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Featural Relativized Minimality in child grammar: An investigation of Mandarin long and short *bei*-passives

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Minqi Liu

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ABSTRACT OF THE DISSERTATION

Featural Relativized Minimality in child grammar:
An investigation of Mandarin long and short *bei*-passives

by

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This dissertation interrogates the representation of syntactic locality constraints, specifically intervention locality, within child grammar. Our focal point is the Intervention Hypothesis, which suggests that children are governed by a strict version of featural Relativized Minimality, leading to comprehension difficulties when partial featural overlap between moved elements and interveners is present.

The unique morphosyntactic properties of Mandarin *bei*-passives afford an ideal platform for our investigation. Syntactic investigations indicate that long *bei*-passives involve movement of the internal argument (IA) across the external argument (EA), which is an embedded subject in this construction, whereas the IA movement in short *bei*-passives does not cross an EA because the EA is not syntactically projected. As such, the IA movement in long *bei*-passives, demonstrated in (1a), provokes intervention, which, based on the Intervention Hypothesis, should cause more difficulty for children's comprehension than short *bei*-passives (1b). Furthermore, unlike in English, Mandarin lacks verbal/adjectival passive homophones to facilitate children's comprehension of short passives. Consequently, children must establish a dependency between the IA and its gap, necessitating crossing an intervening argument in long passives.

(1) a. Long *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ $\boxed{\text{EA}}$ $[_{VP}$ V $(\ldots)$ t $(\ldots)$ $]$ $]$ $]$

Intervention difficulties

b. Short *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ $[_{VP}$ V $(\ldots)$ t $(\ldots)$ $]$ $]$ $]$

No intervention difficulties

Our corpus study shows that long *bei*-passives are more frequent than short *bei*-passives in both child spontaneous speech and their input, which is not observed in any other languages in previous literature. In line with the Intervention Hypothesis, our results from both Experiments 1 and 2 highlight that children's comprehension of long passives is worse than short passives, despite their significantly higher frequency in child and child-directed Mandarin.

The dissertation further investigates which features are computationally relevant for intervention in child grammar. By manipulating three distinct features in Mandarin – Animacy, Number, and Shape – our research illuminates the role of linguistic features in forming a syntactic dependency. Experiment 1 shows that Animacy mismatch improved children's performance on long passives, indicating its participation in children's computation of intervention. An alternative explanation exists for this effect, however. Experiment 2 shows that a mismatch in Number or Shape does not affect children's intervention difficulty with long passives. This leads us to propose that only morphosyntactic features triggering syntactic movement play a role in calculating intervention locality.

In summary, this dissertation provides evidence supporting the Intervention Hypothesis, underscoring the intervention difficulty in children's comprehension of long, but not short, *bei*-passives. Our research suggests that only morphosyntactic features triggering syntactic movement participate in computing intervention locality. This discovery introduces new dimensions to our understanding of syntactic locality constraints in child grammar and exposes cross-linguistic variations in the engagement of different morphosyntactic features in this aspect.

The dissertation of Minqi Liu is approved.

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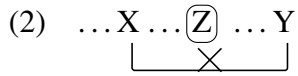
CHAPTER 1

Background and motivation

One of the fundamental properties of human language is the locality of syntactic dependencies. Linguistic studies have long established that the two elements entering into a syntactic dependency (be it a filler-gap, referential, or predication dependency) must be within a limited structural span, which is called a locality domain. The locality domain can be defined by certain structural boundaries (e.g., island constraints, Ross 1967; barriers, Chomsky 1986a, Phase Impenetrability Condition, Chomsky 2000, 2001). Alternatively, it can be defined relatively, specifying that dependencies cannot be established across another potential participant of the same dependency (e.g., A-over-A Principle, Chomsky 1964; Superiority Condition, Chomsky 1973; (featural) Relativized Minimality, Rizzi 1990, 2001, 2004, Starke 2001; Minimal Link Condition, Chomsky 1995). Although there have been significant advances on locality constraints in adult grammar over recent years, there remain many questions regarding how exactly syntactic dependencies are built and how locality constraints are represented in child (and adult) grammars.

In this dissertation, we specifically focus on the first-language (L1) acquisition of the relative type of syntactic locality, referred to as **intervention locality**, examining its representation in child grammar and investigating potential differences between child and adult grammars in this context. Simply put, the dependency between two syntactic elements, X and Y, is disrupted by an intervening element Z, as depicted in (2), where Z is structurally closer to X and has the potential to participate in the same dependency.

(2) 

Specifically, this dissertation explores the effects of intervention locality in child Mandarin

bei-passives and examines the theory of featural Relativized Minimality (fRM; Rizzi 1990, 2001, 2004, 2013) and its extension to language acquisition, namely the Intervention Hypothesis (e.g., Friedmann, Belletti, & Rizzi 2009, Belletti et al. 2012, Mateu & Hyams 2020, 2021).

The unique morphosyntactic properties of *bei*-passives make them an ideal testing ground for this hypothesis. Furthermore, our investigation of the L1 acquisition of *bei*-passives offers valuable insights into the question of what features play a significant role in children's computation of intervention. The following sections in this chapter set the stage for our study, outlining the syntactic background of intervention locality (Section 1.1), exploring the previous studies on (featural) intervention effects in child languages (Sections 1.2 and 1.3), and providing the rationale for our investigation on child Mandarin *bei*-passives (Section 1.4). Section 1.5 outlines the remaining chapters of this dissertation.

1.1. (featural) Relativized Minimality in adult grammar

Intervention locality is observed in a wide range of syntactic phenomena in adult grammar, such as head movement (3), A-movement (4), and A′-movement (5).

(3) a. They could have left.

b. Could$_i$ they ___$_i$ have left?

c. *Have$_i$ they [could] ___$_i$ left?

(4) a. It seems that Mary$_i$ is likely ___$_i$ to win.

b. Mary$_i$ seems ___$_i$ likely ___$_i$ to win.

c. *Mary$_i$ seems that [it] is likely ___$_i$ to win.[1]

(5) a. Who$_i$ do you think that Mary likes ___$_i$?

b. *Who$_i$ do you wonder [why] Mary likes ___$_i$?

[1]This sentence is independently blocked by the ban on hyperraising (i.e., A-movement out of a finite clause).

Rizzi (1990) notes that intervention locality is relativized to the structural types of the elements involved. He proposed the principle of Relativized Minimality (RM) in (6). According to RM, in the ungrammatical sentences in (3c), (4c), and (5c), the movements are deemed unacceptable due to the presence of an intervener (circled), which is structurally closer (in terms of c-command relations) to the landing site of the movement and of the same structural type (head, A-position, or A′-position) as the target.

(6) Relativized Minimality (simplified from Rizzi 1990:7):
In a configuration [. . . X . . . Z . . . Y . . .], Z blocks the dependency between X and Y iff

(i) Z is of the same structural type as X, and

(ii) X c-commands Z and Z c-commands Y

where 'of the same structural type' is understood as X and Z are (i) both heads, (ii) both phrases in an A-position, or (iii) both phrases in an A′-position.

However, the three-way structural type distinction falls short in some cases of intervention in which it is not clear how the intervener could be defined as 'of the same structural type' with the moving element. For example, in (7), elements like negation, downward-entailing quantifiers such as *few*, focus-sensitive adverbs such as *only*, and lexically negative verbs such as *deny* all obstruct the *wh*-movement of *how*.

(7) a. *I asked how$_i$ you did(n't) behave ___$_i$.

b. *How$_i$ did (few) men think that you behaved ___$_i$?

c. *How$_i$ did (only) John think that you behaved ___$_i$?

d. *How$_i$ did you (deny) that you behaved ___$_i$? (Szabolcsi & den Dikken 2014: ex. 17)

In light of these observations, a feature-based approach to RM, known as featural Relativized Minimality (fRM), has been proposed (Starke 2001, Rizzi 2004). Instead of the three categories of structural types, this approach differentiates four classes of specifier positions based on the substantive featural content of their heads: Argumental (person, number, gender, case), Quantificational (*wh*, negation, measure, focus, etc.), Modificational (evaluative, epistemic, negation, etc.)

and Topic. According to this theory, relativized minimality effects occur within the same featural class, but not across. Hence, the interveners in (7), being quantificational like the moved *how*, cause the intervention effects.

Rizzi (2013, 2018) further refines fRM to accommodate the graded judgements concerning weak islands in adult grammar. For instance, in (8), moving *what* across *who* is significantly degraded compared to moving *what book* across *who* (e.g., Pesetsky 1987, Comorovski 1989, Cinque 1990, Villata, Rizzi, & Franck 2016).

(8) a. *What$_{[+Q]}$ do you wonder who$_{[+Q]}$ could buy___?
Identity

b. ??What book$_{[+Q,\ +NP]}$ do you wonder who$_{[+Q]}$ could buy___?
Inclusion

Rizzi proposed that in (8a), the intervener blocks the movement of an element that has identical featural configurations with it, rendering the sentence ungrammatical. In contrast, the intervener in (8b) only bears a proper subset of the features on the moving element which has an additional lexical restriction [+NP], hence the less severe intervention and better acceptance in (8b), as compared with the identity situation (8a). In his revision of fRM as in (9), he proposed that the degree of intervention is a function of the featural distinctness between X and Z, in accordance with the *distinctness hierarchy*.

(9) Featural Relativized Minimality (adapted from Rizzi 2018:347):
In [. . . X . . . Z . . . Y . . .] a dependency between X and Y is disrupted when

(i) X c-commands Z and Z c-commands Y, and

(ii) Z matches X in terms of *relevant syntactic features*.

(iii) The degree of disruption is a function of the featural distinctness of X with respect to Z, in accordance with the *distinctness hierarchy*.

The distinctness hierarchy (Figure 1.1) represents the degree of featural overlap between X and Z, from Disjunction (where X and Z have different featural configurations) to Inclusion (where

Z's featural configuration is a proper subset of X's) to Identity (where X and Z have identical features).[2] Generally, constructions with less featural overlap are more acceptable than those with more overlap. Thus, fRM effectively captures the degree of deviance in intervention structures observed in adult grammar.

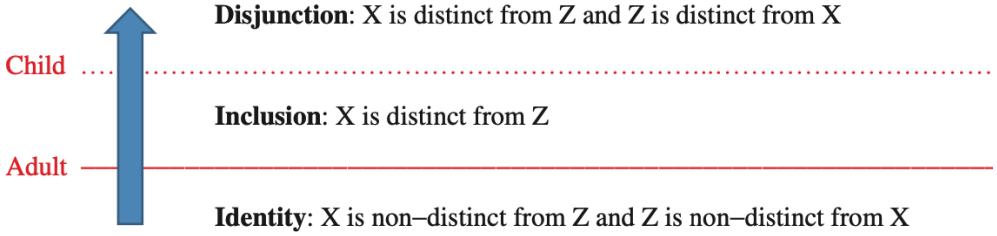


Figure 1.1: The distinctness hierarchy with different cutoff points for adults and children (Rizzi 2018:358)

In this distinctness hierarchy, Rizzi (2018) proposes different cutoff points for adults and children, reflecting the core proposal of the Intervention Hypothesis, which we will discuss in the following section.

1.2. Intervention effects in child grammar

The Intervention Hypothesis claims that children are subject to a stricter version of fRM than adults (e.g., Friedmann et al. 2009, Belletti et al. 2012, Bentea, Durrleman, & Rizzi 2016, Mateu & Hyams 2020, 2021). While adult grammar only prohibits structures in which the target X and intervening element Z share identical morphosyntactic features, as shown in (10a), children face additional difficulties with structures in which Z bears a proper subset of the features on X, as shown in (10b).

(10) a. ... $X_{[F]}$ ... [$\boxed{Z_{[F]}}$ [... $Y_{[F]}$ ...]]

[2]Rizzi (2018) further distinguishes two types of Inclusion relation based on whether the feature in common between X and Z is a criterial feature (i.e., a feature that triggers movement on its own; e.g., [+Q]) or a non-criterial feature (i.e., a feature that participates in the triggering of movement indirectly; e.g., [+NP]) in the sense of Rizzi (1996, 1997), and proposes that the degree of intervention triggered by non-criterial inclusion is less severe than criterial inclusion.

b. ... $X_{[A][B]}$ ... [$\boxed{Z_{[A]}}$ [... $Y_{[A][B]}$ ...]]

Intervention difficulty

Intervention effects have been observed in many constructions in child grammar that involve movement of an NP across a c-commanding NP, such as object relative clauses (RCs) (e.g., Brown 1971, McKee, McDaniel, & Snedeker 1998, Friedmann & Novogrodsky 2004), object *wh*-questions (e.g., Avrutin 2000, Sauerland et al. 2016), object topicalization constructions (e.g., Friedmann & Lavi 2006), object sluicing (e.g., Mateu & Hyams 2021, M. Liu, Hyams, & Mateu 2020, 2022), and raising across an Experiencer (e.g., Hirsch, Orfitelli, & Wexler 2007, Orfitelli 2012, Mateu 2020). For example, in subject RCs (11a) the dependency between the relativized noun and its gap does not cross any intervener, whereas in object RCs, this movement crosses the embedded subject, as shown in (11b). Therefore, the Intervention Hypothesis predicts that object RCs (11b) should be more challenging for children's comprehension than subject RCs (11a) which does not involve intervention. This prediction is borne out in many languages (see Lau & Tanaka 2021 for a meta-analysis on the subject advantage in child acquisition of RCs).

(11) a. Subject RC: Show me the woman [that ___ is drawing the girl]

b. Object RC: Show me the girl [that the woman is drawing ___]

In addition, because the degree of children's intervention difficulty is a function of featural distinctness between X and Z, a mismatch in crucial morphosyntactic features between them mitigates the difficulties. Therefore, we can use children's sensitivity to intervention effects as a diagnostic for what features are relevant for the computation of intervention locality (e.g., fRM) in child grammar.

Some proponents of the Intervention Hypothesis have claimed that only features functioning as attractors for syntactic movement enter into the computation of intervention, such as Number or Gender in some languages (e.g., Belletti et al. 2012, Varlokosta, Nerantzini, & Papadopoulou 2015, Biondo et al. 2022) and lexical restriction [+NP] (e.g., Friedmann et al. 2009, Arnon 2010,

Varlokosta et al. 2015, Villata, Rizzi, & Franck 2016).[3] Others assume a broader approach and argue that any morphosyntactically active feature can be involved in the calculation of intervention, such as Animacy (e.g., Arosio, Guasti, & Stucchi 2011, Durrleman, Bentea, & Guasti 2016, Mateu & Hyams 2021).

Alternatively, cue-based models of sentence processing attribute (children's and adults') comprehension difficulties to memory interference in the encoding, storage, and retrieval of an item when there are other similar items held in memory (e.g., Lewis & Vasishth 2005, Lewis, Vasishth, & Van Dyke 2006, Van Dyke & Lewis 2003, Van Dyke & McElree 2006). These include the Dependency Locality Theory (e.g., Gibson 1998, 2000, Warren & Gibson 2002; see also Choe 2012, Choe & Deen 2016) and Similarity-based Interference (e.g., Gordon, Hendrick, & Johnson 2001, 2004, Lewis et al. 2006).

In the following section, we review previous studies on children's intervention effects, including both the grammatical and the processing approaches, according to the specific features they examined.

1.3. Features relevant for intervention

Lexical NP restriction. DPs containing a lexical NP, designated as [+NP], contrast with DPs without a lexical NP (such as pronouns). Friedmann et al. (2009) first noted that children's comprehension improves when the moved element and the intervener mismatch in lexical NP restriction [±NP] (Starke 2001): Object *who*-questions (12a) (ave. 75% correct) cause less difficulty in children's comprehension in Hebrew than object *which*-questions (12b) (ave. 58% correct).

(12) a. Object *who* question in Hebrew: [. . . $who_{[+Q,\,-NP]}$ . . . [$\boxed{\text{Subj}_{[+NP]}}$ . . . ___]]

Et mi ha-xatul noshex?
ACC who the-cat bites

[3]Unlike ϕ-features, [+NP] itself does not trigger movement. Nevertheless, in some languages "it participates in the fine identification of the landing site of movement in the left periphery" and thus "is involved in the triggering of movement" (see syntactic evidence and discussion in Villata et al. 2016: 79-80; see also Rizzi 1996, 1997 and Friedmann et al. 2009).

'Whom does the cat bite?'

b. Object *which* question in Hebrew: [. . . *which dog*$_{[+Q,\ +NP]}$ . . . [$\boxed{\text{Subj}_{[+NP]}}$ . . . ___]]

Et eize kelev ha-xatul noshex?
ACC which dog the-cat bites
'Which dog does the cat bite?'

This finding, supported by subsequent research, suggests the role of [+NP] in triggering the *wh*-movement and intervention locality computation (e.g., Arnon 2010, Varlokosta et al. 2015, Bentea et al. 2016, Villata et al. 2016; see also Nerantzini et al. 2014 and Varlokosta et al. 2014 for studies with atypical populations).

However, Dependency Locality Theory proposed by Gibson (1998, 2000) offers an alternative explanation, attributing the difficulty in sentence comprehension to the integration cost incurred by introducing new discourse referents. This cost is particularly high for object RCs, which involve new discourse elements that interrupt the dependency of the head noun and its gap. Gibson further proposes that established referents, like pronouns, cause less disruption due to lower integration costs.[4]

Furthermore, Gordon, Hendrick, and Johnson (2001, 2004) observed improved processing of object RCs in English-speaking adults when the intervener was a pronoun or a proper name as compared to a lexical NP. However, they explain these results by appealing to the level of cue matching between NPs: When a retrieval cue is associated with multiple items in memory that have overlapping features (e.g., two NPs that are lexical NPs), it can lead to working memory overload, or Similarity-based Interference. Under this theory, a broader range of features may lead to interference, including (i) morphosyntactic features such as Number (e.g., Gordon et al. 2001, 2004; Van Dyke 2007; Villata, Tabor & Franck 2018; Villata & Franck 2020); (ii) semantic features such as professional occupations (e.g., Lowder & Gordon, 2014; Van Dyke 2007; Van

[4]Choe and Deen (2016), adopting Dependency Locality Theory, proposed the Performance-based Intervention Effects to explain children's comprehension of raising constructions. They found that children performed better when a lexical NP was raised over a pronominal experiencer, rather than vice versa. This directionality, echoed by Choe, Dean, and O'Grady (2014), is not predicted by the grammatical Intervention Hypothesis but aligns with Dependency Locality Theory.

Dyke & McElree 2011); (iii) and possibly phonological features such as phonological overlap (e.g., Acheson & MacDonald 2011).

Number and Gender. Grammatical Number and Gender influence subject movement differently across languages. In Hebrew, the clausal inflectional head uses both Number and Gender as ϕ-features (i.e., features triggering subject movement to Spec, Infl), as seen in the verb agreement system (Shlonsky 1997). In contrast, Italian, despite Gender markings in the DP domain, only includes Number in the verbal ϕ-feature complex affecting subject movement. Belletti et al. (2012) studied Hebrew and Italian children's comprehension of RCs and found that Hebrew-speaking children's performance with object RCs with mismatched Gender (13b) (ave. 67% correct) was significantly better than those with matched Gender (13a) (ave. 81% correct); however, Italian-speaking children's performance showed no significant difference between mismatched (14b) and matched (14a) trials (ave. 52% vs. 57%, respectively). Gender mismatch eased Hebrew object RCs comprehension but had no effect on Italian object RCs.[5] This difference suggests that only morphosyntactic features realized on the inflectional head (i.e., as verb agreement) influence intervention calculations in child grammar, but not the ones merely encoded in the nominal domain. Belletti et al. (2012) therefore propose that "only features functioning as attractors for syntactic movement will enter into the computation of intervention". In this study, the notion of movement-attracting features is essentially equivalent to ϕ-features manifested on the verb.

(13) a. Hebrew object RC with matched Gender:

Tare li et ha-yalda she-ha-isha mecayeret.
Show to-me ACC the-girl(**fem**) that-the-woman(**fem**) draws-**fem**
'Show me the girl that the woman draws.'

b. Hebrew object RC with mismatched Gender:

Tare li et ha-yalda she-ha-rofe mecayer.
Show to-me ACC the-girl(**fem**) that-the-doctor(**masc**) draws-**masc**

[5]In both languages, children performed well with subject RCs in which there is no intervener between the relativized noun and its gap, as predicted by the Intervention Hypothesis.

'Show me the girl that the (male)doctor draws.'

(14) a. Italian object RC with matched Gender:

Mostrami la bambina che la nonna bacia
Show-to-me the girl(**fem**) that the grandma(**fem**) kisses
'Show me the girl that the grandma kisses.'

b. Italian object RC with mismatched Gender:

Mostrami il dottore che la bambina disegna
Show-to-me the doctor(**masc**) that the girl(**fem**) draws
'Show me the (male)doctor that the girl draws.'

Angelopoulos et al. (2022) confirmed these findings in Greek, where Gender is not marked on the verb and does not modulate intervention effects, despite its expression in Greek nominal morphology, just like Italian.

Before Belletti et al.'s work, Adani et al. (2010) found a greater ameliorating effect of mismatched Number than of mismatched Gender in Italian children's comprehension of object RCs, indicating the different status of these features. Biondo et al. (2022) discovered that in Italian adults' online processing of object RCs, Number mismatches enhanced comprehension (i.e., faster reading time), while Gender mismatches did not. These studies suggest varying importance of morphosyntactic feature across languages, with effects depending on the grammatical status of each feature in a specific language.

Animacy. Animacy has long been found to modulate intervention effects in both child and adult sentence comprehension. Previous research that adopted a grammatical approach to analyzing intervention effects has typically viewed Animacy as a morphosyntactic feature (e.g., Garaffa & Grillo 2008, Arosio et al. 2011, Durrleman et al. 2016, Mateu & Hyams 2021), supported by crosslinguistic evidence such as animacy-based distinctions in verb agreement, differential object marking, pronominal forms, possessive forms, double object constructions, etc. (e.g., Torrego 1998, Rosenbach 2012, Aissen 2003, Zaenen et al. 2004, Bianchi 2006, Bayanati & Tovionen

2019).[6] These studies took a less restrictive approach to the grammar-based Intervention Hypothesis, differing from the hypothesis that only morphosyntactic features triggering syntactic movement are relevant (e.g., Belletti et al. 2012, Angelopoulos et al. 2022, Biondo et al. 2022), and instead claim that Animacy, despite not triggering movement to subject position in all languages, can contribute to intervention computation.

For example, Mateu & Hyams (2021) found that English-speaking children's performance on object 'sluicing' (an elliptical construction involving *wh*-movement) (15a) improves significantly when there is a mismatch in animacy features between the intervening subject and the moved object *wh*-phrase (ave. mismatch 85% vs. match 73.75%). Crucially, subject sluicing (15b) is not affected by this Animacy manipulation (ave. mismatch 91.67% vs. match 92.08%) given that there is no intervention as the subject *wh*-movement does not cross any intervener. This contrast suggests that the animacy mismatch *per se* does not facilitate children's comprehension, but that intervention effects are alleviated by a mismatch between the intervener and the moved DP. (See Section 5.3.2 for more discussion of this study.)

(15) a. Object sluicing with mismatched/matched animacy:
The boy pushed something/someone. Can you see what/who ⟨ the boy pushed ___ ⟩?
(the boy: intervener)

b. Subject sluicing with mismatched/matched animacy:
Something/Someone pushed the boy. Can you see what/who ⟨ ___ pushed the boy⟩?

(the angled brackets represent a deleted TP)

Conversely, the processing-oriented literature views Animacy as a semantic cue impacting subject-verb integration (e.g., Traxler et al. 2005, Gennari & MacDonald 2008, Lowder & Gordon 2012, 2014). In their eye-tracking reading experiments, Traxler et al. (2005) found that the object RC difficulty was more significant when the head noun was animate and the embedded DP

[6] In our current study, Animacy was also treated as a morphosyntactic feature due to the selectivity of a Mandarin suffix that requires its host to be animate (see Section 5.1).

was inanimate, than when the animacy configuration was reversed, challenging grammar-based accounts like fRM that do not predict directional differences.[7]

Non-grammatical factors. Processing-based accounts suggest interference can arise when an item in memory and an item being encoded, stored, or retrieved are similar. This implies that non-morphosyntactic factors can modulate both child and adult performance in intervention constructions. For example, King and Just (1991) found that using verbs that establish meaningful sentential relationships (e.g., *The robber$_i$ [that the fireman rescued __$_i$] stole the jewelry*) reduces the processing difficulty of object RCs as compared to an arbitrary noun-verb pairing (e.g., *The robber$_i$ [that the fireman detested __$_i$] watched the program*). Similarly, Lowder and Gordon (2014) found semantic relatedness between the relativized object and the embedded subject (e.g., *killer* and *detective* vs. *baker* and *detective*) facilitated readers' initial processing of the object RC in their eye-tracking studies. In contrast, grammatical approaches do not account for the amelioration effects in the comprehension of intervention constructions by such non-grammatical factors. However, whether semantic similarities between the target and the intervener significantly affect *children's* comprehension of object RCs remains an open question.

Summary. Converging evidence has demonstrated that children experience difficulties comprehending sentences in which a syntactic dependency is established across an intervening element. The Intervention Hypothesis posits that these difficulties arise from stricter locality constraints in child grammar compared to adults and asserts that intervention occurs when an intervening element is structurally closer to the probe searching for some shared feature(s) between the intervening element and the target. Conversely, processing-based accounts attribute these difficulties to the developing processing capacity of children and contend that similarity between an existing item in memory and the item being encoded, stored, or retrieved triggers a parsing problem. Crucially, grammatical accounts argue that intervention is structurally-based, and sensitive to a

[7]See an alternative explanation of the amelioration effects of Animacy mismatch in previous studies in our Section 5.3.2. Their study also suggests that the manipulation of Animacy affects individuals with higher working memory capacity more significantly, indicating that Animacy affects sentence processing the same way as other semantic features, such as NP-relatedness which we will discuss next.

selective group of morphosyntactic features; whereas processing accounts argue that interference is linearly-based and predict any featural difference – morphosyntactic or non-morphosyntactic – could be used as a differentiating cue to overcome the processing difficulty with intervention. We put off discussion of processing-based interference and the grammar-based Intervention Hypothesis to the end of this dissertation (Section 7.2.2)

1.4. Why Mandarin passives

With the aforementioned background in mind, let us delve deeper into how children's acquisition of Mandarin passives provides important insights towards understanding intervention locality in child grammar.

In Mandarin, passives are marked by *bei*. There are two *bei*-passive structures with minimal differences in terms of intervention: *Long passives*, which include an external argument (EA) and *short passives* that do not contain an EA.

(16) a. Long *bei*-passive:

Zhangsan **bei** Lisi da le
Zhangsan BEI Lisi hit PRF
'Zhangsan was hit by Lisi.'

b. Short *bei*-passive:

Zhangsan **bei** da le
Zhangsan BEI hit PRF
'Zhangsan was hit.'

In long passives, the EA functions as an embedded subject capable of binding anaphors and subject-oriented logophors. Crucially, in short passives, the EA is not syntactically projected (see Section 2.1.3). This contrasts with languages like English, in which the EA is projected as a PRO in the short passive structure (e.g., Williams 1985, 1987, Jaeggli 1986, Roeper 1987, Collins 2005, Bhatt & Pancheva 2006/2017; but cf. Schäfer 2012, Bruening 2014, Legate 2014, Alexiadou, Anagnostopoulou, & Schäfer 2015).

The structural difference between long and short *bei*-passives makes Mandarin an ideal testing ground for the Intervention Hypothesis. As illustrated in (17a), the dependency in long passives is interrupted by the EA, an embedded subject that c-commands the gap of the internal argument (IA), while no such intervener exists in short passives as shown in (17b). Consequently, the Intervention Hypothesis predicts that, all else being equal, Mandarin-speaking children will find long passives more challenging to comprehend than short passives due to the intervention by the EA.

(17) a. Long *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ (EA) $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$]]]

Intervention difficulties

b. Short *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$]]]

No intervention difficulties

Secondly, our Mandarin study effectively circumvents a confound encountered in previous research on passives in various languages such as English, namely the 'adjectival strategy' (Borer & Wexler 1987, 1992), which we will discuss in more details in Section 3.2.2. In these languages, short passives with actional verbs are usually *homophonous* with adjectival structures that do not necessarily derive from passivization. For instance, because the past participle form 'closed' in (18) is homophonous with the adjective 'closed', English-speaking children need not represent the movement dependency in the short passive to understand this sentence; instead, they can employ an adjectival interpretation (18b) to perform better in a comprehension task. By contrast, in long passives, the past participle form can only receive a verbal/eventive reading due to the presence of the *by*-phrase (i.e., Agent, Experiencer, or Causer), as opposed to the more straightforward adjectival interpretation. Therefore, the *adjectival strategy* could explain children's improved performance with English short passives, but not with long passives.

(18) English actional short passive: *The door was closed.*

a. Passive/Verbal interpretation of 'closed': Someone closed the door.

b. Adjectival interpretation of 'closed': The door was in a closed state.

In contrast, such verb-adjective homophones do not exist in Mandarin as Mandarin verbal stems do not derive adjectives. For example, as shown in (19c), the only way to make a Mandarin verb adjective-like is to construct a relative clause (19b).

(19) a. guan men
close door
'close the door'

b. men **bei** guan le
door BEI close PRF
'The door was closed.'

c. guan le de men
close PRF REL door
'The closed door' (Lit. 'The door that PRO closed.')

Therefore, Mandarin long vs. short passives form a syntactic minimal pair for the purpose of testing the Intervention Hypothesis. The dependency between the IA and its gap crosses an intervening EA in long passives but not short passives. If Mandarin short passives are easier for children to understand than long passives, it can be attributed solely to the absence or presence of structural intervention, rather than to an adjectival strategy.

Lastly, in Mandarin there is no morphological agreement on the verb, which raises the question of what features – if any – are relevant for intervention in a morphologically 'poor' language like Mandarin. As we have discussed in Section 1.3, some previous studies suggest that only features marked on the verb (i.e., realized on the clausal inflectional head) participate in the calculation of intervention in child grammar, while some other studies suggest that (morphosyntactic or semantic) features do not need to be marked on the verb to trigger intervention. Mandarin provides an important datapoint in intervention research as a language that lacks morphological agreement.

1.5. Outline of the dissertation

In Chapter 2, our focus is on the syntax of Mandarin *bei*-passives. We highlight three crucial properties of this construction and examine existing analyses that effectively explain these properties. First, we observe island effects in both long and short *bei*-passives, indicating that the IA undergoes

syntactic movement to the edge of the *bei*-complement phrase. Second, the surface subject (SS) in *bei*-passives occupies an A-position. This is evident from its ability to bind anaphors within the complement of *bei*, regardless of whether it is a long or short passive construction, and the absence of weak crossover and reconstruction effects in long passives. Lastly, in long *bei*-passives, the EA is an argument c-commanding the gap of the IA. Specifically, it is an embedded subject. This is supported by its ability to bind anaphors and subject-oriented logophors in an object position. Conversely, the EA in short *bei*-passives is not projected in the syntactic structure, even as a null pronoun, suggested by its inability to be bound or controlled, its incapacity to license secondary predicates, and its inability to control into non-purpose adjunct phrases. Considering these three characteristics of *bei*-passives collectively, we can predict that children may encounter difficulties in comprehending long *bei*-passives, but not short ones, based on the Intervention Hypothesis.

