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Predicting Chinese Preschoolers' Acquisition of Aspect Markers: A Corpus-Based Study

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Abstract: This study explored the patterns and predictors of aspect marker acquisition of Chinese preschoolers speaking Mandarin Chinese as their first language (L1). Based on a corpus drawn from 157 preschoolers from Beijing, China, this study set out to explore (1) the developmental pattern of aspect marker acquisition; (2) the interactional pattern between grammatical aspect markers and lexical aspects; (3) the production of temporal adverbs with aspect markers; and (4) the predictors of aspect marker acquisition. The main research findings included the following: (1) the Jonckheere–Terpstra test revealed an age-related increase in children's production of aspect markers, and in particular, there was a significant increase in grammatical aspect markers and lexical aspect subclasses from age 4;6 (Year; Month) onwards; (2) the Friedman's ANOVAs indicated that *-LE* was frequently used in combination with most of the lexical aspect subclasses, among them the *achievement* was the most frequently co-occurring subclass, while the *activities* came second; (3) a series of Chi-square tests showed that using temporal adverbs in combination with aspect markers became increasingly common among older children; (4) the hierarchical regression analysis identified children's preschooling experience as a significant predictor of their early aspectual development, after controlling for the other variables.

Keywords: aspect markers; Mandarin Chinese; preschoolers; corpus-based study

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1. Introduction

Time is a fundamental concept in human cognition and language, and thus, its acquisition and expression in the early years have drawn extensive research interest in the past decade (Liang et al. 2019; Stites and Özçalıskan 2013; Tillman et al. 2017). However, the existing studies have primarily focused on the 'tensed' languages that employ verb inflectional morphology to indicate temporality (e.g., English, German, and French), leaving those 'tenseless' languages relatively understudied (Lin 2012; Qiu and Zhou 2012). Mandarin Chinese, for instance, is a typical 'tenseless' language that does not have a grammatical category for tense expression. Rather, the speakers rely on temporal adverbs, lexical aspects, and various semantic and discourse-pragmatic resources to establish time references (Huang 2000, 2003; Slabakova 2015; Wu 2002). Chinese children need to acquire these adverbs and aspect markers and combine them correctly to express time-related notions. Some studies have explored Chinese preschoolers' acquisition of temporal adverbs (Fu 2002; Liang et al. 2019) and grammatical aspect markers or lexical aspect classes (Chen and Shirai 2010; Li and Bowerman 1998). However, none of these studies has examined the widely accepted Aspect Hypothesis (Shirai and Andersen 1995) using child-to-child naturalistic interaction materials and a comprehensive typology of Chinese lexical and grammatical aspects. Little is known about the influences of the home language environment (e.g., parental literacy practices, age of learning to read/write, etc.) on Chinese

children's early aspectual development. To fill these literature gaps, this study aimed to explore the patterns and predictors of Chinese preschoolers' aspectual development by extracting and analyzing their utterances drawn from the Early Childhood Mandarin Corpus (ECMC, Li and Tse 2011).

2. Grammatical Aspect and Lexical Aspect in Mandarin Chinese

Aspect, or aspect marking, characterizes how speakers perceive an event, either internally or externally (Comrie 1976), while tense refers to the time of the target event in relation to the speech time. In Chinese, time concepts are expressed through free combinations of temporal devices, such as lexical aspect, temporal adverbials, and contextual cues, as well as a range of semantic and discourse-pragmatic resources (e.g., Cao and Xu 2017; Huang 2000, 2003; Slabakova 2015; Tse et al. 2012). According to Smith's (1991) two-component theory, Chinese conveys its aspectual information using two aspectual components which are similar to those of other languages (e.g., Greek): viewpoint aspect (also known as 'grammatical aspect'—GA) and situation aspect (also known as 'lexical aspect'—LA). The former conveys a temporal perspective that focuses on all or part of a situation, while the latter refers to the intrinsic aspectual properties of an idealized situation (Smith 1994), formed by verbs (e.g., pao *[run]*, zuo *[sit]*, du *[read]*) or the interactions between verbs and other structures, such as complements (e.g., tui-kai men *[push the door open]*) and arguments (e.g., sao di *[sweep the floor]*) (Xiao and McEnery 2004).

Firstly, in Chinese, GA comprises a small number of grammatical aspect markers: *-LE*, *-GUO*, *-ZHE*, and *ZAI* (see Table 1). These markers have been widely studied as they are the most common and morphology-like devices used for constructing aspectual reference (Klein et al. 2000; Sun and Grisot 2020; Yang et al. 2018). Among them, *ZAI* indicates that an action or event is in progress and is commonly used with verbs describing *activities* (Klein et al. 2000). Therefore, it is regarded as a typical dynamic imperfective aspect marker (Shirai 1998). However, *-ZHE* concerns enduring or continuous situations (Nicoladis et al. 2020; Zhou et al. 2014). Thus, it is considered a stative imperfective denoting a resultative state (Smith 1991; Shirai 1998). As for *-LE*, there are primarily two subtypes depending on the syntactic positions they occupy in the sentence: (1) the verbal-suffix *-LE* (VF-*LE*) and (2) the sentence-final particle *-LE* (SF-*LE*) (Chang 2013; Erbaugh 1982; Li and Thompson 1989; Zhang 2018). When a sentence concludes with the VF-*LE*, it can be regarded as a third subtype joining VF-*LE* and SF-*LE* (VF/SF-*LE*) (Chen and Shirai 2010). The semantic features of these *-LE*s vary and involve much complexity (detailed in Table 1). Regarding *GUO*, it implies the event happened sometime in the past, and the resultative *states* of the event are no longer obtained at the moment of speaking (Huang 2003; Huang 2018). Such a meaning of 'discontinuity', as argued by some researchers (e.g., Klein et al. 2000; Smith 1991), differentiates *-GUO* from the perfective *-LE* in that *-GUO* is considered more of an 'experiential' aspect in recent studies of Chinese aspectual system (Xu 2019).

Table 1. Grammatical Aspect Markers in Mandarin Chinese.

Grammatical Aspect Markers			Meaning	Examples
ZAI			Indicates that an action or event is in progress.	狗在吃饭. go *ZAI* chi-fan. dog *ZAI* eat. The dog is eating.
ZHE			Describes situations that are viewed as enduring or continuous.	他听着音乐. ta ting *ZHE* yin-yue. he listen to *ZHE* music. He is listening to the music.
GUO			Implies the situation described was experienced at some time point prior to the speech time, and the resultative state of the event no longer obtains at the time of speech.	他去过长城. ta qu *GUO* chang-cheng. he go to *GUO* the Great Wall. He has been to the Great Wall.
LE	VF-*LE*	VF1	Completion or termination of an action/event (Chen and Shirai 2010)	他跌断了腿. ta die duan -*LE* tui. he fall break -*LE* the leg. He broke his leg.
		VF2	Inchoative reading, indicates the beginning of a situation (Chang 2013)	他知道了这件事. ta zhi-dao -*LE* zhe jian shi. he know about -*LE* this. He knows about this now.
		VF3	Indicates the result of an anterior event/action (Chen and Hu 2016; Ljungqvist 2003)	我洗了澡. wo xi -*LE* zao. I wash -*LE* shower. I have taken a shower.
		VF4	Emphasizing the temporal relationship of two or more events (Chen and Hu 2016)	下课了来我办公室. xia ke -*LE* lai wo ban-gong-shi. after class -*LE* come to my office. Come to my office after class.
	SF-*LE*	SF1	Indicates change of state and signals its current relevance state (Chen and Shirai 2010).	他已经起床了. ta yi-jing qi chuang -*LE*. he already get up bed -*LE*. He has already gotten up.
		SF2	Denotes an inchoative reading, highlighting the beginning of a situation (Jin and Hendriks 2005).	系统运行了. xi tong yun-xing -*LE*. system operate *LE*. The system is now operating.
	VSF-*LE*	VSF1	When used with ACH, RVC or ACC, it indicates the resultative state after the attainment of the goals (Chen and Shirai 2010).	窗帘挂好了. chuang-lian gua hao -*LE*. the curtain hang well -*LE*. The curtain is now properly hung.
		VSF2	When used with STA or ACT, it indicates inchoative reading (Chen and Shirai 2010).	他吃饭了. ta chi-fan -*LE*. he eat *LE*. Now he starts eating.
		VSF3	Indicates a perfective reading (Chang 2013)	刚才轮子转了. gang-cai lun-zi zhuan -*LE*. just now tyre turn -*LE*. The tyre just turned.

