Grammatical aspect and event recognition in children's online sentence comprehension

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A R T I C L E   I N F O

A B S T R A C T

This study investigated whether or not the temporal information encoded in aspectual morphemes can be used immediately by young children to facilitate event recognition during online sentence comprehension. We focused on the contrast between two grammatical aspectual morphemes in Mandarin Chinese, the perfective morpheme –le and the (imperfective) durative morpheme –zhe. The perfective morpheme –le is often used to indicate that an event has been completed, whereas the durative morpheme –zhe indicates that an event is still in progress or continuing. We were interested to see whether young children are able to use the temporal reference encoded in the two aspectual morphemes (i.e., completed versus ongoing) as rapidly as adults to facilitate event recognition during online sentence comprehension. Using the visual world eye-tracking paradigm, we tested 34 Mandarin-speaking adults and 99 Mandarin-speaking children (35 three-year-olds, 32 four-year-olds and 32 five-year-olds). On each trial, participants were presented with spoken sentences containing either of the two aspectual morphemes while viewing a visual image containing two pictures, one representing a completed event and one representing an ongoing event. Participants' eye movements were recorded from the onset of the spoken sentences. The results show that both the adults and the three age groups of children exhibited a facilitatory effect trigged by the aspectual morpheme: hearing the perfective morpheme –le triggered more eye movements to the completed event area, whereas hearing the durative morpheme –zhe triggered more eye movements to the ongoing event area. This effect occurred immediately after the onset of the aspectual morpheme, both for the adults and the three groups of children. This is evidence that young children are able to use the temporal information encoded in aspectual morphemes as rapidly as adults to facilitate event recognition. Children's eye movement patterns reflect a rapid mapping of grammatical aspect onto the temporal structures of events depicted in the visual scene.

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1. Introduction

Language comprehension involves the rapid integration of different types of linguistic and non-linguistic information.

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Understanding the mechanism underlying this rapid process is a central component of the study of language comprehension. Research on adult sentence processing has demonstrated that when interpreting a sentence, the human sentence processing mechanism (or the parser), incrementally computes the structural representation and possible meanings of the sentence while drawing on different sources of linguistic and non-linguistic information (e.g., Altmann & Kamide, 1999, 2007; DeLong, Urbach, & Kutas, 2005; Kamide, Altmann, & Haywood, 2003; Omaki,

2010; Pickering, Traxler, & Crocker, 2000; Staub & Clifton, 2006; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005). Much research has examined this rapid and incremental nature of the processing mechanism, of which a key question that has been widely investigated is the role of event knowledge in sentence comprehension (Elman, 2009; Madden & Ferretti, 2009). Knowledge about events includes typical event participants, causal relationships between participants and objects, instruments, time course, and duration (McRae, Hare, Elman, & Ferretti, 2005; Zacks & Tversky, 2001; Zacks, Tversky, & Iyer, 2001). Verbs are an important source of information about events. Previous research found that event information associated with verbs can be used quickly by adults during online sentence comprehension (Altmann & Kamide, 1999; Ferretti, McRae, & Hatherell, 2001; McRae, Spivey-Knowlton, & Tanenhaus, 1998). For example, Altmann and Kamide (1999) found that when interpreting a sentence, the argument structure (i.e., typical event participants) associated with verbs was activated immediately to predict the upcoming object noun phrase, which resulted in anticipatory eye movements towards the most plausible object in the visual display (see also Altmann & Kamide, 2007; Boland, 2005). In the study, the participants heard sentences like (1) and (2) while viewing an image of a scene with a boy, a cake, and a few toys.

(1) The boy will eat the cake.
(2) The boy will move the cake.

In (1) the verb *eat* can take only one of the objects in the visual scene as its argument, namely the cake, whereas the verb *move* in (2) can take any of the objects as its argument. Altmann and Kamide found that the participants were more likely to fixate on the picture of a cake when hearing (1) *The boy will eat…* than when hearing (2) *The boy will move….*. This effect occurred even before the onset of the object noun *cake*. This is evidence that event information associated with verbs can be used immediately by adults to facilitate sentence comprehension.

