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Mental Model Theory and Its Application in Teaching of English Tense and Aspect

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***Keywords*— mental models, reasoning, instruction and learning of English tense and aspect**

Abstract

Mental Model Theory claims that the human cognitive system simulates the mechanisms of the external world, predicts the development of events, makes plans, and solves problems by constructing mental models. Humans build models based on information provided in communication to reason. Inaccurate reasoning may occur when individuals lack sufficient information and fail to construct all possible models. This theory challenges the dominant behaviorist paradigm and contests the rule-based Mental Logic Theory, and has become one of the core concepts in cognitive psychology since its proposal, exerting extensive influence on psychology, linguistics, and even educational domains, and thereby, offering a novel psycholinguistic perspective for language instruction. This article, first reviews the origins, development, core tenets, and fundamental characteristics of Mental Model Theory. It then makes a comparative analysis of learning outcomes between the pilot class and conventional instructional class, and is dedicated to applying research findings on mental models to the instruction of English tense and aspect, with the aim of overcoming the negative influence of language transfer among Chinese learners and exploring effective approaches to teaching and learning English tense and aspect.

I. INTRODUCTION AND THEORETICAL BACKGROUND

1.1 Background and significance

Cognitive psychology, a scientific discipline investigating human mental activities, has long been dedicated to exploring the psychological mechanisms regarding how human beings understand the world, represent reality, and conduct reasoning. In this domain, understanding reasoning processes has consistently remained a central focus. When it comes to how human beings conduct reasoning, perspectives vary dramatically in psychology. Currently, two predominant viewpoints exist: Mental Logic Theory (MLT for short) and Mental Model Theory (MMT for short). MLT emphasizes the crucial role of logical rules and propositional operations in the process of reasoning, claiming that logical computational abilities are innate in the human mind. However, it fails to explain the origin of human logical capacity and have difficulty in providing

satisfactory answers to numerous reasoning phenomena. In contrast, MMT emerges as an alternative, proposing that the human cognitive system constructs models to simulate the mechanisms of the external world, predict how events will develop, plan actions, and solve problems.

MMT, as a significant theoretical framework in contemporary cognitive science, offers a novel perspective on understanding human reasoning processes. It has been exerting a profound influence on fundamental research in psychology, providing strong theoretical support for educational practices, particularly in the field of language teaching. In the instructional contexts of English as a Foreign Language (EFL), the acquisition of tense and aspect consistently poses a primary challenge for native Chinese speakers, since Chinese is a tonal language lacking verbal inflections to express tense and aspect. Traditional grammar teaching often relies on rote memorization and mechanical training, whereas MMT offers a novel approach to tackle this pedagogical difficulty.

1.2 Reasoning process: Mental Logic or Mental Models?

There are two dominant theoretical propositions concerning human reasoning mechanisms in psychological research: Mental Logic Theory and Mental Model Theory. The differing understandings of reasoning processes proposed by these two theories reflect distinct paradigms in the field of cognitive research.

J. Piaget, a key proponent of Mental Logic Theory (which is rooted in formal logic), holds that human reasoning is based on innate logical systems. From this perspective, human brain possesses a rule-based system, with the capacity for syntactic transformation of propositions. This system contains two memory subsystems: one in charge of storing propositional content, the other responsible for the storage of syntactic rules. When confronted with new information, this system can filter relevant data, perform logical computations by applying appropriate rules, and thereby generate new propositions or insights (Piaget, 1968).

The strength of MLT lies in its formalized operability and predictive power, which are the reasons why many cognitive scientists continue to adopt it to explain reasoning processes (Held et al., 2006). Nevertheless, this theory faces several fundamental challenges: firstly, it struggles to explain the origin of human logical abilities. Secondly, it fails to satisfactorily account for how non-experts can reason effectively without any training of formal logic. And most importantly, it cannot sufficiently elucidate the essential distinctions between concrete and abstract reasoning.

Consequently, MMT emerges as a complement and development to MLT. It was first proposed by K. Craik (1943), and later systematically developed by Johnson-Laird (1983, 2001). MMT proposes that human reasoning occurs by constructing and manipulating mental models rather than by means of propositional logic, which fundamentally transforms the traditional understanding of reasoning process, paving a novel way for cognitive research.