Second, in Chinese, the lexical aspect subclasses (LA) have been grouped by Li and Bowerman (1998) into a comprehensive system, which includes *states*, *activities*, *accomplishments*, *achievements* (including *resultative compounds*), *semelfactives*, and *mixed stative-telic verbs*. It originally stemmed from Vendler's (1957) influential taxonomy of four situation

types: *states*, *activities*, *achievements*, and *accomplishments*. Later, Smith (1991) proposed the additional LA subtype: *semelfactives* (e.g., qiao *[knock]*). They differ from *achievements* in that they are atelic and thus can be used with *ZAI* (Dickey 2016) to indicate repeated events or actions (e.g., *ZAI* qiao *[keep knocking]*). In addition, two special subclasses of LA have been developed for Chinese: *resultative compounds* (e.g., Li and Thompson 1989; Tai 1984) and *mixed stative-telic verbs*. (Li 1990). The former has two parts: an activity verb plus a verb or an adjective denoting the resultative state of an action or a word specifying the direction of a movement (Lin 2012; Deng 2019). Moreover, as they indicate the resultant state of action and convey no progressive reading, they normally appear with *-LE* and are incompatible with *ZAI* (Chen 2017). They are usually viewed as a subclass of *achievements* (Chang 2013). Meanwhile, *mixed stative-telic verbs* indicate either the process or the stative result of a given situation, depending on which grammatical aspect marker they co-occur with (Li and Shirai 2011): when a *mixed stative-telic verb* is used with *ZAI*, it describes ongoing progress; when it is used with *-ZHE* or *-LE*, it indicates the stative result of the previous action. In the present study, we propose using the previously mentioned LA subclasses to form a systematic Chinese lexical aspect typology (e.g., Li 1990; Smith 1991; Vendler 1957). Despite some of these subclasses being examined separately or in certain configurations in the previous studies (e.g., Sun and Grisot 2020; Xiao and McEnery 2004), this typology has not been examined entirely using naturalistic interaction materials extracted from real conversations. Therefore, this study aimed to fill this gap by including all the LA subclasses mentioned previously and examining this typology against a Chinese corpus. In the following section, we review the literature on how young children acquire the Chinese aspectual system.

3. Acquisition of Chinese Aspect Markers in Early Years

The aspectual system plays a critical role in Mandarin speakers' temporal expressions (Huang 2003). The existing studies converge on two main topics: (1) children's acquisition patterns of grammatical aspect markers and (2) the interaction between grammatical aspect markers and lexical aspect subclasses. Concerning the first topic, Erbaugh's (1978, 1982) pioneering research found that preschool-aged Mandarin-speaking children acquired *ZAI* and *-ZHE* later than *-LE* but earlier than *-GUO*. This acquisition sequence has been confirmed by a recent study involving Chinese children aged from 3–6 (Li 2016). Zhou's (2004) study found that Chinese children as young as 1.5 years old could produce *-LE* to denote the completeness of an event. However, recent evidence indicated that children younger than 1.5 years could also do so (Liu 2015; Peng and Li 2018). For example, Peng and Li's (2018) longitudinal study of two Mandarin-speaking (L1) children found that the participants began producing *-LE* to denote the completion of actions as early as one year and four months old. Their ability to use *-LE* for indicating a change of state appeared even earlier by at least a month. The research of Zhou et al. (2014) and Yang et al. (2018) further demonstrated that in eye-tracking experiments Mandarin-speaking children around three years old tended to make more eye movements toward the completed situation when they heard *-LE*-sentences than *-ZHE*-sentences. These findings jointly demonstrated children's early-developed sensitivity for detecting the distinct temporal characteristic conveyed by this grammatical aspect marker *-LE*. As for *-GUO*, its first appearance in children's utterances has been documented as subsequent to *-LE* (Peng and Li 2018; Zhou 2004), which could be attributed to various factors, including its complex semantic feature (Xu 2019), or the advanced cognitive ability it requires the speaker to possess. Nevertheless, according to Jin and Hendriks (2005), Chinese children can correctly use all the aspect markers by the age of seven.

Regarding the second topic—the interaction pattern between grammatical aspect markers and lexical aspect subclasses, Shirai and Andersen (1995) proposed the well-known Aspect Hypothesis (AH), containing four major assumptions:

- AH1, children tend to acquire past or perfective markings first and use them in association with *achievements* and *accomplishments*. Subsequently, this association extends to *states* and *activities*;

- AH2, in languages that differentiate imperfective and perfective aspects, children acquire the perfective past before the imperfective past;
- AH3, in languages that have a progressive aspect, children first use progressive aspect marking most frequently with activity verbs, then extend its use to *achievements* and *accomplishments*;
- AH4, children are less likely to use progressive aspect markings with *states*.

The Aspect Hypothesis has been verified by the data drawn from the speakers of English, French, Italian, Turkish, and Russian (see Li and Shirai 2011, for a review), as well as Chinese (e.g., Chang 2002, 2013; Chen and Shirai 2010; Jin and Hendriks 2005; Nicoladis et al. 2020). For instance, Li and Bowerman (1998) found that Mandarin-speaking children (aged 4–6) associated *ZAI* mostly with *activities* and *semelfactives* but not *accomplishments* or *achievements*. Conversely, they used *-LE* mostly with the latter two rather than the former two. Moreover, Li (2016) reported that *ZAI* was mostly used with *activities* and then extended to *accomplishments*. However, deviations from the AH have also been documented. For example, in Chen and Shirai's (2010) and Li's (2016) recent research, young Chinese children under the age of 6 were found producing *-LE* with *states* and using them with *accomplishments* before extending its use to *activities*, which contradicted the assumptions of the AH. Moreover, Jin and Hendriks (2005) reported several cases in which Chinese children incorrectly linked *-ZHE* to *achievements*. Additionally, Luk and Shirai's (2018) investigation found a weaker consistency in AH among bilingual children than in their monolingual peers. The researchers argued that this might be due to a lexical/morphosyntactic transfer, which allows the bilingual children to 'apply English past marking to different verb types early on in their development of past tense marking. Thus, they deviate from the prediction of the AH' (p. 38). These divergent findings could be caused by different experimental designs and relatively small sample sizes. To tackle these issues, this study examined AH using the naturalistic speech data drawn from a large-scale corpus, which collects the naturalistic interaction of Mandarin-speaking children. It also did so by employing a comprehensive typology of Chinese LA and GA.

4. Development of Chinese Temporal Adverbs in Early Childhood

Temporal adverbs constitute a large portion of Chinese adverbs (Ma 2010) and play a significant role in time expression. They express the temporality of events, actions, or states and primarily function as modifiers of verbs or adjectives (Ma 2010; Wang 2017). According to Ma (2010), the temporality denoted by Chinese temporal adverbs includes past (e.g., *jiu* 'already', *gang-cai* 'a moment ago'), present (e.g., *xian-zai* 'now'), future (e.g., *jiu-yao* 'about to'), duration (e.g., *ren-ran* 'still'), sequence (e.g., *ran-hou* 'then'), and frequency (e.g., *you-shi* 'sometimes', *jing-chang* 'often'). One study conducted by Tse et al. (2012) suggested that this classification of temporal adverbs fits the natural utterances of children who speak Cantonese, a major variety of the Chinese language. A recent study by Liang et al. (2019) provided further crosslinguistic evidence supporting this typology in a group of Mandarin-speaking preschoolers.

Several scholars have explored how Mandarin-speaking children acquire temporal adverbs in their early years. Erbaugh (1992) proposed a three-stage model: the proto-temporal stage, the early temporal stage, and the sequenced temporal relations stage. In the first stage, children could only use a few connectives. In the second stage, they begin to produce temporal adverbs, while in the third stage they start uttering multiple events in a sequenced manner. Fu (2002) found that children's acquisition of temporal adverbs demonstrated a present time > future time > past time sequence. A recent study revealed that children as young as two years old had attained the ability to use temporal adverbs to denote past, present, and future events (Liang et al. 2019). This study also identified a significant age effect by which, with increased age, more children could produce all subtypes of temporal adverbs. However, the researchers did not examine whether young children employ aspect markers as an additional temporal device to express temporality. Thus, we still have little understanding regarding how Chinese preschool children adopt various forms of temporal

devices to convey temporal meanings. The present study represents the first attempt to address this understudied issue using a corpus-based approach.

5. Predictors of Aspectual Development

Despite existing literature generating little evidence on the predictors of early aspectual development, previous research has provided a list of candidates ranging from factors embedded in the socio-cultural environment (Rosemberg et al. 2014) to those concerning the linguistic features (Ma et al. 2019) and individual characteristics (Ryu et al. 2015) that cause variations in people's acquisition of temporal morphology. Furthermore, Shirai (2004) pointed out that a potential explanation for the universal tendencies and individual deviations in tense-aspect acquisition invites a multiple-factor account encompassing factors relating to the learners themselves and the external language environment. Therefore, in this study, we are interested in examining the potential influence of learner-external factors.

