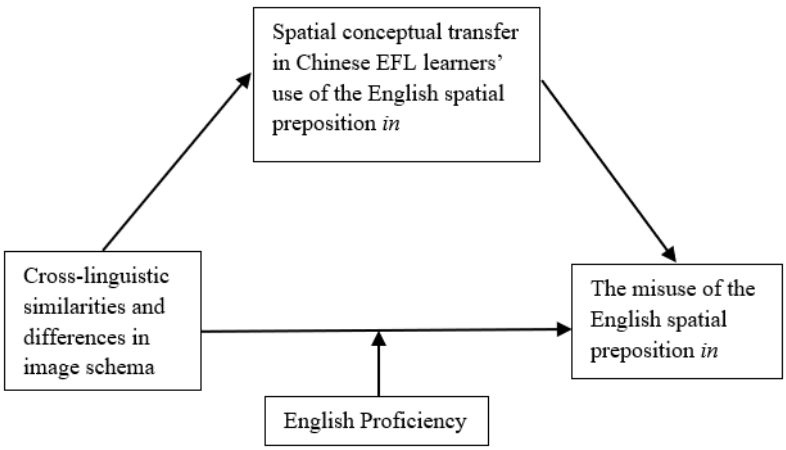

Figure 4. Conceptual framework of spatial conceptual transfer.

3.1 Participants

A total of 150 university students from Anhui Province were divided into three English proficiency groups: low level (LG), intermediate level (IG), and high level (HG), with 50 participants in each group. All participants first completed a basic information questionnaire covering gender, age, grade, major, duration of formal English instruction, time spent abroad, and College English Test (CET) scores, followed by an online vocabulary test.

English proficiency was assessed using two factors: the length of English exposure and proficiency test scores. The length of English exposure was chosen as an index to explore how learners' L1-based conceptualization of the world is reshaped through L2 learning. In China, where English exposure is primarily classroom-based, it was operationalized as the number of years of formal English instruction (Jarvis & Pavlenko, 2008).

Proficiency test scores were based on the results of the vocabulary test and CET-4/6. Vocabulary size, closely linked to skills such as speaking and writing, served as the primary metric, while CET-4/6 scores provided additional assessment of broader language skills, including listening, reading, and writing. Based on the vocabulary size outlined by Meara and Miralpeix (2016), the proficiency levels were defined as follows: Low (2,000–3,500 words), Intermediate (3,500–6,000 words), and High (6,000–10,000 words). Since English majors receive more linguistic training, only non-English majors with no study-abroad experience were included in the study.

Furthermore, the gender ratio within each group did not differ significantly. The low-level group (LG) consisted of first-year students, aged 17–19, with a vocabulary of less than 3,500 words, no CET certification, and 10 years of formal English instruction. The intermediate-level group (IG) included second-year students, aged 18–20, with a vocabulary of around 5,000 words, CET-4 certification, and 11 years of formal English instruction. The high-level group (HG) comprised third-year students, aged 19–21, with a vocabulary of more than 7,000 words, CET-6 certification, and 12 years of formal English instruction. Additionally, nine participants (three from each group) were randomly selected for follow-up introspective interviews. All participants voluntarily signed informed consent forms.

3.2 Instruments

The 65-item prepositional test, adapted from Q. Xu (2015), comprises 32 multiple-choice items targeting 'in,' with ten additional spatial prepositions as distractors to reduce guessing. Q. Xu's (2015) test, which presents spatial prepositions with accompanying pictures, aligns with this

study's focus on spatial relations and image schema related to 'in'. The test's established validity and reliability ensure an accurate assessment of Chinese EFL learners' understanding of spatial prepositions, enabling meaningful comparisons with Xu's findings and supporting discussions on conceptual transfer.

The semi-structured interviews, comprising four key questions, were designed based on the theoretical framework, which focused on four themes: (i) image schema perception, (ii) L1 or L2 influence, (iii) perceived difficulty, and (iv) cognitive processes. This theory-driven, deductive approach aimed to explore participants' conceptualization and use of 'in' in relation to their L1 and L2. To ensure data accuracy and allow participants to articulate their thoughts more freely, the interviews were conducted in Chinese. All interview excerpts were manually coded according to the four predefined themes. The transcriptions were then translated into English and cross-checked by expert translators for accuracy.