Chapter 3 is a literature review on the first language (L1) acquisition of passives in Mandarin and other languages. Specifically, we delve into two significant findings from previous studies. First, we discuss the cross-linguistic pattern where passives with actional verbs are acquired earlier compared to passives with non-actional verbs, particularly subject-experiencer verbs. Second, we examine the observation that children's production of long passives is less frequent than short passives and, in some languages, long passives cause more difficulties in children's comprehension compared to short passives. Additionally, we explore existing theories that address the two major factors influencing children's acquisition of passives: the lexical semantics of the verb and the syntactic mechanisms involved in deriving this construction. We also consider other factors such as input, pragmatics, and processing.

The remainder of the dissertation investigates Mandarin-speaking children's acquisition of *bei*-passives, with an emphasis on the comparison of long vs. short passives and the potential effects of featural mismatch between the external and internal arguments.

Chapter 4 presents a comprehensive corpus study on the spontaneous production of *bei*-passives by Mandarin-speaking children aged 2-6 (N = 1,182) and their caretakers. We examine both the lexical semantics and the grammatical factors in the acquisition of this construction. Our findings

replicate the cross-linguistically robust finding on the actional > non-actional asymmetry in passives. Nevertheless, a distinct observation emerges in Mandarin, where long passives significantly outnumber short passives in *both* children's production and their input. Interestingly, the child data do not entirely reflect adult input, especially in terms of their Animacy configurations. Children – but not adults – predominantly produce long passives with two arguments that mismatch in Animacy features, arguably because this configuration is easier to compute given the stricter intervention constraint in children's grammar.

Chapters 5 and 6 explore children's comprehension of passives according to the two predictions of the Intervention Hypothesis: (i) long passives should be more difficult for children to understand due to the intervention triggered by the EA and (ii) a mismatch in certain morphosyntactic features between the EA and the IA should alleviate the intervention difficulties in long passives. We discuss two sentence-picture matching experiments that were conducted with Mandarin-speaking 3- to 6-year-olds (*N*s = 78 and 80; aged 3;01-6;08, ave. 4;11). Experiment 1 focuses on Animacy, an active feature in the grammar though not morphologically encoded. Experiment 2 focuses on Number and Shape, both morphologically realized on Mandarin classifiers, with Number being a candidate of ϕ-features crosslinguistically and Shape being an inherent lexico-semantic feature.

Anticipating those results, both experiments show that Mandarin long passives are significantly more challenging for children than short passives and actives, as expected due to the structural intervention of the EA in long passives. Short passives are understood as easily as actives, consistent with the Intervention Hypothesis. As for the featural effects, in Experiment 1, the Animacy feature only affected children's performance on long passives, with a mismatch improving their comprehension, as predicted by the Intervention Hypothesis if Animacy is a morphosyntactic feature involved in the computation of intervention. However, an alternative explanation exists for this Animacy effect (e.g., Slobin 1982, Childers & Echols 2004). Experiment 2 finds that neither a mismatch of Number nor Shape improve children's performance with long passives, suggesting that not all features are equally relevant in the comprehension of a syntactic dependency across languages.

Chapter 7 summarizes the dissertation, discussing the implications of the results, some open questions, and potential future directions.

CHAPTER 2

Syntax of Mandarin *bei*-passives

2.0. Introduction

Mandarin is an SVO language, where the subject typically comes before the verb, and the object follows the verb. In an active sentence such as (1), the internal argument (IA) of a transitive verb is expressed as the direct object, which follows the verb. Passivization in Mandarin involves the promotion of the IA to a surface subject (SS) position. The most common passive constructions in Mandarin involve the passive marker *bei* (henceforth "*bei*-passives").[1] There are two types of *bei*-passives in Mandarin, namely "long passives" (2a) and "short passives" (2b). Long *bei*-passives include the external argument (EA), while short *bei*-passives do not.

(1) Lisi da le Zhangsan
Lisi hit PRF Zhangsan
'Lisi hit Zhangsan.'

(2) a. Zhangsan **bei** Lisi da le
Zhangsan BEI Lisi hit PRF
'Zhangsan was hit by Lisi.'

b. Zhangsan **bei** da le
Zhangsan BEI hit PRF
'Zhangsan was hit.'

Previous syntactic studies provide various analyses for *bei*-passives. Abstracting away from the technical details, there are two major approaches to deriving *bei*-passives, differing mainly in their

[1] In addition to *bei*, there are three other verbs in Mandarin that have traditionally been analyzed as passive markers: *jiao* 'call', *rang* 'allow', and *gei* 'give'. Unlike the other three, *bei* has lost its historical verbal meaning 'suffer from; undergo'.

Bei is the most commonly used passive marker in Modern Chinese and occurs in all registers of language use (Xiao, McEnery, & Qian 2006). It is also the only passive marker that does not require the presence of an EA; that is, only *bei* can occur in short passives. In this study, we will focus on *bei*-passives, with the assumption that (long) passives marked by *jiao*, *rang*, and *gei* have the same properties and derivation as the long *bei*-passives.

treatment of the SS. The null operator (NOP) movement analysis proposes that the SS in both long and short *bei*-passives is base-generated as the subject of *bei*, and a null operator is base-generated in the IA position and moved to the edge of the *bei*-complement, creating a predicate, as illustrated in (3) (e.g., Chiu 1993, Ting 1998, Huang 1999, Huang, Y.- H. Li, & Y. Li 2009, Z. Zhang 2010, Bruening & Tran 2015, Ngui 2020). Alternatively, the NP movement analysis argues that the SS is derived via syntactic movement: the IA itself moves to the SS position, as shown in (4) (e.g., N. Liu 2012, Huang 2013, N. Liu & Huang 2016, F. Chen 2021, 2023).

(3) NOP movement approach:

Zhangsan$_i$ BEI [Op$_i$ (Lisi) . . . [$_{VP}$ hit ___$_i$]] (e.g., Huang 1999, Bruening & Tran 2015)
predication; NOP movement

(4) NP movement approach:

Zhangsan$_i$ BEI [___$_i$ (Lisi) . . . [$_{VP}$ hit ___$_i$]] (e.g., F. Chen 2021, 2023)
A-movement; A/A′-movement

In the following section, we will present three important syntactic properties of *bei*-passives: (i) *bei*-passives involve syntactic movement of the IA, (ii) the SS is in an A-position, and (iii) the EA in long passives is in another A-position (an embedded subject), whereas the EA in short passives is not syntactically projected. Then in Section 2.2 we will review the different analyses in the literature and show that both the NOP movement analysis (3) and the composite A/A′-movement analysis (4) can capture these three properties. Finally, in Section 2.3, we will consider what the syntax of *bei*-passives implies for children's acquisition of this construction and offer predictions for our experimental studies. More specifically, the three major syntactic properties lead us to predict that long, but not short, *bei*-passives will be difficult for Mandarin-speaking children to understand due to the intervention of the EA in long passives.

2.1. Syntactic properties of *bei*-passives

In this section we present three properties of *bei*-passives relevant for our acquisition study. Firstly, the derivation of *bei*-passives involves syntactic movement of the IA, as evidenced by island effects.

This movement exhibits both A′- and A-properties. Secondly, the SS of *bei*-passives is in an A-position. We present three pieces of evidence supporting this claim: (i) the SS can bind anaphors in the complement of *bei*, (ii) long *bei*-passives do not exhibit weak crossover effects, and (iii) long *bei*-passives do not display reconstruction effects (except for with some idioms). The third property addresses the different status of the EA in long vs. short passives: In long passives, the EA is an embedded subject that can bind into the complement of *bei*. Conversely, in short passives the EA is not syntactically projected and is interpreted existentially.

2.1.1. The movement of the internal argument (IA)

Existing literature points out that both long and short *bei*-passives are subject to island constraints, implying the presence of a movement dependency (e.g., Ting 1998, Huang 1999, F. Chen 2021, 2023). To illustrate, the attempt to form a *bei*-passive (5b) based on (5a) results in ungrammaticality because the SS is extracted out of a complex NP island (Ross 1967), irrespective of the presence or absence of an EA.[2]

(5) a. Lisi xie le [$_{NP}$ [$_{CP}$ piping Zhang de] wenzhang]
Lisi write PRF criticize Zhang REL article
'Lisi wrote the article that criticizes Zhang.'

b. *Zhang$_i$ bei (Lisi) xie le [$_{NP}$ [$_{CP}$ piping ___$_i$ de] wenzhang]
Zhang BEI Lisi write PRF criticize REL article
Intended: 'Zhang$_i$ suffers from Lisi's/the writing of the article that criticizes him$_i$.'

F. Chen (2023) further notes that both long and short *bei*-passives create (weak) islands, analogous to A′-movement constructions. For instance, in Mandarin the *wh*-adjunct *weishenme* 'why' is

[2]Although both long and short *bei*-passives are subject to island constraints, adding an intrusive pronoun (i.e. a resumptive pronoun in islands) only renders the long passive grammatical, as shown in (i), but not a short passive (ii).

(i) Zhang$_i$ bei Lisi xie le [$_{NP}$ [$_{CP}$ piping ta$_i$ de] wenzhang]
Zhang BEI Lisi write PRF criticize 3SG REL article
'Zhang$_i$ suffers from Lisi's writing of the article that criticizes him$_i$.'

(ii) *Zhang$_i$ bei xie le [$_{NP}$ [$_{CP}$ piping ta$_i$ de] wenzhang]
Zhang BEI write PRF criticize 3SG REL article
Intended: 'Zhang$_i$ suffers from [someone's] writing of the article that criticizes him$_i$.'

island-sensitive, while the *wh*-argument *shei* 'who' is not (Huang 1982; Tsai 1994 +++++). Both long and short *bei*-passives create (weak) islands for *wh*-adjunct movement (in the LF), as shown in (6b), in contrast with *wh*-argument extraction in (7b). Sentences (6a) and (7a) represent the corresponding active forms.[3]

(6) a. wo zhidao jingcha renwei [Zhang *weishenme* mousha-le Lisi]
I know police think Zhang why murder-PRF Lisi
'I know why the police think Zhang murdered Lisi.' (with narrow scope of *why*)

b. ?? wo xiang zhidao Zhang$_i$ bei (jingcha) renwei [___$_i$ *weishenme* mousha-le Lisi]
I want know Zhang BEI police think why murder-PRF Lisi
Intended: 'I want to know the reason x such that Zhang is believed to have murdered Lisi for x (by the police) .' (Adapted from F. Chen 2023)

(7) a. wo zhidao jingcha renwei [Zhang mousha-le *shei*]
I know police think Zhang murder-PRF who
'I know who the police think Zhang murdered.'

b. wo xiang zhidao Zhang$_i$ bei (jingcha) renwei [___$_i$ mousha-le *shei*]
I want know Zhang BEI police think murder-PRF who
Intended: 'I want to know who is x such that Zhang is believed to have murdered x (by the police).' (Adapted from F. Chen 2023)

Another compelling argument for A′-movement in *bei*-passives is its ability to be long distance. It has long been observed that long *bei*-passives permit long-distance dependencies across infinitival clause boundaries. In sentence (8b), which is the passive form of the baseline sentence (8a), the SS *Zhangsan* is interpreted as the object of the most deeply embedded verb. Notably, the EA *Lisi* is obligatory in (8b), a fact that many studies interpret as an indication of a long-distance dependency being unacceptable in short passives (e.g., Ting 1998, Huang 1999).

(8) a. Lisi pai jingcha$_i$ [PRO$_i$ daibu le Zhangsan]
Lisi assign police arrest PRF Zhangsan
'Lisi assigned the police to arrest Zhangsan.'

[3]Another supporting argument comes from the distinction between Mandarin A-not-A questions, which are island-sensitive, and disjunctive *or*-questions, which are island-insensitive (Huang 1991). See F. Chen (2023) for more details.

b. Zhangsan$_i$ bei *(Lisi) pai jingcha$_j$ [PRO$_j$ daibu le ___$_i$]
Zhangsan BEI Lisi assign police arrest PRF
'Zhangsan was "assigned-police-to-arrest" by Lisi.'

However, long-distance dependencies are not exclusively restricted to long *bei*-passives. F. Chen (2023) suggests that *both* long and short passives allow long-distance dependencies (see also Her 2009, Bruening & Tran 2015), and that the restrictions on such dependencies are the same in both passive constructions. The first constraint stipulates that for both types of *bei*-passives, when the dependency crosses an infinitival clause boundary, there cannot be an intervening Case-less NP. According to F. Chen, the EA in (8b), *Lisi*, is obligatory solely due to Case requirements. She follows Burzio's Generalization (1986) that only those verbs that can assign a theta-role to the subject can assign an accusative Case to an object. In the case of (8b), F. Chen contends that if the EA is absent (indicating a short passive), per Burzio's Generalization, the matrix Voice head would not assign Case to the internal argument of the matrix verb, *jingcha* 'police'. Her prediction that no Case-less NPs may intervene in long-distance short passives is borne out in examples with Exceptional Case-Marking (ECM) verbs, such as *yunxu* 'allow' or *jinzhi* 'forbid'. The infinitival complement of these verbs can either have a PRO$_{arb}$ or an overt NP as subject, such as "this company" in (9). In long passives, the EA of the matrix ECM verb is present and the ECM verb can assign Case to the NP that raises to its object position, the subject of its infinitival complement, as shown in (10).

(9) ECM construction:

fayuan jinzhi [{PRO$_{arb}$/zhe-jia gongsi} shengchan zhe-ge chanpin]
court forbid PRO$_{arb}$/this-CLF company produce this-CLF product
'The court forbids {producing this product/this company to produce this product}.'

(10) Long-distance long passive with ECM verbs: (Adapted from F. Chen 2023)

zhe-ge chanpin$_i$ bei fayuan jinzhi zhe-jia gongsi$_j$ [___$_j$ shengchan ___$_i$]
this-CLF product BEI court forbid this-CLF company produce
'This product is forbidden by the court (for this company) to produce .'

By contrast, in short passives, the ECM verb cannot assign Case to this NP due to the absence of the EA. Consequently, extraction of the most embedded IA to the SS position is prohibited when there is an intervening Case-less NP, such as *zhe-jia gongsi* 'this company' in (11). The Case-less NP must move to the subject of BEI, where it can receive Case from the clausal inflectional head, as shown in (12).

(11) Long-distance short passive with ECM verbs: (Adapted from F. Chen 2023)

zhe-ge chanpin$_i$ bei jinzhi [{PRO$_{arb}$/*zhe-jia gongsi} shengchan ___$_i$]
this-CLF product BEI forbid PRO$_{arb}$/this-CLF company produce
'Thi sproduct is forbidden (*for this company) to produce .'

(12) Extracting the intervening NP in (long or short) passives: (Adapted from F. Chen 2023)

zhe-jia gongsi$_i$ bei (fayuan) jinzhi [___$_i$ shengchan zhe-ge chanpin]
this-CLF company BEI court forbid produce this-CLF product
'This company is forbidden (by the court) to produce this product.'

Another instance of long-distance short passives involves subject control verbs, such as *shefa* 'manage to' in (13b), which is a passive derived from sentence (13a). The embedded object *ziliao* 'document' can be extracted to the SS position when the EA does not occur because the intervening PRO subject does not require Case.

(13) a. Subject control construction:

jiandie$_i$ shefa [PRO$_i$ kaobei-le ziliao]
spy manage copy-PRF document
'The spy managed to copy the document.'

b. Long-distance (long or short) passive with subject control verbs:

ziliao$_i$ bei (jiandie$_j$) shefa [PRO$_j$ kaobei-le ___$_i$]
document BEI spy manage copy-PRF
'The document was "managed-to-copy" (by the spy).' (Adapted from Her 2009)

The other restriction on long-distance *bei*-passives observed by F. Chen (2023) is a subject/object asymmetry: Both long and short *bei* passives allow long-distance dependencies across finite clause boundaries as long as the gap is in a subject position, as shown in (14), but not in an object position (15).

(14) Lisi$_i$ bei (jingcha) renwei [$_{CP}$ ___$_i$ mousha le Zhangsan]
Lisi BEI police think murder PRF Zhangsan
'Lisi$_i$ was thought (by the police) that (he$_i$) murdered Zhangsan.'

(Adapted from Her 2009: ex. 25a)

(15) *Lisi$_i$ bei (jingcha) renwei [$_{CP}$ Zhangsan mousha le ___$_i$]
Lisi BEI police think Zhangsan murder PRF
Intended: 'Lisi$_i$ was thought (by the police) that Zhangsan murdered (him$_i$).'

(Adapted from Ting 1998: ex. 28c)

This subject/object asymmetry is not expected if the movement involved in *bei*-passives is (purely) A′-movement. Instead, it is parallel with A-movement in attracting the closest NP. If only A′-movement is engaged in creating the dependency in *bei*-passives, long-distance dependencies across a finite clause boundary should be simultaneously possible or impossible for both subject and object gaps, a fact that contradicts the observed data.[4]

To encapsulate this subsection, the island effects observed in both long and short *bei*-passives show that this construction involves syntactic movement of the IA. This movement exhibits A′-properties: it creates (weak) islands for *wh*-adjuncts and can cross infinitival clause boundaries, provided there is no Case problem. However, should the IA undergo A′-movement, the observed

[4] F. Chen (2023) proposes, following Lee and Yip (2022), that some CP-selecting verbs in Mandarin allow *hyper-raising* (i.e., A-movement out of a finite clause; See e.g., Yoon 2007, Fong 2019, Halpert 2019, Wurmbrand 2019, Lohninger, Kovăc & Wurmbrand 2022). In her analysis, the subject in the embedded finite clause hyperraises into the matrix clause via A-movement to Spec, CP and then undergoes the same derivation as any other passivized object. If this is the case, the asymmetry in subject vs. object extraction across a finite clause boundary in *bei*-passives is explained by the possibility of the subject's hyperraising in Mandarin, which is not available to an embedded object in finite clauses.

(i) Hyperraising and dependencies in *bei*-passives across definite clause boundaries (F. Chen 2023):
$[_{IP}\ NP_{[\phi,\ A']}\ Infl_{[\phi]}\ [_{PassP}\ t\ BEI_{[\phi,\ A']}\ [_{VoiceP}\ (NP_{[\phi]})\ [_{VP}\ V\ [_{CP}\ t\ C_{[\phi][A']}\ [_{IP}\ t\ Infl_{[\phi]}\ \ldots\ ]]]]]]$
A-movement; A/A′-movement; A-movement

subject/object asymmetry in the long-distance dependency across finite clause boundaries in either long or short *bei*-passives is unexpected. Within the scope of this dissertation, we do not aim to resolve this puzzle. Instead, we focus on the notion that both long and short *bei*-passives involve syntactic movement of the IA. As we will discuss in Section 2.2.3, the existence of IA movement is consistent with either an NOP movement analysis or an NP movement approach of the IA.

2.1.2. The surface subject (SS) is in an A-position

In this subsection we delve into three arguments showing that the SS of *bei*-passives occupies an A-position. These arguments include (i) the ability of the SS to bind anaphors within the complement of *bei*, (ii) the lack of weak crossover effects in long *bei*-passives, and (iii) the absence of reconstruction effects in long *bei*-passives (with the exception of certain idioms).

Anaphor binding in long and short *bei*-passives. In long *bei*-passives, the SS is a possible antecedent for anaphor binding, as exemplified in (16), in which the anaphor *ta-ziji* 'himself/herself' is bound by the quantificational SS.

(16) daduoshu ren$_i$ bei ta-ziji$_i$ dabai le ___$_i$
most person BEI 3SG-self defeat PRF
'Most people were defeated by himself/herself.'

Similarly, short passives create an antecedent for anaphor binding in examples like (17), in which the anaphoric indirect object (IO) *ta-ziji* '3SG-self' is bound by the quantificational phrase in the SS/direct object (DO). Here we are assuming that (17) is derived from a structure like (18), in which the coverb/preposition *gei* 'to' is incorporated with the verb, as evidenced by the placement of the PERF marker. If this is the case, in the short passive (17), the gap of the DO is c-commanded by the anaphoric IO and its movement to the SS position feeds the binding of the anaphor, thereby exhibiting an A-property.[5]

[5]However, it is also possible that the gap of the DO c-commands the IO instead, as shown in (i), which derives from a dative construction such as (ii). If this is the case, the binding relation in the short passive (17) is independent of the DO movement to the SS position and as a result this piece of data might be inconclusive.

(i) [daduoshu ren$_i$-de shu]$_j$ bei song-le ___$_j$ **gei** ta-ziji$_i$

(17) [daduoshu ren$_i$-de shu]$_j$ bei song-gei-le ta-ziji$_i$ ___$_j$
most person-GEN book BEI gift-to-PRF 3SG-self
'Most people$_i$'s book was gifted to himself/herself$_i$.'

(18) Verb-Prep incorporation: V$_i$-to$_j$ [t_j IO [t_i DO]]

a. *wo song-**gei**-le [ta-ziji$_i$]$_{IO}$ [daduoshu ren$_i$-de shu]$_{DO}$
I gift-to-PRF 3SG-self most person-GEN book
Intended: '*I gifted himself/herself$_i$ most people's book.'

(ungrammatical due to the unbound anaphor)

b. wo song-**gei**-le [daduoshu ren$_i$]$_{IO}$ [ta-ziji$_i$-de shu]$_{DO}$
I gift-to-PRF most person 3SG-self-GEN book
'I gifted most people$_i$ his/her$_i$ own book.'

No weak crossover (WCO) effects in long passives. Long *bei*-passives are immune to WCO, which results in ungrammaticality when an element is A′-moved over a phrase containing an element that is coindexed with it. Mandarin exhibits such a phenomenon, wherein an A′-moved topic exhibits WCO effects. As shown by (19b), the sentence is unacceptable when the topic is co-indexed with the third person pronoun *ta* in the subject DP. However, this co-indexation is perfectly acceptable in the case of long *bei*-passives, as demonstrated by (19c).

(19) a. ta$_{*i/j}$-de haizi dabai le daduoshu ren$_i$
3SG-GEN child defeat PRF most person
'His/Her$_{*i/j}$ child defeated most people$_i$.'

b. daduoshu ren$_i$, ta$_{*i/j}$-de haizi dabai le ___$_i$
most person, 3SG-GEN child defeat PRF
'Most people$_i$, his/her$_{*i/j}$ child defeated [him/her$_i$].'

c. daduoshu ren$_i$ bei ta$_{i/j}$-de haizi dabai le ___$_i$
most person BEI 3SG-GEN child defeat PRF
'Most people$_i$ were defeated by his/her$_{i/j}$ child.'

(ii) Dative construction: V$_i$ [DO [t_i [to IO]]]

wo song-le [daduoshu ren$_i$-de shu]$_{DO}$ **gei** [ta-ziji$_i$]$_{IO}$
I gift-PRF most person-GEN book to 3SG-self

'I gifted most people$_i$'s book to himself/herself$_i$.'

As for short *bei*-passives, this diagnostic cannot be applied, nor the next diagnostic concerning reconstruction. The rationale behind this is that both diagnostics depend on the interaction between two NPs, namely the SS and the EA, while short passives only involve a single NP, the SS.

No reconstruction effects in long passives. Long *bei*-passives do not exhibit obligatory reconstruction for Principle C, unlike typical A′-movement constructions such as topicalization. Principle C prohibits the co-indexation between a proper name and an NP that c-commands it, as shown in the baseline sentence (20a). In the topicalization construction (20b), the topic, which includes a proper name, must reconstruct into the object position. This prevents co-indexation between the proper name and the subject due to Principle C. However, in the case of the long *bei*-passive example (20c), such co-indexation is grammatical, indicating that the SS does not undergo obligatory reconstruction. If the SS were to reconstruct in its gap position, the proper name *Lisi* would be bound by a co-indexed EA, violating Principle C.

(20) a. $ta_{*i/j}$ dabai le $Lisi_i$-de haizi
3SG defeat PRF Lisi-GEN child
'S/$he_{*i/j}$ defeated Lisi's$_i$ child.'

b. [$Lisi_i$-de haizi]$_k$, $ta_{*i/j}$ dabai le ___$_k$
Lisi-GEN child 3SG defeat PRF
'$Lisi_i$'s child, s/$he_{*i/j}$ defeated.'

c. [$Lisi_i$-de haizi]$_k$ bei $ta_{i/j}$ dabai le ___$_k$
Lisi-GEN child BEI 3SG defeat PRF
'$Lisi_i$'s child was defeated by him/her$_{i/j}$.'

Moreover, the SS in long *bei*-passives does not reconstruct in two additional situations.[6] First, the SS does not reconstruct for pronominal binding. In the active sentence (21a), the pronoun in the object NP is bound by the quantificational subject 'most people'. Conversely, in the passive (21b), this pronoun cannot co-vary with the quantificational EA *daduoshu ren* 'most people', suggesting that the SS does not reconstruct in its gap position and get bound there by the quantificational

[6]A potential caveat is that we are not certain whether these two phenomena are diagnostics for A′-movement in Mandarin because topicalization, which is typically analyzed as an A′-construction in Mandarin, does not show reconstruction in these two contexts either.

phrase. The same applies to the reflexive *ta-ziji* 'himself/herself' in the long *bei*-passive example (22b), in contrast with its active form (22a).

(21) a. daduoshu ren_i dabai le ta_i-de haizi
most person defeat PRF 3SG-GEN child
'Most $people_i$ defeated his/her_i child.'

b. *[ta_i-de haizi]$_k$ bei daduoshu ren_i dabai le ___$_k$
3SG-GEN child BEI most person defeat PRF
Intended: 'For most people x, x's child was defeated by x.'

(22) a. daduoshu ren_i dabai le ta-$ziji_i$
most person defeat PRF 3SG-self
'Most $people_i$ defeated himself/$herself_i$.'

b. *ta-$ziji_i$ bei daduoshu ren_i dabai le ___$_i$
3SG-self BEI most person defeat PRF
Intended: '*Himself/$herself_i$ was defeated by most $people_i$.'

Second, the SS in long *bei*-passives does not exhibit referential opacity. The active baseline sentence (23a) is ambiguous, presenting two readings: A *transparent reading*, wherein the NP *na-ge zuifan* 'that criminal' is interpreted outside of the scope of the intensional verb *xiwang* 'hope', and an *opaque reading*, where this NP is interpreted within the scope of the intensional operator. *Referential opacity* occurs when a moved element is interpreted opaquely with respect to an intensional operator that it crosses over, suggesting reconstruction. In order to construct natural-sounding passives with intensional verbs such as *xiwang* 'hope', we utilized long-distance dependencies. In (23b), if the SS were to reconstruct in the IA position, we should be able to get the opaque reading in which the NP 'this criminal' is interpreted under the intensional verb 'hope', contrary to the observed fact: As shown in (24) and (25), *bei*-passives are only compatible with scenarios conveying the transparent reading but not the opaque reading, in contrast with the active baseline which is appropriate in both scenarios.

(23) a. Active:

Zhangsan xiwang Lisi pingyong na-ge zuifan
Zhangsan hope Lisi hire that-CLF criminal

'Zhangsan hopes that Lisi hires that criminal'

b. Long passive:

na-ge zuifan$_i$ bei Zhangsan xiwang Lisi pingyong ___$_i$
that-CLF criminal BEI Zhangsan hope Lisi hire
Lit. 'That criminal$_i$ was hoped by Zhangsan that Lisi hires [him$_i$].'

(24) Scenario for an transparent reading: *Jack is a criminal. Zhangsan does not know it and he hopes that Lisi will hire Jack.*

✓ Active (23a) ✓ Long passive (23b)

(25) Scenario for a opaque reading: *Zhangsan believes that Jack is a criminal and he hopes that Lisi will hire Jack. However, in the actual world, Jack is not a criminal.*

✓ Active (23a) ✗ Long passive (23b)

We have thus far examined evidence demonstrating a lack of reconstruction effects in *bei*-passives. We now turn to two (apparent) counterexamples that some studies have used to assert that the SS in *bei*-passives does undergo reconstruction.

Aoun and Li (1989) claim that *bei*-passives exhibit quantificational scope reconstruction, as evidenced by example (26), which allows for both the surface scope and the inverse scope readings. However, as Huang (1993) points out, the inverse scope reading is feasible only when 'one woman' is given a specific reference. When a specific interpretation is unattainable, as with the quantificational EA in (27), the inverse scope reading also becomes unacceptable. Huang argues that there is no quantificational scope reconstruction in *bei*-passives.[7]

[7] Aoun and Li (1989) report that ((i)) is also ambiguous in terms of the scoping relations between the indefinite SS and the universal quantifier EA. In this example, the inverse scope reading does not rely on the specific interpretation of the EA (the EA is not referential).

(i) yaoshi liang-ge xiansuo bei mei-ge ren zhaodao ...
if two-CLF clue BEI every-CLF person find
'If two clues were found by everyone...' (adapted from Aoun & Li 1989: ex. 4a)
✓ Surface scope: two >> every ✓ Inverse scope: every >> two

However, our judgement for this sentence aligns with Huang (1993), viz. that the inverse scope reading is hard to access. Moreover, even if such a reading is acceptable for some speakers, it only holds when the indefinite NP is

(26) mei-ge ren dou bei yi-ge nvren zhuazou le
every-CLF person all BEI one-CLF woman arrest PRF
'Everyone was arrested by one woman.' (adapted from Aoun & Li 1989: ex. 4a)

✓ Surface scope: every >> one ✓ Inverse scope: one >> every

(27) henduo xuesheng bei mei-ge laoshi jiao-guo
many student BEI every-CLF teacher teach-EXP
'Many students have been taught by every teacher.' (adapted from Huang 1993: ex. 67)

✓ Surface scope: many >> every ✗ Inverse scope: every >> many

Another inconclusive argument concerning reconstruction effects in *bei*-passives regards idioms. Some (but not all) VO idioms can be passivized, with the idiomatic object being the SS in a *bei*-passive while maintaining the idiomatic interpretation. For example, in (28), the VO idiom *chu fengtou* 'draw public attention' (lit. 'vent wind') can be passivized. The idiomatic object *fengtou* 'wind' is promoted to the SS position in (28b), but it presumably needs to reconstruct in the embedded VP to be interpreted with the idiomatic verb *chu* 'vent' to derive the intended idiomatic meaning. The same is true of the commonly cited examples in (29).

(28) a. zhe-ci Lisi **chu** le **fengtou**
this-time Lisi vent PRF wind
'This time Lisi drew public attention (by showing off his skills/talents)'

(Lit. 'This time Lisi vented the wind.')

b. zhe-ci **fengtou** bei Lisi **chu** le
this-time wind BEI Lisi vent PRF
'This time the public attention was drawn by Lisi (by showing off his skills/talents).'

(Lit. 'This time the wind was vented by Lisi.')