1.3 Purpose and methodology

By integrating theoretical analysis with pedagogical practice, the study first conducts a systematic literature review of MMT. It then expounds the core propositions and fundamental characteristics of MMT. Innovatively, the study conducts a systematic application of MMT to English tense-aspect teaching in China, with a particular focus on present perfect, present perfect continuous, and the counterfactual usages of past perfect, the grammatical areas where many English learners commonly struggle, aiming at probing into the feasibility of application of MMT to the instruction of tense and aspect of English verbs.

In the study, both quantitative and qualitative methods are employed to demonstrate how to apply the theory into the instruction of specific grammatical items in English. The practical effectiveness of such kind of application is evaluated through test analyses and interviews.

By constructing intuitive mental models, the study seeks to facilitate the learners' comprehension of temporal relationships and syntactic features of these

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grammatical items, thereby enhancing the efficiency and accuracy of language learning.

1.4 Structure of the article

This article comprises five sections: The Introduction roughly presents the research background, debates concerning the theory, and research pedagogy. The second section delineates the development of MMT, its core tenets, and defining features. The third section exhaustively expounds the specific application of the theory to the teaching of English tense and aspect. The fourth section discusses the effectiveness and limitations of the study. The last section is the conclusion, synthesizing the research findings and proposes the directions for future work. The study strives to comprehensively present MMT's theoretical value and its potential of application to English instruction, providing novel insights for English grammar instruction in Chinese classrooms. The subsequent part is the review of MMT, exploring the development and tenets of the theory in depth.

II. REVIEW OF MENTAL MODEL THEORY

2.1 The origin and development of the theory

In the field of psychology, MMT develops through three major stages, reflecting the evolution of cognitive science from behaviorism to cognitive neuroscience.

2.1.1 Rudimentary stage (1940s-1950s)

The concept of mental models was first proposed by Scottish psychologist Kenneth Craik in 1943. In his work *The Nature of Explanation*, Craik systematically elucidates mental models. From his perspective, the human cognitive system simulates the operating mechanisms of the external world by constructing "small-scaled models". These models share an isomorphic relational structure with the processes in real world, enabling people to predict the development of events, plan activities and solve problems (Craik, 1943: 61).

Craik's contributions lie in his breakthrough in the dominating paradigm of behaviorism, transferring the research focus from observable behaviors to internal mental representations, and placing the special emphasis on the predicative function of the models. He claims that mental models enable organisms to react to the future events before they occur, which lays the critical foundations for the cognitive revolution afterwards.

2.1.2 Theory establishment phase (1960s-1980s)

With the rise of cognitive psychology, MMT achieves substantial development with the systematic elaboration of Johnson Laird. Johnson Laird (1983) defines mental models as "mental representations that possess a structural isomorphism to real or imagined situations" (p. 419). Researches in this period share three distinctive characteristics:

Experimental validation: Researchers validate that human beings rely on models rather than formal logic to reason by designing a series of experiments, including syllogistic reasoning and conditional reasoning (Johnson-Laird & Byrne, 1991).

Interdisciplinary expansion: The theory enjoys an extensive application in the field such as Artificial Intelligence, linguistics and pedagogy, fostering the trend of multidisciplinary research.

Computational modeling: Researchers develop computer programs to simulate human model-constructing processes, such as Johnson-Laird's "PSYCOP" system.

2.1.3 Further exploration of the theory (1990s-now)

In the 21st century, MMT is shifting its research focus toward the neural underpinnings of model construction, through integration with cognitive neuroscience. Neuroimaging techniques, such as fMRI, have confirmed that different reasoning tasks activate specific neural networks in the brain (Held et al., 2006). Researchers are also investigating the dynamic updating mechanisms, concerning how people revise the existing models with the influx of new information (Hemforth & Konieczny, 2006). Furthermore, they explore the impact of working memory capacity on individual differences in reasoning, which cover how working memory capacity influences model-building capabilities when facing complex reasoning tasks, and the relationship between model errors and cognitive load (Capon et al., 2003). Besides, researchers also examine cultural differences, which focus on whether cultural

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background will engender the pattern differences in model-building (Nisbett et al., 2001) , and propose the PMRI framework which employs perception, memory, reflection, and inference modules to enable dynamic and efficient reasoning for complex tasks (Zeng (2025).

2.2 Main idea of Mental Model Theory

The framework proposed by Johnson-Laird (1983, 1991) contains three key components: construction of mental models, the fundamental characteristics of mental models, and classification of the models.

2.2.1 Construction of mental models

The complete reasoning process of modeling contains six sequential phases (Johnson-Laird & Byrne, 1991: 35):

Comprehension of the premise: interpreting the input information based on the knowledge of language and the world.