Language input has been widely found as an important external factor influencing children's acquisition of aspect markers. For example, Wong's (2009) study reported that the frequency of adult input significantly related to Cantonese-speaking children's acquisition of aspect markers. The researchers argued that the accumulated linguistic exposure facilitated the acquisition of aspect markers and influenced the order of their acquisition. Such input–output association aligns with the usage-based model (Tomasello 2003), emphasizing the indispensable role of language input in fostering the emergence of particular syntactic constructions. Similar correlation patterns were also observed among second language learners (Kim and Lee 2006; Ryu et al. 2015).

For young children, the language input mainly comes from two sources: family and preschool settings. Recent research has shown that young children's language input from these immediate language environments plays a crucial role in shaping their early language development (e.g., Chen and Shirai 2010; Justice et al. 2018). For example, Li et al. (2022) reported that different parental language input patterns were associated differently with bilingual children's usage of Chinese and English interrogatives. In addition, Yeung and King's (2016) investigation revealed that different types of parental literacy practices (i.e., shared reading, English materials exposure, etc.) uniquely predicted different aspects of children's early language skills (e.g., vocabulary, letter knowledge). These findings highlighted the contribution of the children's immediate language environment as it decides the child's quantity and quality of language input. However, children's acquisition of aspect markers and their association with factors embedded in their immediate language environment has received scant research attention. This study attempts to address this understudied issue.

6. The Aim of this Study

Most previous studies on Chinese children's acquisition of the aspectual system drew data from preconditioned elicitation tasks (Jin and Hendriks 2005; Li and Bowerman 1998), resulting in data taken out of natural contexts, which are thus less representative of children's genuine use of aspect markers. Furthermore, some researchers gathered data from corpora comprising adult–child conversations (Chen and Shirai 2010; Erbaugh 1982; Huang 2003), which employed quite small samples (less than 5). Therefore, a large-scale corpus-based investigation is warranted as it provides naturalistic data and real examples of the aspect markers used in non-experimental contexts. In addition, given the extremely limited evidence—one exception being a study (Wen 1995) reporting that adults who learn Chinese as a second language sometimes use a temporal adverb and a sentence-final *LE* to express the immediate future—on whether and how Chinese children produce aspect markers along with other time-encoding devices such as temporal adverbs, this study set out to address this knowledge gap for the first time. Last but not the least, this empirical investigation will provide new understandings of the potential predictors of Chinese aspectual development. The following research questions guided this study:

RQ1: What are the developmental patterns of aspect markers in Chinese preschool children?

RQ2: What interactional pattern can be observed between grammatical aspect markers and lexical aspect subclasses?
RQ3: Do Chinese preschoolers produce grammatical aspect markers with temporal adverbs?
RQ4: What are the predictors of aspectual development in Chinese preschoolers?

7. Method

7.1. Corpus

The Early Childhood Mandarin Corpus (ECMC, Li and Tse 2011) used in this study is a large-scale corpus containing the natural utterances of monolingual Mandarin-speaking children during 30 min free play sessions. Overall, 192 preschool children were randomly selected from eight preschools located in four major districts of Beijing: Dongcheng district, Xicheng district, Chaoyang district, and Haidian district. The sample consisted of children from four age ranges (i.e., 2;6, 3;6, 4;6, and 5;6), with each age range comprising an equal number (n = 24) of boys and girls. All children in this Corpus were native speakers of Mandarin and so were their parents at home and their teachers in preschools.

7.2. The Communication Task

Firstly, participants from the same age group were randomly paired (boy/boy, girl/girl, or boy/girl). They were then invited to play freely in a separate room located in the kindergarten, where a set of toys was provided (e.g., cooking materials, fruits and faux foods, vehicles, furniture, electrical appliances, hospital materials, etc.). Only one dyad of participants was allowed to play in this area at one time. Each pair of children played with the same set of toys. During the 30 min play sessions, they were instructed to play freely with the toys and were encouraged to talk to each other as much as they wanted. All the children were allowed to talk for the same time length: 30 min. A digital camera videotaped their natural conversations while a trained research assistant observed their activities throughout the play sessions without making interventions.

7.3. Transcription of Data

We adopted the transcription conventions set up by Tse et al. (2012) in the transcription stage. First, research assistants transcribed the children's free conversations to a level of detail that captured all the audible words and word fragments (including overlapping speech), with the non-lexical fillers (e.g., 'uh') and other vocalizations (e.g., laughter) also found in the Corpus. Next, other members of the research team proofread the transcripts independently against the taped audio clips to ensure the accuracy of the transcription. Discrepancies or mistakes were settled by resorting back to the original tape. After that, the script was segmented into individual utterances. Given that this study did not aim at examining children's erroneous use of aspect markers (this topic warrants another study), the first two authors carefully read through all the segmented utterances and removed the ones with incorrect/unintelligible (n = 39, see examples given below) aspect markers, as analyzing children's misuse of aspect markers goes beyond the purpose of this study. Afterwards, the third author, a senior researcher in child language development, reviewed the final Chinese script before coding and analyzing it.

1. Hai shi tang -*ZHE* ba.
   Let's lie down-*ZHE* here.
2. Ta *ZAI* zuo yi-zi.
   He is sitting down on the chair.

7.4. Coding Scheme

Each child's utterance was coded on three levels: (1) grammatical aspect markers; (2) lexical aspect subclasses; and (3) presence (or absence) of temporal adverbs. First, the typology of the four main Chinese grammatical aspect markers (i.e., *-LE*, *-GUO*, *ZAI*, *-ZHE*) was employed to assist in the coding of the grammatical aspect markers (Sun and Boye 2019; Sun and Grisot 2020). *-LE* was further divided into subtypes, depending on its unique

syntactic and semantic features: sentence-final *-LE*, verbal-*LE*, and a combination of the two (for more details, see Table 1). Second, to code lexical aspect classes, we adopted Li and Bowerman's (1998) classification of seven Chinese lexical aspect classes (see Appendix A Table A1). The following steps were then taken to code the lexical aspect classes: (a) we read the target sentences (the ones containing grammatical aspect markers) a few times until we were reasonably sure about their interpretation; (b) we removed the grammatical aspect markers from the utterances (e.g., Ta pao *-LE* 'he run *-LE*' and Ta ZAI pao 'he *ZAI* run' should both be Ta pao 'he runs'); and (c) we applied Steps 1–6 of the operational tests (see Appendix B) to classify the target lexical aspect subclass. Lastly, each utterance was read again to determine the presence or absence of temporal adverbs, using the six-subtype coding scheme (i.e., past, present, future, frequency, duration, sequence) established in previous research (Liang et al. 2019; Ma 2010) as a reference.

The first and second authors independently coded 10% of all the utterances to classify the grammatical aspect markers and lexical aspect classes. Cohen's Kappa was calculated as 0.912 and 0.874, respectively, indicating a high inter-coder reliability level. Discussions were held to resolve discrepancies. Afterwards, the first author coded the remaining data.

7.5. Parental Report

The Home Language Environment Survey (HLES) was administered to one of the parents of each participating child in this study. The HLES was derived from the Home Literacy Environment Index (HLEI) (Li and Rao 2000). It consists of twenty-nine questions (single-choice ones and multiple-choice ones) to investigate parental beliefs and practices about constructing a home language environment. It includes, for instance, questions concerning family language environment ('what languages are spoken at home?'), parental involvement ('do you have regular storytime for reading to your child at home?'), language resources ('how many Chinese/English children's books do you have at home?') and the like. The previous study's validity and reliability have been tested with the sample from Beijing, Hong Kong, and Singapore (Li and Rao 2000).

8. Results

In total, 157 children produced grammatical aspect markers in their natural utterances (n = 1821), which were included in the data analysis. Descriptive statistics revealed that (see Table 2) the children's average production of aspect markers increased with their age (from 6.48 at 2;6 to 18.98 at 5;6). This growing pattern will be further examined in the following section. Among the grammatical aspect markers, *-LE* and *-GUO* were the most and least frequently used subtypes, respectively, in all age groups (except for group 3;6). In terms of lexical aspect subclasses, all but one subclass (i.e., *semelfactives*) showed a similar rising pattern, with *achievements* (n = 668), *activities* (n = 429), and *resultative compounds* (n = 415) being the top three most frequently used LA subclasses. In addition, the children produced temporal adverbs denoting *all* six types of temporality; the most frequently used ones found within each subtype were: *hai* 'still' (duration), *zong-shi* 'always' (frequency), *kuai* 'about to' (future), *yi-jing* 'already' (past), *zheng* 'now' (at present), and *you* 'then' (sequence).