(29) a. **pianyi** bei Lisi yi-ge ren **zhan** le
advantage BEI Lisi one-CLF person occupy PRF
'The advantage was taken by Lisi alone.' (Adapted from N. Liu & Huang 2016)

b. **niu(-pi)** dou bei Lisi **chui** le
cow-skin all BEI Lisi blow PRF

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embedded under conditional 'if' or the existential verb *you* 'there be' (in Mandarin, indefinite NPs are in general not allowed in the subject position). It is unclear how conditionals and the existential verb affect quantificational scope.

'The bluffing was all done by Lisi.'

(Lit. 'The cow(hide) was all blown by Lisi.') (Adapted from Huang 2013)

Nonetheless, there is controversy regarding the idiomatic reconstruction data. Nunberg, Sag, and Wasow (1994) distinguish "idiomatically combining expressions" (e.g., *pull strings*) from "idiomatic phrases" (e.g., *kick the bucket*). For the former, there are parallelisms between their literal and idiomatic meanings (e.g., *pull strings*: pull = exploit, strings = connections) and the idiomatic meanings are distributed among different syntactic parts of the idiom. As a result, the idiomatic meaning is preserved even when part of the idiom is modified (e.g., *pull strings that weren't available for anyone else*), quantified (e.g., *pull all strings*), topicalized (e.g., *those strings, he wouldn't pull for you*) and so on.

In Mandarin, some idioms do lose their idiomatic meanings in *bei*-passives (i.e., there is no reconstruction). As shown in (31), the idiomatic meaning of *chi cu* 'feel jealous' that is available in actives (30) is not accessible in *bei*-passives, in which the phrase is interpreted as its literature meaning 'eat vinegar'.

(30) a. Lisi **chi cu**
Lisi eat vinegar
'Lisi feels jealous.'
(Lit. 'Lisi eats vinegar.')

b. Lisi **chi** Zhang-de **cu**
Lisi eat Zhang-GEN vineger
'Lisi feels jealous of Zhang.'
(Lit. 'Lisi eats Zhang's vinegar.')

(31) a. **cu** bei Lisi **chi** le
vinegar BEI Lisi eat PRF
✓ 'The vinegar was eaten by Lisi.'
✗ 'Jealousy was felt by Lisi.'

b. Zhang-de **cu** bei Lisi **chi** le
Zhang-GEN vinegar BEI Lisi eat PRF
✓ 'Zhang's vinegar was eaten by Lisi.'
✗ 'Jealousy of Zhang was felt by Lisi.'

According to Nunberg, Sag, and Wasow (1994), the 'passivizable' idioms in Mandarin, such as *zhan pianyi* 'take advantage' (lit. 'occupy advantage'), are idiomatically combining expressions, while the 'impassivizable' idioms such as *chi cu* 'feel jealous' (lit. 'eat vinegar') are idiomatic phrases that cannot be decomposed. If that is the case, the idiomatic objects in our previous examples bear parts of the idiomatic meanings and do not need to reconstruct in order to receive

the intended idiomatic interpretations (see also Bruening & Tran 2015 and F. Chen 2023 for similar discussions).

To sum up this subsection, we have shown that the SS in both long and short *bei*-passives is in an A-position, as evidenced by its ability to bind anaphors in the complement of *bei* in both long and short constructions, as well as the absence of weak crossover (WCO) effects and reconstruction effects in long *bei*-passives. The A-properties of the SS align seamlessly with the NOP movement analyses, which propose a base-generated SS. On the other hand, these characteristics pose challenges for the NP movement approaches to explain (though their proposed solutions are discussed in Section 2.2.2).

2.1.3. The external argument (EA) in long vs. short *bei*-passives

So far we have reviewed two properties shared by long and short *bei*-passives. Next we will demonstrate that these two constructions differ in a crucial way regarding the EA. For long passives, the important question is whether the EA forms a constituent with *bei*, as illustrated in (32a), or occupies a syntactic position that c-commands the gap of the moved IA as in (32b).

(32) a. IA_i [[*bei* EA] V $\_\__i$] b. IA_i [*bei* [EA V $\_\__i$]]

As for short passives, the critical question is whether the EA is syntactically projected but phonologically null, or interpreted existentially but not projected in the structure.

2.1.3.1. The EA in long passives is an embedded subject

Some early studies considered *bei* to be a preposition (or a coverb) that combines with the EA to form a constituent, as previously illustrated in (32a) (e.g., Wang 1970, Travis 1984, Li & Thompson 1989) However, there is no evidence that the EA and *bei* forms a constituent. For example, they cannot be moved together like typical prepositional phrases, as shown by the contrast between (33) and (34) (e.g., Huang 1999).

(33)

a. Zhangsan bei Lisi da le
Zhangsan BEI Lisi hit PRF
'Zhangsan was hit by Lisi.'

b. *bei Lisi Zhangsan da le
BEI Lisi Zhangsan hit PRF
Intended: 'By Lisi, Zhangsan was hit.'

(34) a. Zhangsan [dui Lisi] hen keqi
Zhangsan to Lisi very polite
'Zhangsan is very polite to Lisi.'

b. [dui Lisi] Zhangsan hen keqi
to Lisi Zhangsan very polite
'To Lisi, Zhangsan is very polite.'

Instead, it has been argued that the EA has properties of an argument in a subject position, as demonstrated in (32b) (e.g., Y.-H. Li 1990, Chiu 1993, Ting 1998, Huang 1999, Huang, Y.-H. Li, & Y. Li 2009). For instance, the subject-oriented logophor *ziji* 'self' can be bound by *Lisi* in (35a), when it is preceded by *bei*, but not in (35b), when it is preceded by a preposition *gen* 'with'. This contrast suggests that in the long passive construction, *Lisi* c-commands *ziji* from an argument position (i.e., an embedded subject), thereby supporting the bracketing in (32b) as opposed to the PP analysis in (32a).

(35) a. Zhangsan$_i$ **bei** [**Lisi$_j$** guan zai **ziji$_{i/j}$**-de fangjian] (*bei* NP)
Zhangsan BEI Lisi lock at self-GEN room
'Zhangsan$_i$ was locked by Lisi$_j$ in his$_{i/j}$ own room.' (Huang et al. 2009:118)

b. Zhangsan$_i$ [**gen Lisi$_j$**] taolun **ziji$_{i/*j}$**-de xiangfa (P NP)
Zhangsan with Lisi discuss self-GEN opinion
'Zhangsan$_i$ discussed with Lisi$_j$ his$_{i/*j}$ own opinions.' (Huang et al. 2009:117)

Further evidence in support of the bracketing in (32b) pertains to the binding of compound reflexives such as *ta-ziji* 'himself/herself'. According to Huang et al. (2009), compound reflexives in Mandarin are anaphors that adhere to Binding Principle A, as demonstrated in (36); they are bound within their local domain. In *bei*-passives, it has been observed that the EA can bind a compound reflexive, as shown in (37). This finding indicates that the EA is situated in an argument position that c-commands the indirect object *ta-ziji*.[8]

[8]Some evidence suggests that *ta-ziji* has a subject-oriented logophoric use that is analogous to the bare reflexive *ziji* (e.g., Huang et al. 2009). In this case, *ta-ziji* can refer to any subject without regard to c-command relations but cannot refer to any object. For instance in the example below, *ta-ziji* can refer to the main clause subject *Wangwu*, the subject within the relative clause *Zhangsan*, or the EA/embedded subject under the passive marker *Lisi*, but not the

(36) Zhangsan$_i$ zhidao Lisi$_j$ lao piping **ta-ziji$_{*i/j/*k}$**
Zhangsan know Lisi incessantly criticize 3SG-self
'Zhangsan$_i$ knows that Lisi$_j$ criticizes himself$_{*i/j/*k}$ all the time.'

(37) zhe-feng xin bei Lisi$_i$ ji-gei le **ta-ziji$_i$**
this-CLF letter BEI Lisi mail-to PRF 3SG-self
'This letter was mailed by Lisi$_i$ to himself$_i$.'

Chiu (1993) provides additional evidence demonstrating the binding capability of the long passive EA. She points out that the long passive EA can control into adjuncts, as shown in (38a) in which PRO is c-commanded by the EA. Conversely, an NP inside an adjunct PP is unable to control this PRO because there is no c-command relation, as illustrated in (38b).[9]

(38) a. Akiu$_i$ bei [Lisi$_j$ [**PRO$_{*i/j}$** kai che] zhuangdao le]
Akiu BEI Lisi drive car hit PRF
'Akiu was hit by Lisi while [Lisi was] driving.'

b. Akiu$_i$ [wei Lisi$_j$] [**PRO$_{i/*j}$** kai che] song qian gei ta mama
Akiu for Lisi drive car send money to his mother
'For Lisi, Akiu, driving the car, sent the money to his mother.'

Multiple lines of evidence converge to demonstrate that the EA in long passives occupies an argument position, specifically an embedded subject position beneath *bei*. These findings cannot be accommodated by an adjunct analysis of the EA (e.g., Ngui 2020).

---

object in the relative clause *Akiu*.

(i) Wangwu$_1$ tingshuo [$_{CP}$ [$_{DP}$ [$_{CP}$ Zhangsan$_2$ xie-gei Akiu$_3$ de] xin] bei Lisi$_4$ ji-gei le **ta-ziji$_{1/2/*3/4}$**]
Wangwu hear Zhangsan write-to Akiu REL letter BEI Lisi mail-to PRF 3SG-self
'Wangwu$_1$ heard that the letter which Zhangsan$_2$ wrote to Akiu$_3$ was mailed by Lisi$_4$ to himself$_{1/2/*3/4}$.'

Although the discussion of the anaphoric vs. logophoric use of *ta-ziji* is beyond this dissertation, if it were the case that in our example (37) *ta-ziji* is a logophor, it would still be valid that the long passive EA functions as an embedded subject.

[9]Here Chiu analyzes the first VP in the Serial Verb Constructions (SVC) as an adjunct. While the structure of the SVC is subject to debate and is not the focus of this dissertation, it is worth noting that the difference in binding between the long passive EA in (38a) and the P complement in (38b) remains clear regardless of the SVC's structure.

2.1.3.2. The EA is not projected in short passives

The EA is semantically present in short passives, as it can be modified by a 'subject-oriented' adverb (39a) and control the PRO subject of an infinitival purpose clause (39b).[10]

(39) a. zhe-sou chuan bei guyi ji-chen le
this-CLF ship BEI intentionally hit-sink PRF
'This ship was intentionally sunk.'

b. ?zhe-sou chuan bei ji-chen le [PRO lai mihuo diren]
this-CLF ship BEI hit-sink PRF to confuse enemy
'This ship was sunk to confuse the enemy.'

However, this does not necessarily mean that the EA in short passives is syntactically projected (e.g., Williams 1985, 1987, 2015, Bhatt & Pancheva 2006/2017, Bruening 2013; cf. Landau 2010). It has long been argued in the literature that the short *bei*-passive structure does not contain an implicit EA. Huang (1999) and many followers cite the lack of A′-properties in short *bei*-passives as evidence that short *bei*-passives do not have the same structure as long *bei*-passives, implying that short passives do not project the EA. We will discuss this approach in more detail in Section 2.2.1.

Bruening and Tran (2015) observed that, unlike a PRO, the missing EA in Vietnamese short passives cannot be bound or controlled; rather, it is interpreted as an existential quantifier like 'someone' (see also Williams 1987, Baker, Johnson, & Roberts 1989, Bruening 2013 a.o.). Here we adapt their example and show that it is the same with Mandarin short *bei*-passives. In the active sentence (40a), the subject controls the PRO, thus the reference of PRO co-varies with the quantifier phrase. By contrast in the short passive version (40b), this reading is unavailable; instead the EA of the passive verb is interpreted as an existential quantifier (i.e., 'someone').

(40) a. suoyou jizhe$_i$ dou xiwang PRO$_i$ caifang zongtong
all reporters all hope interview president
'All the reporters$_i$ hope PRO$_i$ to interview the president.'

[10]There is ongoing debate about these two diagnostics and their application in short passives (e.g., Williams 1985, 1987, 2015, Roeper 1987, Farkas 1988, Landau 2000, Bhatt & Pancheva 2006/2017, Bruening & Tran 2015, Biggs & Embick 2020, Michelioudakis 2021). In this dissertation we will not discuss this issue and will focus more on whether the EA is *syntactically* projected instead.

b. suoyou jizhe dou xiwang zongtong bei caifang
all reporters all hope president BEI interview
'All the reporters hope that the president will be interviewed (by someone).'

Not: 'All the reporters$_i$ hope that the president will be interviewed by them$_i$.'

(Adapted from Bruening & Tran 2015: ex. 29b)

Furthermore, if the EA were realized as a null pronoun in short passives, it should be able to license secondary predicates and control into adjuncts (e.g., Chomsky 1986b, Safir 1987, Landau 2010). We show below in (41c), (42c), and (43) that short *bei*-passives fail these two diagnostics.

In (41c), *chi-jiao* 'barefooted' is not a secondary predicate associated with the missing EA; instead, it can only be predicated of a local PRO bound by the SS.

(41) a. Zhangsan chi-jiao dabai le Lisi
Zhangsan bare-foot defeat PRF Lisi
'Zhangsan$_i$ defeated Lisi [PRO$_i$ barefooted].'

b. Lisi bei Zhangsan chi-jiao dabai le
Lisi BEI Zhangsan bare-foot defeat PRF
'Lisi was defeated by Zhangsan$_i$) [PRO$_i$ barefooted].'

c. Lisi bei chi-jiao dabai le
Lisi BEI bare-foot defeat PRF
✓'Lisi$_i$ was defeated [PRO$_i$ barefooted].'

✗ 'Lisi was defeated (by someone$_i$) [PRO$_i$ barefooted].'

Similarly, in (42c) the sentence is unacceptable because the depictive *hanjinjin* 'sweaty' cannot be associated with the inanimate SS. If there were a PRO as the EA in this short passive, it should be able to license the depictive *hanjinjin* 'sweaty'.

(42) Examples adapted from Z. Chen and Y. Li (2021: ex. 9a and 9b)

a. Lisi hanjinjin-de tuihuan le zhubao
Lisi sweaty-ADV return PRF jewelry
'Lisi returned the jewelry sweatily.'

b. zhubao bei Lisi hanjinjin-de tuihuan le
jewelry BEI Lisi sweaty-ADV return PRF
'The jewelry was returned by Lisi sweatily.'

c. *zhubao bei hanjinjin-de tuihuan le
jewelry BEI sweaty-ADV return PRF
Intended: 'The jewelry was returned sweatily.'

In (43), the missing EA cannot control into the temporal adjunct phrase, which is unexpected if the EA is realized as PRO.

(43) *Lisi bei [shuijiao zhiqian] da le
Lisi BEI sleep before hit PRF
Intended: 'Lisi had been hit [before PRO went to sleep].'

To sum up this subsection, we have demonstrated that the EA in long *bei*-passives is an embedded subject c-commanding the gap of the IA and that the missing EA in short *bei*-passives is structurally absent and interpreted existentially. Except for some analyses that treat the EA as an adjunct, this property is accounted for by most of the previous studies that we will discuss in Section 2.2 .

2.1.4. Summary

In this section, we have examined three fundamental characteristics of *bei*-passives. Firstly, there is syntactic movement of the IA, as evidenced by the island effects present in both long and short passives. We have demonstrated that both long and short *bei*-constructions adhere to island constraints and create weak islands for *wh*-movements, aligning with A′-movement. Similarly aligned with A′-movement is the capability of *bei*-constructions to sustain long-distance dependencies. However, this movement also shows non-A′-like properties for the long-distance dependencies across finite clause boundaries in both long and short *bei*-passives.

Secondly, the SS of both types of *bei*-passives is in an A-position. The SS is able to bind anaphors in the complement of *bei* regardless of whether the EA is present or absent. Furthermore, in long *bei*-passives there are neither weak crossover effects nor reconstruction effects. The only exception is idiomatic reconstructions for some (but not all) idioms in *bei*-passives. Nonetheless, this exception is a topic of ongoing debate and the decomposable idiomatic meanings of those idioms might account for this effect.

Lastly, the EA in long *bei*-passives functions as an embedded subject that c-commands the gaps of the IA, as evident from its binding capabilities. Conversely, the EA in short *bei*-passives is not projected in the syntactic structure. Instead, it is interpreted existentially (i.e., 'someone'). The absent EA in short passives cannot be bound or controlled, cannot license secondary predicates, and cannot control into (non-purpose) adjuncts.

In the remaining sections of this chapter, we will review previous analyses in the literature and discuss their explanations for the three properties we have examined. Finally, in Section 2.3 we will discuss the implications of these syntactic properties for children's acquisition of *bei*-passives, with a particular focus on the predictions made by the Intervention Hypothesis.

2.2. Syntactic derivation of *bei*-passives

There is ongoing debate regarding the derivation of *bei*-passives. Section 2.2.1 presents a review of three analyses which propose a base-generated SS, further suggesting that *bei*-passives derive from the movement of a null operator (NOP), an idea we label as the 'NOP movement approach'. In contrast, Section 2.2.2 highlights two analyses advocating that the IA itself moves to the SS position, an approach we will refer to as the 'NP movement approach'.

As we will illustrate in Section 2.2.3, both the NOP movement approach (particularly as posited by Huang (1999) and Bruening & Tran 2015) and the NP movement approach (as recently advocated for by F. Chen 2023) successfully explain the three crucial properties discussed in Section 2.1, which are most relevant to our acquisition studies. Although we will briefly touch upon the strengths and weaknesses of these analyses when applicable, we do not intend to endorse any specific proposal. What is important for our research program is the three properties and the understanding that both the NOP movement and the NP movement approaches have the same implications for children's acquisition of *bei*-passives. Consequently, both theories guide us to form consistent predictions, as we will outline in Section 2.3.

2.2.1. Base-generation and null operator (NOP) movement analyses

Base-generation theories posit that the SS in both long and short *bei*-passives is base-generated in the subject position (e.g., Chiu 1993, Ting 1998, Huang 1999, Huang, Y.- H. Li, & Y. Li 2009, Z. Zhang 2010, Bruening & Tran 2015, Ngui 2020).[11] These theories argue that *bei* functions as a two-place predicate, introducing the base-generated SS as its argument and selecting a secondary predicate of the SS. In the context of long passives, these theories posit that a null operator (NOP) movement creates the secondary predicate, as depicted in (44). The NOP functions as a lambda operator at LF, converting a proposition into a predicate.

(44) NOP-movement in long passives:

Zhangsan_i BEI $[_{IP}$ Op_i Lisi hit $\_\_\_i$]
predication; A′-movement

However, base-generation theories diverge when explaining the derivation of short passives. Huang (1999) proposes that in short passives, the SS controls a PRO that undergoes A-movement from an object position, as depicted in (45) (see also Ting 1998, Huang et al. 2009).

(45) A PRO-movement analysis of short passives (e.g., Huang 1999):

Zhangsan_i BEI $[_{VP}$ PRO_i hit $\_\_\_i]$
control; A-mvmt

Since this analysis posits an A-movement for short *bei*-passives, it fails to derive the A′-properties of this construction which parallel those of long *bei*-passives, as outlined in Section 2.1.1.

[11] Arguments for a base-generated SS include the diagnostic of 'subject-oriented' adverbs: For example, in (i), *guyi* 'intentionally', when occurring above *bei*, denotes that it was the SS *Zhangsan*'s intention to get hit.

(i) Zhangsan **guyi** bei (Lisi) da le
Zhangsan intentionally BEI Lisi hit PRF
'Zhangsan intentionally got hit (by Lisi).'

Huang (1999) argues that a raised SS would hold only a Theme/Patient role, rendering it incompatible with *guyi* 'intentionally' that only associates with Agents or Experiencers. Under his base-generation approach, the SS is base-generated in the subject position, assigned an Experiencer theta role by *bei*, and thus is a possible associate of a 'subject-oriented' adverb preceding *bei*. Huang then proposes, and many follow, that *bei* in both long and short passives is a two-place predicate taking an Experiencer as its subject and the SS in Mandarin *bei*-passives is base-generated as an Experiencer of *bei*. However, as Bruening and Tran (2015) points out, this argument is problematic because 'subject-oriented' adverbs do not require their associate to be a grammatical subject, nor an Agent or Experiencer, and the SS in *bei*-passives is not an Experiencer of *bei*.

In contrast, other base-generation analyses suggest that short passives also involve NOP movement, thereby offering a unified approach for both long and short *bei*-passives. Bruening and Tran (2015) argue that NOP movement is present in both constructions, with the primary distinction being that BEI selects an active VoiceP in long passives and a passive VoiceP in short passives, as demonstrated in (46). Their analysis highlights the crucial difference between long passives (active VoiceP) and short passives (passive VoiceP) as being the projection of the EA as a subject in the former and its lack of projection in the latter.

(46) Bruening and Tran's (2015) analysis:

a. Long passives: Zhangsan$_i$ BEI [$_{\text{VoiceP}}$ Op$_i$ Lisi VOICE$_{\text{ACTIVE}}$ [$_{\text{VP}}$ hit ___$_i$]]
predication; A′-movement

b. Short passives: Zhangsan$_i$ BEI [$_{\text{VoiceP}}$ Op$_i$ VOICE$_{\text{PASS}}$ [$_{\text{VP}}$ hit ___$_i$]]
predication; A′-movement

Ngui (2020) offers another analysis that posits NOP movement for short passives, drawing on Legate's (2014) examination of Acehnese passives. According to this approach, the EA is existentially bound by the Voice$_{\text{Passive}}$ head in both long and short *bei*-passives, rather than being syntactically projected. Instead, an initiator PP, headed by a null preposition, introduces the initiator (e.g., *Lisi*) as depicted in (47). This PP functions as an optional adjunct: its presence results in a long passive, while its absence leads to a short passive.

(47) Ngui's (2020) analysis:

Zhangsan$_i$ [Op$_i$ BEI [$_{\text{Voice}_{\text{Passive}}\text{P}}$ ([$_{\text{PP}}$ ∅ Lisi]) [$_{\text{VoiceP}}$ VOICE$_{\text{PASS}}$ [$_{\text{VP}}$ hit ___$_i$]]]]
predication; A′-movement

The NOP movement approach generally addresses the three crucial properties of *bei*-passives as detailed in Section 2.1. Firstly, it posits an NOP movement for the IA, thus explaining the island effects discussed in Section 2.1.1. Secondly, the SS is hypothesized to be base-generated in an argument position, which accounts for its A-properties, such as anaphor binding, absence of WCO, and lack of reconstruction, as demonstrated in Section 2.1.2. Thirdly, both Huang's (1999) and Bruening and Tran's (2015) analyses suggest that the EA is an embedded subject in long

passives but remains unprojected in short passives, reflecting the asymmetry observed between these two constructions in Section 2.1.3. (However, Ngui's (2020) adjunct treatment of the EA fails to derive this contrast.)

In conclusion, Huang's (1999) and Bruening and Tran's (2015) NOP movement analyses effectively capture the three key properties of *bei*-passives. However, as discussed in Section 2.1.1, the subject/object asymmetry observed in long-distance *bei*-passives poses a challenge for all base-generation and NOP movement theories.

2.2.2. NP movement analyses

In contrast to the NOP movement approach, which advocates for a base-generated SS, the NP movement approach proposes that the IA itself undergoes movement to the SS position (e.g., N. Liu 2012, Huang 2013, N. Liu & Huang 2016, F. Chen 2021, 2023).

A crucial question for these analyses is how such movement can circumvent potential minimality violations in long *bei*-passives. Evidence of binding from Section 2.1.3 shows that both the EA and SS in long *bei*-passives are arguments c-commanding the IA gap. As exemplified in (48), both the SS and EA c-command the locative object 'himself's room' and can bind the anaphor *ta-ziji* (see Section 2.1.3.1 for further discussion). Consequently, A-movement of the IA across a c-commanding EA to the SS position would violate the principle of minimality, since the EA is structurally closer to the SS and should be targeted by the probe that triggers this A-movement, as depicted in (49) (e.g., Chomsky 1964, Rizzi 1990, Chomsky 1995).

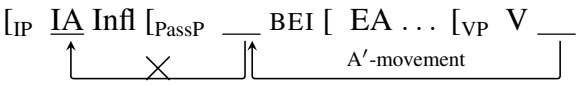
(48) Zhangsan$_i$ bei Lisi$_j$ guan-zai ta-ziji$_{i/j}$-de fangjian
Zhangsan BEI Lisi lock-at 3SG-self-GEN room
'Zhangsan$_i$ was locked by Lisi$_j$ in his$_{i/j}$ own room.'
(Lit. 'Zhangsan$_i$ was locked by Lisi$_j$ in himself$_{i/j}$'s room) (Adapted from Huang 1999)

(49) The long passive IA cannot undergo A-movement:
... [$_{PassP}$ IA BEI [(EA) ... [$_{VP}$ V __]]] (Minimality violation)

On the other hand, if this movement were A′-movement, it would not be able to feed a sequen-

tial A-movement required to derive the A-properties of long *bei*-passives that we have shown in Section 2.1.2 without violating the *Ban on Improper Movement* (e.g., Chomsky 1973, 1981; May 1979; Fukui 1993, Abels 2007; Williams 2003).

(50) The long passive IA cannot undergo A′-movement:

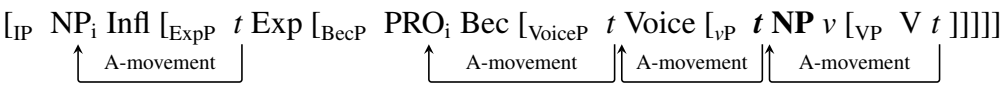


(Ban on Improper Movement)

N. Liu and Huang (2016) attempt to address this issue by postulating two equidistant Spec *v*P positions in their derivations. Their analysis for *bei*-passives distinguishes three types of *bei*-passives: short passives, local long passives, and long-distance long passives.[12] For short passives and local long passives, they seek to reconcile conflicting arguments indicating that the SS is base-generated (e.g., 'subject-oriented' adverb test) versus derived (e.g., idiomatic reconstruction) by proposing two derivations: control and raising.

They decompose *bei* into two functional heads, EXPERIENCE (Exp) and BECOME (Bec), asserting that the control structure of a *bei*-passive involves both, as shown in (51), while the raising structure involves only BECOME, as shown in (52). In the control derivation (51), the SS is base-generated as the Experiencer of *bei* controlling the PRO, which accounts for the 'subject-oriented' adverb diagnostic. Meanwhile, in the raising derivation (52), the SS is derived and therefore can be reconstructed, accounting for the idiomatic reconstruction data. To circumvent the locality problem illustrated in (49), they suggest that in Mandarin *bei*-passives, the *v* projects two *equidistant* specifier positions, boldfaced in (51) and (52). The EA occupies one of these equidistant specifier positions. The IA undergoes A-movement to the other unoccupied specifier of the *v*P and then cyclically A-moves to the Spec, IP.

(51) N. Liu and Huang's (2016) control analysis for local long passive:



[12]They adopt Huang's (1999) NOP movement analysis for the long-distance long passives.

(52) N. Liu and Huang's (2016) raising analysis for local long passive:

$[_{IP}$ NP Infl $[_{BecP}$ *t* Bec $[_{VoiceP}$ *t* Voice $[_{vP}$ ***t*** **NP** *v* $[_{VP}$ V *t*]]]]]

A-movement A-movement A-movement A-movement

However, their ambiguous raising or control analysis raises more questions than it answers. It remains unclear how these derivations can prevent the probe from extracting the EA (that is equidistant as the moved IA) instead. Moreover, like Huang's (1999) analysis, it cannot derive long-distance short *bei*-passives.

F. Chen (2023) adopts Longenbaugh's (2017) composite A/A′-movement analysis of English *tough*-construction and proposes a similar derivation for *bei*-passives. This composite movement approach is based on van Urk's (2015) featural view of the A/A′ distinction (53) and the concept of "composite probing" (54). Composite probing occurs when two (or more) features on the same head probe together in unison, searching for the structurally closest goal which bears both features involved in the probe and ignoring goals with only one of the features.

(53) **The featural view of the A/A′ distinction**: Differences among A- and A′-movement are derived from properties of the features involved in the associated Agree (Chomsky 1995, 2001) relations, not the position movement targets.

(54) **Composite probe hypothesis**: A head bearing both ϕ- and A′-features can, in principle, license a composite ϕ/A′-probe that triggers composite A/A′-movement.

In F. Chen's analysis, BEI hosts a composite probe comprising both a ϕ-feature and an A′-feature, triggering composite A/A′-movement of the closest NP with both ϕ- and A′-features, namely the IA, to Spec, PassP, as shown in (55a). This step is followed by a terminating step of A-movement to Spec, IP, as illustrated in (55b). Following Bruening (2013) and Bruening and Tran (2015), F. Chen proposes that the BEI head embeds an active VoiceP in long passives, in which the EA is an embedded subject c-commanding the gap of the IA; whereas the BEI head embeds a passive VoiceP, in which the EA is existentially bound by BEI but not syntactic projected.

(55) Composite A/A′-movement feeding A-movement (Chen 2021, 2023)

a. Step 1: Composite A/A′-movement to Spec, PassP

$[_{\text{PassP}}\ \underset{\text{A/A′-movement}}{\text{NP}_{[\phi,\,\text{A}']}}\ \text{BEI}_{[\phi,\,\text{A}']}\ [_{\text{VoiceP}}\ (\text{NP}_{[\phi]})\ [_{\text{VP}}\ \text{V}\ (\ldots)\ t\ (\ldots)\ ]\ ]\ ]$

b. Step 2: A-movement to Spec, IP

$[_{\text{IP}}\ \underset{\text{A-movement}}{\text{NP}_{[\phi,\,\text{A}']}}\ \text{Infl}_{[\phi]}\ [_{\text{PassP}}\ t\ \text{BEI}_{[\phi,\,\text{A}']}\ \ldots\ t\ (\ldots)\ ]$

This composite A/A′-movement analysis effectively elucidates the three syntactic properties of *bei*-passives discussed in Section 2.1. Firstly, the IA undergoes movement to the SS position, accounting for the island effects seen in both long and short *bei*-passives. Secondly, in Step 2 (55b), the IA undergoes A-movement to the SS position, which explains the A-properties such as anaphor binding, absence of WCO, and lack of reconstruction. Lastly, following Bruening (2013) and Bruening and Tran (2015), F. Chen suggests that the EA is an embedded subject in long *bei*-passives and existentially bound by *bei* in short *bei*-passives, thus explaining the argumenthood of the EA in the former construction and its absence in the latter.

Additionally, compared to the other approaches, F. Chen (2023) offers solutions to the two restrictions of long-distance dependencies observed in both long and short *bei*-passives. Firstly, dependencies between the SS and its gap can be established across infinitival clause boundaries provided there is no intervening Case-less NP. Secondly, dependencies across finite clause boundaries are permissible only if the gap is in the embedded subject position, but not in the object position. For a more detailed exploration, interested readers are advised to refer to Chen's work.