3.3 Data Analysis

The prepositional test data were scored and analyzed quantitatively. Only 'in'-targeted items were included, with at least four items representing each context. One point was awarded for each correct answer, and context scores were calculated as the ratio of correct responses to the total number of items in that context. For example, Context I included six items, so a participant's score in this context was obtained by dividing the number of correct answers by six. Statistical analyses examined: (1) differences in the use of 'in' across seven contexts, (2) differences across three proficiency levels within each context, and (3) interaction effects between context and proficiency. Consequently, a repeated-measures ANOVA was conducted. This is the most appropriate statistical test for analyzing within- and between-group differences, with a significance level of 0.05 (Field, 2024). Interview data were analyzed qualitatively using thematic analysis (Clarke & Braun, 2017) to examine how L1 conceptual transfer influenced preposition use.

4. RESULTS

4.1 Results of the Use of 'in' across Seven Contexts

The analysis revealed a strong relationship between the use of 'in' and seven contexts. The aim was to determine whether the frequency of use varied significantly across these contexts. Descriptive statistics for participants' use of 'in' across seven contexts are presented in Table 2.

Table 2. Descriptive statistics for the use of 'in' across seven contexts.

Average Score	Mean	Standard deviation	*N*
Context I	0.773	0.269	150
Context II	0.173	0.196	150
Context III	0.296	0.251	150
Context IV	0.451	0.284	150
Context V	0.313	0.274	150
Context VI	0.460	0.316	150
Context VII	0.395	0.325	150

Table 2 presents the descriptive statistics for the use of 'in' across the seven contexts. As shown, Context I yielded the highest mean score (M = 0.773, SD = 0.269), indicating that participants used 'in' most consistently in this context. In contrast, Context II demonstrated the lowest mean score (M = 0.173, SD = 0.196), suggesting the greatest difficulty or lowest accuracy in this context. The remaining contexts showed moderate use, with Context VI ranking second-highest. To determine whether these differences were statistically significant, a one-way ANOVA

was conducted. Results in Table 3 indicate a significant effect of context on the use of 'in' (F = 70.150, $p < 0.05$).

Table 3. ANOVA results on the effect of contexts.

Source	Sum of squares	*df*	Mean square	*F*	Sig.
Between groups	32.222	6	5.370	70.150	0.000
Within groups	79.848	1043	0.077		

To further identify where the differences occurred, a post-hoc LSD test was performed (Table 4). The test revealed multiple significant pairwise differences between contexts. Context I differed significantly from all other contexts, confirming it as the highest-performing category. Similarly, Context II showed significant differences from most other contexts, reinforcing its position as the lowest-performing category.

Table 4. The post-hoc LSD test for multiple comparison.

Contexts	I	II	III	IV	V	VI	VII
I		0.600*	0.477*	0.322*	-0.460*	-0.313*	-0.378*
II	-0.600*		-0.123*	-0.278*	0.140*	-0.287*	-0.222*
III	-0.477*	0.123*		0.156*	0.017	-0.164*	-0.099*
IV	-0.322*	0.278*	-0.156*		0.138*	0.008	0.057
V	0.460*	-0.140*	-0.017	-0.138*		-0.147*	-0.082*
VI	0.313*	0.287*	0.164*	-0.008	0.147*		0.065*
VII	0.378*	0.222*	0.099*	-0.057	0.082*	-0.065*	

Note. * The mean difference is significant at the 0.05 level.

The frequencies in Contexts III and V were not significantly different from each other but did differ from those in other contexts. Similarly, the frequency in Context IV did not significantly differ from Contexts VI or VII. However, it was significantly different from the others.

4.2 Results of the Use of 'in' across Three Proficiency Levels within Each Context

This analysis examined whether English proficiency influenced learners' accuracy in using 'in' across the seven contexts. Table 5 presents descriptive statistics for high-, intermediate-, and low-proficiency learners within each context. As shown, the overall trend indicates that higher proficiency levels were associated with greater accuracy in the use of 'in.'

Table 5. Descriptive statistics for the use of 'in' across three proficiency levels.