8.1. Early Development of Aspect Markers

Before conducting data analysis, we performed the Shapiro–Wilk test and a visual inspection of the Q-Q plot to determine data normality. The results indicated the non-normal distribution of the data across all age groups (Shapiro–Wilk test $ps < 0.05$, the data points strayed from the diagonal line in an obvious non-linear fashion). Thus, we adopted the nonparametric Jonckheere–Terpstra test (T_{JT}) to explore the developmental pattern of the children's utterances of aspect markers (research question #1). The Jonckheere–Terpstra test is a rank-based nonparametric test used to determine a statistically significant trend between an ordinal independent variable and a continuous or ordinal dependent variable. In other words, it can be used to determine the significance of a trend in the data: whether an increase in one variable results in an increase or decrease in another

variable. In our case, the four age groups to which the children belonged served as the independent variable (ordinal), while the number of aspect markers produced by the children served as the continuous dependent variable. As Table 3 presents, there is a significant age effect: as the children got older, they tended to make more frequent use of all aspect markers (TJT = 6491.00, z = 6.01, $p < 0.001$). From age 4;6 onwards, the children's use of GA and LA saw a significant rise in frequency. Table 3 also shows variations in the developmental patterns of different aspect markers. For grammatical aspect markers, *-LE*, *-ZHE*, and *ZAI* demonstrated a significant increasing trend, while *-GUO* did not. Among the former three, *-LE*, the most frequently used grammatical aspect marker, saw a significant increase around 4;6 (the average rank rose from 58.49 at 3;6 to 83.99 at 4;6, then to 106.71 at 5;6), while the other two (*-ZHE* and *ZAI*) experienced the increase at a later time (at 5;6). Apart from *semelfactives*, all other lexical aspect subclasses demonstrated a significant age-related increasing pattern in terms of lexical aspect subclasses. Among them, *states* and *activities* experienced a significant rise at 4;6, while *accomplishments*, *achievements*, *resultative compounds*, and *mixed stative-telic verbs* did so at 5;6. Despite these different developmental patterns, the children in the younger groups (2;6 and 3;6) did not differ significantly in their production of aspect markers. All these findings jointly indicated that (1) the Chinese children were capable of producing various aspect markers to denote temporality from very early years (2;6), and (2) they became more frequent in their use of aspect markers around age 4.

Table 2. Children's Average Production of Aspect Markers in all age Groups.

Aspect Markers	Age Groups (N = 157)			
	2;6 M (*SD*)	**3;6 M (*SD*)**	**4;6 M (*SD*)**	**5;6 M (*SD*)**
GAs	6.48 (*1.41*)	7.15 (*1.19*)	10.79 (*1.22*)	18.98 (*2.11*)
-LE	5.52 (*1.28*)	5.82 (*1.06*)	9.33 (*1.00*)	15.71 (*1.73*)
-GUO	0.15 (*0.09*)	0.41 (*0.18*)	0.12 (*0.06*)	0.33 (*0.08*)
-ZHE	0.52 (*0.20*)	0.65 (*0.17*)	0.83 (*0.27*)	1.94 (*0.38*)
ZAI	0.30 (*0.09*)	0.26 (*0.10*)	0.50 (*0.17*)	1.00 (*0.24*)
LAs	6.48 (*1.41*)	7.15 (*1.19*)	10.79 (*1.22*)	18.98 (*2.11*)
States	0.15 (*0.08*)	0.26 (*0.11*)	0.93 (*0.21*)	1.52 (*0.26*)
Activities	1.18 (*0.27*)	1.56 (*0.32*)	2.86 (*0.51*)	4.52 (*0.63*)
Accomplishments	0.09 (*0.05*)	0.18 (*0.10*)	0.31 (*0.10*)	0.69 (*0.19*)
Achievements	3.18 (*0.87*)	2.91 (*0.53*)	3.88 (*0.46*)	6.27 (*0.87*)
Resultative compounds	1.21 (*0.31*)	1.59 (*0.42*)	2.31 (*0.31*)	4.67 (*0.48*)
Semelfactives	0.15 (*0.10*)	0.00 (*0.00*)	0.10 (*0.08*)	0.04 (*0.03*)
Mixed stative-telic verbs	0.52 (*0.19*)	0.65 (*0.21*)	0.40 (*0.10*)	1.27 (*0.22*)

Note. GA = grammatical aspect markers, LA = lexical aspect markers. The number of children that produced aspect markers in the four age groups was 33, 34, 42, and 48, respectively.

8.2. Interaction Pattern of Grammatical Aspect Markers and Lexical Aspect Subclasses

We conducted a series of Friedman's ANOVAs to explore the interaction patterns of the grammatical aspect markers and lexical aspect subclasses to address research question 2 and examine the Aspect Hypothesis (AH).

-Le. The results indicated that *-LE* was used frequently with most of the lexical aspect subclasses examined in this study (see Figure 1): *states*, *activities*, *accomplishments*, *achievements*, and *resultative compounds*. Concerning their co-occurrence with *-LE*, the Friedman's ANOVA analysis found a significant difference ($ps < 0.001$), with *achievements* being the most frequently co-occurring subtype (see example '3') and *activities* the second (see '4'). In addition, *achievements* were significantly more likely to be used with *-LE* than other LA subclasses ($ps < 0.001$) in all age groups. The magnitude of these differences mostly represented a medium-to-large effect size ($rs > 0.5$) by the conventions (Cohen 1988).

3. Na-ge xiao qi-che huai ('broken', achievement) *-LE*.
That small car is broken.

4. Wo chao-cai ('frying the food', activity) *-LE*.
   I have started frying the food.

Table 3. Average Ranks of Aspect Marker Production by Children in all age Groups.

Aspect Markers	Age Groups (N = 157)				T_{JT} [a]	z [b]
	2;6	3;6	4;6	5;6		
GAs	53.08 $_{a}$	59.91 $_{a/b}$	82.42 $_{b}$	107.35 $_{c}$	6491.00 ***	6.01
-LE	53.48 $_{a}$	58.49 $_{a}$	83.99 $_{b}$	106.71 $_{c}$	6497.50 ***	6.04
-GUO					4963.00	1.80
-ZHE	63.68 $_{a}$	73.32 $_{a}$	71.94 $_{a}$	99.73 $_{b}$	5710.50 ***	3.94
ZAI	73.08	69.19 $_{a}$	74.87	93.64 $_{b}$	5313.50 ***	2.80
LAs	53.08 $_{a}$	56.91 $_{a/b}$	82.42 $_{b}$	107.35 $_{c}$	6491.00 ***	6.01
States	55.45 $_{a}$	60.00 $_{a}$	85.29 $_{b}$	103.15 $_{b}$	6282.50 ***	6.05
Activities	56.15 $_{a}$	63.35 $_{a/b}$	81.37 $_{b/c}$	103.72 $_{c}$	6209.00 ***	5.20
Accomplishments	70.05 $_{a}$	72.50	80.12	88.78 $_{b}$	5232.00 ***	2.94
Achievements	60.82 $_{a}$	65.24 $_{a}$	83.42	97.39 $_{b}$	5878.50 ***	4.11
Resultative compounds	53.95 $_{a}$	59.60 $_{a/b}$	80.07 $_{b}$	109.02 $_{c}$	6533.50 ***	6.24
Semelfactives					4524.50	−0.524
Mixed stative-telic verbs	69.86 $_{a}$	73.22 $_{a}$	69.60 $_{a}$	97.60 $_{b}$	5469.50 ***	3.16

Note. Figure in each cell represents the average rank within each age group. Columns with different subscripts indicate a significantly different column average rank at the 0.05 significance level (with Bonferroni correction); in some cells, more than one subscript is used to indicate a nonsignificant difference between them and the adjacent cells. [a] The T-J statistics. [b] The standardized J-T statistics. *** $p < 0.001$.