This composite A/A′-movement derivation does not trigger a minimality violation (i.e., intervention). Since the EA only has ϕ-features, it does not satisfy the composite probe and hence, does not interrupt the A/A′-movement of the IA.[13]

However, a lingering problem faced by this analysis is the violation of the Ban on Improper (i.e., A′-before-A) Movement. F. Chen (2023) stipulates, following Longenbaugh (2017) and Neeleman and van De Koot (2010), that the prohibition of Improper Movement stems from the

[13]F. Chen's (2023) further shows that in cases where two NPs with both ϕ- and A′-features move from the complement to BEI, only the NP closer to BEI can be the SS.

fact that A′-moved phrases obligatorily reconstruct in the lowest position in the chain, thereby rendering them unavailable for further A-movement; and that the composite A/A′-movement is unlike A′-movement in this respect, as evidenced by its lack of reconstruction effects, therefore its highest copy is available for further A-movement. However, this stipulation is problematic, as it is easy to show that A′-moved phrases do not obligatorily reconstruct into the tail of the chain.[14] We put off further investigation of the composite A/A′-movement approach to future research.

2.2.3. Summary

In this section we have explored two analyses of the derivation of *bei*-passives in prior literature: NOP movement (56) and NP movement (57).

(56) NOP movement approach:

Zhangsan$_i$ BEI [Op$_i$ (Lisi) . . . [$_{VP}$ hit ___$_i$]] (e.g., Huang 1999, Bruening & Tran 2015)

predication; NOP movement

(57) NP movement approach:

Zhangsan$_i$ BEI [___$_i$ (Lisi) . . . [$_{VP}$ hit ___$_i$]] (e.g., F. Chen 2021, 2023)

A-movement; A/A′-movement

These two approaches diverge on whether the SS is base-generated or derived. Under the NOP movement analysis, the IA is a null operator that moves to the edge of the *bei*-complement, thereby creating a predicate of the base-generated SS. In contrast, the NP movement approach proposes a movement of the IA to the SS position. Despite these differences, the three major properties

[14] For example, sentence (i) is scopally ambiguous (e.g., Kroch 1998, Cinque 1990, Cresti 1995). The surface-scope reading (i-a) assumes that there is a certain set of books that Mary should read and asks how many such books there are, whereas the reconstructed-scope reading (i-b) does not assume any particular books in mind. If the quantificational expression "how many books" obligatorily reconstructs into the object position, there should be no surface-scope reading, contrary to fact.

(i) How many books$_i$ should Mary read ___$_i$ this year?

(a) Surface-scope reading (how many >> should)
For what number *n*: There are *n*-many (particular) books *x* such that it is necessary that Mary read *x* this year.

(b) Reconstructed-scope reading (should >> how many)
For what number *n*: It is necessary that there be *n*-many books *x* such that Mary reads *x* this year.

of *bei*-passives that are most pertinent to our acquisition study (Section 2.1) are compatible with both approaches. Therefore, as we will demonstrate in the following section, these two types of syntactic analyses both lead us to the same predictions for children's acquisition of *bei*-passives.

2.3. Implications for L1 acquisition of *bei*-passives

Stepping aside from the theoretical debate between the NOP movement vs. NP movement approaches, we have focused on three critical syntactic properties of Mandarin *bei*-passives, which are anticipated by both types of syntactic analyses. These three properties are:

(58) a. The derivation of *bei*-passives involves syntactic movement of the IA.

b. The SS is in an A-position.

c. The EA in long *bei*-passives is in another A-position (an embedded subject) while the EA in short *bei*-passives is not projected in the structure.

The Intervention Hypothesis posits that children adhere to a stricter version of featural Relativized Minimality (Rizzi 1990, 2001, 2004). For adults, structural intervention occurs when the intervener has identical features with the probe/target and such intervention renders the sentence ungrammatical. For children, even a partial overlap in featural configurations between the intervener and the moved element causes comprehension difficulties, and a mismatch in the featural configurations ameliorates this intervention effect (e.g., Friedmann et al. 2009, Arnon 2010, Belletti et al. 2012, Bentea et al. 2016, Mateu & Hyams 2020, 2021, Biondo et al. 2022).

As *bei*-passives involve syntactic movement of the IA – whether as a null operator or a full NP – Mandarin-speaking children must establish a movement dependency between the IA and its gap in order to accurately comprehend the sentence. Moreover, given that the SS of *bei*-passives is in an A-position and that the EA in long passives is an embedded subject that c-commands the IA gap, we conclude that the EA triggers intervention in long passives because it is not only structurally closer to the probe (on the BEI/Voice head), but is also of the same type as the SS (i.e., they both are arguments).

As illustrated in (59a), the Intervention Hypothesis predicts that the IA movement in long passives should be challenging for children due to the intervention triggered by the EA, which shares some morphological features with the moved IA and is structurally closer to the probe. In contrast, as shown in (59b), there is no intervention in short *bei*-passives due to the structural absence of the EA. Hence, the Intervention Hypothesis predicts an asymmetry in children's comprehension of long vs. short *bei*-passives, with long passives being more difficult for them to understand.

(59) a. Long *bei*-passives:

$\ldots [_{beiP}\ \text{Op/NP}_{[A,\,A']}\ \text{BEI}\ [_{VoiceP}\ \boxed{\text{NP}_{[A]}}\ [_{VP}\ \text{V}\ (\ldots)\ t\ (\ldots)\ ]\ ]\ ]$

Intervention difficulties

b. Short *bei*-passives:

$\ldots [_{beiP}\ \text{Op/NP}_{[A,\,A']}\ \text{BEI}\ [_{VoiceP}\ [_{VP}\ \text{V}\ (\ldots)\ t\ (\ldots)\ ]\ ]\ ]$

No intervention difficulties

Note that in the diagrams (59), we stay agnostic in terms of whether the derivation involves NOP or NP movement, and we do not identify which A-features or which A′-features are involved in this derivation.[15]

In the remainder of the dissertation, we will examine Mandarin-speaking children's acquisition of *bei*-passives. In the following chapter, we will review the previous literature on children's acquisition of passives in other languages as well as in Mandarin. In Chapter 4, we will discuss our corpus study on the production of *bei*-passives in child and child-directed Mandarin, which

[15]In accordance with F. Chen's analysis, which suggests an overlap in ϕ-features between the EA and the IA, the Intervention Hypothesis further predicts that a mismatch in ϕ-features between these two arguments should mitigate the intervention difficulties children encounter in comprehending long *bei*-passives. Candidates for ϕ-features cross-linguistically include Person, Number, Gender, and Animacy. However, it remains uncertain which features, if any, function as ϕ-features in Mandarin, given the absence of morphological agreement in this language.

In the subsequent chapters detailing our acquisition studies, we examine the effects of Animacy and Number (and also Shape, which is not a candidate for ϕ-features), on children's comprehension of *bei*-passives. To preview, our results show that Animacy seems relevant for intervention (yet the evidence is not conclusive), while Number (and Shape) are irrelevant. Our results are most compatible with an analysis that does not treat Number (and maybe Animacy) as a feature which participates in triggering the syntactic movements illustrated in (59), at least in child grammar. Alternatively, considering the lack of evidence for the existence of ϕ-features in Mandarin, one might propose that it is a D feature, rather than a ϕ-feature, that participates in the syntactic derivation shown in (59).

Therefore, in our diagrams (59), we do not specify which features are at play but only show that there is intervention by the EA in long *bei*-passives.

is the first large-scale corpus study on this topic. In particular, we looked at Mandarin-speaking children and adults' production of long vs. short passives and a potential Animacy-mismatch effect in child passives. In Chapters 5 and 6, we will present experimental evidence showing intervention effects in children's comprehension of long, but not short, *bei*-passives and discuss the amelioration or lack of amelioration effects of two additional features in Mandarin – Number and Shape.

CHAPTER 3

Previous literature on L1 acquisition of passives

The first language (L1) acquisition of passive constructions has been a subject of significant interest for decades. Numerous studies have shown that passives are typically acquired at a later stage relative to other aspects of child grammar in many languages, including English (e.g. Turner & Rommetveit 1967, Hayhurst 1967, Horgan 1978, Maratsos et al. 1985, Gordon & Chafetz 1990, Fox & Grodzinsky 1998), German (Mills 1985), Hebrew (Berman 1985), Spanish (Pierce 1992, Oliva & Wexler 2018), Dutch (Verrips 1996, Koutamanis 2015), Greek (Terzi & Wexler 2002), Serbian (Perovic et al. 2014), among many others. However, some previous studies have reported early acquisition of passives in some languages, such as Sesotho (Crawford 2005, Demuth et al. 2010), Inuktitut (Allen & Crago 1996), and Kiché Mayan (Pye & Poz 1988).

In Section 3.1, we examine two significant findings in the passive acquisition literature: (i) passives involving actional verbs are acquired earlier than those with non-actional verbs, particularly subject-experiencer verbs, and (ii) in some languages, short passives are acquired earlier than long passives. In Section 3.2, we explore various theoretical frameworks that seek to account for the factors affecting children's passive acquisition, such as lexical semantic restrictions (Section 3.2.1), non-adultlike syntactic derivation (Section 3.2.2), as well as other factors like the low frequency of passives in children's input, pragmatic considerations, and processing of passives. Lastly, in Section 3.3, we will delve into prior research on the acquisition of passives in child Mandarin.

3.1. Major findings

In this section we review two major findings in previous studies. In Section 3.1.1, we demonstrate the verb-based asymmetry in children's acquisition of passives. More specifically, passives with

actional verbs such as *kick* and *kiss* are acquired earlier than passives with non-actional verbs (especially subject-experiencer verbs) such as *see* and *like*. This asymmetry has been a focal point in previous literature, leading many researchers to propose different explanations for passive development, which we will discuss in Section 3.2.

Although the impact of different verb types on passive acquisition is not the primary focus of this dissertation, the actional/non-actional asymmetry has been confirmed in our corpus study. As we will show in the next chapter (Section 4.3.1), Mandarin-speaking children produce more actional passives than non-actional passives compared to their input. Additionally, since non-actional verbs may pose extra challenges in children's passive comprehension, our experimental studies (Chapters 5 and 6), whcih aim to test the structural intervention in passives, only include actional verbs. This approach helps to avoid any difficulties caused by non-actional verbs, which are not within the scope of our research interests.

More relevant to the objectives of this dissertation is the second finding from previous studies, which examines children's comprehension of long and short passives in child grammar (Section 3.1.2). As discussed in Section 2.3, the Intervention Hypothesis predicts that Mandarin long passives should be more difficult for children to comprehend than short passives because of the structural intervention by the EA.

3.1.1. Actional vs. non-actional passives

A consistent cross-linguistic finding in previous studies is that children's difficulty in acquiring passives is associated with the types of predicates being passivized. Generally, passives with actional verbs that denote a (typically physical) action (e.g., *kiss, kick, find*) are acquired earlier than those with non-actional verbs that denote mental or perceptual states (*see, love, remember*). Converging evidence reveals that English-speaking children comprehend actional (short) passives by around age 4, while they do not show adultlike performance on non-actional passives until much later (e.g., Maratsos et al. 1985, Sudhalter & Braine 1985, Gordon & Chafetz 1990, Hirsch 2011, Orfitelli 2012, Messenger et al. 2012, Nguyen & Snyder 2017).

For instance, Maratsos et al. (1985) conducted two comprehension experiments on English passives. In their character-selection task, 4- and 5-year-olds (N = 14 and 17, respectively) performed above chance on actional passives (e.g., *find, hold, wash, shake*) but struggled with non-actional passives (e.g., *remember, forget, like, miss*), with accuracy rates of 67% and 40%, respectively. In their sentence-picture matching task, children (N = 80) until the age of 7 still had trouble comprehending non-actional passives. Note that in both experiments, children showed adultlike performance with non-actional verbs in active sentences, suggesting that the actional/non-actional asymmetry is specific to passives and not due to an overall difficulty with non-actional verbs. This persistent asymmetry between actional vs. non-actional passives is observed in many other languages as well, such as Dutch (Verrips 1996), Greek (Terzi & Wexler 2002), Catalan (Gavarró & Parramon 2017, González García 2018), Spanish (Oliva & Wexler 2018), Italian (Volpato et al. 2016), European Portuguese (Agostinho 2020), Japanese (Sano et al. 2001), and Russian (Babyonyshev & Brun 2004) (but cf. Demuth, Moloi, & Machobane 2010 who reported good comprehension for both actional and non-actional passives in child Sesotho).

However, there is no consensus among previous studies regarding the classification of actional vs. non-actional verbs.[1] Some researchers have suggested a more fine-grained distinction of verb types in child passives beyond the traditional binary classification. Nguyen and Pearl (2021) conducted a meta-analysis of the seven potentially relevant lexical semantic features examined in previous literature that could affect children's performance on *long* verbal passives, as summarized in Table 3.1 (see also Nguyen 2021).[2] In Nguyen and Pearl's study, three of the seven features that determine the lexical semantic profiles of the verbs focused on the thematic role of the subject and object of the verb (in the active), namely OBJ-EXP (Object-Experiencer, i.e., verbs whose object in the active is an Experiencer such as *frighten* and *surprise*), SUBJ-EXP (Subject-Experiencer, i.e., verbs whose subject in the active is an Experiencer such as *forget* and *love*), and AGT-PAT (Agent-

[1]For example, in Demuth et al.'s (2010) experiment with Sesotho-speaking children, their set of non-actional verbs includes verbs that would be categorized as actional verbs using Maratsos et al.'s (1985) standard, such as *help*, *expel*, and *leave behind*.

[2]Note that these seven features were proposed by various researchers to explain specific experimental results. They were not intended to be mutually exclusive, and it is unclear to what extent they overlap semantically.

Patient, i.e., verbs whose subject is an Agent and object a Patient in the active such as *hug* and *discover*).

Table 3.1: Descriptive lexical semantic features used in prior experimental studies with example verbs with (+) and without (−) that feature (adapted from Nguyen 2021: Table 2.4).

Studies	**Feature**	**Signal**	+	−
Maratsos et al. (1985) among many others	ACTIONAL	Observable	*eat*	*scare*
Liter et al. (2015)	STATIVE	Simple present tense in "out of the blue" context	*scare*	*eat*
	VOLITIONAL	"deliberately VERB"	*annoy*	*see*
Pinker et al. (1987)	AFFECTED	X affects Y	*annoy*	*like*
Messenger et al. (2012)	OBJ-EXP	−ACTIONAL where object is Experiencer	*frighten*	*chase*
	SUBJ-EXP	−ACTIONAL where subject is Experiencer	*like*	*annoy*
	AGT-PAT	+ACTIONAL where θ-roles = Agent, Patient	*eat*	*whisper*

Nguyen and Pearl's (2021) approach to the verb-based asymmetry in passive acquisition was different from previous studies, as they examined the lexical semantic profile of verbs rather than relying solely on a single lexical feature such as ±ACTIONAL. This study identified five types of verbs based on their lexical semantic profiles, as outlined in Table 3.2. Through their meta-analysis of 30 previously studied verbs, Nguyen and Pearl identified the age at which children succeed on passives with each verb and estimated the age of acquisition (AoA) for each of their semantic profiles.[3] They found that Profile 1 verbs (typical actional verbs) are acquired first and provided a more detailed distinction among non-actional verbs.[4] They further conducted a Truth-Value Judgement (TVJ) experiment with 19 four-year-old English-speaking children (aged 3;11-5;01, *M*

[3]Nguyen and Pearl determined a verb's AoA by identifying the earliest age in relevant studies at which children begin performing significantly above chance. In cases where studies only provided performance data for groups of verbs, an AoA was assigned to each individual verb within the group.

[4]These 30 verbs are collected from experiments by de Villiers and de Villiers (1972), Maratsos and Abramovitch (1975), Maratsos et al. (1985), Gordon and Chafetz (1990), Fox and Grodzinsky (1998), Hirsch and Wexler (2006b), O'Brien, Grolla, and Lillo-Martin (2006), Crain, Thornton, and Murasugi (2009), Messenger et al. (2012), Orfitelli (2012), Nguyen (2015), and Liter et al. (2015).

= 4;07). The results revealed that children of this age had difficulty understanding passives with verbs of Profiles 4 and 5, as detailed in Table 3.2.

Table 3.2: Nguyen and Pearl's (2021) categorization of verbs based on their lexical semantic profiles and results from her meta-analysis and TVJ experiment.

Profile	**1**	**2**	**3**	**4**	**5**
ACTIONAL	+	−	−	−	−
STATIVE	−	+	−	−	+
VOLITIONAL	+	+	−	−	−
AFFECTED	+	+	−	−	−
Thematic status	AGT-PAT	OBJ-EXP	AGT-PAT	SUBJ-EXP	SUBJ-EXP
Example verbs	*wash* *fix*	*surprise* *frighten*	*discover* *find*	*spot* *forget*	*love* *believe*
Predicted AoA based on previous results	3yos	3-4yos	4-5yos	4-5yos	5yos
Correct responses in TVJ task by 4yos	81.58%	86.84%	71.05%	50%	39.47%

Nguyen and Pearl's (2021) meta-analysis and experiment uncovered the developmental trajectory of lexical semantic cues that impact the interpretation of long verbal passives in English-speaking children. According to them, children exploit lexical semantic information from their input in order to learn which verbs can passivize and which cannot. The results also demonstrated that not all non-actional verbs cause the same level of difficulty for children's passive comprehension. Specifically, passives with non-actional verbs categorized under Profiles 2 and 3 are acquired earlier compared to those under Profiles 4 and 5. This suggests that comprehension difficulties are specific to *subject-experiencer verbs*, i.e., Profiles 4 and 5 (see also Aravind & Koring 2022).

3.1.2. Short vs. long passives

Another factor that could potentially affect children's acquisition of passives is the presence vs. absence of an external argument (EA), which distinguishes long vs. short passives. Long passives contain an overt EA, which is usually an Agent or Experiencer, such as *the cat* in (1a), while short passives (1b) do not.

(1) a. Long passive: *The dog was bitten/seen by the cat*.

b. Short passive: *The dog was bitten/seen*.

Previous studies on children's (spontaneous or elicited) production of these two types of passives show a clear pattern, that is, long passives are much rarer than short passives. For instance, Horgan (1978) showed that English-speaking children aged 2 to 13 (N = 234) produced far more short passives ('truncated passives') than long passives ('full passives') in picture description tasks.[5] The same long < short passive production asymmetry has been replicated in subsequent studies in child English (e.g., Baldie 1976, Horgan 1978, Gordon & Chafetz 1990),[6] as well as in many other languages, even those in which early acquisition of passives is observed. For example, Sesotho-speaking children acquire passives relatively early (e.g., Demuth 1989, Demuth et al. 2010, Kline & Demuth 2010; cf. Crawford 2005). A longitudinal study of the spontaneous production of four Sesotho-speaking children aged 2;1-4;2 showed that long passives are less frequent than short passives in all age intervals; overall only 21% of these children's passives are long (Demuth 1989; Kline & Demuth 2010) (See also Pye & Poz 1988 on K'iche' Mayan and Allen & Crago 1996 on Inuktitut among others for similar results).

Now we turn to children's comprehension of these two types of passives. In child English, although most of the comprehension experiments have found slightly better performance on short passives than long passives, these differences did not reach statistical significance (e.g., Maratsos & Abramovitch 1975, Maratsos et al. 1985, Gordon & Chafetz 1990, Hirsch & Wexler 2006a,b, O'Brien et al. 2006, Orfitelli 2012).[7]

However, there is cross-linguistic variation when it comes to children's comprehension of long vs, short passives. Armon-Lotem et al. (2016) conducted a large-scale study on 5-year-old chil-

[5]In Horgan's study, children's 'full passives' included not only long passives with *by*-phrases but also those with prepositional phrases headed by *with, from, for*, and *of* someimtes erroneously (e.g., **The lamp was broken of the ball*). Short passives were more frequent in child speech than all of these full passive constructions combined.

[6]Despite the higher frequency of short passives than long passives in child English, Budwig (1990) found that both types of passives are produced around the age of 3.

[7]The only exception is a subset of subjects (8 out of 13) in Fox and Grodzinsky's (1998) study that performed significantly better on short non-actional passives than long non-actional passives. However, Fox and Grodzinsky's result was not replicated by Hirsch and Wexler (2006b) with a much larger group of children (N = 60). See Orfitelli (2012:8) for a detailed discussion of Fox and Grodzinsky's results.

dren's comprehension of actional passives in 11 languages, among which 8 languages have both long and short passives in the (adult) grammar. The results of their four-choice sentence-picture matching tasks revealed that children performed significantly better on short passives than on long passives in Catalan, Dutch, German, Hebrew, Lithuanian, and Polish. However, for Danish and English, no statistically significant differences were found between these two types of passives.

In the case of Mandarin, including the current dissertation, intriguing findings have emerged. As Chapter 4 will discuss, our corpus study of child Mandarin revealed that Mandarin-speaking children between the ages of 2 and 6 produce long *bei*-passives more frequently than short *bei*-passives in their spontaneous speech. However, this pattern may be specific to Mandarin, as child-directed Mandarin also displays a long $>$ short passive asymmetry, which is not observed in other languages. See the end of Section 4.4.1 for a discussion of Mandarin-specific factors that might contribute to the relatively higher frequency of long passives in both child and adult Mandarin. Despite the relatively higher frequency of long passives, these constructions pose more difficulties for children's comprehension compared to short passives in Mandarin, as demonstrated by Xu and Yang (2008) and our experiments (Chapters 5 and 6). We will argue that this is due to the intervention effects triggered by the EA in long, but not short, *bei*-passives.

Another intriguing observation from previous studies is that the animacy features of the arguments in long passives influences children's performance. Long passives that are "nonreversible" involve the assignment of nonreversible theta-roles, wherein the Agent NP is animate while the Theme NP is inanimate, such as *The bone was eaten by a dog*. In contrast, "reversible" long passives feature both arguments as animate, as in *The fox was eaten by a dog*. It has long been noted that children perform better with nonreversible long passives than reversible long passives (e.g., Bever 1970; Strohner & Nelson 1974; Van der Lely & Dewart 1986).[8] This asymmetry is consistent with our finding in Experiment 1, that long passives with Animacy-mismatched EA and IA

[8]Contrary to the aforementioned observations, Aschermann, Gülzow, and Wendt (2004) conducted a cross-linguistic study comparing the performance of German-speaking and English-speaking children in relation to passives that varied in plausibility (likely, neutral, or unlikely). Interestingly, their findings did not replicate the previously observed pattern. The plausibility of an event did not have any significant effect on the children's understanding or comprehension.

are easier for children to understand compared to long passives with Animacy-matched arguments (Section 5.2). This Animacy effect can be explained by the Intervention Hypothesis (e.g., Arosio et al. 2011, Durrleman et al. 2016, Bentea et al. 2016, Mateu & Hyams 2021) or by children's preference for a "canonical event", in which an animate Agent acts on an inanimate Theme (e.g. Chapman & Miller 1975, Corrigan 1982, Slobin 1982), which we will discuss in more details in Section 5.3.2.

3.2. Theoretical accounts

Numerous hypotheses have been put forward to explain children's challenges in acquiring passives. Lexical-semantics accounts (Section 3.2.1) propose that children possess an adult-like grammar, but their use and performance of passives is limited to verbs with specific semantic properties. Studies in this line of research focus on explaining the well-established verb-based asymmetry, namely, the fact that passives with actional verbs are acquired earlier across languages compared to passives with non-actional verbs, especially subject-experiencer verbs.

On the other hand, grammar-based accounts (Section 3.2.2) generally posit that children's grammar is subject to development and their earlier comprehension of certain types of passives is due to child-specific heuristic strategies (e.g., the "adjectival strategy") that result in seemingly adult-like performance despite having a non-adult-like grammar. We present three major grammar-based hypotheses: (i) children's difficulty with passives lies in forming A-chains (e.g., Borer & Wexler 1987, 1992), (ii) the difficulty stems from an absolute locality constraint, the Phase Impenetrability Condition (Wexler 2004), or (iii) the difficulty arises from intervention locality (e.g., Hyams & Snyder 2005, Snyder & Hyams 2015, Orfitelli 2012).

Finally in Section 3.2.3 we introduce additional accounts that attribute children's difficulties with passives to (i) the scarcity of passives in their input, (ii) pragmatic requirements, or (iii) their developing processing capability.

3.2.1. Lexical-semantics accounts

Lexical-semantics accounts assert that children possess adult-like passive grammar but struggle with specific types of passives based on the lexical semantic properties of the verb. For example, Maratsos et al. (1985) adopt Hopper and Thompson's (1980) transitivity scale and define this restriction in terms of *semantic transitivity*. This concept encompasses a range of properties related to the verb and its arguments, including animacy, definiteness, intentionality, and the affectedness of the object. They argue that children can easily recognize typical actional verbs as passivizable due to their higher degree of semantic transitivity. However, only until a later age do children extend the set of passivizable verbs to those lower on the semantic transitivity scale, such as mental or perceptual state verbs.

Other studies have likewise appealed to lexical-semantics to investigate passive acquisition. Pinker et al. (1987) conducted a series of novel verb learning studies with 3- to 8-year-old English-speakers and argued that verbs that have an affected object are more productively passivized than those with an unaffected object. (cf. Gordon & Chafetz 1990). Additionally, Liter et al. (2015) propose a three-way distinction based on the eventivity and agentivity of the verb and found in two Truth Value Judgment Tasks that English-speaking children aged 3 to 6 performed better with eventive agentive passives (*paint, fix, wash*) than eventive nonagentive passives (*forget, find, spot*), which, in turn, were better than noneventive nonagentive passives (*know, hate, love*).[9] These studies offer further evidence for the impact of lexical semantic properties on children's passive acquisition.

However, these lexical-semantics accounts might be more a circular restatement than a solution to the verb-based contrast in child passives. Even though constraints like semantic transitivity, affectedness, or eventivity might seem intuitive, It is still unclear why and how exactly these lexical-

[9]In Liter et al.'s (2015) study, a verb is considered agentive if it can be modified by 'deliberately' and a verb is considered eventive if it cannot appear in the (habitual) simple present. Based on Liter's criteria, all the actional verbs tested in previous studies are eventive agentive verbs, except for 'find', which is eventive nonagentive. As for the non-actional verbs previously tested, some are eventive nonagentive (e.g., *hear, see, forget*), some are noneventive nonagentive (e.g., *know, remember, miss*), and *watch* is eventive agentive.

semantics properties modulate children's passives and how children acquire these properties in the first place. Despite these limitations, lexical-semantics accounts provide a lens into the empirical ground and help us better understand the uneven acquisition pace in passive development. For example, as mentioned in Section 3.1.1, Nguyen and Pearl (2021) demonstrate a relationship between children's performance and the fine-grained lexical semantic profiles of the verb, which took into consideration not only semantic features, such as actionality and affectedness, but also the thematic status of the arguments. Their detailed description of children's developmental trajectory of English passives has refined the commonly assumed difficulties with non-actional passives, narrowing them down to a subset of non-actional verbs, specifically subject-experiencer verbs.[10]

3.2.2. Grammar-based accounts and the 'adjectival strategy'

Grammar-based accounts typically view the verb-based asymmetry as evidence that passive development is delayed until school age (around age 6), as observed with non-actional/subject-experiencer verbs. This perspective includes the A-Chain Deficit Hypothesis (ACDH; Borer & Wexler 1987, 1992), the Universal Phase Requirement (UPR; Wexler 2004), and the Argument Intervention Hypothesis (AIH; Orfitelli 2012). Another viewpoint suggests that children exhibit knowledge of passive grammar by age 4, as observed with actional verbs, but passives for non-actional verbs require further development. This approach is adopted in the Universal Freezing Hypothesis (UFH; Hyams & Snyder 2005, Snyder & Hyams 2015).

Despite their differing assumptions regarding the specific ways in which child grammar deviates from adult grammar, grammar-based accounts all agree that the child's grammar needs to mature for the relevant syntactic mechanisms needed to derive passives to become available (be it A-movement, phase identification, or circumventing intervention). Before these syntactic mechanisms are in place, children assign an adjectival structure to actional short passives – an *adjectival*

[10]This finding has led Aravind and Koring (2022) to hypothesize that young children's difficulties in passives with subject-experiencer verbs result from their early misanalysis of transitive subject-experiencer verbs as unaccusatives, which are non-passivizable. They also proposed a more refined classification of experiencer-predicates beyond the binary subject/object-experiencer distinction, based on cross-linguistic morphosyntactic evidence. This hypothesis has found indirect support from some prior studies and awaits further testing in future empirical research.

strategy – which seemingly allows them to seemingly understand these ambiguous forms without adult-like syntactic mechanisms. However, it is important to note that the adjectival strategy has certain limitations, which will be discussed later in this section.

A-Chain Deficit Hypothesis (ACDH). Borer and Wexler (1987, 1992) proposed the A-Chain Deficit Hypothesis (ACDH), suggesting that the delay in passive development is due to children's inability to construct an A-chain between the underlying object and the surface subject (SS) position, as illustrated in (2b). This ability is thought to mature around the age of 5.

(2) a. Mary wrote the book. → b. The book was written ___ (by Mary).
A-movement

However, this claim has proven to be problematic, as evidence shows that 'premature' children have no difficulty forming A-chains of the VP/*v*P-internal subjects that move to Spec TP (e.g., Stromswold 1996, Friedmann 2007, Snyder & Hyams 2015).

Universal Phase Requirement (UPR). The Universal Phase Requirement (UPR), proposed by Wexler (2004), offers an alternative perspective to the problematic ACDH. The UPR suggests that the delay in children's development of passives is not due to an inability to form A-chains, but rather stems from their non-adultlike definition of phasal categories.

Based on phase theory (e.g., Chomsky 2000, 2001, 2008), syntactic derivations proceed in a local manner, such that certain structures (phases) are encapsulated and spelled out immediately. The Phase Impenetrability Condition (PIC; Chomsky 2000, 2001) requires that movement out of a phase can proceed only from its edge, i.e., the head and its specifiers.

(3) Phase Impenetrability Condition (PIC; Chomsky 2000:108, 2001:13)
The domain of a head X of a phase XP is not accessible to operations outside; only X and its edge are accessible to such operations.

In adult grammar, there are two phasal categories, namely C and transitive *v*. The UPR posits that adult passives involve a defective *v*, which does not select an EA and does not define a phase. In

line with this assumption, the UPR argues that premature children (up until around age 6) lack non-phasal *v*, leading them to view all *v*Ps as strong phases. Consequently, in the pre-mature grammar, the IA of the verb is not accessible at the higher phase and thus cannot move to Spec TP under the PIC, thereby rendering passives ungrammatical, as illustrated in (4).

(4) $[_{TP} \quad \ldots [_{\boxed{vP}}$ Mary ***v*** $[_{VP}$ write $[_{DP}$ the book]] . . .] . . .]

The UPR relies on the assumption that adult passives involve defective *v*, but Legate (2003) argues that passive *v* also defines a strong phase in adult grammar, citing evidence from reconstruction, Antecedent Contained Deletion (ACD) movement, and nuclear stress assignment. Moreover, the UPR predicts that unaccusatives (e.g., *Mary arrived*), which also involve a defective *v* according to Chomsky (2000, 2001), should be acquired late since all *v*Ps are strong phases in child grammar. However, empirical findings contradict this prediction, as unaccusatives are acquired early in child languages (e.g., Snyder, Hyams, & Crisma 1995, Lorusso et al. 2005, Friedmann 2007, Shimada & Sano 2007, Friedmann & Costa 2010, 2011, Snyder & Hyams 2015; but cf. Babyonyshev et al. 2001).