Contexts	Proficiency	Mean	Standard deviation	*N*
Context I	High-level	0.893	0.105	50
	Intermediate-level	0.777	0.232	50
	Low-level	0.650	0.353	50
Context II	High-level	0.184	0.196	50
	Intermediate-level	0.200	0.205	50
	Low-level	0.136	0.210	50
Context III	High-level	0.324	0.262	50
	Intermediate-level	0.356	0.260	50
	Low-level	0.208	0.210	50
Context IV	High-level	0.505	0.305	50
	Intermediate-level	0.480	0.247	50
	Low-level	0.370	0.287	50
Context V	High-level	0.390	0.295	50
	Intermediate-level	0.355	0.286	50
	Low-level	0.195	0.191	50
Context VI	High-level	0.635	0.259	50
	Intermediate-level	0.485	0.317	50
	Low-level	0.260	0.252	50

Table 5 continued…

Context VII	High-level	0.600	0.307	50
	Intermediate-level	0.340	0.306	50
	Low-level	0.245	0.255	50

A one-way ANOVA was conducted to examine whether these differences were statistically significant. As shown in Table 6, proficiency level had a significant effect on performance (F = 39.542, $p < 0.05$). This indicated that variation in accuracy across proficiency groups was not due to chance.

Table 6. ANOVA results on the effect of English proficiency.

Source	Sum of squares	*df*	Mean square	*F*	Sig.
Between Groups	7.871	2	3.935	39.542	0.000
Within Groups	104.200	1047	0.100		

Post-hoc LSD comparisons were then used to determine which proficiency levels differed from one another (Table 7). Results showed that all pairwise comparisons were statistically significant at the 0.05 level. This confirmed that high-, intermediate-, and low-level learners performed differently in their use of 'in'.

Table 7. The post hoc LSD Test – Multiple Comparisons.

Proficiency	High-level	Intermediate-level	Low-level
High-level		0.077*	0.210*
Intermediate-level	-0.077*		0.133*
Low-level	-0.210*	-0.133*	

Note. *. The mean difference is significant at the 0.05 level.

Overall, proficiency level significantly influenced accuracy in the use of 'in', with higher proficiency generally leading corresponding more to accurate usage. However, this developmental trend was not uniform across all contexts. The exceptions observed in Contexts II and III suggest context-dependent variation. This may be influenced by semantic or syntactic constraints specific to those environments.

4.3 Results of the Interaction Effects Between Context and Proficiency

Two-way ANOVA results (Table 8) indicated that both context and English proficiency had significant effects on the use of 'in', and that the interaction between the two variables was also significant, $F(12, 1029) = 3.554$, $p < 0.001$. The findings revealed that although context and proficiency jointly influenced learners' use of 'in', higher-proficiency learners did not consistently outperform lower-proficiency learners across all contexts. Notably, the effect of proficiency was less pronounced in Contexts II and III, suggesting that English proficiency exerted a weaker influence in these contexts. This pattern indicates that certain conceptual configurations, especially those involving partial enclosure and static embedding, pose persistent challenges that are less susceptible to improvement through increased linguistic proficiency alone.

Table 8. ANOVA results of between-subjects effects.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	42.958a	20	2.148	31.979	0.000
Intercept	175.604	1	175.604	2614.498	0.000
English Proficiency	7.871	2	3.935	58.591	0.000
Context	32.222	6	5.370	79.958	0.000
EP*Context	2.865	12	0.239	3.554	0.000
Error	69.113	1029	0.067		
Total	287.675	1050			
Corrected Total	112.071	1049			
R Squared = 0.383 (Adjusted *R* Squared = 0.371)					

4.4 Results of Introspective Interviews

The introspective interviews provided supporting evidence of a relationship between L1 spatial conceptual transfer and preposition use. Analysis of the interview data was organized into four themes: (1) image schema perception, (2) L1 or L2 influence, (3) perceived difficulty, and (4) cognitive processes. Overall, the findings suggest that L1 spatial conceptual transfer led to conceptual errors, many of which learners were unaware of.

4.4.1 Theme 1: Image schema perception

After being shown selected items with pictures, participants were asked 'Do you analyze the image schema of figure and ground in the picture when choosing the preposition?' All nine participants answered 'Yes'. The use of prepositions was found to be based on the perception of the image schema of containment and support.