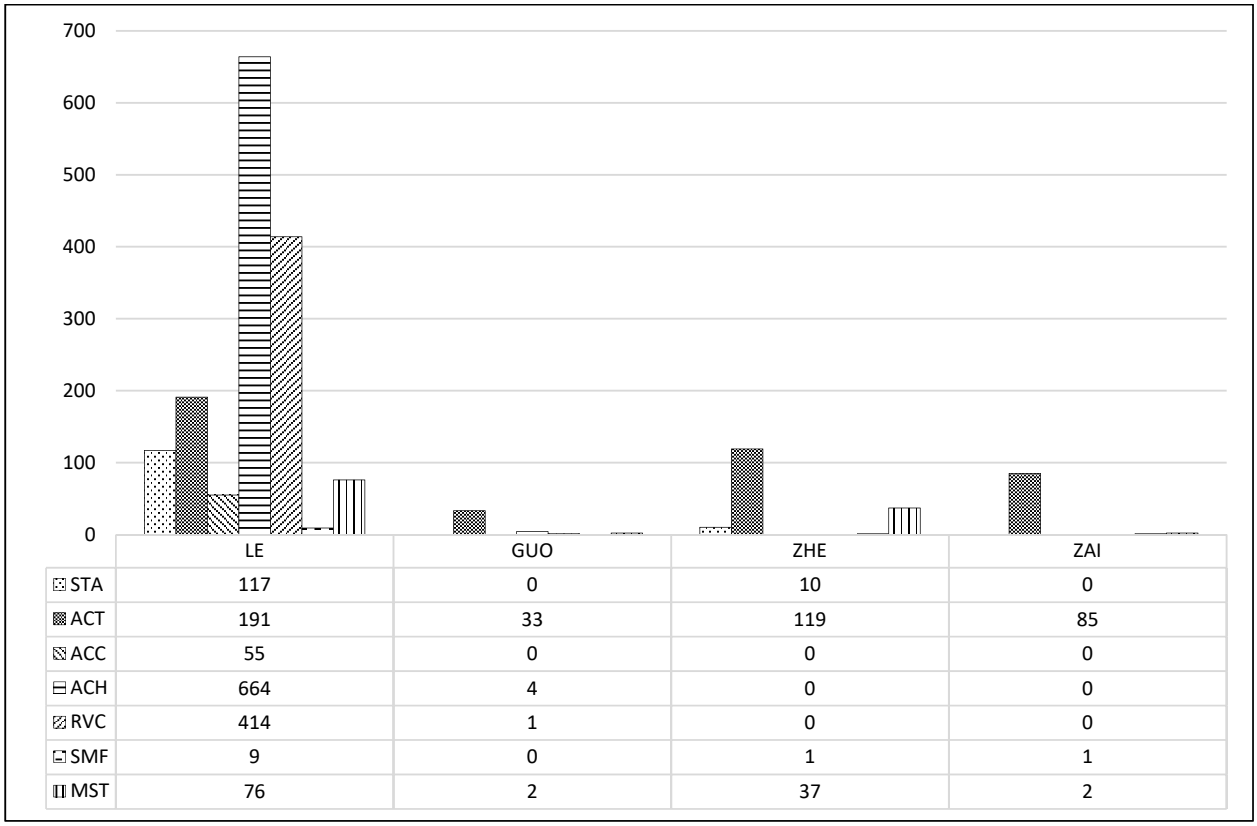

Figure 1. Frequency of grammatical aspect markers and lexical aspect subclass combinations. Note. STA = States, ACT = Activities, ACC = Accomplishments, ACH = Achievements, RVC = Resultative compounds, SMF = Semelfactives, and MST = Mixed stative-telic.

We further investigated the interaction pattern between three subtypes of *-LE* (i.e., SF-*LE*, VF-*LE*, and VSF-*LE*) and the two most frequently co-occurring lexical aspect subclasses:

achievements and *activities*. With regard to SF-*LE*, which has two interpretations—SF1 (indicating a change of state and a signal of its current relevance state) and SF2 (highlighting the beginning of a situation)—the analysis showed that *activities* occurred more frequently with SF2 than SF1 to produce an inchoative reading ($T = 426$, $p < 0.001$, $r = 0.29$, see '4'). In contrast, *achievements* were more likely to be co-occurring with SF1 than SF2 to indicate a state change ($T = 20$, $p < 0.001$, $r = -0.61$, see '5'). In terms of VF-*LE*, VF3 was significantly more likely (ps < 0.001) than the other subtypes to be used with both *achievements* and *activities* to indicate the resultative state of a previous event (see Table 4 and examples '6' and '7'). As for VSF-*LE*, *activities* tended to appear more frequently with VSF2 to denote an inchoative reading (see '8'), while *achievements* were more likely to be used with VSF1, as shown in example '9', to indicate a changed state that is currently relevant.

5. Wo chi-wan ('finished eating', achievement) fan -*LE*.
   I have finished eating.
6. Wo zhao-dao ('found', achievement)-*LE* zhe-ge.
   I have found this.
7. Wo zhao ('looking for', activity)-*LE* ban-tian.
   I have been looking for it for quite some time.
8. Yi en zhe-ge jiu xiang ('making sound', activity)-*LE*.
   It starts making a sound when you push this.
9. Dou fei-zou ('fly away', achievement)-*LE*.
   All have flown away.

Table 4. Mean Rank of the Combinations of VF-*LE*/VSF-*LE* and Activities and Achievements [a].

Lexical Aspect	VF					Effect Size of Pairwise Comparison		
	VF1 [b]	VF2	VF3	VF4	χ^2	1v3	2v3	4v3
Activities	2.52	2.28	2.82	2.38	33.08 ***	- [c]	*−0.21* *	-
Achievements	2.24	2.02	3.46	2.28	118.10 ***	*−0.48* ***	*−0.56* ***	*0.46* ***
	VSF					Effect Size of Pairwise Comparison		
	VSF1	VSF2	VSF3		χ^2	3v2	3v1	2v1
Activities	2.06	2.17	1.77		35.93 ***	*0.20* **	-	-
Achievements	2.98	1.53	1.49		259.60 ***	-	*0.75* ***	*0.73* ***

Note. The number in each cell represents the mean rank of the VF-*LE*/VSF-*LE* and activities and achievements combinations. Italic figures represent the effect sizes of the pairwise comparisons, which are calculated as $r = Z/\sqrt{N}$ (Field 2013), where z is the standardized test statistics and N is the number of observations. VF-*LE* = verbal-suffix -LE, VSF-*LE* = verbal-suffix -*LE* at the sentence-final position. [a] As the resultative compound is considered as a subclass of achievements, it is included in achievements in our calculation. [b] The subtypes of VF-*LE* and VSF-*LE* correspond to those found in Table 2. [c]—represents nonsignificant results of pairwise comparison. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

-Guo. *-GUO* was used only with three lexical aspect subclasses (see Figure 1): *activities*, *achievements* (*resultative compounds* included), and *mixed stative-telic verbs*. Among them, *activities* became more frequently used with *-GUO* (see example '10') than the other two subclasses after the children turned 3;6.

10. Wo chao ('fry', activity) -GUO -*LE*.
    I have already fried it.

Zai and ***-Zhe.*** In our Corpus, *ZAI* was used almost exclusively with one lexical aspect subclass: *activities* (n = 85, see example '11', only one case of *semelfactives* and two cases of *mixed stative-telic verbs* were identified). *-ZHE* was used mainly with *activities*, *mixed stative-telic verbs*, and *states*. In all age groups, *activities* were more likely to be used with *-ZHE* than the other two subclasses (see example '12'). Pairwise comparisons indicated that in the 5;6 age group, *activities* were significantly ($p < 0.001$) more likely to be found with *-ZHE* than *states* or *mixed stative-telic verbs*.

11. Wo ZAI da-dian-hua ('making phone call', activity).
    I am making phone calls.

12. Wo na ('hold', activity) -ZHE liang-ge bing-ji-ling.
    I am holding two ice-creams in my hands.

8.3. Testing the Aspect Hypothesis (AH)

Regarding the first assumption of AH (AH1), we found that the children from the 2;6 age group produced both perfective and imperfective aspect markers, *-LE* and *ZAI* (we consider *ZAI* as a typical imperfective aspect marker), although the latter occurred in a much smaller amount (see Table 2). Meanwhile, *-LE* was used with *achievements* (*resultative compounds* included, n = 1078), *activities* (n = 191), *states* (n = 117), and *accomplishments* (n = 55). Therefore, the sequence of acquisition suggested in AH1 cannot be ascertained in light of the present data. To test AH2, we first identified utterances denoting past temporal reference using such temporal adverbs as *yi-jing* ('already', even though yi-jing can be used to express future events, it is mostly used by young children for describing events that happened in the past; see Liang et al. 2019) or *gang-cai* ('just now'). Then, we read each utterance to determine their perfectiveness/progressiveness. The results indicated that the past progressive did not occur in the children's speech until they reached 4;6. When they did occur, they appeared in a much smaller amount compared to the past perfective, with a ratio of 3: 44. In addition, the finding of *ZAI* verified the third (AH3) and the fourth (AH4) assumption of the Aspect Hypothesis as it confirmed that progressive aspect marking is used most frequently with activity verbs. The only inconsistency with the third assumption was that no *achievements* or *accomplishments* were used with progressive marking in this study.