Initial construction of the models: constructing mental representations reflecting the syntactic meanings of the premise.

Generation of the conclusion: extracting the implicit propositions from the models constructed.

Search for counterexamples: attempting to construct the alternative models which can falsify the initial conclusion.

Verification and adjustment of the models: accepting the models if no counterexamples could be found, otherwise revising the models.

Output of the conclusion: producing the final inferential outcome: conclusion.

To be specific, at the beginning, the listener comprehends the premise of the proposition or what she sees or hears based on her linguistic and world knowledge. To comprehend the entities described by the premise, the listener must construct a mental model, in which the implicit information contained in the premise is explicitly represented. Furthermore, only by enriching and complementing the implicitly conveyed information, can an initial conclusion be reached. In the second phase, the listener delineates the models constructed in the first phase. On this basis, in the third phase, a tentative conclusion can be formulated. During the fourth phase, the listener attempts to verify or falsify the conclusion she has just achieved by constructing alternative models which can negate the initial conclusion. If no such alternative models are found, the listener would consider that the conclusion she has made is valid, and the interpretation of what she has heard is correct. Otherwise, the listener reverts to the second phase to search until exhaust all the possible models (Johnson-Laird & Byrne, 1991: 35). Nonetheless, the listener sometimes can not infer correctly, and fail to find the alternative models. Consequently, conclusions drawn in this phase stays probabilistic and even inferential errors might arise (Johnson-Laird, 1991; Held et al., 2006). Crucially, what MMT emphasizes is the non-logical nature of reasoning, that is, there is no need for people to master formal logical rules so long as they can construct and operate mental models to achieve the goal of valid reasoning.

2.2.2 The fundamental characteristics of mental models

Mental models possess three fundamental characteristics: structural isomorphism, incompleteness, and dynamicity (Johnson-Laird, 1983: 397-422). Structural isomorphism means that mental models are consistent with the structure of the situation they represent. For example, "The knife is to the left of the fork." Understanding this sentence, the spatial arrangement of mental models corresponds to the actual spatial relationship of how the knife and fork are laid. Incompleteness refers to the understanding that mental models generally contain the key features rather than all the details of the situation or events. For instance, when comprehending an event, the constructed mental models may only keep the key elements such as time, place, participants, and crucial occurrences. Dynamicity suggests that mental models can be updated at any time with the input of new information. For example, when hearing "…but in fact…", the original models will be correspondingly adjusted to assist the comprehension process.

2.2.3 Classification of mental models

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Based on the contents mental models represent, they can be roughly categorized into the following types.

Model Type	Represented Objects	Typical Examples
Spatial models	Spatial relationships of objects	Map navigation, furniture arrangement
Temporal models	Sequential relationships of events	Schedule planning, historical events
Causal models	Causal chains	Accident analysis, combing relationships
Social models	Interpersonal interactions	Role-play, social division of labor

2.3 Controversies and development

Despite the wide influence, MMT, faces criticisms from different aspects. The core concepts of the theory are not defined clearly, or even there is no need to propose such a theory (Rips 1984, 1986; Goldman, 1986). The theory fails to expound general issues in reasoning and some abstract reasoning phenomena, and has difficulty in falsification (Rips, 1984, 1986). The construction of models actually relies on inferential rules, which has little essential differences with MLT (Goldman, 1986). However, against these criticisms, comfortingly, MMT, "model-based approach" in cognitive science, as a complement to the traditional "rule-based approach", has been evolving all the way. Through experiments, researchers prove that mental models can represent concrete scenarios, abstract and even imagined situations. They possess computability and can satisfactorily expound reasoning issues concerning propositions, conditionals as well as relational sentences (Johnson-Laird, 1998; Zwaan et al., 2002; Pauen, 2006; Rehkamper, 2006). MMT provides meaningful insights for discourse analysis, facilitating knowledge acquisition in pedagogical contexts.

III. APPLICATION OF MENTAL MODEL THEORY IN THE TEACHING OF ENGLISH TENSE AND ASPECT

With the development in educational psychology, particularly the in-depth research on second language acquisition, the application of theories of cognitive psychology to teaching practice, especially the instruction of English language, has always been a key focus in both academic and educational circles. Due to language transfer, Chinese linguistic environment, which the Chinese students are familiar with, provides support for language learning while simultaneously posing challenges for the mastery of many grammatical items, among which, the comprehension and application of English tense and aspect, have always been obstacles in the way.