Subtheme 1: Containment

(1) Yes, I see a boy in the telephone box. (P1)

(2) Yes, there is a fish in the water. (P4)

(3) Yes, it shows a boy in the telephone box. (P7)

Subtheme 2: Support

(4) Yes, I see a boy on the tree. (P2)

(5) Yes, the image of two objects is clear, a bend is on the road. (P3)

(6) Yes, the car is on the square. (P5)

Participants selected 'in' when they perceived objects as enclosed or surrounded. Some responses reflected confusion between 'in' and 'on', suggesting reliance on visual cues rather than linguistic rules. These responses demonstrate that although students recognized spatial relationships, they sometimes misapplied schemas based on perceived rather than linguistically appropriate spatial relations.

4.4.2 Theme 2: L1 or L2 Influence

Participants were asked 'Which language comes to your mind first, Chinese or English?' Seven participants answered, 'Chinese', while only two initially thought of the spatial relations in English, indicating that the primary influence was from L1. These responses suggest that L1 conceptual frameworks strongly influenced learners' judgments during preposition selection.

Subtheme 1: L1 (Chinese)

(7) Of course, it's Chinese. (P8)

(8) Chinese. (P9)

Subtheme 2: L2 (English)

(9) English, because it's an English question. (P4)

(10) English. (P6)

4.4.3 Theme 2: L1 or L2 Influence

Participants were asked 'Do you find it challenging?' All participants responded that it was easy, even for items easily confused with 'on'. This suggests that such conceptual errors were made unconsciously.

(11) It's easy. (P1)

(12) It's easy to choose an English preposition. (P5)

(13) No challenge for me. (P9)

4.4.4 Theme 4: Cognitive Processes

Participants were asked 'Why did you choose this preposition?' All participants reported that their choices were based on the spatial relationship between the objects depicted in the pictures. This indicates that cognitive processes influenced preposition use.

(14) I just look at the spatial relation, and see a car on the square, which helps me decide. (P6)

(15) I see a bend on the road. (P3)

(16) The picture shows the boy on the tree, so I selected *on*. (P2)

5. DISCUSSION

5.1 The Use of 'in' across Seven Contexts

Cross-linguistic similarities facilitated positive transfer, supporting the accurate use of 'in' (Yu & Li, 2017; H. Zhang & Liu, 2013). Context I exhibited the highest frequency of 'in', suggesting that the shared image schema between 'in' and *li* promoted positive transfer and reflected the most prototypical use of 'in'. Contexts VI and IV followed, showing partial alignment and moderate positive transfer. Overall, these contexts appeared to closely align with L1 spatial conceptualization, with some cross-linguistic similarities. Interestingly, Context VII did not show the lowest frequency of 'in', suggesting that cross-linguistic similarity may facilitate its use.

On the other hand, cross-linguistic differences caused negative transfer, hindering the use of 'in' (Yu & Li, 2017). Specifically, Context II exhibited the lowest frequency of 'in', suggesting that negative L1 transfer stems from cross-linguistic differences in partial enclosure. These differences indicate a mismatch in the spatial conceptualization of partial enclosure between L1 and L2. In Item 40 'The foot is put ___ the stirrup', English conceptualizes the stirrup as a container due to mental closure, the foot is partially enclosed within the stirrup's boundary. However, in Chinese, the stirrup is perceived as a supporting surface for the foot, causing learners to substitute 'in' with 'on'. Similarly, Context III, which exhibited the second-lowest frequency of 'in', highlights a mismatch in how English and Chinese encode static embedding relations. In Item 33 'There is a hole ___ the tablecloth', the static embedding relation is conceptualized as containment through conceptual projection from hollowness to solidness in English. In contrast, Chinese speakers perceive a hole as an upper part of the tablecloth (*zai* tablecloth *shang*), leading them to use 'on' instead of 'in'. Context V demonstrated that learners struggle with the functional shift between containment and supporting. This shift, influenced by cross-linguistic differences, adds another layer of difficulty in acquiring the correct use of 'in'.

These findings are also consistent with previous studies by Li and Liu (2015) and Q. Xu (2015), which indicate that cross-linguistic differences in cognitive processing and object categorization are key conceptual mechanisms driving L1 transfer and influencing the use of 'in'. Furthermore, this study demonstrates that such cross-linguistic differences manifest in schematic

relations between figure and ground, with mental closure and conceptual projection playing critical roles in prepositional use.