8.4. Co-Occurrence of Grammatical Aspect Markers and Temporal Adverbs

Out of all the children's utterances (n = 1821) examined in this study, those containing the grammatical aspect (GA)–temporal adverb (TA) combinations comprised only a small portion (n = 146, 8.02%). Despite that, we performed a Chi-square test to address the third research question. (Do Chinese preschoolers produce grammatical aspect markers with temporal adverbs?). To do that, the number of children in each age group who did and did not produce GA–TA combinations was calculated. Table 5 presents some noteworthy results from our analysis. First, the outcome of the Chi-square test indicated a significant relationship between the children's production of GA–TA combinations and their age [χ^2 (3, N = 157) = 17.35, $p < 0.001$]. This association represented a moderate effect size [Cramer's V = 0.33, $p < 0.001$] by convention (Cohen 1988). Second, both the amount and the percentage of the children who uttered GA–TA combinations showed a steady increasing trend as they grew. Meanwhile, the number and the percentage of those who did not do so demonstrated a decreasing pattern. Third, such a developmental trajectory is further highlighted by the subscripts in Table 5: among the children aged 2;6, a significantly larger proportion of them (75.8%) did not use GA–TA combinations; whereas among the children aged 5;6, a significantly greater proportion of them (66.7%) did produce such combinations. Our findings indicated that compared to the younger children, using temporal adverbs in combination with aspect markers has become a more commonly observed practice among the older children. We present some of the examples below:

13. wo *zao-jiu* (temporal adverb, 'long ago') ban-jia (move) *-LE*.
    I have moved long ago.
14. wo *yi-jing* (temporal adverb, 'already') *zhun-bei-hao* (get ready) *-LE*.
    I have gotten ready already.
15. *wo gang* (temporal adverb, 'just now') *shi* (test)-*GUO sai-che*.
    I tested the race car just now.

Table 5. Number of Children Producing Grammatical Aspect Markers (GA)–Temporal Adverb (TA) Combinations in all age Groups.

GA–TA Combinations	Age Groups (N = 157)				χ^2
	2;6 (n = 33)	3;6 (n = 34)	4;6 (n = 42)	5;6 (n = 48)	
Yes n (%)	8 $_{b}$ (*24.2*)	11 $_{a}$ (*32.4*)	17 $_{a}$ (*40.5*)	32 $_{b}$ (*66.7*)	17.35 ***
No n (%)	25 $_{a}$ (*75.8*)	23 $_{a}$ (*67.6*)	25 $_{a}$ (*59.5*)	16 $_{a}$ (*33.3*)	*df* = 3 Cramer's V = 0.33 ***

Note. The percentages in brackets were calculated for each age group. Columns with different subscripts have significantly different column proportions at the 0.05 significance level. *** $p < 0.001$.

8.5. Predicting Early Development of Aspect Markers

First, we conducted a Spearman correlation analysis to explore potential factors within the home language environment (as examined by the HLES) that correlated with the children's production of aspect markers. The results in Table 6 indicated that the following variables significantly correlated with the children's aspect marker production (*ps* < 0.05): Age, Gender, Years of Preschooling (i.e., years of receiving kindergarten education for each child), Early learning center attendance, Age of learning to read in Mandarin, and Age of learning to write in Mandarin.

Table 6. Correlation Matrix.

		1	2	3	4	5	6	7
1	Frequency of AM	1						
2	Age	0.509 **	1					
3	Gender	−0.157 *	0.007	1				
4	Years of preschooling	0.552 **	0.798 **	−0.012	1			
5	Early learning center attendance	0.178 *	0.284 **	−0.032	0.237 **	1		
6	Age of learning to read in Mandarin	0.195 *	0.395 *	0.039	0.270 **	0.035	1	
7	Age of learning to write in Mandarin	0.188 *	0.401 **	0.019	0.235 **	0.117	0.499 **	1

Note. AM = aspect markers. * $p < 0.05$; ** $p < 0.01$.

Next, we conducted a three-step hierarchical regression analysis with the children's production of aspect markers as the dependent variable to determine these correlated factors' relative contribution. The results are shown in Table 7. In Step 1, we entered Age and Gender to control for their effects. In Step 2, we entered Age of teaching Mandarin to read and Age of teaching Mandarin to write, as these variables represent the parents' home-based literacy involvement and were found to be contributors to the children's language development (Li et al. 2008; Li and Rao 2000). Finally, in Step 3, we entered Early learning center attendance and Years of Preschooling to understand the contribution of center-based educational experience to the variation in the children's early development of aspect markers.

As shown in Table 7, the changes in R^2 between the three steps indicated that: (1) age and gender jointly explained 27.4% of the variation in individual production of aspect markers. In addition, age was a significant predictor of the production of aspect markers ($\beta = 0.498$, $p < 0.001$); (2) Age of teaching Mandarin to read and Age of teaching Mandarin to write only jointly accounted for a small portion of the variations in aspect marker production (0.2%), and neither of them were found to be the significant predictor of the dependent variable; (3) Early learning center attendance and Years of Preschooling jointly accounted for another 6.8% additional variation in the children's aspect marker production. In particular, the children's Years of Preschooling were found to be a significant positive predictor ($\beta = 0.430$, $p < 0.001$), while Early learning center attendance was not. Our finding suggests that parents' home-based literacy activities contribute little to children's

acquisition of aspect markers; rather, it is the children's preschool education experience that significantly influences how children acquire and make use of aspect markers.

Table 7. Summary of Hierarchical Regression Analyses Predicting Frequency of Aspect Markers.

Steps	Predictors	β	R^2	ΔR^2	F
Step 1			0.274	-	25.131 ***
	Age	0.498 ***			
	Gender	−0.156 *			
Step2			0.276	0.002	12.501 ***
	Age of learning to read in Mandarin	−0.046			
	Age of learning to write in Mandarin	−0.006			
Step 3			0.345	0.068	11.310 ***
	Early learning center attendance	0.027			
	Years of preschooling	0.430 ***			

Note. * $p < 0.05$; *** $p < 0.001$.

9. Discussion

As the first corpus-based exploration of the patterns and predictors of early aspectual development in Chinese preschool children, this study provided empirical evidence illustrating young children's acquisition of the aspectual system in Chinese, a 'tenseless' language. It has also generated crosslinguistic evidence to partially corroborate the Aspect Hypothesis. Additionally, this study has examined how children adopted temporal adverbs in combination with aspect markers in their expression of time. Finally, it has also found that the years of preschooling significantly contributed to children's early aspectual development. This section will discuss these findings and their educational implications.

9.1. The Developmental Pattern of Chinese Aspect Markers in Early Years

First, this study found a significant age-related increase in aspect marker production and a dramatic growth around age 4 in Mandarin-speaking children. This finding aligns with Grant and Suddendorf's (2011) claim that young children gradually gain the linguistic maturity to express temporal relationships over the pre-primary years. Moreover, it reveals a crucial stage where such development becomes perceivable. Yet, as this study did not directly measure children's understanding of temporal concepts, such a link remains to be empirically verified in future studies. Moreover, this study found that Chinese children could use the grammatical aspect markers and lexical aspect subclasses appropriately from as young as two years old. This finding substantiates the findings of Chen and Shirai (2010), Yang et al. (2018), and Zhou (2004) that children below three years old develop a sensitivity to the aspectual information conveyed by various aspectual markings, which lays the cognitive groundwork for them to mentally process and verbally express temporality.

Second, this study found that *-LE* was far more frequently used among the grammatical aspect markers than the other three markers, following the pattern of *-ZHE* > *ZAI* > *-GUO* in the four age groups. This distribution pattern not only lends support to Erbaugh's (1978, 1982) and Liu's (2009) findings that from an early stage children produce predominantly more *-LE* than other grammatical aspect markers, but also generally aligns with Chen and Shirai's (2010) claim that apart from *-LE* the other three aspect markers do not show a dramatic increase as children grow up. However, contrary to Chen and Shirai's (2010) finding that the proportion of each aspect marker remains stable over time, in our study, such a proportion shows a widening trend. This is because as the children grow up, the token frequency of *-LE* produced by them shows a nearly threefold (see Table 2) rise.

Third, we found that the very young children (2;6) could produce the lexical aspect subclasses, and there was a significant age-related increase in its frequency of utterance. However, some variations were found: while the production of *activities* and *states* expe-

rienced a significant increase at 4;6, *accomplishments*, *achievements*, *resultative compounds*, and *mixed stative-telic verbs* saw an increase at a later stage (5;6). This difference is partly caused by the inherent aspectual properties of these lexical aspect classes: while *activities* and *states* represent atelic situations and are normally used for encoding situations close to the speech time, other LA subclasses represent telic situations and are usually linked to past events (Huang 2000, 2003). Such a phenomenon might be accounted for by Bohnemeyer and Swift's (2004) concept of the 'default aspect', which refers to the preferred or exclusive aspectual interpretation of certain predicates. Furthermore, the existing studies (Fu 2002; Zhou 2004) have found that young children talk about present situations more often than those indicating past events. Thus, it is plausible that lexical aspect subclasses relating to ongoing situations such as *activities* and *states* would have gone through earlier and faster development.