3.1 Cognitive challenges of the English tense-aspect system

As languages from different cultural backgrounds, and evolving through different historical environments, Chinese and English, have distinct typological differences in tense-aspect systems. Chinese, is the key representative of Sino-Tibetan language family. The core features of this family include its tonal systems and isolating structures. This isolating structure possesses minimal inflections, primarily relying on lexical devices, such as temporal adverbs "已经" (yǐjīng, already), and "正在" (zhèngzài, currently, now), and contextual cues to express different tenses and aspects, without consideration of the verb inflections. In contrast, English, an inflectional language, the representative of Indo-European language family, boosts of its morphology, and exhibits a highly grammaticalized tense-aspect feature, requiring speakers to adopt different inflectional forms in accordance with the temporal relationship between the time when they speak and the action occurs. Therefore, a complex tense-aspect network is constructed by means of the morphological changes of verbs, such as *-s*, *-ed*, and *-ing*, and auxiliary verb combinations, such as *have/has + v.-ed*, or *be + v. ing*. This typological divergence poses great cognitive demands on Chinese learners when confronted with the mastery of English tense-

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aspect system. According to empirical studies by Li & Shirai (2000), the learning difficulties that hinder Chinese learners' English mastery roughly fall into the following three aspects: conceptual transfer which concerns markers like "了" (le) and "过" (guo) in Chinese aspect, formal confusion which refers to the mixing usage of the simple past with the present perfect, and difficulties in hypothetical usage, which means the problems with the mastery of backshifting of tense in English subjunctive mood.

3.2 Theoretical basis for the application of Mental Model Theory

3.2.1 Cognitive mechanisms of tense-aspect representation and model construction

In the view of MMT, three cognitive operations are involved in the process of tense-aspect comprehension (Klein, 1994): temporal anchoring, to determine the relationship between Event Time (ET) and Speech Time (ST), perspective taking: to select the viewpoint for observing the event, and framing: to construct the internal phase structure of the event (onset-duration-completion).

Therefore, in this article, 4 principles are proposed in the instructional process. The first principle is multimodal representation. According to this principle, visual symbols (icons), spatial arrangement, and linguistic descriptions are all employed to construct models. The second principle to follow is perspective-shifting, which trains language learners to switch temporal perspectives, such as "looking back from the present". The third principle involves validation of counterexamples, which instructs leaners to search for exceptions to verify the validity of modeling. The last principle concerns progressive complexity, requiring the instructing process to gradually transit from concrete scenarios to abstract usages. The next section is the practical application of the principles in the instruction of English tense-aspect system.

3.3 Model construction of specific grammatical items

3.3.1 Dynamic modeling of present perfect aspect

The perfect aspect is formed by *has/have/had* + *v.-ed* participle. Its usage generally falls into 2 categories: Resultative usage refers to the fact that the occurrences of actions or processes precede the time when speakers speak at an unspecified time, while are completed when the speech occurs and are relevant to the present. In contrast, continuative (uncompleted) usage lays emphasis on the fact that the actions or states start at a past point, continue to the time when the speech occurs, might continue or have just ended (Zhang, 2021). Here, we take present perfect "have lived" as an example, to illustrate the cognitive processes of modeling. First, the learners must anchor the starting point of "*living*" prior to ST, adopt the current moment as the viewing perspective, and then construct an action frame encompassing the durative phase of the action. The following two modeling approaches are adopted to tackle the two usages above.

3.3.1.1 Completed usage（Resultative）

- Features of models：emphasis on the impact of the past actions on the current.
- Demonstration：

```
TEXT
[Point of action completion]————————●————[moment of speech]
        (break)        (The window is still broken now.)
```

- Example: "Someone has broken the window."
- Error：remind the learners not to collocate the sentence with adverbial phrases indicating the past, which means we can not say "*Someone has broken the window last week."

3.3.1.2 Uncompleted usage（Continuative）

- Features of models：representation of the time continuation of actions lasting from past to present.
- Demonstration：

```
TEXT
[Starting point]————————————————●[moment of speech]
  (live          in          Beijing)
(still living here)
```

- Example: "I have lived in Beijing since 2010."

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- Adverbial usage: this time continuation should cooccur with durational adverbials such as *since/for*.