The immediate activation of event information during online sentence comprehension has also been found to be influenced by the morphology of verbs that signals tense and aspect (Altmann & Kamide, 2007; Becker, Ferretti, & Madden, 2013; Carreiras, Carriedo, Alonso, & Fernandez, 1997; Ferretti, Gagné, & McRae, 2003; Ferretti, Kutas, & McRae, 2007; Ferretti, Rohde, Kehler, & Crutchley, 2009; Ferretti et al., 2001; Madden & Zwaan, 2003; Magliano & Schleich, 2000). Human languages often use morphology to refer to the temporal structures of events (e.g., *ongoing* versus *completed*). In this paper, we focus on the contrast between the *imperfective* versus *perfective* aspect. Imperfective aspect makes specific reference to the internal structure of events by focusing on the ongoing process, but makes no reference to their completion. Perfective aspect refers to events as completed by focusing on the endpoint of the events rather than the ongoing process/internal structure (Comrie, 1976; Smith, 1991). English uses grammatical morphemes to mark aspect. Consider (3a) and (3b), for example. (3a) contains the grammatical morpheme –*ing*, which makes it clear that the event of planting a flower is currently in progress. By contrast, (3b) contains the grammatical morpheme –*ed*, which indicates that the event of planting a flower has been completed.

(3) a. The old lady is planting a flower.
     b. The old lady has planted a flower.

The examples illustrate that the use of grammatical morphemes is closely related to the temporal structures of events, e.g., whether the event is ongoing or has been completed. Previous research found that the aspectual information encoded in grammatical morphemes can be used immediately by adults to construct representations of events during sentence comprehension. For example, using a picture verification task, Madden and Zwaan (2003) found that English-speaking adults were more likely to choose the picture depicting an completed event when reading a sentence containing a perfective morpheme (e.g., –*ed*), but they chose both pictures (e.g., one depicted a completed event and one described an ongoing event) equally often when reading a sentence containing an imperfective morpheme (e.g., –*ing*). Madden and Zwaan interpreted the finding as evidence that when encountering an event described in the perfective aspect, English-speaking adults constructed a representation of the event as having been completed. By contrast, when encountering an event described in the imperfective aspect, they constructed a representation of the event as having both intermediate phases and endpoint. Other event information encoded in aspectual morphemes like event location and participant roles has also been found to play an important role in sentence comprehension (e.g., Carreiras et al., 1997; Ferretti et al., 2007).

Taken together, previous research has shown that event information associated with verbs and verb morphology plays an important role in sentence comprehension. Adults can use the information immediately and effectively to construct representations of events. Previous research on child sentence processing found that like adults, children are also able to use the argument structure (i.e., typical event participants) associated with verbs to anticipate upcoming referents (Andreu, Sanz-Torrent, & Trueswell, 2013; Fernald, Zangl, Portillo, & Marchman, 2008; Nation, Marshall, & Altmann, 2003). For example, children also exhibited anticipatory eye movements to the edible objects upon hearing a sentence containing the verb *eat* (e.g., (1)). Similar to adults, this effect occurred before the onset of the object noun, e.g., *cake*. This is evidence that event information associated with verbs can be activated immediately by children in online sentence comprehension.

Using off-line judgement tasks, Wagner and colleagues found that three-year-old English-speaking children already make a distinction between perfective and imperfective aspect (e.g., Wagner, 2001, 2006; Wagner & Carey, 2003). However, as far as we know, no previous studies have looked at children's online use of grammatical aspect, i.e., whether or not the temporal information encoded in aspectual morphemes (e.g., *ongoing* versus *completed*) function to facilitate children's event recognition during online sentence comprehension. The present study