9.2. Interaction Patterns within and beyond the Aspectual System

As Smith's (1991) two-component theory suggested, the proper establishment of aspectual information relied on the interaction between grammatical aspect markers and lexical aspect subclasses. Given its prevalence in children's utterances in our corpus, LE co-occurred with almost all the lexical aspect subclasses examined in this study, with *achievements* being used significantly more than the other subtypes across all the age groups. A similar finding has been documented in other investigations (Jin and Hendriks 2005; Li and Bowerman 1998) involving children aged 2 to 7, which indicated that the combination of *-LE* and *achievements* is acquired by children from an early stage and remains strong over the subsequent years. In addition, *activities* ranked the second most frequently co-occurring lexical aspect subclass with *-LE* in all age groups. These findings, including those of this study, indicate that children can make appropriate GA–LA combinations as early as two years old and differ greatly from the age range (about 10 years old) reported by Jin and Hendriks (2005).

Therefore, to gain a deeper understanding of the interaction between *-LE* and *achievements/activities*, we further broke *-LE* down into three subtypes (i.e., SF-*LE*, VF-*LE*, and VSF-*LE*), whose interpretations vary as a function of diverse semantic and syntactic constraints (Xu et al. 2019; Xu 2020). The results showed that *activities* tended to be used with the SF-*LE* that denotes an inchoative reading (Chang 2013; Chen and Shirai 2010; Lin 2003). *Achievements* tended to occur with the SF-*LE*, denoting a changed state that is currently relevant. In terms of the VF-*LE* co-occurring with *activities* and *achievements*, both combinations (i.e., VF-*LE-activities* and VF-*LE-achievements*) involved primarily the VF-*LE*, which indicates the resultative state of a previous action (Chen and Hu 2016; Ljungqvist 2003). Finally, concerning VSF-*LE* co-occurring with *activities* and *achievements*, we found that in the former combinations (i.e., VSF-*LE-activities*), *activities* tended to be used with the VSF-*LE*, which implies an inchoative reading (Chen and Shirai 2010; Jin and Hendriks 2005), while the latter combinations (VSF-*LE-achievements*) contained the VSF-*LE*, which highlights the current state of a changed situation (Chang 2013; Lin 2003). These findings shed new light on the intricate interactions between Chinese grammatical aspect markers and lexical aspect subclasses in preschoolers' natural speech.

In addition, this study also found that *-GUO* was the least produced grammatical aspect marker among the four, used with only three lexical aspect classes: *activities*, *achievements*, and *mixed stative-telic verbs*, with *activities* being used slightly more often than the other two subtypes. This finding is open to different interpretations. First, it might indicate that preschool children have not developed a comparable level of ability to use *GUO* for the other three grammatical aspect markers. According to Erbaugh's (1982, 1992) longitudinal research, children acquire *-GUO* as the last grammatical aspect marker, around age 4. Second, from a semantic perspective, *-GUO* relates to a situation that was experienced previously, and the resultative states are no longer obtainable at the time of speech (Huang 2003). This 'discontinuity' effect may add cognitive weight to children as it requires them

to decentralize themselves from the present and relocate to a past timepoint. Third, it could be due to the low-structured toy-playing situation that all the children were engaged in.

Lastly, this study found that *ZAI* was used almost exclusively with one lexical aspect class—*activities*. However, in Jin and Hendriks' (2005) study, Mandarin-speaking children produced a certain portion of *ZAI* with *states*. This discrepancy might be due to the different ages of the participants. In Jin and Hendriks' (2005) study, children with an average age beyond five years old may have developed and have at their disposal a much richer repertoire of grammatical–lexical combinations (Deng 2019). ZHE was more likely to be used in combination with *activities* than *states* or *mixed stative-telic verbs*, which is in line with previous studies (Jin and Hendriks 2005). However, such a difference only reached a statistically significant level after the children turned 4;6, indicating yet again a gradual process of acquiring GA–LA combinations.

9.3. Testing the Aspect Hypothesis

This study also examined whether the Aspect Hypothesis (AH) could be applied to this corpus' naturalistic Chinese language data. Past research on learners of other languages (e.g., English, Italian, French, Japanese, Russian, etc.) has generally confirmed the AH's four statements, with some variations detected (Chen and Shirai 2010). Our study did not differ much in this respect. For AH1, this study provided no evidence confirming it as children in the youngest age group (2;6) produced both perfective and imperfective markers and used the former (i.e., *LE*) appropriately with most of the lexical aspect subclasses. Nevertheless, this study provided empirical evidence supporting AH2. Only children in the older age groups (4;6 and 5;6) produced the imperfective past, while children in all age groups could produce the perfective past in much greater amounts. This finding could be considered a reflection of young children's immature mental ability to redirect themselves to a prior timepoint. According to McCormack and Hoerl (2008), there may be important changes between 3 and 5 years old in children's ability to think about points in time independently of the events—an ability they call 'temporal decentralizing'. Additionally, this study provides partial verification to AH3 in that the children in this corpus made frequent use of the progressive aspect marker *ZAI* with *activities*. However, they did not extend its use to *achievements*. This is reasonable given that *achievements* have an inherent temporal endpoint (Smith 1994). Thus, they are incompatible with *ZAI*, which indicates an ongoing situation. Lastly, our study confirmed AH4 in that the progressive aspects are less likely to occur with *states*. Such a finding differed from that of Jin and Hendriks' (2005) work, in which children did produce *ZAI* with *states*. Again, the age of the participants and the language-elicitation task employed (story-telling from picture books) may have led to different outcomes. Further studies, however, are needed to follow up on this discrepancy.

9.4. Interactions between Grammatical Aspect Markers and Temporal Adverbs

Our study investigated another important, yet somehow surprisingly neglected, issue: how preschool children combine different sets of time-encoding devices (i.e., grammatical aspect markers and temporal adverbs) to express temporal information. Our data showed that less than 10% of children's utterances included grammatical aspect markers and temporal adverbs. Thus, although temporal adverbs play a key role in encoding time in Chinese (Liang et al. 2019), they seldom appear when the aspectual system is in place for time expression. Another possible explanation of such a phenomenon comes from the crosslinguistic evidence suggesting that children tend to acquire grammatical markers before producing temporal adverbials in their speech (Shirai 2009; Weist 1986).

Despite that, our analysis revealed a noticeable age-related pattern that, as children get older, more of them become capable of combining grammatical aspect markers with temporal adverbs to express time. Among children in the 5;6 age group, those who could produce such combinations significantly outnumbered those who could not, demonstrating a distinctive pattern to those aged 2;6. This finding sheds new light on several matters

relevant to children's early acquisition of the temporal system. First, a large volume of research has suggested that as children grow they become more mature in their usage of temporal adverbs (Chang 2004; Liang et al. 2019; Tse et al. 2012) and aspectual systems (Chen and Shirai 2010; Erbaugh 1982; Deng 2019). Thus, older Chinese-speaking children would have developed a richer repertoire of these devices to produce more such combinations. Second, viewing from a semantic perspective, temporal adverbs typically function as sentence modifiers to provide additional semantic content to the utterance (Liang et al. 2019; Wang 2017). Thus, our findings suggested that older children were more capable of and likely to reinforce temporal features of the focal event by including the additional temporal device. Third, this finding supports previous crosslinguistic studies that illustrated children's gradual acquisition of temporal systems in their first languages (L1) (Deng 2019; Pawlak et al. 2006; Weist et al. 1997; Weist et al. 2004). Our finding that children in the 5;6 age group produced more GA–TA combinations than those aged 2;6 partly reflected this notion.

9.5. Predicting Chinese Aspectual Development

This study has examined the factors embedded in the children's immediate language environment to explore their predictive power on children's aspectual development. Regression analysis yielded two outcomes worthy of discussion. First, it was found that after controlling for age and gender effects, the children's age at which parents started teaching them to read and write did not significantly predict their acquisition of temporal aspects. Second, these two factors jointly explained a nearly negligible portion of the dependent variable's variations (0.2%). This may seem, at first glance, a counter-intuitive result, given that there is a bulk of existing research underscoring the influential role of parental literacy practices in affecting children's emerging literacy skills (Colliver et al. 2021; Dale et al. 2015; Niklas and Schneider 2017). However, this finding might be attributed to one or a combination of the following reasons: (a) these two factors merely focused on the children's age when the parents' literacy teaching began. Thus, they offer little specification of the quantity and quality of the parents' teaching practice; (b) although previous research revealed that Chinese parents' formal literacy activities could exert significant effects on children's literacy competency and overall school readiness (Justice et al. 2018; Lau et al. 2011; Li et al. 2008), there might only exist a weak link between children's acquisition of temporal systems and the parents' home-based literacy practices; (c) as the data collected in this study are all in spoken form, the parents' introduction of reading/writing activities may not directly translate into the children's oral competency of time-encoding.

