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Children's assignment of grammatical roles in the online processing of Mandarin passive sentences

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ABSTRACT

Children's difficulty understanding passives in English has been attributed to the syntactic complexity, overall frequency, cue reliability, and/or incremental processing of this construction. To understand the role of these factors, we used the visual-world paradigm to examine comprehension in Mandarin Chinese where passives are infrequent but signaled by a highly valid marker (BEI). Eye-movements during sentences indicated that these markers triggered incremental role assignments in adults and 5-year-olds. Actions after sentences indicated that passives were often misinterpreted as actives when markers appeared *after* the referential noun ("*Seal BEI it eat*" → The seal is eaten by it). However, they were more likely to be interpreted correctly when markers appeared *before* ("*It BEI seal eat*" → It is eaten by the seal). The actions and the eye-movements suggest that for both adults and children, interpretations of passive are easier when they do not require revision of an earlier role assignment.

Introduction

One of the basic problems facing language learners is determining who did what to whom. For example, given an active sentence like (1), a learner of English might decide that first noun phrases (NP1s) are always mapped onto agents (seal = *the eater*) and second noun phrases (NP2s) are always mapped onto themes (fish = *the eaten*). However, this strategy would lead to misinterpretations when the learner encounters a passive construction like (2).

(1) The seal is quickly eating the fish.
(2) The seal is quickly eaten by the shark.

This alternation between actives and passives has long served as an important test case for exploring the development of the syntax-semantics interface. Prior research has found that while young English-speaking children readily produce and comprehend actives, they have profound difficulties with passives (Bever, 1970; Borer & Wexler, 1987; Brooks & Tomasello, 1999; Budwig, 2001; Harris & Flora, 1982; Horgan, 1978). This pattern is also observed in languages like French (Sinclair, Sinclair, & De Marcellus, 1971), German (Mills, 1985), and Hebrew (Berman, 1985). Critically, it persists throughout the school-aged years (Gordon & Chafetz, 1990; Maratsos, Fox, Becker, & Chalkley, 1985; Messenger, Branigan, & McLean, 2012b; Messenger, Branigan, McLean, & Sorace, 2012a; Stromswold, Eisenband, Norland, & Ratzan, 2002; Sudhalter & Braine, 1985), raising questions about the nature of syntactic development and the possible role of processing constraints during language acquisition.

In the present paper, we explore these questions by turning to a useful cross-linguistic test case, passive sentences in Mandarin Chinese. In the remainder of the

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Introduction, we will briefly review prior developmental research on passives in English, introduce four accounts explaining children's patterns of comprehension, and discuss reasons why data from Mandarin might be informative. Finally, we will lay out an experiment that distinguishes between these accounts by examining interpretations of passives using an eye-tracking and act-out paradigm.

Children's difficulties with passives and possible explanations

Previous studies have noted several idiosyncrasies in children's performance with passive sentences in English (see Messenger et al., 2012a for a more detailed summary of this literature). For example, relative to their active counterparts, full passives (those that include the *by*-phrase) are rare in children's speech and do not reliably appear in naturalistic samples until age four (Budwig, 2001; Harris & Flora, 1982; Horgan, 1978). This asymmetry also extends to children's comprehension. Three- to 5-year-olds are slower and less accurate at selecting depicted events for passives compared to actives (Stromswold et al., 2002). Furthermore, when asked to act-out passive sentences, children will often perform active versions instead (Baldie, 1977; Bever, 1970; Brooks & Tomasello, 1999; Gordon & Chafetz, 1990; Harris & Flora, 1982; Horgan, 1978; Lempert, 1990; Maratsos et al., 1985; Messenger et al., 2012b; Pinker, Lebeaux, & Frost, 1987; Sudhalter & Braine, 1985; Turner & Rommetveit, 1967).

Several hypotheses have been suggested for why these errors occur. These theories often draw on common mechanisms and are not mutually exclusive. In fact, the each of the last two theories can be seen as building upon the one before. However, in order to make clearer connections between theories and predictions, we will focus on the core properties of four prominent accounts.