Universal Freezing Hypothesis (UFH) and Argument Intervention Hypothesis (AIH). The Universal Freezing Hypothesis (UFH, Hyams & Snyder 2005, Snyder & Hyams 2015) and the Argument Intervention Hypothesis (AIH, Orfitelli 2012) also reject the claim of the ACDH that children lack A-chains. However, unlike the UPR , which relies on absolute/domain-based locality constraints (i.e., the Phase Impenetrability Condition), the UFH and AIH focus on relative/item-based locality constraints, specifically the (featiral) Relativized Minimality (fRM; Rizzi 1990, 2001, 2004, Starke 2001).

(5) Featural Relativized Minimality (adapted from Rizzi 2018:347):
In [. . . X . . . Z . . . Y . . .] a dependency between X and Y is disrupted when

(i) X c-commands Z and Z c-commands Y, and

(ii) Z matches X in terms of *relevant syntactic features*.

(iii) The degree of disruption is a function of the featural distinctness of X with respect to Z, in accordance with the *distinctness hierarchy*.

According to the UFH and AIH, children have difficulty with passives due to violations of fRM , which requires that a movement dependency not to be disrupted by an intervener that is structurally closer to the probe and shares some crucial morphosyntactic feature with the moved element. In the case of passives, both the UFH and the AIH are grounded in Collins' (2005) syntactic analysis of English passives but emphasize on different aspects. Under Collins' analysis, the thematic subject is generated in the canonical EA position, rather than as an adjunct headed by *by* and therefore, it structurally intervenes between the base position of the IA and its final position in Spec TP. To account for how English-speaking adults overcome the potential Relativized Minimality violation (i.e., intervention) caused by the structural presence of the EA, Collins proposed a mechanism called *smuggling*. This mechanism involves phrasal movement of the participle phrase (PartP) across the EA to the Spec-VoiceP position. From there, the IA becomes accessible for further movement to Spec-TP, as illustrated in (6). The term "smuggling" reflects the idea that phrasal movement feeds the movement of the IA, which is otherwise impossible due to the intervention of the EA, as if the IA is "smuggled" by the phrasal movement.

(6) Smuggling approach to English passives (Collins 2005)

a. Long passives:

$[_{TP}$ the book$_j$ $[_{T'}$ was $[_{VoiceP}$ $\underline{[_{PartP}$ written$_k$ $[_{VP}$ t$_k$ ___$_j]]_i}$ $[_{Voice'}$ by $[_{vP}$ Mary $[_{v'}$ v ___$_i]]]]]]$

b. Short passives:

$[_{TP}$ the book$_j$ $[_{T'}$ was $[_{VoiceP}$ $\underline{[_{PartP}$ written$_k$ $[_{VP}$ t$_k$ ___$_j]]_i}$ $[_{Voice'} \varnothing$ $[_{vP}$ PRO $[_{v'}$ v ___$_i]]]]]]$

According to the UFH, children lack the smuggling derivation that adults employ to circumvent the intervention triggered by the EA. The UFH posits that children over-apply the Freezing Principle (e.g., Ross 1967, Wexler & Culicover 1983, Müller 1998) which prohibits movement out of a phrase that has itself undergone movement, an operation that is required for the smuggling deriva-

tion. Consequently, in child grammar the phrasal movement of the PartP, if there is any, would not feed the IA movement to Spec-TP, rendering verbal passives impossible for young children.

The UFH claims that smuggling is available for children at about the age of 4, at which point children start to understand and produce true verbal passives. To account for the further delay observed in non-actional passives, which occurs until around age 6, Snyder and Hyams (2015) adopt Gehrke and Grillo's (2007, 2009) and Grillo's (2008) semantic smuggling approach into their framework. They argue that non-actional passives need not only smuggling but also semantic coercion, which is available at around age 6.[11]

A problem of the UFH is that it relies on the notion of smuggling, which is itself subject to criticism (e.g., Gehrke & Grillo 2009; see e.g., Legate 2014, Bruening & Tran 2015 for alternative analyses against smuggling).

In response to these concerns, Orfitelli (2012) proposes the Argument Intervention Hypothesis (AIH), which avoids explicit reference to smuggling. The AIH posits that children experience delays in acquiring constructions involving movement over an intervening argument, as illustrated in (7).

(7) $[_{TP}$ . . . $[_{vP}$ Mary v $[_{VP}$ write $[_{DP}$ the book]] . . .] . . .]

Orfitelli examined two potential intervention constructions in English, namely verbal passives and subject-to-subject raising (StSR). In her experiments with 4- to 6-year-olds ($N = 30$), she found that children's comprehension of English StSR is poor with StSR predicates that select an intervening experiencer (whether overt or not) such as *seem, appear*, but good with 'non-experiencer' StSR predicates such as *(be) about, (be) likely*, which do not. Even when the experiencer is implicit

[11]The semantic smuggling approach attributes the actional/non-actional asymmetry to the different event structures (Travis 2000) of the two verb types. A typical actional predicate has a causing sub-event VP_1 that introduces an EA and a consequent sub-event VP_2 that introduces an IA, whereas non-actional verbs, being stative, have homogenous internal event-structure. VP_2 serves as the 'container' in which the IA is smuggled past the EA. This predicts that passivization is possible only with predicates of structurally complex events (i.e., actional predicates). In this proposal, a non-actional verb can be still passivized if it is semantically coerced from stative into eventive and this semantic coercion first becomes possible around age 6, accounting for the relative delay in non-actional passives.

in the sentence, an StSR with an experiencer predicate (8a) was more challenging for children to understand than StSR with a non-experiencer predicate (8b).

(8) a. StSR with an experiencer predicate: The dog seems (to (me)) ___ to be purple.
intervener

b. StSR with a non-experiencer predicate: The pig is about ___ to roll in the mud.
no intervener

Crucially, Orfitelli found a near perfect within-subject correspondence in the acquisition of StSR experiencer sentences and in non-actional verbal passives. If a child exhibited delays in one of these structures, they also experienced delays in the other. Conversely, if a child had mastered one of these structures, they had also mastered the other. Based on these findings, Orfitelli, following Collins (2005), posited the presence of an implicit EA in short passives, as in (6b). She argued that the intervention triggered by the EA leads to delayed comprehension of both short passives and long passives in English.

Both the UFH and the AIH attribute children's difficulties with English passives to the structural intervention of the EA, which c-commands the gap of the IA, as evidenced by its ability to bind into its complement (e.g., Collins 2005, Angelopoulos, Collins, & Terzi 2020; but cf. Bruening 2013, Legate 2014, Alexiadou et al. 2015) Therefore, these two theories align with the broader body of research on the Intervention Hypothesis.

As discussed in Section 1.2, the Intervention Hypothesis specifically makes reference to fRM and claims that children are subject to a stricter version of this locality constraint. While most studies provide evidence for the Intervention Hypothesis from children's acquisition of A′-construction, such as relative clauses, Orfitelli's (2012) studies on English StSR and passive constructions expands the empirical support for this hypothesis to include A-movement constructions. Along with this line of research, our current study on child Mandarin passives, which – unlike other languages – exhibit mixed A/A′-properties, aims to further investigate the effects of featural configurations of the intervening and moving elements in intervention constructions.

Discussion on the adjectival strategy. Before concluding our discussion of grammar-based accounts, it is important to address the concept of the "adjectival strategy" often assumed in these theories. Based on the observation that children's early passives usually convey stative meanings (e.g., Horgan 1978, Maratsos et al. 1985), Borer and Wexler (1987, 1992) proposed (and many subsequent researchers have followed) the idea that children interpret verbal passives as their homophonous adjectival passive counterparts (which do not involve movement) until their passive grammar matures. This interpretation is depicted in (9).

(9) **The adjectival strategy**: Children interpret actional verbal passives as adjectival passives.

a. Verbal passive: *The door was closed.* (Interpretation: Someone closed the door.)

b. Adjectival passive: *The door was closed.* (Interpretation: The door was in a closed state.)

This strategy relies on the existence of pairs of syntactic homophones (s-homophones), as described by Babyonyshev et al. (2001), which are (strings of) words with distinct structures but the same pronunciation. It has been suggested that the availability of such s-homophones accounts for the actional > non-actional passive asymmetry in languages. According to Borer and Wexler, the adjectival strategy is not applicable to non-actional passives because non-actional verbs "do not make good adjectives" (e.g., "*the closed door*" vs. "**the seen girl*"). Therefore, the adjectival strategy, which is the only available derivation in the early stages on these approaches, applies to actional verbs but not non-actional verbs, giving rise to children's better performance with actional but not non-actional passives.

However, this assumption immediately runs into problems. Some actional predicates do not form good adjectives, such as *hold* (??*a held letter*), while some non-actional predicates are acceptable as adjectives, such as *remember* (*a remembered poem*) (e.g., Weinberg 1987, Hirsch & Wexler 2006b). Hirsch and Wexler (2006b) thus argue that children's passive performance should depend on how good the corresponding adjectival passive of that verb is. Following Embick (2004), Hirsch and Wexler (2006b) distinguished two types of adjectival passives: *resultative passives* entail an event (e.g., *The tank is filled*) while *stative passives* do not (e.g., *The door is open*) (see also Kratzer

2000 and Anagnostopoulou 2003). This distinction is evident in their ability to be modified by a manner adverbial (e.g., *The tank is carefully filled*/**The door is carefully open*). Hirsch and Wexler (2006b) propose that children's adjectival passives are resultative in nature. They argue that verbs, regardless of their actionality, that do not imply a resulting target state do not form good adjectival passives. Therefore, they predict that verbs like *hold*, despite being actional, do not form good adjectival passives because they do not imply a resulting state. Conversely, verbs like *remember*, despite being non-actional, should form good adjectival passives. However, their prediction contradicts the empirical findings. Passives with *held* are acquired at around age 3, whereas passives with *remembered* are acquired at around age 5, as indicated by the meta-analysis conducted by Nguyen and Pearl (2021).

Furthermore, according to Borer and Wexler's hypothesis, in languages where there are no verbal/adjectival passive s-homophones, children are expected to perform poorly on verbal passives and equally poorly on both actional and non-actional passives. This prediction is only partially supported by the findings in Greek, a language that lacks homophonous verbal and adjectival passives (Terzi & Wexler 2002). In a two-choice sentence-picture matching test, Terzi and Wexler (2002) examined Greek-speaking children (3;8-5;10, N = 30) on their comprehension of long passives with actional verbs, which were tested in verbal and adjectival passives, and non-actional verbs, which were tested in verbal passives because they do not occur in adjectival passives. The results showed that children performed well with adjectival passives (83% correct at age 3), while struggling with verbal passives (44% correct for actional verbal passives and 20% correct for non-actional passives at age 5). These findings indicate that without the presence of s-homophones, children's acquisition of verbal passives is delayed, which is in line with the adjectival strategy hypothesis. However, there is still an asymmetry in children's comprehension of passives between actional and non-actional verbs, even in the absence of an adjectival strategy. This suggests that the predicate-based asymmetry in children's understanding of passives is independent of the adjectival strategy.

Although the adjectival strategy does not fully explain the predicate-based asymmetry in child

passives, it does not discount the possibility that children employ this strategy to interpret verbal passives that they struggle to understand. Cross-linguistic evidence supports the idea that early passives are initially interpreted as adjectival. Longitudinal data from English-speaking children aged 1;08–5;00, examined by Israel, Johnson and Brooks (2000), demonstrate changes in children's passive use during early development, progressing from adjectival and stative usage to eventive usage. Further evidence can be seen in the spontaneous production data of Russian-speaking children. Perfective verbal passives in Russian are homophonous with certain adjectival passives. Babyonyshev and Brun (2004) found that among the 212 passives produced by the children (aged 2;6-3;9), 193 (91%) were in the perfective aspect, while the percentage of perfective passives in their input was much lower (44.2%). Similar evidence in Romance languages has been found by Gavarró and Parramon (2017), Oliva and Wexler (2018), Agostinho (2020), and others, providing additional support for the presence of an adjectival interpretation in child grammar.

As previously shown in Section 1.4, in Mandarin, the adjectival strategy is not available due to the absence of verbal/adjectival passive s-homophones. Nevertheless, the actional passives are still more frequent than non-actional passives in child production compared to their input, as observed in our corpus study (Chapter 4). However, since the primary focus of this dissertation is on examining intervention effects in long and short passives in child Mandarin, we will not further discuss the actional vs. non-actional asymmetry or the adjectival passive phenomenon.[12] In our experimental studies, we used only actional verbs in order to minimize verb-based effects.

3.2.3. Other difficulties: input infrequency, pragmatics, and processing

Input infrequency. As has been generally observed, passives are infrequent in children's input. Gordon and Chafetz (1990) analyzed the input of English-speaking children using data from the Brown corpus (Brown 1973). Out of 86,655 utterances directed at three children of varying ages (2;3-4;11, 1;6-2;3, and 2;3-5;1), they identified 313 passive constructions, accounting for a mere

[12] A previous study by Zeng et al. (2016) claimed that Mandarin-speaking children interpret short actional passives as adjectival/stative; nonetheless, this study is subject to serious methodological problems (see discussion in Section 3.3).

0.36% of the input.[13] Among these passives, 98.72% were short passives, with only four exceptions. The input contained a higher proportion of actional passives (70.29%) compared to non-actional passives (29.71%). A low frequency of passives in children's input has been reported in other languages as well, including Dutch (Verrips 1996), German (Abbot-Smith & Behrens 2006), Japanese (Yoshida 1996), Spanish (Cychosz & Garrote Salazar 2016), and Serbian (Djurkovic, 2007).

Additionally, research on certain languages indicates both earlier acquisition of passives and a higher frequency of passives in children's input, as observed in Sesotho (e.g., Demuth 1990, Kline & Demuth 2010, Demuth et al. (2010), Jakarta Indonesian (Gil 2008), Zulu (Suzman 1987), K'iche' Mayan (Pye & Poz 1988), Inuktitut (Allen & Crago 1996). For example, Sesotho-speaking children around the age of 3 not only produce passives in appropriate discourse contexts, perform well with both actional and non-actional passives, but also successfully construct passives using novel verbs, demonstrating productive use of passives (e.g., Demuth 1989, Demuth 1990, Demuth et al. 2010, Kline & Demuth 2010). Demuth et al. (2010) and the other studies cited here attributed this to the higher frequency of passives in Sesotho input and the language's unambiguous passive morphology, both facilitating earlier acquisition of passives in this language.[14] In a cross-linguistic study, Allen and Crago (1996) proposed a link between the frequency of passive constructions in children's input and their production of passives. On average, English-speaking adults use 1.1 passive constructions per hour, Sesotho-speaking adults produce 2.74 passives per hour, and Inuktitut-speaking adults produce 8.9 passives per hour. Correspondingly, Sesotho and Inuktitut-speaking children produced more passives per hour than their English-speaking counterparts.

[13]These 313 passives identified in the study include three categories: verbal, adjectival, and adjunct passives. A passive is considered verbal if it has a logical subject or if the context implies one. Gordon and Chafetz also used the tense and aspect as a cue to distinguish verbal vs. adjectival passives, the former with past tense and the latter simple present. The third category, adjunct passives, features passivized verbs that act as adjuncts to their subjects, as seen in examples such as *You got your back sunburnt* and *You need your diaper changed*).

[14]Sesotho exhibits clear morphological distinctions between verbal passives and adjectival constructions. Kline and Demuth (2008) propose that this absence of ambiguity in Sesotho may make the syntax and semantics of passives more transparent for children, facilitating their earlier passives.

Pragmatics of (long) passives. Rather than attributing children's difficulties with (long) passives to their developing grammar, pragmatics-based accounts suggest that young children have mastered the syntax of passives but their performance is (negatively) affected by some pragmatic factors. Crain and Fodor (1989) suggest that the rarity of long passives in both child and adult speech can be attributed to the pragmatic constraints associated with these constructions. They note that long passives are "appropriate only in certain discourse situations", unlike short passives. In an elicited production experiment with English-speaking preschoolers (N = 35), Crain, Thornton, and Murasugi (1987/2009) successfully elicited long passives from children as young as 3;04 by using pragmatic contexts that included an alternative character who could have been the Agent in the target event, contrasting with the actual Agent. As illustrated in example (10), the two potential Agents, *the Incredible Hulk* and *Darth Vader* contrast.

(10) **Adult**: *See, the Incredible Hulk is hitting one of the soldiers. Look over here. Darth Vader goes over and hits a soldier. So Darth Vader is also hitting one of the soldiers. Ask Keiko which one.*

Child: *Which soldier is getting hit by Darth Vader*? (Crain et al. 2009: ex. 3)

Building on this notion, O'Brien, Grolla, and Lillo-Martin (2006) collected Truth Value Judgment data from seven English-speaking 3-year-olds (M = 3;4) and discovered that children performed at chance on long (actional or non-actional) passives when the stories included only one potential Agent or Experiencer. However, their performance significantly improved when the context provided an additional character, making the referent of the EA contrastive. According to their findings, the contrast between two potential Agents or Experiencers in the context motivates the use of the *by*-phrase in a passive and makes long passives pragmatically appropriate. These studies indicate that children's difficulty with long passives stems from pragmatically infelicitous experimental materials rather than a delayed development of verbal passives.

Nevertheless, subsequent experimental studies failed to replicate the findings of O'Brien et al. For instance, Deen et al. (2018) employed the same protocol as O'Brien et al. and discovered that children aged 3;10-4;6 (N = 9, M = 4;1) comprehended long non-actional passives at chance

levels, even with the presence of a third character, suggesting that they struggled to understand passives that would be pragmatically suitable according to O'Brien et al.'s criteria (see also Nguyen 2015 and Nguyen & Snyder 2017). Intriguingly, Deen et al. observed in subsequent experiments that topicalizing the Theme/object significantly enhanced children's comprehension of passives. They marked a participate as a topic in the context by explicitly mentioning it in their lead-in question, such as "something interesting happened with A. Could you tell us what happened?", in which A is the topic. Deen et al. also found facilitative effect of repeating the test sentences, which indicates that children encounter processing challenges when interpreting long passives. We discuss processing effects later in this section.

Building on the discourse infelicity hypothesis proposed by O'Brien et al. (2006), Liter and Lidz (2021) suggest that children struggle with non-actional passives due to a conflict between their inclination for the Theme/SS of the passive to be the sentence's topic and the information structure of a non-actional passive, in which the non-actional verb denotes properties of the mental state of its Experiencer/EA, but not the Theme/SS.[15] They argue that the non-actional long passive (11c) is infelicitous out-of-the-blue because the at-issue meaning conveyed by the non-actional verb *know* relates to the mental state of the Experiencer *Amy*, which is a non-topical argument of the sentence, whereas this issue is not present in actional long passives actional long passives (11a). Moreover, they highlight that when the Experiencer is a quantificational phrase, such as *everyone* in (11b), the non-actional long passive becomes pragmatically felicitous even in out-of-the-blue contexts. This is because the predicate now denotes certain characteristics of the topic, *Andy*, viz. that Andy is popular.[16]

(11) a. Actional long passive: *Andy was hugged by Amy*.

[15]For Liter and Lidz (2021), the notion of 'non-actional verbs' is equivalent to subject-experiencer verbs. Their experiment included eight non-actional/subject-experiencer verbs: *know, love, like, miss, spot, see, forget*, and *hear*.

[16]Liter and Lidz noted that this discourse manipulation of non-actional passives is not restricted to quantifiers, but also adverbial modification, as in (ii).

(i) #*Andy was seen by Amy.*

(ii) *Andy was frequently seen by Amy.*

b. Non-actional long passive with quantificational EA: *Andy was known by everyone*.

c. Non-actional long passive with referential EA: #*Andy was known by Amy*.

Although there is a difference in felicity between (11c) and (11b) in out-of-the-blue contexts, this is not always the case in non-neutral discourse contexts. In their Truth Value Judgment Task, Liter and Lidz (2021) used contexts which make the Theme argument pragmatically prominent.[17] They observed that English-speaking 4-year-olds ($N = 34$) performed significantly above chance for non-actional long passives when the stories explicitly emphasized the topic, i.e., the Theme/SS of the passive, regardless of whether the *by*-phrase contained a referential or quantificational EA. They propose that the asymmetry between actional and non-actional passives is a pragmatic artifact and that English-speaking 4-year-olds have already acquired the syntax of verbal passives.

Note that both Deen et al.'s (2018) and Liter and Lidz's (2021) studies discovered that children's comprehension of long non-actional passives in a Truth Value Judgment Task is enhanced when the topic is explicitly marked in the context. These findings align with the Intervention Hypothesis as well, because presumably, making the Theme/SS a topic adds an extra [TOPIC] feature to this element. This makes it more distinct from the intervener, the Experiencer/EA, in the long passives. According to the Intervention Hypothesis, this featural mismatch facilitates children's understanding of an intervention construction.

Processing. Another non-syntactic account of children's difficulties with passives is the Incremental Processing Hypothesis proposed by Y. Huang et al. (2013). They suggest that children incrementally interpret utterances as they unfold, with a tendency to map the Agent role onto the first NP they encounter due to the prevalence of the canonical SVO word order in Mandarin. Because children are known to struggle with revising incorrect interpretations that they establish early in the processing sequence (e.g., Trueswell et al. 1999, Hurewitz et al., 2000, Choi & Trueswell 2010), they struggle to revise their initial incorrect parsing of a passive Theme SS as the Agent during online processing, which leads to incorrect comprehension of passives.

[17] Their test materials contain multiple potential Excperiencers for a non-actional event and thus are all felitous contexts for long passives, according to O'Brien et al.'s (2006) discourse infelicity hypothesis.

Y. Huang et al. (2013) employed an eye-tracking during act-out paradigm to test Mandarin-speaking adults and 5-year-olds (N = 52, M =5;6) on passive sentences marked by *bei* (passive marker) and active sentences marked by *ba*, which signals object-fronting. In this experiment, each test sentence is marked by either *bei* or *ba* and contains two argument – a full NP and a pronoun – that vary in which comes first. The visual scenes included three toys: one expressed NP, one likely Agent, and one likely Theme or Patient. For example, in the trials shown in (12) and (13) that describe an 'eat' action, the expressed NP is the seal, the likely Agent is a shark, and the likely Patient is a fish.

(12) Full NP1 condition:

a. *bei*-passive

haibao **bei** ta henkuai jiu chi-diao le
seal BEI 3SG quickly just eat-up PRF
'The seal has been quickly eaten by it.'

b. *ba*-active

haibao **ba** ta henkuai jiu chi-diao le
seal BA 3SG quickly just eat-up PRF
'The seal has quickly eaten it.'

(13) Pronoun NP1 condition:

a. *bei*-passive

ta **bei** haibao henkuai jiu chi-diao le
3SG BEI seal quickly just eat-up PRF
'It has been quickly eaten by the seal.'

b. *ba*-active

ta **ba** haibao henkuai jiu chi-diao le
3SG BA seal quickly just eat-up PRF
'It has been quickly eaten the seal.'

If the full NP (e.g., the seal) is interpreted as the Agent in the sentence, participants would interpret the pronoun as the Patient and have the seal eat the fish in the act-out task. On the other hand, if the full NP is parsed as a Patient, participants would interpret the pronoun as the likely Agent, prompting them to make the shark eat the seal.

The Incremental Processing Hypothesis predicts that in Full NP1 conditions, children will initially parse the full NP1 in *bei*-passives as an Agent and will need to revise this Agent-first bias upon encountering *bei*, leading to less accurate act-out performance for *bei*-passives (12a) compared to *ba*-actives (12b). In contrast, in the Pronoun NP1 conditions, since the first NP they encounter is an ambiguous pronoun that can refer to any of the three toys on screen, children will postpone theta-role assignment until after the onset of *bei*/*ba* and the full NP. As a result, children will be more accurate with *bei*-passives in the Pronoun NP1 conditions (13a) than the full NP1 conditions (12a). Results show that children's strong Agent-first bias is lessened in Pronoun NP1 conditions (13a), consistent with the Incremental Processing Hypothesis. This demonstrates that the children's the Agent-first interpretation is a contributing factor to the difficulty in comprehending passives.[18]

The Incremental Processing Hypothesis was adopted by Deen et al. (2018), who found that repeating the test sentence increased English-speaking 4-year-olds' accuracy on long non-actional passive sentences to 83.3%, compared to a 55% success rate without repeating the test sentence. They argued that repeating the test sentence allows children to correct their parsing mistakes, such as the Agent-first bias, and thus improves their performance.

3.2.4. Summary of previous accounts

In this section, we have explored the major accounts proposed to explain the challenges children face in acquiring passives. The lexical-semantics accounts attribute children's difficulties, partic-

[18] Y. Huang et al. (2013) based their conclusion on only the first half of the trials, during which both children and adults exhibited the pattern predicted by their Incremental Processing Hypothesis. However, the children's performance in the second half of the study was not as anticipated. Unlike adults, whose performance with passives improved in the second half of the study, the tested children consistently interpreted all utterances as if they were active sentences, leading to a decline in their performance with passives compared to the first half of the study. This unexpected outcome was not accounted for in their research.

ularly with non-actional passives, to the inherent lexical semantic properties of certain verb types. On the other hand, the grammar-based analyses argue that children's struggles with passives stem from their pre-mature grammar. Additionally, we have acknowledged that there are other factors that may contribute to children's difficulties in passive acquisition, such as the scarcity of passives in their input, pragmatic conditions, and processing limitations. It is important to note that these accounts are not necessarily mutually exclusive. While this dissertation explores structural factors affecting children's accquisiton of of passives, it does not exclude the possibility that non-grammatical factors, including lexical-semantics, processing constraints, or pragmatic considerations, may also play a role in children's challenges with passives.

3.3. Previous studies on child Mandarin passives

Child Mandarin passive production. Early studies on child Mandarin passives indicate that *bei*-passives start to emerge in their speech between the ages of 2;06 and 3 (e.g., Lin 1991, Tse et al. 1991, Zhou, Kong, & Li, 1992). In a longitudinal study by S.-R. Hu (2013), it was found that Mandarin-speaking children (N = 2) began producing grammatical long actional passives at around the age of 3, and short actional passives at approximately 3;6.

Furthermore, Deng, Mai, and Yip (2018) investigated the aspectual properties of child Mandarin passives. With longitudinal naturalistic data from one child (1;7 to 3;4) and additional data from four corpora (0;11–3;5, N = 85), they found that children's *bei*-passives predominantly associate with telic predicates and show a strong correlation with perfective rather than imperfective aspect from the beginning, mirroring their input data.[19] Thus, *bei*-passives in child Mandarin have the adultlike aspectual properties at an early stage.

Previewing the results from our extensive corpus study (Chapter 4), we observed long *bei*-passives with a range of verbs at around age 2;06, such as (14), and short passives (15) at around

[19]In Deng et al.'s (2018) investigation, a predicate is deemd perfective if (i) it is marked by the perfective *-le* or the experiential *-guo*, or (ii) the sentence contains post-verbal resultative clause marked by *-de* or appear with a verb-final *-de* in the *shi…de* clefts. A predicate is coded as imperfective if it is marked by the progressive *zai* or the durative *-zhe*.

age 3, confirming the early production of *bei*-passives observed in previous literature. Additionally, we found that the majority of children's *bei*-passives contain resultative predicates, aligning with the telicity condition observed by Deng et al. (2018).

(14) ... Guaiguai tongtong bei Xiongxiong chi-guang (2;06)
Guaiguai all BEI bear eat-up
'...Guaiguai was all eaten up by the bear.'

(15) ni ganggang you-mei-you bei ya-bian? (3;02)
you just.now have-not-have BEI press-flat
'Have you been pressed flat just now?'

Child Mandarin passive comprehension. Xu and Yang (2008) carried out a two-choice sentence-picture matching task with Mandarin-speaking children aged 3- to 5-years old ($N = 48$). They identified two asymmetries in children's performance. Firstly, passives containing subject-experiencer verbs were more challenging for children than those with actional or object-experiencer verbs, a finding that corresponds to the verb-based asymmetry observed in other languages. Secondly, 4-year-olds demonstrated adultlike comprehension of short actional passives, while even the oldest group examined (5-year-olds) struggled with long actional passives (see also Chang 1986). The observed advantage of short actional passives over long ones aligns with findings in some languages, but not all.

H. Liu (2009, see also H. Liu & Ning 2009) conducted two large-sample experiments with Mandarin-speaking 2- to 6-year-olds (2;00-6;11, $N = 812$, $M = 4;03$), suggesting a delayed acquisition of Mandarin passives in both comprehension (compared to *ba*-actives) and production (compared to unaccusatives). In their two-choice sentence-picture matching task, even the oldest age group (6-year-olds) exhibited below-chance performance with *bei*-passives (41% correct), while their performance with *ba*-actives was at ceiling (94%). However, this study faced methodological problems due to the limited number of stimuli. Despite the large number of participants, each child was tested with only eight sentences in the comprehension experiment (four *bei*-passives and four *ba*-actives), containing just two test verbs (one actional verb and one resultative verb compound). Westfall et al. (2014) argue that statistical power reaches an asymptote depending on stimulus

sample size; even with infinite participants, power can remain low if the stimuli are limited. Furthermore, the experiment presented test sentences in pairs with minimal differences (either with passive marker *bei* or active marker *ba*) and identical argument NPs and verbs. This pairing and high similarity likely introduced unnecessary difficulties to the task. Their elicited production test was also problematic in conflating short passives with unaccusatives in their analysis. Despite these limitations, their production study indicates that it is possible to elicit long passives from 2-year-olds (31%) and that children above the age of 5 show improved ability to produce long passives in the appropriate context (72%).

Zeng, Mao, and Duan (2016) also suggested a delayed acquisition of verbal passives in Mandarin, arguing that young children interpret eventive verbal passives as stative adjectival passives without syntactic movement, in line with Borer and Wexler's (1987, 1992) ACDH and adjectival strategy hypothesis. As we have discussed above, Mandarin lacks the verbal/adjectival passive homophones, making the adjectival strategy unavailable to Mandarin-speaking children. Nonetheless, Zeng et al. proposed a distinction between eventive vs. stative short passives based on the verb: For them, short *bei*-passives with a bare actional verb are eventive, such as (16a), while short *bei*-passives with a resultative verb compound are stative (16b); and long passives are always eventive regardless of the verbs.

(16) a. Eventive short passives

xiao lan feng bei ti le
small blue bee BEI kick PRF
'The small blue bee was kicked.'

b. 'Stative' short passives

xiao lan feng bei ti-huai le
small blue bee BEI kick-break PRF
'The small blue bee was kicked and broken.'

They found that in a four-choice sentence-picture matching task, 4-year-olds tended to choose pictures depicting stative readings (46.8%) over eventive readings (34.3%) for eventive short passives

(16a). They concluded that young children have a non-adultlike interpretation of short passives as stative rather than eventive. However, their task had a strong bias towards stative readings. The pictures corresponding to a stative reading (16b) depicted the result state of an event while the pictures corresponding to an eventive reading (16a) depicted the event itself. The problem is that the result state of an event (the stative picture) entails the event (the eventive picture) by demonstrating the result of the event that has happened, just as the sentence (16b) entails (16a). Therefore, children could still choose a stative picture even with an eventive interpretation of the passive. This issue raises questions about the validity of their conclusion that young children have a non-adultlike interpretation of short passives.