Second, our analysis found that the children's Years of Preschooling were a significant predictor of the children's acquisition of aspect markers. This factor is closely linked to the children's preschool experience. Our finding strengthened Droit-Volet's (2016) view that children's time-expressing ability and the associated temporal understanding mature as a consequence of the joint effects of "brain maturation, the experience of the temporal regularities of events, or the emergence of conscious awareness of the passing of time" (p. 102). Every day in preschools is demarcated into various periods, designated to regularly occurring activities, such as 'breakfast', 'group time, 'free-play time', etc. These routines may help children recognize the sequential events that happen in an orderly fashion (e.g., children know that the 'snack time' comes after 'nap time), which facilitates their gradual development of time. As Seefeldt (1997) pointed out, children develop time concepts more effectively when they are linked meaningfully to events in their everyday lives. In addition, following the usage-based model (Kim and Lee 2006; Tomasello 2003), the teachers' classroom language usage may have affected children's acquisition of aspects. This structured language input (e.g., 'we are going to have lunch after the free play) may have provided language materials for children to pick up and adopt in their expressions with increased accuracy and confidence. However, a further empirical study is needed to determine the predictive power of teachers' time-related talk on children's acquisition of aspect markers. It is also possible that as the children were not taken out of the kindergarten

environment—to which they have developed adequate familiarity—they showed more willingness to talk extensively with their age-mates and, hence, produced richer language output containing temporal information.

10. Conclusions, Limitations, and Implications

This study aimed to explore the developmental patterns and predictors of aspectual development among Chinese preschoolers by analyzing the data drawn from a Chinese corpus. First, a noticeable age-related increase was found in the children's production of aspect markers. In particular, from age 4;6 onwards, the children's production of grammatical aspect markers and lexical aspect subclasses experienced a significant rise. Second, the analyses showed that *-LE* was used frequently in combination with most of the lexical aspect subclasses examined in this study; among them, the *achievements* were the most frequently co-occurring subtype and *activities* the second. Third, the results also confirmed three out of the four statements of the Aspect Hypothesis. Fourth, this study found a marked age-related pattern showing that older children were more capable of combining grammatical aspect markers and temporal adverbs in their natural expression of temporality. Lastly, the children's Years of Preschooling significantly predicted their aspectual development after controlling for all other variables.

However, this study has several limitations: first, the data extracted from this corpus were cross-sectional rather than longitudinal; future studies may consider adopting a longitudinal design to capture the developmental trajectory of early aspectual acquisition more accurately. Further research may also consider adopting an experimental study design where each child's total utterance is strictly controlled in order to address the issue of individual variations in children's language production. Second, we were unable to confirm AH1, partly due to the restricted age range of the participants of this study. Thus, other researchers may consider extending their corpora's age range down to 2 years, should they wish to depict a more comprehensive picture of children's early aspectual development. Third, it should be noted that although *-LE* infrequently appeared with *accomplishment* in our study, it could be attributed to the children's omitting of quantity in their speech. For example, *chi yi-ge ping-gwo* ('eat one apple') is an accomplishment, but *chi pinggwo* ('eat apple') denotes an activity. Therefore, further investigation may consider exploring a bidirectional relationship between *-LE* and *accomplishment/activities*. Fourth, the present study did not include the parents' language input data as the predictor of children's aspectual development, as some other studies have done (e.g., Wong 2009). As seen in the result, there remained a fairly sizeable variation in the dependent variable unaccounted for by our current factors. Future studies may consider collecting adult data in a similar conversational context so that the uniqueness of the children's and adults' use of temporal expression can be empirically compared. Last but not the least, as children grow, they spend more hours in preschools. Thus, the factors within preschool settings (e.g., types and length of activities and the teachers' language input) should be included in future research as potential predictors.

Nevertheless, this study's findings offered some new insights into the under-studied issue of how young Chinese children develop their linguistic competency for temporal expression. Our findings indicated that Chinese preschoolers relied heavily on the aspectual system to convey temporal notions as speakers of an 'aspectual' language. In some cases, temporal adverbs were employed as an additional set of linguistic resources. Moreover, this study has provided crosslinguistic evidence to partially support the Aspect Hypothesis that has been found and verified mostly amongst speakers of the 'tensed' languages. Furthermore, this study explored the potential environmental predictors of children's aspectual development for the first time and found that their preschool experience demonstrated a significant impact. This invites further studies to delve deeper into the preschool-based influential factors and the underlying mechanisms.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Lexical Aspect Subclasses in Mandarin Chinese.

Lexical Aspect Subclasses	Semantic Features		
	[±Dynamic]	[±Telicity]	[±Punctuality]
STA	−	−	−
ACT	+	−	−
ACC	+	+	−
ACH (RVC)	+	+	+
SMF	+	−	+
MST-*ZAI*	+	+	−
MST-*ZHE*/*-LE*	−	−	−

Notes. This table is based on Vendler's (1957) and Smith's (1994) classifications of lexical aspect subclasses, including the mixed stative-telic verbs included in the present work. STA = States, ACT = Activities, ACC = Accomplishments, ACH = Achievements, RVC= Resultative verb compounds, SMF = Semelfactives, MST-*ZAI* = Mixed stative-telic verbs used with grammatical aspect marker *ZAI*, MST-*ZHE*/*-LE* = Mixed stative-telic verbs used with grammatical aspect marker *-ZHE* or *-LE*.

Appendix B

Operational Tests for Categorizing Lexical Aspect Subclasses

Adapted from Li and Bowerman (1998). Verbs or verb phrases (VP) are indicated in bold italics.

marks grammatically incorrect sentences.

Step 1: States or Non-States

Does the predicate of the utterance present state in a simple present statement with a possible habitual reading?

If no States (e.g., wo ai ni. "I love you", no habitual reading).

If yes Non-state verbs, which include all other lexical aspect subclasses listed in Appendix A (e.g., wo tian chi mi-fan. "I eat rice every day", habitual reading possible) Go to step 2.

Step 2: Punctual or Durative

Can you say "X kai-shi VP" (="X begin to VP") without an iterative interpretation?

If yes Accomplishments (e.g., Ta kai-shi xie yi-feng xin "he begins to write a letter) or Activities (e.g., Ta kai-shi pao-bu "he begins to run") or Mixed stative-telic verbs (e.g., Ta

kai-shi chuan yi-fu "he begins to put on clothes") or Semelfactives (e.g., Ta kai-shi qiao men "he begins to knock the door")

If no Achievements or Resultative verb compounds (e.g., # Ta kai-shi si "he begins to die" or # Ta kai-shi shuo wan "he begins to finish talking") Step 3.

Step 3: Achievements or Resultative verb compounds

Resultative verb compounds commonly take the form of V+Adj (e.g., sha-si "kill dead") or V+V (kan-dong "read understand), whereas Achievements do not take such forms.

Step 4: Telic or Atelic

Can "X cha-dian VP le" (="X almost VP le") mean "X started V but did not complete it"?

If can Accomplishments (e.g., Ta cha-dian pao dao xue xiao le "he almost ran to the school", could mean that he started running but he did not reach the school).

If cannot Activities (e.g., Ta cha-dian you le yong "he almost swam", indicating in fact he did not swim) or Semelfactives (e.g., Ta cha-dian qiao le men "he almost knocked on the door", indicating he did not knock on the door) or Mixed stative-telic verbs (e.g., Ta cha-dian chuan le yi-fu "he almost put on the clothes", indicating, in fact, he did not put on the clothes). go to step 5.

Step 5: Activities/ Mixed stative-telic verbs or Semelfactives

Can you say "X zai V" with an iterative/repetitive (i.e., iteration on one occasion, not habitual) reading?

If can Semelfactives (e.g., Ta zai ke-sou "he is coughing", iterative reading)

If cannot Activities (e.g., ta zai pao-bu "he is running") or MTS (e.g., ta zai chuan yi-fu "he is putting on the clothes") go to step 6.

Step 6: Activities or Mixed stative-telic verbs

When Mixed stative-telic verbs are used in combination with ZAI, they present a progressive reading, but the verb itself is a telic verb. However, verbs fall under the umbrella of Activities are all atelic.

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