3.3.2 Process model of present perfect continuous aspect

Present perfect continuous aspect, is formed by *have/has been + V. -ing*, enjoying the similarities to present perfect aspect but with emphasis on its uncompleted dimension, which indicates that the action is going on at the speech time, and is highly possible to continue in the future. The modeling of the present perfect continuous aspect should focus on the following two dimensions: one is its continuation, or its continuous extension along the timeline. The other is "processuality", the dynamic features of action progression. For example: to understand the sentence "She has been writing the report the whole morning." one possible model constructed is:

```
TEXT
Timeline：[Start]————————●[Now]
Action flow：writing → writing → writing
Implication：The report is not finished: the wet ink, scattered drafts, or ongoing writing action.
```

- Contrastive training: comparison with the present perfect aspect sentence.
    - "*have written*"：with emphasis on the completion of action: the completed report on the desk.
    - "*have been writing*"：with emphasis on the process of "*writing*", the action continues till now, and the report is still probably being revised now.

3.3.3 Counterfactual model of past perfect aspect

Past perfect aspect, consisting of "*had + V. -ed* participle", represents the completion of an action at a certain moment in the past, or the start of an action in the past and possible continuation at the speech time and afterwards (Zhang, 2021). This aspect has one special usage, that is, in certain structures, it can be employed to express some subjective hypothetical scenarios contrary to the reality in the past, with *if/only if* clauses as its typical examples. In *if/only* conditional clauses, it can denote the alternative outcome from a past vantage point. For example, "If Tom had arrived yesterday, he would have traveled together with them." In this clause, Tom, actually, did not arrive yesterday. Therefore, he could not go travelling with them. Here, the speaker expresses his view out of his own imagination, even though that outcome does not occur.

3.3.3.1 Standard usage (Temporal sequence)

- Model：

```
TEXT
[past of the past]————[past reference point]————[present]
      (had left)              (arrived)
```

- Sentence: "When we arrived, he had left."

3.3.3.2 Subjunctive mood（Imaginative usage）

Model construction procedures:

- Construction of factual model: "Tom did not arrive yesterday."
- Construction of counterfactual model: "If Tom had arrived yesterday..."
- Deduction of hypothetical outcome: "he would have traveled with them."

3.4 Strategies for instructions

3.4.1 Model-based teaching procedures

Model-based approaches comprise 5 steps:

Step 1: Contextualization: authentic contexts are established for target tense-aspect, such as description of personal experiences (use of perfect aspect)

Step 2: Model demonstration: temporal relationships are demonstrated by visualized tools. Tools of different colors are proposed to differentiate real spaces from hypothetical ones, such as temporal wheels, animated timelines, or magnetic sticks.

Step 3: Collaborative modeling: different student groups are assigned different modeling tasks. In this environment, verb cards are provided for students to arrange temporal relations.

Step 4: Discussion of counter examples: erroneous usages are presented for error correction. For example: "*I lived here for 10 years."

Step 5: Productive application: communicative tasks requiring the use of target tense and aspect are

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designed, including interviews, reports, story continuation, or schedule planning.

3.4.2 Design of typical activities

Activity 1：Temporal detective

- **Objective**： training ability of temporal anchoring for past perfect aspect
- **Procedures**：

  Step 1: A crime scenario is provided. For example: The wallet was gone at 10 this morning.

  Step 2: Students are required to construct the timeline of the suspect according to clues such as fingerprints, or witnesses.

  Step 3: Group discussion and report: the past perfect aspects should be included in the report.

Activity 2: Life timeline task

- **Objective**：mastery of the usage of present perfect continuous aspect
- **Procedures**：

  Step 1: Mark the significant life events from birth to present.

  Step 2: Mark the continuous life states with different colors. For example, "Since my family moved to Beijing, I have lived in Chaoyang District."

  Step 3: Conduct peer interviews. Learners take turns to interview their partners, with questions such as "How long have you …?".

IV. TEACHING EVALUATION AND REFLECTION

4.1 Empirical research design

4.1.1 Methodology

The mixed research methods are adopted in the study to examine the effectiveness of model-based instruction. In the section of quantitative research, pretest, intervention and posttest are designed. The participants are 100 first-year non-English majors in a certain institute. They are randomly divided into the control group (Traditional instruction) and pilot group (Mental Model pedagogy) according to the teaching arrangement of the Department. For the learning outcomes, test of multiple choices with 20 items, and written production tasks are employed. As to the qualitative research, achievement analysis, semi-structured interviews (10 students per group), and teacher instructional journals are all included to collect sufficient data.