In summary, the Mandarin literature reveals that children's production of *bei*-passives occurs early but their comprehension of *bei*-passives involves various asymmetries and possible delays. However, methodological concerns in some studies suggest the need for further research to clarify these findings and provide a more comprehensive understanding of Mandarin passive acquisition.

CHAPTER 4

Corpus study: Production of *bei*-Passives in Child and Child-Directed Mandarin

4.0. Introduction

In this chapter we present our investigation of *bei*-passives in child speech and their input, which is the first large-scale corpus study on children's production of passives in Mandarin.[1]

Previous investigations of child Mandarin have rarely delved into children's production of passives. A longitudinal study by Hu (2013), however, investigated two Mandarin-speaking children (aged 1;0-5;4 and 0;10-5;7, respectively). Her findings imply that both long and short *bei*-passives occur very early in child language, as exemplified in (1) and (2) respectively. In the study periods, Child 1 produced seventeen long *bei*-passives and five short ones, and Child 2 produced nine long *bei*-passives and seven short ones in the study periods.[2]

(1) First occurrences of long passives in Hu's records:

a. bei *na-ge* *mao* yao-diao le (Child 1, age 2;6)
BEI that-CLF cat bite-off PRF
'[*e*] was bitten off by that cat.' ([*e*] stands for a dropped subject/topic)

b. bei *wo* chi-le (Child 2, age 2;11)
BEI I eat-PRF
'[*e*] was eaten by me.'

[1]Part of this chapter has been published in the Proceedings of the 46^{th} annual Boston University Conference on Language Development (M. Liu 2022).

[2]No information was given about the total number of utterances in child production and their input in Hu's (2013) study.

(2) First occurrences of short passives in Hu's study:

a. ta jiu bei bing zai binggui shangmian (Child 1, age 3;6)
3SG just BEI freeze at freezer top
'She/He/It was just frozen on top of the freezer.'

b. bei yao-le (Child 2, age 1;11)
BEI bite-PRF
'[*e*] was bitten.'

On its face, Hu's (2013) observation that long *bei*-passives are produced early in child Mandarin conflicts with findings from other languages, as well as with the experimental studies of child Mandarin, which have shown a delay in the comprehension of long passives. Xu and Yang's (2008) two-choice picture selection test with 48 Mandarin-speaking children aged 3 to 5 revealed that with bare actional verbs, long *bei*-passives pose significantly more difficulty for children than short *bei*-passives, in which, recall, the EA is not projected (Section 2.1.3). Even the oldest group tested (age 5) struggled with long actional passives, achieving only 60.4% correct responses, despite showing adult-like comprehension on short actional passives, with 95.8% correct responses. We will revisit this puzzling production-comprehension asymmetry in section 4.5, where we propose that children's comprehension difficulty with long passives in Xu and Yang's (2008) experiments arises from a specific source: intervention by overlapping morphosyntactic features.

In the following sections, we first examine various properties of spontaneous production corpora of Mandarin-speaking children and their caretakers. This includes an examination of the overall frequency of passives (Section 4.2) and the different predicate types in passives (Section 4.3.1 actional vs. non-actional, Section 4.3.2 simplex vs. resultative). Our study has replicated two consistent findings in previous literature: passives appear infrequently in children's input and their production, and passives with actional verbs significantly outnumber those with non-actional verbs.

In Section 4.4, we investigate potential intervention effects in the production data. Section 4.4.1 investigates whether child Mandarin shows the short $>$ long passive asymmetry observed in children's production in other languages. Data show that in *both* child and child-directed Mandarin, long *bei*-passives are significantly more prevalent than short passives, a pattern that is not seen

in any other languages examined in the literature. We discuss the possible factors leading to this phenomenon at the end of that subsection. Section 4.4.2 further examines the featural conditions in long *bei*-passives. The results demonstrate that most of children's long passives contain two arguments (when they are full NPs) that are mismatched in Animacy, unlike their adult input.

4.1. Data collection and coding

For the current study, we analyzed data from the Mandarin corpora on CHILDES (CHIld Language Data Exchange System, MacWhinney 2000), listed in Table 4.1, which contain the spontaneous productions of 1,182 monolingual Mandarin-speaking children aged 2 to 6, as well as their language input (Child-Directed Speech, CDS) during the recorded sessions, both transcribed in the standard CHAT format (Codes for the Human Analysis of Transcripts, MacWhinney & Snow 1990).

Table 4.1: Mandarin corpora investigated in the current study

Corpus	**Age**	**# of children**	**Notes**
Chang2	3;4–4;4	16	Spontaneous production in longitudinal studies
ChangPlay	3–6	21	
Erbaugh	2;0–3;9	4	
TCCM (part)	2;0–3;4	10	
Tong (part)	2;0–3;5	1	
Zhou3 (part)	2;0–4;5	1	
Chang1	3;6–4;5, 5;7–6;5	24	Spontaneous production during toy play sessions or other home activities
ChangPN (part)	3–6	72	
LiZhou	3–6	80	
Zhou1 (part)	2, 4	15	
Zhou2	3–6	15	
ZhouDinner	4–5	80	
AcadLang	3–6	15	Spontaneous production during picture description tasks
Xinjiang (part; No CDS)	4–6	60	
ZhouAssessment	3–6	334	
LiReading	3–6	214	Spontaneous mother-child conversations initiated by picture-book reading activities
TCCM-Reading	2	20	
ZhouNarratives	3–6	200	
Total number of children:		**1,182**	

The MLU command was used in the Computerized Language Analysis (CLAN; MacWhinney

2000) software to calculate the number of utterances produced by the children and the adults in each file. The KWAL command was used to extract all child and adult utterances containing the Mandarin passive marker *bei*, as well as the two lines before and two after the target utterances to provide context.

For each grammatical *bei*-passive utterance, we coded (i) whether the verb is actional or non-actional (including subject- and object-experiencer verbs), (ii) whether the predicate is simplex or resultative (including resultative verb compounds and resultative *-de* phrase), (iii) whether the structure is a long passive or short passive, the criterion being whether there is an overt EA phrase after *bei*. For the long passives, we annotated the NP types of the two arguments (full NP, pronoun, proper name, or *wh*-phrases) and the animacy level of each full NP.

4.2. Frequency of passives

In total, our data contain 214,871 utterances produced by children aged 2 to 6, and 340,305 utterances in their input, child-directed speech (CDS). After excluding 19 incomplete sentences, three indistinguishable utterances (i.e., those marked with 'XXX' in the transcripts), and three immediate repetitions, there are a total of 395 *bei*-passive utterances in the child corpora. We also excluded any production of the homophones of the passive marker *bei*, such as *bei* 'quilt, duvet'. Among children's production of *bei*-passives, 39 were ungrammatical constructions and thus excluded, including transitivity errors (3), word order errors (4), uninterpretable sentences, and other types of errors.

(3) *konglong yijing bei zou-diao le (3;11)
dinosaur already BEI walk PRF
Intended: 'The dinosaur already walked away.' or 'The dinosaur was already let go.'

(4) *mao guan-qilai le bei (3;10)
cat lock-up PRF BEI
Intended: 'The cat was locked up.'

In total, we found 356 grammatical *bei*-passives produced by 2- to 6-year-olds (see Appendix A for a breakdown of the data), making up 0.166% of their total utterances. In the CDS, there are

1,005 *bei*-passives, 0.295% of the total utterances recorded in our data. All of the passives produced by the adults were grammatical, and no adult data were excluded. Data show that passives are infrequent in both child (0.166%) and child-directed (0.295%) Mandarin, consistent with the low frequencies of passives in some previous studies on other languages (see Section 3.2.3 for discussion).

4.3. Predicate-based comparisons

4.3.1. Actional vs. non-actional passives

The extensive research on children's acquisition of passives across diverse languages reveals an effect of verb type. Specifically, passives with actional verbs occur earlier and more frequently in child speech and are easier for children to comprehend than passives with non-actional verbs, particularly subject-experiencer verbs (e.g., *like, hate, fear*) (see Section 3.1.1 for details).

Before comparing these two types of predicates in Mandarin passives, we note that light verbs – which are semantically bleached (i.e., are neither actional nor non-actional) – also occur in the data. An example is provided in (5), where the light verb *nong*, which can roughly be translated as 'make', does not form a predicate on its own.

(5) a. na-ge yeshi bei wo **nong**-huai de (2;07)
that-CLF also BEI I make-break SFP
'That one was also broken by me.'

b. Kendeji bei wo **nong**-diao le (3;04)
KFC BEI I make-drop PRF
'The KFC chicken was dropped by me.'

All of the 32 light-verb passives found in child speech coupled with an actional secondary predicate and depicted actional events, mirroring the 55 light-verb passives in the CDS. Therefore, we categorize them as actional passives in our analysis. Figure 4.1 shows the frequency of passives with actional vs. non-actional verbs produced by Mandarin-speaking 2- to 6-year-olds (see a breakdown of the data in Appendix A).

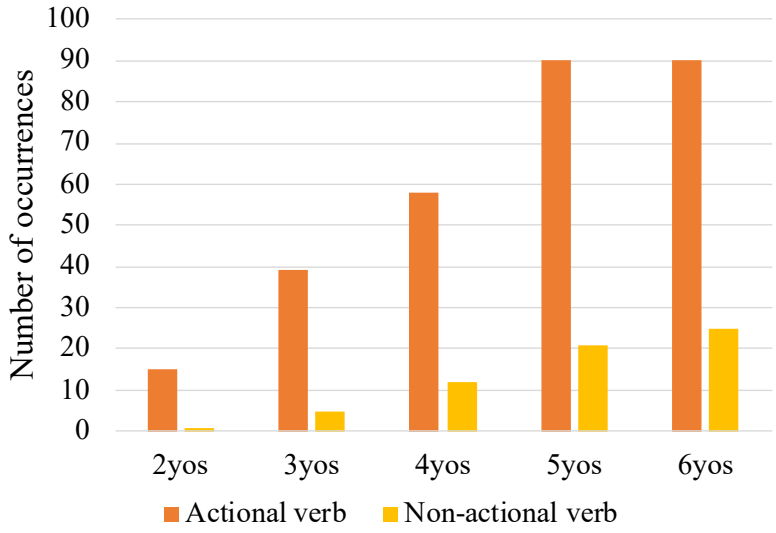


Figure 4.1: Numbers of actional vs. non-actional *bei*-passives produced by 2- to 6-year-olds

Consistent with the robust actional > non-actional passive asymmetry documented in previous studies, our corpus study also discovered that most of the 356 grammatical passives produced by 2- to 6-year-old Mandarin-speaking children (82.02%) contained an actional predicate, with examples provided in (6).

(6) a. bei mama **na**-zou le (2;01)
BEI mom take-away PRF
'[*e*] was taken away by mom.'

b. ni ganggang you-mei-you bei **ya**-bian? (3;02)
you just_now have-not-have BEI press-flat
'Have you been pressed flat just now?'

c. buxiaoxin bei **zhuang**-dao le (3;06)
accidentally BEI bump-into PRF
'[I] was accidentally knocked down.'

d. zhu-baba bei **jiao**-xing la (3;11)
pig-dad BEI call-awake SFP
'Papa Pig was waken up.'

Non-actional passives, such as (7), constitute only 17.98% of the child data. In contrast to the wide range of verbs used in actional passives, non-actional passives found in our data are limited

to only four verbs: *kan* 'see', *xia* 'scare', *faxian* 'discover', and *ting* 'hear'. Moreover, among the total 64 non-actional passives produced by children, 39 were passives of a single verb – the verb *xia* 'scare' – and 34 of these passives with *xia* 'scare' came from one corpus, ChangPN (Chang & McCabe 2013). This corpus elicited personal experiences from children with one of the elicitation questions being *Ni (you) bei xia(dao) guo ma?* "Have you ever been scared?", which was also the only question targeting a non-actional verb. As a result, children's production of passives with this non-actional verb was disproportionately more frequent than the other (non-actional) verbs.

(7) a. jiu bei [/] bei ta **kan**-jian le (2;09)
then BEI BEI 3SG see-seen PRF
'Then [*e*] was seen by him/her.'

b. wo bei Maidanglao shushu **xia**-dao (3;08)
I BEI McDonald uncle scare-arrive
'I was scared by Uncle McDonald.'

c. ta haipa bei **faxian** (4;03)
3SG fear BEI find
'S/he is afraid of being found.'

d. ranhou bei yeye nainai **ting**-dao (5;06)
afterwards BEI grandpa grandma hear-arrive
'Afterwards [I] was heard by grandpa and grandma.'

In the CDS for these children, 58.31% of the *bei*-passives were actional. Compared to the CDS, 2- to 6-year-olds produced significantly more actional passives than non-actional ones ($X^2(1) = 63.10, p < .001$), as illustrated in Figure 4.2.

To sum up, we have observed the same actional $>$ non-actional passive asymmetry in child Mandarin as in previous literature concerning other languages. Our corpus data also show that Mandarin-speaking 2- to 6-year-olds are more likely to produce actional passives as compared to their input.

4.3.2. Simplex vs. resultative passives

Our investigation extended beyond the contrast between passives with actional vs. non-actional predicates, and additionally explored the prevalence of resultatives in Mandarin passives. English

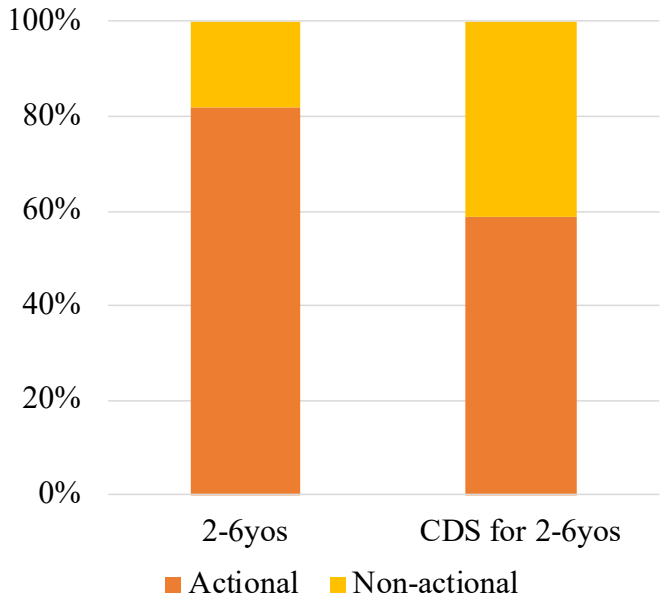


Figure 4.2: Percentages of different verb types in child vs. child-directed Mandarin passives

resultative constructions as in (8), feature a secondary predicate (underlined) that specifies the resultant state.

(8) a. I hammered the iron <u>flat</u>.

b. The dog barked me <u>awake</u>.

In Mandarin, there are two types of resultative constructions: resultative verb compounds (RVCs) (9a) and resultative *-de* phrases (9b). The primary predicate depicts a causing event (such as hammering in (9a) and barking in (9b)) that causes the resultant state denoted by either a verb such as *bian* 'flat' in (9a) or a *-de* phrase such as *wo xing le* 'I woke up' in (9b).

(9) a. wo chui-<u>bian</u> le zhe-kuai tie
I hammer-flat PRF this-CLF iron
' I hammered the iron flat.'

b. gou jiao-**de** <u>wo</u> <u>xing</u> <u>le</u>
dog bark-DE I wake PRF
'The dog barked me awake. (Lit. 'The dog barked (and as a result) I woke up.')

Our corpus data found that children's passive input contain both types of resultative predi-

cates, featuring 818 passives of RVCs (10a) and 25 passives with resultative *-de* phrases (10b). Altogether, resultative predicates formed the most prevalent predicate type of passives (83.88%) produced by the children's caretakers, while simplex verbs (denoting a single event) make up only 13.93% of the data.[3]

(10) a. shu dou bei chui-dao le a?
tree even BEI blow-fallen PRF SFP
'Even the tree was blown down?'

b. bei zhuren yang-**de** *pang-pang de*
BEI owner raise-DE fat-fat SFP
'[The cat] was raised fat by the owner.'

(Lit. '[The cat] was raised by the owner as a result [it] got fat.')

Within passives produced by Mandarin-speaking children, only two predicate types were present – 265 RVCs and 91 simplex verbs, with no instances of resultative *-de* phrases. Most of child passives (74.44%) contained RVCs, with some examples in (11); only 25.56% employed a simplex verb as the main predicate, as in (12).

(11) a. na-ge yeshi bei wo nong-huai de (2;07)
that-CLF also BEI I make-broken SFP
'That one was also broken by me.'

b. bei Guaiguai shuai-huai le (2;09)
BEI Guaiguai drop-broken PRF
'[*e*] was dropped by Guaiguai and (thus) is broken.'

c. daxiang bei dajuren cai-si (3;10)
elephant BEI giant step-dead
'The elephant was stepped on by the giant and (thus) is dead.'

d. ranhou wo bei xia-ku le (4;06)
then I BEI scare-cry PRF
'Then I was scared and (thus) cried.'

(12) a. bei wenzi yao le (2;06)
BEI mosquito bite PRF

[3]Other types of passive predicates (2.19%) in the CDS included serial verb constructions, verbs with duration/frequency phrases, *wh*-words, etc.

'[I] was bitten by the mosquito.'

b. bei mama ma (3;06)
BEI mom scold
'[I] was scolded by mom.'

c. yinwei huluobu hui bei tuzi tou (4;05)
because carrot will BEI rabbit steal
'. . . because carrots will be stolen by rabbits.'

d. ta-de jiao bei yu chi le (5;0)
3SG-GEN foot BEI fish eat PRF
'His/Her foot was eaten by the fish.'

Compared to their input CDS, children's passives contained only one type of resultative predicates, namely RVC, but not resultative *-de* constructions, which contain an embedded clause. Although the majority of children's passives were resultative (74.44%), they produced fewer resultatives than in their input (83.88%), as shown in Figure 4.3 ($X^2(1) = 23.46, p < .001$).

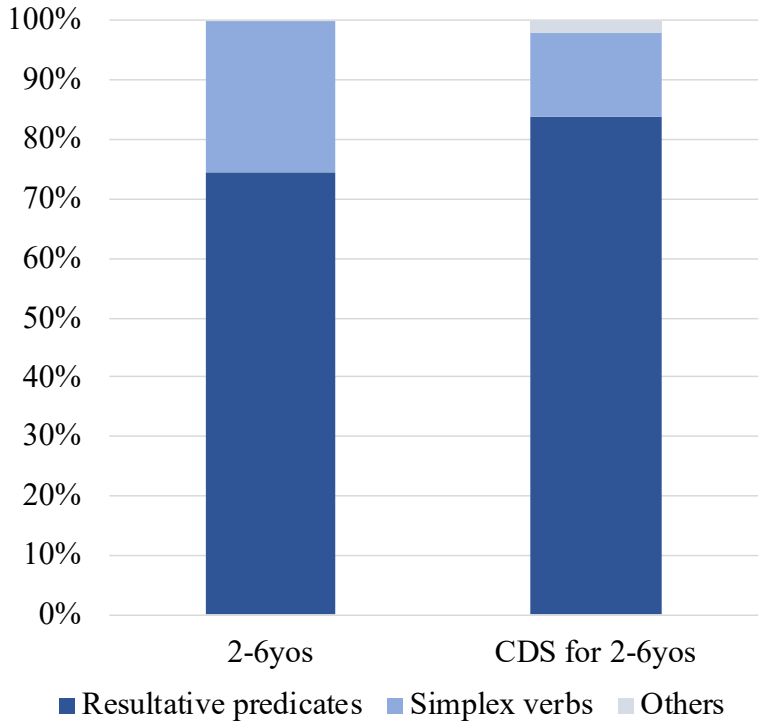


Figure 4.3: Percentages of *bei*-passives with different predicate types produced in child and child-directed Mandarin

In sum, our findings indicate that resultative predicates, particularly RVCs, are the most common type of passives in both child and child-directed Mandarin. Nonetheless, children are less likely to produce resultative passives compared to adults.

The dominance of RVCs in passive data might not come as a surprise, given their overall prevalence in Mandarin, regardless of whether the sentence is passive or not. For instance, Hsu, Rispoli, and Hadley (2019) revealed in their corpus study that, on average, every fifth utterance containing verbs in children's input contained an RVC. Furthermore, children's verbal output at age three consisted of approximately nine to ten RVCs per 100 utterances with verbs.

4.4. Examining potential intervention effects

Recall from Section 2.1, where we discussed the syntactic properties of *bei*-passives, that in long passives (13) the EA (e.g., *houzi* 'monkey') structurally intervenes between the IA and its gap, whereas in short passives (14) there is no such intervention.

(13) a. huli bei houzi da le
fox BEI monkey hit PRF
'The fox was hit by the monkey.'

b. Long *bei*-passives: . . . [$_{\text{PassP}}$ NP BEI [$_{\text{VoiceP}}$ (NP) [$_{\text{VP}}$ V (. . .) *t* (. . .)]]]
Intervention difficulties

(14) a. huli bei da le
fox BEI hit PRF
'The fox was hit .'

b. Short *bei*-passives: . . . [$_{\text{PassP}}$ NP BEI [$_{\text{VoiceP}}$ [$_{\text{VP}}$ V (. . .) *t* (. . .)]]]
No intervention difficulties

The Intervention Hypothesis, based on fRM, posits that the A′-dependency between the IA *huli* 'fox' and its gap in (13b) should be harder for children to understand compared to (14b). Furthermore, the more overlapping morphosyntactic features the two arguments in (13a) have, the more challenging the dependency in (13b) should be. Our experimental studies (Chapters 5 and 6) examine these predictions by comparing children's comprehension of long vs. short passives while manipulating three different features, namely Animacy, Number, and Shape.

In the current corpus study, we set the stage for such investigations by looking at the frequencies of long vs. short passives (Section 4.4.1) and further examining the featural conditions in long passive production (Section 4.4.2) in both child and child-directed Mandarin.

4.4.1. Long vs. short passives

Previous studies on children's production of passives in other languages have all found that long passives occur less frequently than short passives, even in languages where children acquire both types of passives early, such as Sesotho (e.g., Demuth et al. 2010) (see Section 3.1.2). In this section, we investigate this contrast in child and child-directed Mandarin.

Our corpus data indicate that Mandarin-speaking children, from as early as ages 2 to 3, already use a range of different verbs in both long and short passives confirming Hu's (2013) previous observation of early passive production in her longitudinal study. Some early examples from our data are shown in (15) and (16) .

(15) Early long *bei*-passives:

a. bei *mama* na-zou le (2;01)
BEI mom take-away PRF
'[*e*] was taken away by mom.'

b. Guaiguai tongtong bei *xiongxiong* chi-guang (2;06)
Guaiguai all BEI bear eat-up
'Guaiguai is all eaten up by the bear.'

c. maobi huai le. bei *wo* nong-huai le (2;07)
brush_pen break PRF BEI I make-break PRF
'The brush pen is broken. [The brush pen] was broken by me

(16) Early short *bei*-passives:

a. ta bei zhe-yangzi zhuan zhuan zhuan zhuan... (2;08)
3SG BEI this-way spin spin spin spin
'S/he was spun and spun in this way.'

b. ni ganggang you-mei-you bei ya-bian? (3;02)
you just_now have-not-have BEI press-flat
'Have you been pressed flat just now?'

c. da-jiujiu yeshi bei pen-shang (3;04)
eldest-uncle also BEI spray-on
'Eldest uncle was also sprayed on.'

As demonstrated in Figure 4.4, among the 356 grammatical *bei*-passives produced by 2- to 6-year-olds, long passives (61.24%) were significantly more frequent than short passives (38.76%) ($p < .001$, binomial test). This contradicts previous studies in other languages showing a higher percentage of short passives in children's spontaneous production (e.g., Horgan 1978 on English, Pye & Poz 1988 on Kiché, and Kline & Demuth 2010 on Sesotho).

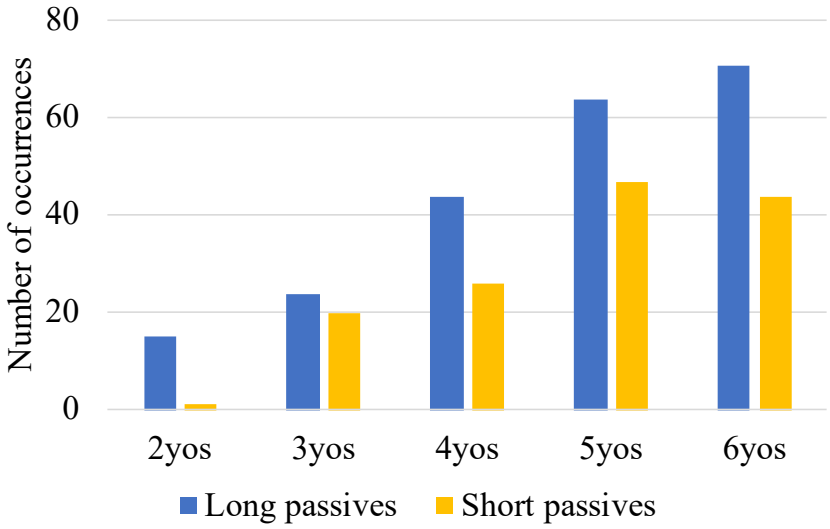


Figure 4.4: Numbers of long and short *bei*-passives produced by 2- to 6-year-olds

Our results also show a similarly high frequency (58.5%) of long passives in the 2- to 6-year-olds' input data (CDS), as shown in Figure 4.5 (cf. a corpus study by Gordon & Chafetz 1990 showing that only 4% passives in child-directed English are long passives). Considering that the high proportion of long *bei*-constructions in the CDS is not significantly different from that of the child data ($X^2(1) = 0.81, p = .37$), we suggest that the higher frequency of long *bei*-passives in child Mandarin are due to the higher frequency of such constructions in children's input, compared to the short ones.

Of course, this begs the question of why Mandarin long passives are more prevalent than short passives in the CDS. This is potentially due to some Mandarin-specific factors that influence *both*

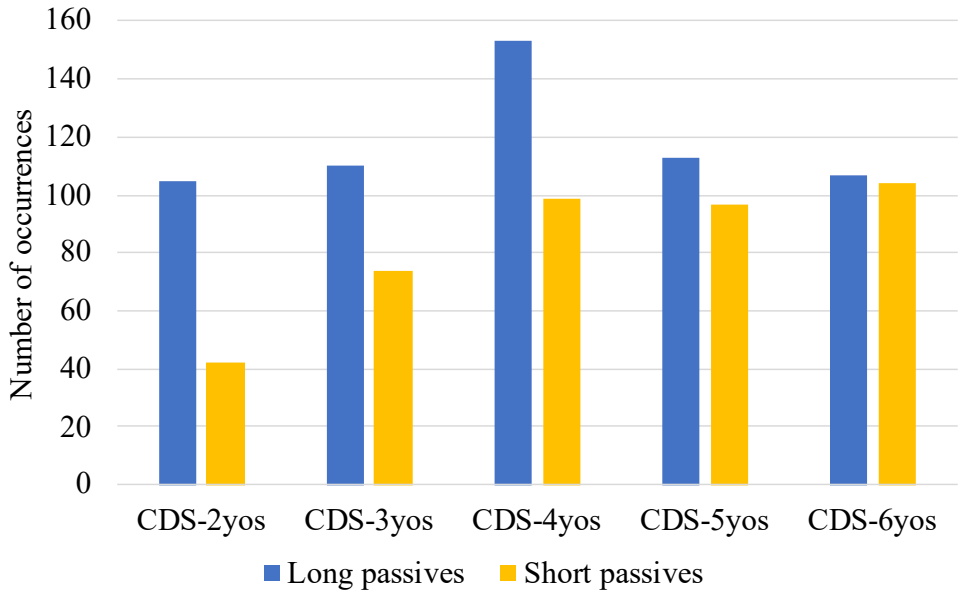


Figure 4.5: Numbers of long and short *bei*-passives in 2- to 6-year-olds' input

children and adults alike. In adult-to-adult speech, long *bei*-passives are also more common than short passives. In a corpus study on Mandarin *bei*-passives, Guo and Chow (2013) randomly retrieved a number of novels published in an influential magazine in China within the ten years prior to their study and collected a sample size of 499,309 characters (approximately 313,448 words). In total, they found 497 *bei*-passives, of which long passives ("agentive") (56%) were also more frequent than short passives ("agentless") (44%).

However, Xiao et al. (2006) found the opposite trend in their larger-scale corpus study comparing (Mandarin) Chinese and English passives. They examined two Chinese corpora, one containing written Chinese published in the early 1990s (one million words) and the other containing phonecall dialogues in 1996 (appr. 300,000 words), as well as two comparable English corpora, one with written texts in 1991–1992 (one million words) and one with conversational data sampled in 1985–1994 in the UK (appr. four million words). Combining the two Chinese corpora they found 511 long *bei*-passives (39.3%) and 789 short *bei*-passives (60.7%). Although long passives were less frequent in their study than short passives, the frequency of long passives was still much higher in Chinese than in English. In the written English corpus, only 10.8% of *be*-passives were

long and 89.2% were short, and in the spoken English corpus, long *be*-passives were even rarer (5.1%) than the short ones (94.9%). The frequency of long passives in adult Chinese is significantly higher than that in adult English ($X^2(1) = 1097.66, p < .001$).

What factors contribute to the higher frequency of long *bei*-passives in *both* child and adult Mandarin is an open question. Pragmatics seems to play an important role in the usage of long (as opposed to short) passives.[4] However, it is not clear why there should be any pragmatic differences between Mandarin and the languages in which long passives are rare in (both child and adult) spontaneous speech. Note that Mandarin long *bei*-passives show A′-properties that are not observed in long passives in those other languages, leaving open the question whether the syntactic differences between Mandarin and other languages might contribute to this contrast.[5]

Determining the underlying cause of the unique distribution of short and long passives in Mandarin is outside the scope of this dissertation. Assuming children produce long passives for the same reason(s) as adults (whatever that may be) or because they are following their input in some sense, the interesting question for us is how children are able to circumvent the intervention restriction in their grammar. We turn to this question now.

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[4]For example, for English-speaking children, both comprehension and production of long passives both improve when there is a third character (in addition to the Agent and the Theme) forming a contrastive set with the Agent (Crain & Fodor 1989, O'Brien et al. 2006, Crain et al. 2009).

[5]It is also worth noting that in many (if not most) Chinese dialects (e.g., Cantonese/Yue, Min, Wu, Hakka/Kejia, Gan, Xiang), the EA is obligatory in passives, i.e., only long passives are allowed (e.g., C. Zhou 2016). When the EA is unknown or generic, an abstract noun is inserted as the EA, e.g., Cantonese *yahn* 'person' for human or *yeh* 'thing' for non-human (e.g., Matthews & Yip 2013).