5.2 The Use of 'in' across Proficiency Levels within Each Context

The overall variation in the use of 'in' across three proficiency levels revealed a clear trend: as English proficiency increased, the frequency of 'in' steadily improved. This suggests that as learners' L2 proficiency increased, the use of 'in' became more L2-native-like, reflecting a gradual reduction in negative L1 conceptual transfer (Jarvis & Pavlenko, 2008; Li & Liu, 2015). An important implication of this developmental variation in conceptual transfer is that increasing English proficiency enables learners to recognize cross-linguistic similarities and differences in image schema, making them more sensitive to these distinctions and reducing negative L1 conceptual transfer. These findings align with CTH and partially support the assumption that greater L2 exposure facilitates the development of more native-like L2 spatial conceptual patterns (Jarvis & Pavlenko, 2008). However, the frequency of 'in' did not rise with increasing English proficiency in Contexts II and III, suggesting that spatial conceptualization involving mental closure and conceptual projection is difficult to reconstruct in their L2.

5.3 The Interaction Effects Between Context and Proficiency

The interaction effects showed that English proficiency had a weaker influence in Contexts II and III. Learners are often unaware of the conceptual differences between partial enclosure and static embedding relations, both of which tend to be interpreted as supporting surfaces within their L1 conceptual framework. Kong and Wang (2002) found that Chinese-speaking children, at around the age of 1 year and 8 months, first acquired the spatial terms *li* and *shang*. This suggests that spatial conceptual patterns established during childhood are resistant to restructuring in L2.

These findings suggest that targeted teaching strategies, such as task-based learning, explicit instruction, and VR-enhanced input, are needed to address challenges in conceptual transfer. Task-based learning can reinforce concepts and conceptualization patterns by engaging students in contrastive analysis activities that require them to apply prepositions in meaningful contexts. Through explicit instruction, teachers can systematically highlight the distinction between mental closure and conceptual projection, using transparent containers and solid objects to visually demonstrate the difference between 'in' and 'on'. Additionally, VR simulations can provide immersive experiences that allow learners to interact with spatial relations dynamically. Together, these strategies help learners recognize cross-linguistic similarities and differences in image schemas, aiding them in overcoming persistent L1 influence and improving their understanding of English spatial prepositions.

6. CONCLUSION

Cross-linguistic similarities in image schema led to positive conceptual transfer in Chinese EFL learners' acquisition of the English spatial preposition 'in', facilitating its correct use. In contrast, cross-linguistic differences caused negative transfer, hindering the accurate use of 'in'. English proficiency was identified as a key factor influencing this process. As proficiency increased, the accuracy of preposition use improved generally. However, Contexts II and III did not align with this trend, as the conceptual differences inherent in these contexts proved difficult to overcome. The findings have important pedagogical implications for teaching English spatial prepositions.

In the teaching process, teachers should focus on spatial concepts and the conceptualization of figure-ground relations to enhance awareness of conceptual differences. Additionally, a contrastive analysis of conceptual differences between English and Chinese is essential for effective instruction. Specifically, teachers can use task-based learning, explicit instruction or VR-enhanced activities to address these differences and support students in the reconstruction of

L2 concepts and conceptualization patterns. Sufficient English learning experiences are crucial for reducing L1 conceptual transfer and facilitating the development of L2 concepts and conceptualization patterns. Therefore, teachers should prioritize the absorption of English input, using visual aids and innovative tools to help students engage with the conceptual content of vocabulary expressions beyond just prepositional meanings.

This study focused primarily on cross-linguistic similarities and differences in image schemas and English proficiency. However, other factors, such as collocational frequency, cognitive flexibility, and explicit instruction, may also significantly influence the acquisition of spatial prepositions. Additionally, this study only conducted a cross-sectional examination of university-level English learners. To gain a deeper understanding of how L1 and L2 conceptual patterns evolve as proficiency develops and influence learners' use of spatial prepositions, future research may adopt a longitudinal approach to track changes in conceptual restructuring.

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CRediT authorship contribution statement

H.X. – Investigation, Formal Analysis, Data Curation, Visualization, Writing – Original Draft, Writing – Review & Editing
S.R.S. – Conceptualization, Methodology, Resources, Supervision, Writing – Review & Editing

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT (version GPT-5.2) to improve language and readability only. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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