Syntactic account

Transformational theories of syntax have argued that passives are derived from initial representations of their active counterparts, followed by a movement operation that raises sentence objects into subject position (Borer & Wexler, 1987, 1992; Chomsky, 1981; Wexler 2005). Borer and Wexler (1987, 1992) have suggested that knowledge of this movement operation is absent in children's early grammar and does not mature until the early school-aged years (*A-Chain Deficit Hypothesis*). This theory provides a straightforward account for why young children fail to produce passives in their spontaneous speech. It also explains why passives are often misconstrued as actives during early comprehension.

Frequency account

Many have argued that early difficulties with passives reflect a lack of experience with the construction (Brooks & Tomasello, 1999; Demuth, 1989; Gordon & Chafetz, 1990; Harris & Flora, 1982). Passives are far less frequent than actives in children's input: In a survey of the CHILDES corpora, Stromswold, Eisenband, Norland, and Ratzan (2002) found that full passives accounted for less than 0.2% of adult utterances to children (see also calculations by Maratsos et al., 1985 and Gordon & Chafetz, 1990). Even within the passive construction, comprehension has been found to be better for more frequent forms. Children are more likely to understand *get*-passives compared to *be*-passives (Harris & Flora, 1982) and are more successful with sentences featuring known verbs compared to novel ones (Brooks & Tomasello, 1999; Tomasello, Brooks, & Stern, 1998). Finally, cross-linguistic evidence has revealed greater proficiency in languages where passives are more frequent, e.g., Inuktitut (Allen & Crago, 1996), K'iche' Mayan (Pye & Poz, 1988), and Sesotho (Demuth, 1989, 1990). For example, Demuth (1989) found that 2- and 3-year-old speakers of Sesotho, a Bantu language with productive passivization, produced three times as many passive sentences as their English-speaking counterparts.

Cue-based account

Cue-based accounts, like the Bates and MacWhinney's Competition Model (1987, 1989) propose that children determine the meaning of sentence by using linguistic and non-linguistic cues whose strength depend upon the degree to which they are associated with a particular interpretation. The relative weight of each cue depends on its reliability (the proportion of times it predicts the relevant role assignment) and its frequency, with the combination of the two determining its validity. In the case of role assignments, NP1s in English are typically agents since active sentences occur far more frequently than passive sentences (Gordon & Chafetz, 1990; Maratsos et al., 1985; Stromswold et al., 2002). In contrast, passives in English are associated with less reliable cues, including verb morphology (*-en* in *eaten*) and the *by*-phrase ("*by the shark*") (Li, Bates, & MacWhinney, 1993; Maratsos & Abramovitch, 1975; Stromswold et al., 2002). The *-ed*/*-en* suffix is typically associated with the past tense ("*The girl kicked the ball*") or adjectival states ("*The girl was tired*"). Similarly, the *by*-phrase is often used to mark locations ("*I passed by the mall*") and maker/author relationships ("*I read a book by Tolstoy*"). Also in passive constructions, it is often dropped altogether. Since the package of morphological cues that mark the English passive are only informative as a set, the acquisition of these distributed cues might be particularly difficult for children (Slobin, 1973).

Consequently, the greater reliability of word order compared to morphological cues may lead English-speaking children to favor the former over the latter during sentence interpretation. This bias would lead to successful comprehension of actives but, it would cause systematic misinterpretations for passives. Prior work has found that children sometimes ignore the verb morphology and *by*-phrase and generate active interpretations for passive sentences (Bever, 1970; Turner & Rommetveit, 1967). Similarly, cross-linguistic research has found that 2-year-olds identified the likely agent based on the cue that was most informative in their language. While learners of English relied on word order (NP1 = agent), learners of Italian relied on animacy cues (animate NP = agent) (Bates et al., 1984). This and other work has highlighted strong effects of cue reliability during language acquisition (MacWhinney, Bates, & Kliegl, 1984; MacWhinney, Pléh, & Bates, 1985).