Even within (the sub-varieties of) Mandarin, the non-canonical passive markers – e.g., *jiao* 'ask, order', *rang* 'allow, ask', and *gei* 'give' – also require the presence of a following EA, in contrast with the canonical passive marker *bei* in Mandarin that we are interested in. Diachronically, the requirement for an EA in passives in these Chinese dialects seems to correlate with the different grammaticalization pathways of the passive markers. Passive markers that historically derive from a transitive verb or a causative verb require the presence of an EA and rejects short passive forms, e.g., Cantonese 畀/俾, Northern Mandarin 着. By contrast, passive markers that historically derive from verbs meaning 'undergo' or 'suffer' do not have this restriction and can occur both in long and short passives, e.g., Mandarin 被 (*bei*), Southwestern Mandarin 着 (e.g., C. Zhou 2016).

4.4.2. Featural conditions in long passives

Despite the similar prevalence of long passives over short passives in child and adult production, the question still remains why these children can produce long passives in the first place, given the intervention restriction in their grammar.

Our prediction is that the long passives produced by these children are most likely to contain two arguments with *mismatched* morphosyntactic features, as opposed to matched ones. This mismatch potentially circumvents the complexity introduced by structural intervention in long passives. To examine this hypothesis, this part of our study investigates the feature content of the IA and the EA in children's and adults' production of long *bei*-passives. Previous studies have discussed the effects of certain features in children's acquisition of intervention constructions. However, not all of them are suitable for our corpus study.

For instance, grammatical Gender, which has been found to modulate intervention effects in child Hebrew (Belletti et al. 2012), is absent in Mandarin morphosyntax. Additionally, grammatical Number is relevant for intervention in many languages (e.g., Italian, Adani et al. 2010 2012; English, Adani et al. 2014; Spanish, Mateu 2022) and is marked in Mandarin but it seldom occurs in our spontaneous data. This is because in Mandarin, Number is encoded on the classifiers (e.g., Cheng & Sybesma 1999, 2012) (see Section 6.2) and these classifiers only occur when there is a numeral phrase (17a), or a demonstrative phrase, such as (17b).

(17) a. *(wu)-ge pingguo
five-CLF apple
'five apples'

b. *(zhe (yi))-ge pingguo
this one-CLF apple
'this (one) apple'

In our corpus study, only two child-produced long passive utterances contained classifiers in both the IA and the EA. As a result, the spontaneous production data is limited when examining the match/mismatch of grammatical Number on classifiers. Nevertheless, the effects of Number in children's comprehension of passives can be examined experimentally, with careful manipulations of the classifiers in the arguments, as we do in Experiment 2 (to be discussed in Section 6.3).

Another morphosyntactic feature that has been shown to modulate intervention effects in other languages is Animacy. For example, in English, Animacy is a morphosyntactic feature that affects its pronominal forms (e.g., *s/he* vs. *it*; *who* vs. *what*), as well as syntactic constructions such as genitives (e.g., *the boy's hands* vs. *??the clock's hands*) and double object constructions (e.g., *I sent Lisa a book* vs. *??I sent Los Angeles a book*). Mateu & Hyams (2021) found that Animacy mismatches facilitated English-speaking children's comprehension of object sluicing constructions (in which the object *wh*-phrases move across a subject, triggering intervention), but not of subject sluicing constructions where there was no intervention (see more details about this study in Section 5.3.2).

In our corpus analysis, the Animacy of each overt NP was annotated based on the context provided by the two utterances preceding and following the *bei*-passives as well as on our world knowledge. The distinction was binary, i.e., animate vs. inanimate, with humans and animals considered as equally animate. While dolls and stuffed animals might also be considered animate by children, there were no such references in the data. Cartoon characters such as *dahuilang* 'Big Bad Wolf' were all considered animate.

Moreover, Bentea et al. (2016) showed that in object *wh*-questions and object resultative clauses in child French, an Animacy mismatch only has a facilitating effect if this feature is on a [+NP] phrase (e.g., animate *quelle dame* 'which lady' and inanimate *quelle balle* 'which ball'), but not on a [−NP] phrase (e.g., animate *qui* 'who' and inanimate *qu(e)'* 'what'). In order to control for this factor, our study only examined long passives in which *both* arguments are of the same NP type.

We identified four types of overt NP in our data, including (i) full NPs (*xiongmao* 'panda', *zhe-ge daxiang* 'this elephant', etc.), (ii) personal and demonstrative pronouns (*wo* 'I', *zhe-ge* 'this', etc.), (iii) proper names, and (iv) *wh*-phrases (*shei* 'who', *shenme* 'what', etc.). However, the long passives with two pronouns, two proper names, or two *wh*-arguments had very small sample sizes: There were only three long passives with two pronominal arguments, one with two proper names, and none with two *wh*-arguments. Therefore, these types of long passives were excluded and only the long passives with two full NP arguments were included, such as (18). In what follows, 'long

passive' refers to long passives with two full NP arguments.

(18) daxiang bei da juren cai-si (3;10)
elephant BEI big giant trample-dead
'The elephant was trampled to death by the big giant.'

There were a total of 35 long passives in child speech and 52 in the CDS that met our criteria. As shown in Figure 4.6, in the child data, 77.1% of the long passives contained Animacy-*mismatched* arguments, while the adult data showed the opposite – 76.9% of the passives contained Animacy-*matched* arguments ($X^2(1) = 24.7, p < .001$). As such, children's production did not correspond to their input with respect to Animacy (mis)match.

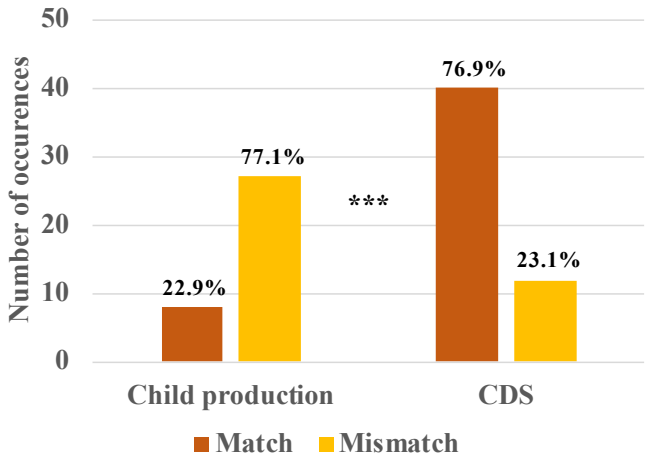


Figure 4.6: Animacy match/mismatch in long *bei*-passives with two full-NPs

This suggests that the prevalence of long passives with mismatched Animacy in child Mandarin cannot be solely explained as an effect of input. We hypothesize that long passives with arguments matched in Animacy would violate children's intervention restriction, in line with the Intervention Hypothesis that predicts a *comprehension* difficulty in this case. Children may resort to other alternative constructions to circumvent producing long passives when both arguments are animate, such as actives or short passives.

4.5. Summary and Discussion

Our analysis of spontaneous production data from 1,182 Mandarin-speaking children aged 2 to 6, along with the CDS they received, reveals both similarities and differences between the usage of passives in child Mandarin and in the CDS.

In several respects, the children's speech appears to mirror their input. Firstly, passives occur infrequently in both child and CDS Mandarin, a characteristic also observed in other languages. However, the second notable feature of Mandarin passives sets it apart from other languages: long passives are significantly more frequent than short passives in both child and CDS Mandarin. In this dissertation we do not attempt to investigate why this is the case (see discussion in Section 4.4.1). We propose that the predominance of long passives over short ones in children's data might reflect their frequency in children's input. Alternatively, children may produce a higher frequency of long passives for the same reasons adults do, although the precise pragmatic or other factors behind this trend remain unidentified at this point.

Conversely, there are areas where Mandarin-speaking children's spontaneous speech does not replicate their input. Firstly, like their counterparts learning other languages, Mandarin-speaking children are more likely to produce actional passives rather than non-actional ones, a trend that is not significant in their input. Second, although most of adults' and children's passives are resultative, children are less likely to produce resultative passives than adults, and instead they use more simplex predicates. Last, children – but not adults – overwhelmingly produce long passives with two arguments that mismatch in Animacy features, arguably because that configuration is easier to compute given that children are subject to a stricter intervention constraint than adults, according to the Intervention Hypothesis.

Our hypothesis predicts that if the features (such as Animacy and NP type) of the IA and the EA match, children will find long *bei*-passives difficult to comprehend, and/or produce. In this regard, let us recall the apparent conflicting comprehension-production results in previous Mandarin studies: Mandarin-speaking children produce grammatical long *bei*-passives as early as the

age of 3 but seem to have delayed comprehension of long (but not short) actional passives. In Xu and Yang's (2008) picture-selection task with images depicting two animals acting out two verbs with reversed theta-role assignments (e.g., *The cat was hit by the dog* vs. *The dog was hit by the cat*), children aged 3-5 generally performed worse on long passives (average 57.3% correct) than the short ones (average 88.6%). By the age of 5, children already show near-ceiling performance on short actional passives but their comprehension of long actional passives is significantly worse. We can now explain these comprehension results by considering the NPs used in Xu and Yang's (2008) study: all the long passives tested in their experiment contained two Animacy-*matched* full-NP arguments such as 'the cat' and 'the dog', which – by our hypothesis – should trigger an intervention effect and hence produce poor performance. Thus, the poor performance on long passives in their study may be largely due to the Animacy feature match; it does not necessarily demonstrate delayed acquisition of (all) long passives.

We therefore predict that children's comprehension of Mandarin long passives will improve with two arguments that have mismatched Animacy features. As will be shown in section 5.2, this prediction is borne out in our experiment examining the Animacy feature in the comprehension of passives by Mandarin-speaking 3- to 6-year-olds.

CHAPTER 5

Animacy and Intervention Effects in child Mandarin passives

5.0. Introduction

In this chapter we present the results of an experimental study testing for intervention effects in Mandarin-speaking children's comprehension of *bei*-passives. Recall that in in our corpus study (Chapter 4), we found that Mandarin-speaking 2- to 6-year-olds (*N* = 1,182) produced more long *bei*-passives (61.2%) in their spontaneous speech than short *bei*-passives, showing no significant difference from their input ($X^2(1) = 0.78, p = .38$), in which long passives (58.5%) were also more frequent than the short ones. Intriguingly, unlike adults, a majority of children's long passives contained two arguments exhibiting Animacy mismatch. This discovery was a key factor driving our current experimental study, in which we manipulated the Animacy of the two arguments to investigate the effect of (featural) intervention.

Despite the higher frequency of long passives in children's input and spontaneous speech compared to short passives, we anticipate, given the syntactic characteristics of Mandarin passives (Section 2.1) and the Intervention Hypothesis, that (i) long passives will pose more comprehension difficulties for children than short passives, and (ii) comprehension of long passives by children, unlike actives, will improve when the Animacy of the IA and the EA are mismatched.[1]

This chapter will initially shed light on the status of the Animacy feature in Mandarin, illustrating that it is morphologically active, albeit not explicitly marked in the verbal or nominal domains. Section 5.2 presents our Experiment 1, a study on children's comprehension of long and short *bei*-

[1]Mandarin short passives only have one argument, namely the IA (there is no implicit EA, see discussion in Section 2.1.3) and therefore were excluded in our analyses of featural match vs. mismatch between the IA and the EA in both Experiment 1 and Experiment 2 (Chpater 6).

passives, while manipulating the Animacy of the NPs. Section 5.3 delves into the implications of our findings concerning intervention effects in child Mandarin and an alternative explanation for the Animacy effects detected in children's passives.

5.1. Animacy and its status in Mandarin

In typological studies, Animacy is often characterized as a three-tier hierarchy: Human > Non-human Animal > Inanimate (e.g., Comrie 1989, Yamamoto 1999). In certain languages, Animacy plays a role in verb agreement. For example, in Persian, subject-verb agreement of Number is only observed with animate subjects, whereas inanimate subjects, plural or not, only occur with the default singular agreement (e.g., Bayanati & Toivonen 2019).

In Mandarin, verb agreement is absent, and Animacy is not manifested in any form on verbs. Nonetheless, there is reason to consider Animacy an active morphosyntactic feature in Mandarin, rather than a purely semantic one. In Mandarin, the collective/'plural' suffix *-men* may only attach to animate nominals, including personal pronouns (1a) and human-denoting NPs (1b), but not inanimate NPs (1c).[2] In other words, the suffix *-men* syntactically selects for animate NPs, which implies that Animacy features are utilized in the grammar, although Animacy is not realized on an inflectional head or as a designated marker in the nominal domain.

(1) a. Personal pronouns: *wo* 'I' *wo-men* 'we'
b. Human NPs: *xiaohai* 'child' *xiaohai(-men)* 'children'
c. Inanimate NPs: *pingguo* 'apple' *pingguo(*-men)* 'apples'

Child Mandarin adheres to these rules as well, except that *-men* can sometimes attach to non-human NPs when they are anthropomorphized – for example to NPs referring to animals, such as *xiao niao* 'little bird' in (2). In rarer cases, inanimate NPs – when anthropomorphized – can be treated as human NPs in child speech and be suffixed by *-men* as well. For example, in (3), this

[2]There is debate on whether this suffix is a plural morpheme in Mandarin. There is evidence to believe it is not, see Footnote 2 on Page 117 for more discussion on the properties of this suffix. What is important for our discussin here is that the distribution of this suffix depends on the animacy level of the NP.

suffix is associated with an inanimate NP *xiao-cao* 'grass' when the sentence describes the feelings of the grass.

(2) xiao-niao-men dou pao-le (6;01)
little-bird-PL all run-PRF
'All the little birds fled away.'

(3) haoduo xiao-cao-men hui hen teng (4;02)
many little-grass-PL will very hurt
'Many grass will hurt.'

In our exploration for the suffix *-men* produced by 2-to-6-year-olds using the corpus data collected in Chapter 4, we found 402 occurrences of *-men*, among which 142 were found on personal pronouns, 257 on nouns, and 3 were speech errors. We then examined the Animacy levels of those 257 noun bases for this suffix. Only 2 (0.78%) of them were anthropomorphized inanimate entities and the other ones were all animate, including 142 (55.25%) human NPs and 113 (43.96%) non-human animate NPs (e.g., animals, monsters, and dwarfs). This result shows that Mandarin-speaking children adhere to the animate-inanimate distinction when it comes to the Animacy requirement of the suffix *-men*, indicating that Animacy is a morphosyntactic feature not only in adult Mandarin, but also in child Mandarin grammar.

Although in our corpus study, 2- to 6-year-old Mandarin-speakers produced more long passives than the short ones – presumably due to the higher frequency of long passives in their input (Section 4.4.1), we still observed a potential effect of structural intervention in children's long passives. Namely, children's long passives were more constrained than in the adult input, as the majority of the long passives they produced contained NP arguments with mismatched Animacy features, despite the opposite trend in their input (Section 4.4.2). These results inspired our first experiment.

5.2. Experiment 1

5.2.1. Control for predicate-based difficulties

Previous studies have demonstrated that children's performance with passives is affected by the types of verbs in the sentences. As discussed in Section 3.1.1, previous studies across different languages have shown that passives with actional verbs are easier for children to acquire (i.e., produced earlier and more frequently and easier to comprehend) than those with non-actional verbs (e.g., Maratsos et al. 1985, Gordon & Chafetz 1990, Hirsch & Wexler 2006b, Volpato, Verin, & Cardinaletti, 2016, Oliva & Wexler 2018, Agostinho 2020). Our purpose in this study is not to test the effect of verb type, but rather to examine the difference between children's comprehension of long vs. short *bei*-passives, and the potential effects of intervention difficulties in child grammar. Thus, we intended for the test verbs in our experiments to be as easy as possible for children, to eliminate any potential difficulty linked with the verb.

For this reason, all the test verbs in our experiments are actional and we opted for resultative verb compounds (RVCs) over bare verbs. Descriptively, Mandarin RVCs can be decomposed into two verbal components: The second component denotes some 'result' of the action or process conveyed by the first one, hence the name (Li & Thompson 1989). RVCs are a highly frequent type of predicate in Mandarin and occur in child speech as early as around the age of one and a half (e.g., Yang 2006, Deng 2019). RVCs are also highly frequent in child and child-directed passives: Our corpus study (Chapter 4) found that most of the main verbs in passives in child speech (74.44%) and their input (81.39%) were RVCs. Regarding children's comprehension of RVC passives, Xu and Yang's (2008) results showed that Mandarin-speaking 3- to 5-year-olds generally performed marginally better with passives of actional RVCs (average 75.00%) than passives of bare actional verbs (average 70.83%).

In other words, the actional RVCs examined in our experiment should represent the simplest verb condition for children, relative to the non-actional or bare verbs. This means that any comprehension difficulty in passives – particularly long passives – cannot be ascribed to the inherent

complexity of the verb forms. Recall that Mandarin-speaking children need to correctly establish the dependency between the internal argument (IA) and its gap in order to interpret short passives because the adjectival strategy is not available in Mandarin (see Section 1.4 for the absence of verbal/adjectival passive homophones in Mandarin, and Section 3.2.2 for discussion on the adjectival strategy). If intervention – which is absent in the derivation of short passives – is the sole source of difficulty in children's comprehension of long passives (as opposed to the potential difficulties caused by the verbs, the *bei* morpheme, or the displacement of an IA), then children's comprehension of short passives should be as good as the active sentences (the control trials).

5.2.2. Design and materials

Experiment 1 was a two-choice sentence-picture matching task with a 3 × 2 design, crossing three Sentence Types (actives, long passives, and short passives) and two Featural Conditions (Animacy match vs. mismatch). In total, there were 36 trials, six per condition. These trials varied among four verbs: *zhuang-dao* 'bump into', *lan-zhu* 'block (the way of)', *ya-dao* 'pin down', and *la-zhu* 'pull'.

A complete list of the trials in Experiment 1 is available in Appendix B. Table 5.1 illustrates our Animacy manipulation in this experiment. As shown in Table 5.1, the EA/Agent in the

Table 5.1: Manipulation of Animacy in Experiment 1

Sentence type	**Feature**	**Test sentence** (IA/Theme Subject)		(EA/Agent)		(IA/Theme Object)
Actives	Match			[+ani]	V	[+ani]
	Mismatch			[+ani]	V	[−ani]
Long passives	Match	[+ani]	BEI	[+ani]	V	
	Mismatch	[−ani]	BEI	[+ani]	V	
Short passives	*(N/A)*	[+ani]	BEI		V	
		[−ani]	BEI		V	

test sentences remained animate across the Match/Mismatch conditions, while the animacy of the IA/Theme varied. We exclusively utilized animate EAs/Agents to ensure the test scenarios were natural because previous studies indicated that an inanimate EA/Agent independently causes com-

prehension difficulty in children as it signifies a "non-canonical event" (e.g., Slobin 1982, Childers & Echols 2004). See more discussion in Section 5.3.2 at the end of this chapter.

In actives and long passives, the *match* conditions contain sentences with two animate NPs, such as (4a) and (5a), whereas the *mismatch* conditions are sentences such as (4b) and (5b) in which the EA/Agent is animate and the IA/Theme is inanimate. For example, the active sentence (4b) has an animate EA/Agent as the surface subject and the long passive (5b) has an animate EA/Agent as the embedded subject under *bei*.

(4) a. Active; Match (trial 13)

houzi la-zhu le xiao-mao
monkey pull-hold PRF little-cat
'The monkey pulled the cat.'

b. Active; Mismatch (trial 7)

xiao-zhu la-zhu le gongjiaoche
little-pig pull-hold PRF bus
'The pig pulled the bus.'

(5) a. Long passive; Match (trial 27)

xiao-niu bei daxiang la-zhu le
little-cow BEI elephant pull-hold PRF
'The cow was pulled by the elephant.'

b. Long passive; Mismatch (trial 35)

xiao-qiche bei xiao-zhu la-zhu le
little-car BEI little-pig pull-hold PRF
'The car was pulled by the pig.'

In short passives, there is only one NP – the IA/surface subject – rendering the featural match vs. mismatch manipulation inapplicable. Nonetheless, the "Match" or "Mismatch" between the Agent and the Patient/Theme of the event was depicted in the test pictures in the same manner as the other two sentence types, thus controlling for potential extralinguistic factors such as complexity of the pictures. The IA/surface subject was animate in half of the short passive trials such as in (6a), and inanimate in the other half (6b). The Agent of the event in the images was always animate.

(6) a. Short passive; [+ani] subject (trial 2)

huli bei la-zhu le
fox BEI pull-hold PRF
'The fox was pulled.'

b. Short passive; [−ani] subject (trial 9)

xiao-qiche bei la-zhu le
little-car BEI pull-hold PRF
'The car was pulled.'

5.2.3. Predictions for Experiment 1

The Intervention Hypothesis leads to the following predictions. First, long passives in general will be more difficult for children to understand than actives and short passives because the movement of the IA crosses an intervener, the EA, which is not projected in the short passive structure. Second, if Animacy is a relevant feature for intervention then Animacy-mismatched long passives (5b) will be easier than the matched ones (5a). Last, we anticipate no improvement in children's performance with two Animacy-mismatched arguments in the active trials where there is no IA movement (i.e., (4b) will *not* be easier than (4a)), nor will Animacy play any role in the comprehension of short passives (6a) and (6b) where there is no intervening argument.

5.2.4. Procedure

Prior to the test, we conducted a familiarization/training session to ensure that the NPs used in this experiment were familiar to young children and to acquaint them with the task of picture selection. In this session, the child was asked to name all the animal characters in Figure 5.1 and the inanimate objects in Figure 5.2.[3] If the child was unfamiliar with any animal or item, which was not the case in our experiment, the experimenter would provide its name. The children were then instructed that their task was to indicate which of the two pictures best matches the sentence they would hear. They completed two training trials with intransitive sentences in this session. All participants were successful in completing the training and passed these two training trials.

The main test session consisted of 36 trials, arranged in a semi-random order to avoid repetition of the same sentence types or verbs. In each trial, the child was shown two pictures on a computer screen while listening to a pre-recorded test sentence. These pictures depicted the same verb but with opposite theta-role assignments, as shown in Figure 5.3. For half the trials, the test sentence corresponded with the left picture, and for the other half, the right picture. The side of the correct

[3]The animate NPs tested in Experiment 1 included *xiaozhu* 'pig', *xiaogou* 'dog', *xiaoyang* 'sheep', *xiaoniu* 'cow', *houzi*, 'monkey', *daxiang* 'elephant', *xiaomao* 'cat', and *huli* 'fox'. The inanimate NPs included *da kache* 'truck', *xiao qiche* 'car', *gongjiao che* 'bus', *xiao huoche* 'train', *da xiangzi* 'box', *da shu* 'tree', and *da shitou* 'rock'. A complete list of test trials is provided in Appendix B.

Figure 5.1: Animal characters in the training session

Figure 5.2: Inanimate items in the training session of Experiment 1

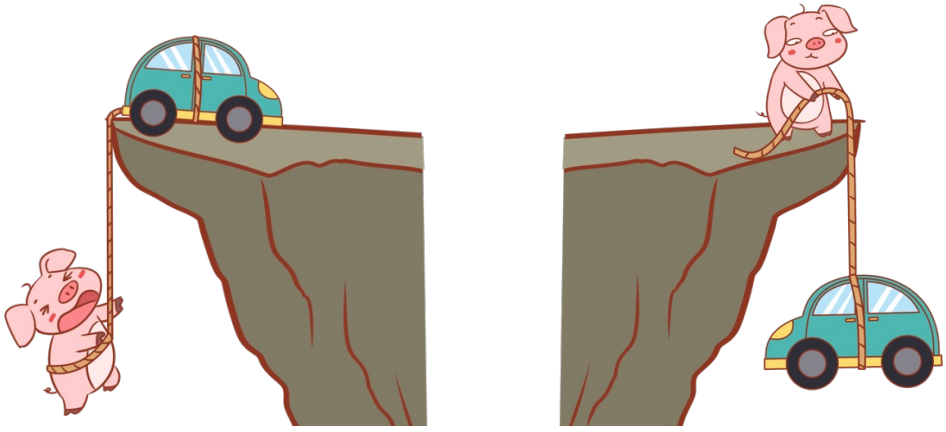


Figure 5.3: Example trial in Experiment 1 for sentence (5b) '*The car was pulled by the pig.*'

choice was also semi-randomized across trials to avoid three or more than three consecutive correct answers on the same side.

Due to the COVID-19 pandemic, the experiment was conducted online via a video call, with the child and their caretaker/teacher on the one end and the experimenter on the other end. The experimenter shared her screen, displaying the materials in a PowerPoint slideshow. During the test, the child communicated their answers by pointing to the selected picture, and the adult accompanying them verbally reported which side of the screen was indicated. The test continued only after an answer was given for the previous trial. If a child was unsure about which picture to choose, the experimenter would replay the recorded sentence once more, encouraging them to do their best. The adult accompanying the child was specifically instructed that the test results were anonymously stored, did not reflect the child's cognitive capabilities or intelligence, and that they should always report the child's responses truthfully. The child's choices (left vs. right) were written down and later coded as correct vs. incorrect by the experimenter.

5.2.5. Subjects

The final sample includes data from 78 monolingual Mandarin-speaking 3- to 6-year-olds. All participants were recruited from Changsha, Hunan Province, China, and surrounding areas, through local daycare centers and kindergartens. The participating families received a compensation of RMB 60 yuan in cash (approximately USD 10). None of the participants had a history of language or cognitive impairment. Participant data is given in Table 5.2.

Table 5.2: Age information of subjects in Experiment 1

Age	Age Range	Mean	Number
3-year-olds	3;01-3;11	3;08	18
4-year-olds	4;01-4;11	4;05	23
5-year-olds	5;00-5;11	5;05	18
6-year-olds	6;00-6;08	6;04	19
All subjects	**3;01-6;08**	**4;11**	**78**

An additional 9 children were tested but excluded due to their chance or below-chance performance on the control trials: three or more errors in the 12 active sentences (binomial test, $p = .05$).

5.2.6. Results

Because our dependent variable is binary (i.e., correct vs. incorrect responses), we use a mixed-effects logistic regression model to used R (R Core Team 2013) to analyze our data . In our model, Age (in months) was considered a continuous variable. Nonetheless, a more detailed age-based breakdown of our results is provided in Table 5.3 for a transparent demonstration.

Table 5.3: Experiment 1 results by age (excluding the verb 'pin down')[a]

Age	Actives			Long Passives			Short Passives			Ave.
	Match	MisM	Ave.	Match	MisM	Ave.	[+ani]	[−ani]	Ave.	
3	93.33%	91.67%	92.59%	77.78%	86.11%	81.48%	91.67%	90.00%	90.74%	**88.27%**
4	94.78%	95.65%	95.17%	75.65%	72.83%	74.40%	93.48%	86.09%	89.37%	**86.31%**
5	91.11%	88.89%	90.12%	75.56%	91.67%	82.72%	90.28%	94.44%	92.59%	**88.48%**
6	95.79%	96.05%	95.91%	78.95%	92.11%	84.80%	96.05%	93.68%	94.74%	**91.81%**
Ave.	**93.85%**	**93.27%**	**93.59%**	**76.92%**	**84.94%**	**80.48%**	**92.95%**	**90.77%**	**91.74%**	**88.60%**

[a] MisM = Mismatch; [+ani] = animate subject; [−ani] = inanimate subject

The full model includes **Sentence Type** (actives, long passives, and short passives), **Featural Condition** (match/mismatch for long passives and actives; not applicable to short passives), and **Age** (in months), as well as all their interactions. Additionally, the model includes random intercepts for participants and verbs, to allow for individual differences across children and tested verbs. The significance of each fixed and random effect was tested using step-wise model comparisons with the *anova()* function in R.

The random effect of verb turned out to be significant ($\chi^2(1) = 62.904, p < .001$), so we first examined children's performance on each verb separately. Table 5.4 shows the breakdown of the results by verb in the control trials (i.e., active sentences). Among the four verbs, the verb *ya-dao* 'pin down' proved particularly difficult for children to understand, as it was the only verb with a correct rate of less than 90% in the control trials. Furthermore, as shown in Table 5.5, children behaved disproportionately better with this verb when it was tested in the Animacy-matched scenarios (e.g., Figure 5.4a) than in the mismatched ones (e.g., Figure 5.4b), with a 92.31% average correct rate across *all* sentence types in the former and only 65.13% in the latter, even in the active control trials (97.44% vs. 83.33%).

Table 5.4: Correctness of the four verbs in the control trials of Experiment 1

		Animacy-match, active sentences	Animacy-mismatch, active sentences	All actives
zhuang-dao	**'bump into'**	96.15%	87.18%	93.16%
lan-zhu	**'block'**	91.67%	98.72%	94.02%
ya-dao	**'pin down'**	97.44%	83.33%	88.03%
la-zhu	**'pull'**	93.59%	89.96%	93.59%
Average		94.44%	89.96%	92.20%

Table 5.5: Correctness of the four verbs in all Match/Mismatch conditions in Experiment 1

		Match	Mismatch	Average
zhuang-dao	**'bump into'**	86.67%	82.05%	84.62%
lan-zhu	**'block'**	86.67%	95.51%	90.60%
ya-dao	**'pin down'**	92.31%	65.13%	77.21%
la-zhu	**'pull'**	89.74%	91.28%	90.60%
Average		88.60%	82.91%	85.75%

(a) The verb *ya-dao* 'pin down' in Animacy-matched scenarios

(b) The verb *ya-dao* 'pin down' in Animacy-mismatched scenarios

Figure 5.4: Example pictures for the verb 'pin down' in Experiment 1

It is unclear why children had difficulties particulary with the verb *yadao* 'pin down' when it had an inanimate Theme (see Figure 5.4b), compared to an animate Theme (Figure 5.4a). However, because of its distinctive behavior, we excluded the trials with this verb from our analysis. The model was then re-run, and the results are discussed below.

We first analyzed the entire set of data. Step-wise model comparison showed that Age (in months) ($\chi^2(6) = 7.86, p = .25$) was not a significant predictor of children's performance. There were significant effects of Sentence Type ($\chi^2(8) = 78.11, p < .001$) and Featural Condition ($\chi^2(6) = 13.09, p = .04$). More specifically, as shown in Figure 5.5, children performed worse with long passives than actives (z-value $= -6.73, p < .001$), while their performance with short passives and actives was not significantly different (z-value $= -0.69, p = .49$), consistent with our first prediction on the effect of Sentence Type.