4.1.2 Implementation procedures

This research, lasting one semester, targets the use of three tense-aspect structures: present perfect, present perfect continuous and the counterfactual usage of past perfect. The pilot group practice modeling one hour per week, while the control group keep the standard teaching plan.

4.2 Findings

4.2.1 Quantitative results

The learners' achievements in the test of the pilot group significantly surpass the control group, among which the greatest improvement lies in the pilot group's mastery of perfect counterfactual usage, with the accuracy rise from 24% to 72%. Furthermore, the correct usage of continuous structures, such as "*for/since* structures" climbs to 35%.

4.2.2 Qualitative results

Learners' behaviors mainly exhibit the following characteristics in the process of modeling.

Strategy Type	Percentage	Behavioral Pattern
Spatial	55%	Timeline drawing
Verbal	32%	Oral temporal descriptions
Kinesthetic	13%	Simulated time flow through gestures

Common errors in modeling center on the understanding of "*have been doing*", which is mistakenly viewed as "discrete" rather than "continuous" sequence. Another error is the confusion concerning "*had done*" versus "*would have done*" in temporal orientation.

Analysis of the interviews: A visual learner reports "drawing timeline helps me to 'see' instead of memorizing the rules". An imagery-dependent learner recalls that "had done" is like "knotting things together in the past", which guarantees the correct usage in learning. Meanwhile, color-sensitive learners consider marking real versus hypothetical events

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with different colors in the learning process greatly facilitates their mastery of the subjunctive mood.

4.3 Reflections and instructional implications

4.3.1 The application of Mental Model Theory

MMT enjoys unique advantages whereas also exhibits certain limitations in the study. It can effectively solve the problems involving the shifting of temporal reference, such as tense concord in indirect speech, reduce cognitive load regarding grammatical terms, by substituting "temporal window" for terms like "perfect aspect", and enhance the long-term retention, as imagery encoding contributes to longer-term retention compared with rule memorization. Nevertheless, it must be acknowledged that individual differences and cognitive preference both affect learning outcomes. About 10 to 15 percent of learners have a low working memory capacity for model construction. Furthermore, western learners' linear-time models contradict circular concepts of time held by some learners with Chinese as their native language. Besides, over-visualization in modeling process might result in a superficial understanding of abstract functions of tense and aspect.

4.3.2 Implications for instructional improvement

The findings suggest further improvement concerning the following differentiated instructional strategies.

Learner Type	**Adapted Modeling Approach**	**Instructional Adjustment**
Visual	Animated dynamic timelines	Provide visualization software or tools
Verbal	Textual temporal relation frameworks	Develop structured linguistic templates
Kinesthetic	Body timeline activities	Design classroom spatial interaction games

In the field of cultural adaptation, circular time representations such as diagrams of season cycle can be integrated into the model. Moreover, contrastive analysis of markers between English and Chinese aspects is also a must, such as "着", "了" and "过" with different tense-aspect representations.

4.4 Limitations and implications for further research

Mental models can satisfactorily represent concrete and abstract and even hypothetical scenarios, serving as the foundations for visual imagery. Nonetheless, participants in this study are all first-year college students, not covering elementary and middle school language learners. Moreover, there exists temporal limitations, since in this institute curriculum, English instruction is mainly concentrated in the first year, resulting in the lack of delayed post-testing, evaluation of test results and long-term efficacy of knowledge retention. Therefore, cross-age investigations should be conducted to discuss the learning outcomes of different aged learners if time permits. Additionally, modeling data, by means of multi-sensory, including visual, auditory and tactile channels, can be collected to compare and verify the research findings. Based on the experiments of researchers, VR-based immersive tense-aspect training systems might also be developed, to enhance learning outcomes.

V. CONCLUSION

This study conducts a systematic investigation of how MMT can be applied in the instruction of English tense and aspect among Chinese college learners. It confirms the efficacy of the theory in grammatical instruction, and provides a novel cognitive pathway for college English teaching. Construction of models can produce visualization of abstract structures, facilitating the process of identifying the unfamiliar domain of knowledge and mastering new grammatical items. Abstract tense-aspect relations can be transformed to mental models, which significantly enhances the learners' mastery of complex temporal concepts. Future research can cover learners of different ages and cultural backgrounds, exploring the strategies for age and cultural adaptation, to optimize the theory's application contexts. Additionally, MMT should not

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be confined to the understanding of grammatical items. It can also provide insights in the instruction of diverse contexts such as discourse analysis and creative writing.

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