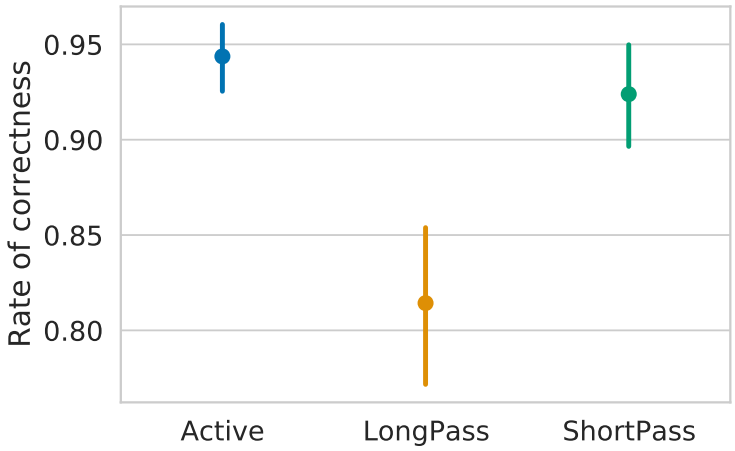


Figure 5.5: Rates of children's correct response for the three Sentence Types in Experiment 1

To examine the effect of featural manipulation between the IA and the EA, we focused on trials with sentences with two arguments (i.e., excluding short passives). The interaction between Sentence Type and Featural Condition was also significant ($\chi^2(2) = 6.41, p = .04$). The difference between the Animacy-matched vs. mismatched trials was only significant in long passives ($\chi^2(2) = 9.34, p = .01$) – with Animacy-mismatched trials outperforming the matched ones (z-value $= 2.31, p = .02$) – but not in actives ($\chi^2(2) = 0.26, p = .88$), as shown in Figure 5.6.[4] These

[4]The manipulation of the Animacy level of the only argument in short passives had *no* significant effects on chil-

results are consistent with the predictions of the Intervention Hypothesis, although they could also align with an alternative explanation, as discussed in Section 5.3.2.

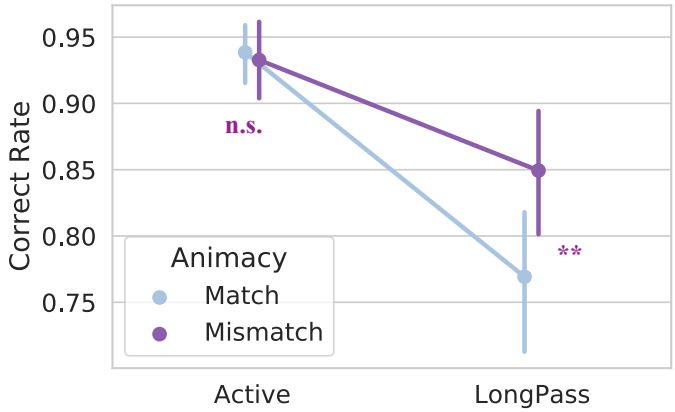


Figure 5.6: Interaction between sentence types and feature conditions in Experiment 1

5.3. Discussion

5.3.1. Intervention effects in long passives

As outlined in Section 2.1.3, the EA is a structural intervener in the dependency between the IA and its gap in long *bei*-passives, whereas it is structurally absent in short *bei*-passives:

(7) a. Long *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ $\boxed{\text{EA}}$ $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$ $]$ $]$ $]$

Intervention difficulties

b. Short *bei*-passives:

$\ldots [_{beiP}$ IA BEI $[_{VoiceP}$ $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$ $]$ $]$ $]$

No intervention difficulties

We therefore expect intervention effects only in long passives in Mandarin and therefore children should have more difficulty with long passives than short passives. Our results bear out

dren's performance ($\chi^2(2) = 2.06, p = .36$) – children did *not* find short passives with a [−ani] subject easier than those with a [+ani] subject (z-value $= -1.05, p = .30$).

this prediction: Long passives are significantly more difficult than short passives and actives for Mandarin-speaking 3- to 6-year-olds.

Moreover, short passives were comprehended as accurately as their active counterparts, indicating that neither the passive marker *bei* nor the images used in the experiment were inherently difficult for the children and their performance was independent of these factors. Considering the delayed acquisition of passives in many (but not all) languages, the good performance (even for the youngest group tested) on Mandarin short passives might be surprising, especially given that there is no adjectival strategy in Mandarin (i.e., short passives are not homophonous with adjectival passives; see Section 1.4). However, under the Intervention Hypothesis, this is expected: In contrast to languages such as English, in which the EA in short passives is an implicit argument that is present in the structure but phonologically null (e.g., Colins 2005; c.f. Legate 2014), in Mandarin short passives, the EA is *not* syntactically projected. That is to say, there is no argument intervening for the syntactic movement of the IA in short passives; therefore, short passives in Mandarin are not predicted to be especially difficulty for children.[5] Our findings suggest that children encounter difficulty in establishing the dependency between the IA and its gap only when this process is hindered by an intervening EA, as seen in Mandarin long *bei*-passives.

Lastly, our manipulation of the Animacy feature affected children's performance on long passives exclusively, improving comprehension when there was a mismatch between the Animacy of the IA and the EA. This interaction between Sentence Type and Featural Condition is also predicted by the Intervention Hypothesis because the mismatch in the Animacy of the two arguments – a morphosyntactic feature in Mandarin – mitigates the difficulty caused by structural intervention, and structural intervention only exists in long passives. However, as we discuss below, these results are also compatible with another explanation, as are most other studies that have looked at animacy as an intervention-triggering feature.

[5]In languages where the EA is realized as an implicit argument (but not an adjunct) in short passives, the Intervention Hypothesis predicts that the short passives should be equally difficult for children as the long passives, due to the intervention effects. For example, Orfitelli (2012) argued that English-speaking children are subject to the intervention difficulties in both long and short passives because there is an implicit EA in the latter.

5.3.2. An alternative explanation of the Animacy effects

To create naturalistic test scenarios, we ensured that the EA/Agent was always animate. It was the Animacy of the IA/Theme (i.e., object in active sentences and subject in passives) that varied depending on the different Featural Conditions. Therefore, the Animacy-matched trials contained two animate arguments but never two inanimate ones, whereas the Animacy-mismatched trials had an animate Agent and an inanimate Theme, but never the other way around.

Studies have shown that an inanimate EA independently causes difficulty in children's comprehension as it represents a "non-canonical event" (e.g., Slobin 1982, Childers & Echols 2004). For example, in a production study by de Villiers (1980), 37 English-speaking children (2;10-4;10) were trained to produce passives (and cleft sentences) in imitation and expansion tasks. In general, children produced more correct passives with an animate Agent and an inanimate Theme, compared to passives with animate Agent and Theme, no matter which of these two types of sentences they were trained with.[6]

Thus, while our intent was to reduce the (extralinguistic) oddness of having an inanimate EA/Agent in the test sentences, it is possible that children's better performance with the Animacy-mismatched long passives might have come from their preference for a canonical event, in which an animate Agent acts on an inanimate Theme (e.g. Chapman & Miller 1975, Corrigan 1982, Slobin 1982).

In other words, the match $<$ mismatch asymmetry may not have been due to a mismatch in Animacy features *per se*, but rather due to an extra-grammatical strategy by which children, when faced with a difficult structure, such as an intervention configuration, default to a canonical "animate = Agent"/"inanimate = Theme" association. This same strategy could explain the results

[6]This is a simplified way of summarizing de Villiers' data. In fact, she tested three types of sentences: Type A was sentences with two animate NPs and a reversible action (e.g., *pig hit sheep*); Types B and C were sentences with an animate Agent and an inanimate Theme, differentiated (roughly) by the level of semantic transitivity of the verb, e.g., *dog bite chair* (Type B) vs. *dog smoke pipe* (Type C). Her definition of "prototypical" sentences would be Type A, contra to our study and the other research cited here arguing that the "prototypical" sentence is contains an animate Agent and an inanimate Theme. In her experiment, four groups of children were trained on Type A sentences and one group was trained on Type C sentences. In either case, children's performance with Type A sentences (animate Agent and Theme) was worse than Types B and C (animate Agent and inanimate Theme).

from previous studies investigating the interaction between Animacy and intervention effects (e.g., Arosio et al. 2011, Durrleman et al. 2016, Bentea et al. 2016). The only exceptions are a study by Mateu and Hyams (2021) that tested all four possible animacy combinations, i.e., both animate ([+][+]), both inanimate ([−][−]), animate subject with inanimate object ([+][−]), and inanimate subject with animate object ([−][+]), and a study by Adani (2012) that tested three (excluding the [−][−]). In both these studies, children's advantage with Animacy-mismatched sentences seemed to come from the canonical [+][−] mismatch, but not the non-canonical [−][+] mismatch.

Here we discuss Mateu and Hyams' study on English-speaking children's comprehension of sluices, i.e., a CP with a *wh*-remnant and an elided TP. In subject sluices, such as (8), the movement of the *wh*-phrase is not intervened; whereas in object sluices, such as (9), it is intervened by the (later-deleted) embedded subject.

(8) a. Someone is pushing the boy, can you see who ~~[___is pushing the boy]~~? ([+][+])
b. Something is pushing the car, can you see what ~~[___is pushing the car]~~? ([−][−])
c. Someone is pushing the car, can you see who ~~[___is pushing the car]~~? ([+][−])
d. Something is pushing the boy, can you see what ~~[___is pushing the boy]~~? ([−][+])

(9) a. The boy is pushing someone, can you see who ~~[the boy is pushing ___]~~? ([+][+])
b. The car is pushing something, can you see what ~~[the car is pushing ___]~~? ([−][−])
c. The boy is pushing something, can you see what ~~[the boy is pushing ___]~~? ([+][−])
d. The car is pushing someone, can you see who ~~[the car is pushing ___]~~? ([−][+])

In their study, English-speaking 3- to 6-year-olds performed worse on object sluices (9) compared to subject sluices (8) in a character-selection task, arguably due to intervention effects that only occur in the object sluices. These children did better with object sluices when the subject and object mismatched in Animacy (9c-d) with an average 85% correct rate, compared to the matched trials (9a-b), 73.75%.

However, children's performance was different in the two mismatch cases: the [+][−] object sluices such as (9c) were much easier for children (92.5%) than the [−][+] ones such as (9d)

(77.5%). The [+][−] mismatch contributed most of the advantage of the Animacy-mismatched trials over the matched ones, while the [−][+] mismatch did not seem to improve children's performance compared to the match condition. Mateu and Hyams also tested children's comprehension of RCs and found exactly the same patterns: (i) object RCs were harder than subject RCs, (ii) the mismatch in Animacy improved children's performances with object RCs, and (iii) the [+][−] mismatch contributed most of this improvement. It is fair to say that in both object sluices and object RCs, the intervention effects in children's comprehension were mitigated by the canonical [+][−] Animacy mismatch *alone*.

From early childhood, children can distinguish between animate vs. inanimate entities and utilize Animacy cues to assign thematic roles (e.g., Rakison & Poulin-Dubois 2001, Gelman & Opfer 2002, Stoops, Luke, & Christianson 2014). Thus, any study attempting to manipulate Animacy as a morphosyntactic feature relevant for intervention runs into the problem of children's preference for or better performance with canonical events (animate Agent with inanimate Theme). To avoid this confounding issue, our next experiment examined two other features in Mandarin, Shape and Number. These features do not show the same kind of intrinsic extra-grammatical bias as Animacy and the potential effect on Mandarin passive comprehension.

CHAPTER 6

Number, Shape, and Intervention Effects in child Mandarin passives

6.0. Introduction

Along the same lines as Experiment 1 in the previous chater, Experiment 2 examines Mandarin-speaking children's comprehension of *bei*-passives with respect to (i) the presence of an intervener and (ii) the effects of featural match/mismatch between the two arguments in actives and long passives (short passives only have one argument). According to the Intervention Hypothesis, the comprehension of long passives by children is predicted to be inferior to that of short passives and actives, due to the structural intervention by the EA in long passives.

As previously discussed in Section 1.3, languages vary in which features are relevant for intervention, and the (type of) features involved in intervention is not a settled issue. In Chapter 5, we discussed the role Animacy plays in modulating children's intervention difficulties in Mandarin. However, a confounding factor exists, specifically that children may favor an animate Agent and inanimate Patient, mirroring a "canonical event". Thus, in the current chapter, we conduct a second experiment manipulating two different features – Number and Shape – in order to more reliably investigate what features are relevant for the computation of intervention in child languages.

In Mandarin, Number and Shape are encoded on *classifiers*, which conveniently allows for minimal difference control in the two relevant features in the test sentences. Unlike Experiment 1, where the mismatch conditions involved only a unidirectional Animacy mismatch (i.e., an animate Agent with an inanimate Theme, but not vice versa), Experiment 2 involves bidirectional feature

mismatch. In Section 6.1, we recapitulate the background of our research question – Which features are involved in intervention locality in child grammar? – and propose predictions for our experiment based on three different hypotheses. In Section 6.2, we show that both Number and Shape are encoded on Mandarin classifiers and introduce the three classifiers used in our experiment. Section 6 lays out the details of Experiment 2 and Section 6.4 discusses our findings and their implications.[1]

6.1. Which features are relevant for intervention?

6.1.1. A recap on previous literature

Here we recapitulate the theoretical and empirical background of our study that has been introduced in Sections 1.2 and 1.3. The Intervention Hypothesis claims that children are subject to a stricter version of fRM, such that even a partial overlap in relevant features between the intervener and the target element causes difficulties in their comprehension (e.g., Friedmann et al. 2009, Adani et al. 2010, Belletti et al. 2012), as illustrated in (1).

(1) $\ldots\ X_{[A][B]} \ldots [\ \boxed{Z_{[A]}}\ [\ \ldots\ Y_{[A][B]} \ldots\ ]\ ]$
Intervention difficulty

Previous studies in different languages have shown that the intervention difficulty is mitigated when particular features of X and Z mismatch; these features include *Number* (Italian, Adani et al. 2010; English, Adani et al. 2014; Spanish, Mateu 2022), *Gender* (Hebrew, Belletti et al. 2012), *Animacy* (Italian, Arosio et al. 2011; French, Durrleman et al. 2016, Bentea et al. 2016; English, Mateu & Hyams 2020, 2021), and *lexical restriction or NP type* (e.g., Hebrew, Friedmann et al. 2009; English, Choe 2013).

Languages vary in which features are relevant for intervention. Belletti et al. (2012) proposed that "only features functioning as attractors for syntactic movement will enter into the computation of intervention". They arrived at this conclusion based on their observation that Gender modulates

[1]Part of this chapter has been published in the Proceedings of the 47^{th} annual Boston University Conference on Language Development (M. Liu, Mateu, and Hyams 2023).

intervention in child Hebrew but not child Italian. In this study, the researchers used verbal inflection as the sole diagnostic for identifying features that trigger syntactic movement. Therefore, their hypothesis essentially posits that only features realized on the clausal inflectional head (i.e., as verb agreement) are relevant for intervention.

However, other proponents of the Intervention Hypothesis assume a wider stance and argue that any morphosyntactic feature can be involved in the computation of intervention, even if it is not realized on the inflectional head, for example, Animacy (see Arosio et al 2011; Durrleman et al 2016; a.o.).

Lastly, memory-based processing approaches such as Similarity-based Interference (e.g., Gordon et al. 2002; Lewis et al. 2006; a.o.) also appeal to a notion of intervention but differ from structural accounts in that they are linear and do not rely specifically on morphosyntactic features – the triggering similarities may be along any dimension, i.e., morphosyntactic, purely semantic, or phonological.

In this chapter we aim to address the question by examining two different features in Mandarin long passives. We lay out the predictions of Experiment 2 in more detail in the following section.

6.1.2. Predictions for Experiment 2

In Experiment 2 in the current chapter, we examine intervention effects in child Mandarin passives with respect to two different features: Number and Shape. Number is a morphosyntactic feature encoded on the classifier head in Mandarin; and Shape is an inherent lexico-semantic feature that is also realized on the classifier (see Section 6.2). Neither of these two features triggers verb agreement in Mandarin, a language that globally lacks morphological agreement.

To diagnose the features involved in the calculation of intervention in child grammar, we can examine the mismatch-facilitation effect in children's long passive comprehension. If a feature contributes to intervention computation, a mismatch between the external and internal arguments regarding that feature in long passive trials would reduce the difficulty of intervention in children's comprehension, compared to feature-matched long passives.

Based on the various features analyzed and hypotheses proposed in previous literature (see Section 1.3), we put forth three hypotheses regarding the relevant features for intervention in child grammar. Each hypothesis predicts a different outcome for our experiment, as outlined below:

The first hypothesis (2a) aligns with the memory-based approaches such as Similarity-based Interference (e.g., Gordon et al. 2001, 2004, Lewis & Vasishth 2005, Van Dyke 2007), under which a broader range of features may lead to interference, including (i) morphosyntactic features, such as Number; (ii) semantic features, such as professional occupations; (iii) and phonological features, such as phonological overlap (see references in Section 1.3).

(2) a. Hypothesis I: All linguistic features, including morphosyntactic as well as lexico-semantic features, are relevant for intervention.

b. Prediction of Hypothesis I: The mismatch of either the Number or Shape feature will facilitate children's comprehension of long passives, compared to the all-matched trials, because both Number and Shape are morphologically realized on Mandarin classifiers.

Our second hypothesis (3a) corresponds to the grammar-based approaches to children's intervention effects that posit the involvement of morphosyntactic features in intervention, regardless of whether they are encoded on the clausal inflectional head (e.g., Garaffa & Grillo 2008, Friedmann et al. 2009, Arosio et al. 2011, Durrleman et al. 2016, Mateu & Hyams 2021).

(3) a. Hypothesis II: Only morphosyntactic features (e.g., Number) – but not lexico-semantic features (e.g., Shape) – are relevant for intervention, even if they are not overtly realized on the inflectional head.

b. Prediction of Hypothesis II: We will observe an improvement in children's interpretation of long passives with a Number mismatch but not a Shape mismatch.

Our last hypothesis (4a) aligns with the grammar-based approaches that argue only morphosyntactic features triggering syntactic movement are involved in the calculation of intervention (e.g., Belletti et al. 2012, Angelopoulos et al. 2022, Biondo et al. 2022). Specifically, these features are

realized on the clausal inflectional head (i.e., as verb agreement).

(4) a. Hypothesis III: Only features triggering syntactic movement (as evidenced by verbal inflection) are represented in the computation of intervention locality.

b. Prediction of Hypothesis III: Neither Number nor Shape will show mismatch facilitation effects because neither of these two features is instantiated in the verb in Mandarin. Therefore, there is no evidence that they trigger syntactic movement (at least for children).

In the following section we present some background on Mandarin classifiers and how Number and Shape are encoded on this head. Experiment 2 is discussed in Section 6.3 and addresses the question of what features participate in intervention in child grammar by examining the match/mismatch effect of these two features in Mandarin-speaking children's comprehension of passives.

6.2. Number, Shape, and their realization on classifiers in Mandarin

Mandarin lacks obligatory Number marking on nouns.[2] It has been argued that the classifier (Cl^0) is the locus of grammatical number in Mandarin as it bears the individualizing function (i.e., of picking out a single instance of the predication provided by the NP) that is required in counting (e.g., Chierchia 1998, 2010, Cheng & Sybesma 1999, 2012, Borer 2005). Therefore in Mandarin, numerals do not directly combine with nouns; instead, a classifier is obligatory, as shown in (5).

(5) a. san***(-ge)** pingguo
three-CLF apple
'three apples'

[2]Some have proposed that the suffix *-men* is a plural morpheme in Mandarin (e.g., Y.-H. Li 1999, Jiang 2017). However, there is evidence to believe that this suffix is not a plural morpheme. First of all, Mandarin bare nouns can be interpreted as either singular or plural – in other words, *-men* is not required to denote plurality. Second, *-men* is different from a plural morpheme in both its distribution and semantics, in that it is restricted to person pronouns and human-denoting nouns; it sometimes appears on proper names; and it can only have a definite interpretation. Based on these properties, many studies have argued against the analysis of *-men* as a plural morpheme in Mandarin (e.g., Iljic 1994, 2001, Kurafuji 2004, Chierchia 2010, Kim & Meng 2022).

b. $[_{\text{NumP}}\ \text{Num}^0\ [_{\text{ClP}}\ \textbf{Cl}^0\ [_{\text{NP}}\ \text{N}^0]\ ]\ ]$ (e.g., Cheng & Sybesma 1999; cf. N. Zhang 2011)

The classifier *-ge* in (5a) is a non-plural, general classifier that can combine with any numeral. In Mandarin, there is a plural classifier *-xie* which combines only with the numeral *yi* 'one' to mark the DP as (indefinite) plural, as shown in (6b) (e.g., Norman 1988, C. Li & Thompson 1989, Cheng & Sybesma 1999, Y.-H. Li 1999, 2012, Y.-H. Li & Shi 2003, Wu 2019).

(6) a. yi-**ge** pingguo
one-CLF apple
'one apple'

b. yi-**xie** pingguo
one-CLF_{PL} apple
'some apples'

What is important for our experiment design is that *-xie*, which we treat as a classifier, bears a Number feature [+PL] and it therefore is different from the non-plural classifier *-ge* in our test sentences, creating a Number mismatch condition, although different theories exist in the literature regarding the status of *-xie* in Mandarin, which we briefly discuss below.

First, the observation that *-xie* can be followed by the general classifier *-ge* in some Mandarin dialects (usually in colloquial speech), as shown below in (7c), has led some researchers to conclude that *-xie* is not a classifier but a quantifier which is parallel to English *some/several* (e.g., Borer 2005, Hao 2020).

(7) a. zhe-ge/ben shu
this-CLF book
'this book'

b. zhe-xie shu
this-CLF_{PL} book
'these books'

c. zhe-xie -ge/*ben shu
this-CLF_{PL} -CLF book
'these (many) books'

However, examples like (7c) are more of an idiosyncratic usage than evidence against a classifier analysis of *-xie*. First, this combination is highly restricted because *-xie* can only co-occur with the general classifier *-ge* but not other classifiers in Mandarin, such as *-ben* in (7c). Secondly, the

interpretation of (7c) is different from (7b) in which there is not a secondary classifier *-ge*. Some studies have analyzed the *-ge* after *-xie* as a clitic that expresses the speaker's subjective attitude, such as exaggeration, casualness, negativity, or discontent – as opposed to a general classifier (e.g., Y. Li 2014). Lastly, when it follows *-xie*, *-ge* usually undergoes phonetic reduction in that it becomes shorter and its falling tone is replaced by a neutral tone. This reduction is not observed when *-ge* follows quantifiers such as *henduo* 'many', suggesting that *(zhe/yi)-xie* is different from regular quantifiers. The pragmatic effects and the syntactic derivation of the co-occurring *-xie* and *-ge* are beyond the scope of our current study.

A second apparent counterexample to *-xie* being a plural classifier is that it can combine with mass nouns such as *shui* 'water' (e.g., *yi-xie shui* 'some water'), which has led some researchers to argue that *-xie* is a partitive classifier (e.g., Chao 1968) or an indefinite classifier (e.g., Zhu 1982). Indeed, *-xie* denotes partitive quantification like the English *some* when it combines with mass nouns. Nonetheless in our experiment, all the nouns were count nouns (e.g., *gou* 'dog', *mao* 'cat') and therefore the classifier *-xie* can only be interpreted as a plural classifier and not a partitive one, which requires mass nouns. There is also another alternative analyses of *-xie* in previous literature as a collective or plural element on the Num^0 head (e.g., Iljic 1994, 2001, S.-F. Yang 2005). Our study remains agnostic as to these analyses.

Additionally, in Mandarin, there exist some "specific classifiers" that mark the inherent *lexical* (thus *non-morphosyntactic*) properties of the noun such as the shape or size of the denoted entity. For example, the shape-specific classifer (i.e., classifiers restricted to the nouns that denote entities of a specific shape) in the examples below, *-tiao*, s(emantically)-selects for some nouns denoting long-bodied entities, such as snakes and streets in (8a), but not entities of other shapes in (8b).

(8) a. yi-**tiao** she/jie
one-CLF snake/street
'a snake/street'

b. yi-**tiao** *houzi/*che
one-CLF monkey/car
Intended: 'a monkey/car'

By contrast, the general classifier *-ge* in (5a) and (6a) does not have such s-selection requirements and is often (but not always) interchangeable with other specific classifiers. It is the most common

classifier in Mandarin (e.g., C. Li & Thompson 1989). It also the first classifier children acquire and functions as a place-holder for Cl^0 before children produce specific classifiers that have semantic restrictions (e.g., Erbaugh 1986, Loke 1991, Q. Hu 1993).

In Experiment 2, we manipulated these three classifiers in our test sentences (Section 6.3.1): (i) the general classifier *-ge* that is non-plural and non-shape-specific, (ii) the plural classifier *-xie* that encodes the [+PL] feature, and (iii) the shape-specific classifier *-tiao* that s-selects for a long-bodied entity. All three of them occur early in child spontaneous speech, as shown by the utterances in (9) (CHILDES corpora, MacWhinney 1990). We therefore expect 3-year-olds, the youngest age we tested, to have knowledge of these classifiers. Nevertheless, as we will discuss in our experiment procedure (Section 6.3.2), we also verified this in a pre-test session.

(9) a. hai you yi-**ge** jiuhuche (2;2)
still have one-CLF ambulance
'There is still an ambulance.'

b. yi-**xie** xiaoqiche (2;9)
one-CLF_{PL} car
'some cars'

c. zhebian yi-**tiao** xian (2;4)
here one-CLF line
'Here is a line.'

By manipulating these three classifiers (*-ge*, *-xie*, and *-tiao*), we were able to test the effects of the match/mismatch of Number and Shape features on children's comprehension of long passives, as shown in Table 6.1.

Table 6.1: Manipulation of the classifiers in Long Passives in Experiment 2

	Long Passive trials
Match	[$_{DP}$ *yi-**ge** . . .*] *bei* [$_{DP}$ *yi-**ge**. . .*] . . .
Number Mismatch	[$_{DP}$ *yi-**xie** . . .*] *bei* [$_{DP}$ *yi-**ge**. . .*] . . . OR [$_{DP}$ *yi-**ge** . . .*] *bei* [$_{DP}$ *yi-**xie**. . .*]. . .
Shape Mismatch	[$_{DP}$ *yi-**tiao** . . .*] *bei* [$_{DP}$ *yi-**ge**. . .*] . . . OR [$_{DP}$ *yi-**ge** . . .*] *bei* [$_{DP}$ *yi-**tiao**. . .*] . . .

6.3. Experiment 2

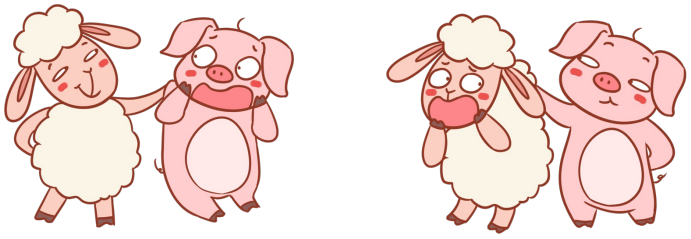
6.3.1. Design and materials

The experiment was a two-choice sentence-picture matching task with a 3 × 3 design, crossing three Sentence Types (Actives, Long Passives, and Short Passives) and three Feature Conditions (Match, Number Mismatch, and Shape Mismatch). In total, there were 54 trials, six per condition, varying among 4 verbs: *zhuang-dao* 'bump into', *yao-zhu* 'bite', *zhua-dao* 'catch', and *ya-zhu* 'pin down'. As in Experiment 1, these verbs were all actional RVCs, which presumably make the scenarios and sentences easy for young children to understand. Unlike Experiment 1, none of the verbs were excluded. Children performed well (above 95% correct) with all four verbs in the control trials (i.e., Actives).[3]

By controlling the classifier of the DP, in this experiment we manipulated (i) the **Number** of the DP with the plural classifier *-xie* vs. the non-plural, general classifier *-ge*, and (ii) its lexical property – more specifically the **Shape** of the entity – with the shape-specific classifier *-tiao* vs. the non-shape-specific, general classifier *-ge*. The sub-figures in Figure 6.1 exemplify the Match scenarios (Fig. 6.1a), the Number Mismatch scenarios (Fig. 6.1b), and the Shape Mismatch scenarios (Fig. 6.1c) for the verb item *zhua-dao* 'catch'. See Appendix C for a complete list of trials.

Actives and Long Passives contain both the EA and the IA. In the *Match* trials, both are marked with the general classifier *-ge*, as in (10a) and (11a). In the *Number Mismatch* condition, such as (10b) and (11b), half of the trials had the first DP (Agent in Actives or Patient in Long Passives) marked with the plural classifier *-xie*, and the second with the non-plural general classifier *-ge*. The other half reversed the order of the two classifiers with *-xie* on the first and *-ge* on the second. Likewise, in the *Shape Mismatch* sentences, such as (10c) and (11c), the distribution of the two classifiers – the non-shape-specific *-ge* and the shape-specific *-tiao* – was also balanced.

[3]The verb 'pin down' was excluded from Experiment 1 because children performed poorly on the control trials (i.e., active sentences) containing this verb when the two arguments mismtach in animacy. Nonetheless, this is not a problem in the current experiment because all the arguments were animate and children understood this verb well with animate arguments.



(a) A Match scenario (one-***ge*** sheep and one-***ge*** pig)

(b) A Number Mismatch scenario (one-***xie*** cows vs. one-***ge*** elephant)

(c) A Shape Mismatch scenario (one-***tiao*** dragon vs. one-***ge*** cow)

Figure 6.1: Example test pictures for *zhua-dao* 'catch' in Experiment 2

(10) a. Active; Matched (trial 34)

yi-**ge** houzi zhua-dao le yi-**ge** huli
one-CLF monkey catch PRF one-CLF fox
'A monkey caught a fox.'

b. Active; Mismatched in Number (trial 4)

yi-**xie** xiao-mao zhua-dao le yi-**ge** xiao-gou
one-CLF_{PL} little-cat catch PRF one-CLF little-dog
'Some cats caught a dog.'

c. Active; Mismatched in lexical properties (trial 40)

yi-**ge** yazi zhua-dao le yi-**tiao** xiao-yu
one-CLF duck catch PRF one-CLF little-fish
'A duck caught a fish.'

(11) a. Long passive; Matched (trial 21)

yi-**ge** xiao-yang bei yi-**ge** xiao-zhu zhua-dao le
one-CLF little-sheep BEI one-CLF little-pig catch PRF
'A sheep was caught by a pig.'

b. Long passive; Mismatched in Number (trial 51)

yi-**ge** daxiang bei yi-**xie** xiao-niu zhua-dao le
one-CLF elephant BEI one-CLF_{PL} little-cow catch PRF
'An elephant was caught by some cows.'

c. Long passive; Mismatched in lexical properties (trial 24)

yi-**tiao** xiao-long bei yi-**ge** xiao-niu zhua-dao le
one-CLF little-dragon BEI one-CLF little-cow catch PRF
'A dragon was caught by a cow.'

In Short Passives there was only one argument in the syntactic structure, the IA surface subject. Nonetheless, the "Match" or "Number/Shape Mismatch" between the agent and the patient of the event was depicted in the test pictures in the same way as the other two sentence types (shown in Figures 6.1), controlling for potential extralinguistic factors such as complexity of the pictures. The "*Match*" short passives contain an IA subject with the general classifier *-ge* (12a). In the "*Number Mismatch*" short passives, half of the trials have a subject marked with *-xie* (plural) as in (12b), and the other half with *-ge* (non-plural). The pictures paired with these sentences depicted events with Number-Mismatched arguments as in Figure 6.1b (above). Similarly, for the "*Shape Mismatch*" short passives, the distribution of the shape-specific classifier *-tiao* and the general classifier *-ge* is also balanced between trials, and all were tested with Shape-Mismatched pictures as Figure 6.1c (above).

(12) a. Short passive; Matched (trial 26)

yi-**ge** xiao-zhu bei zhua-dao le
one-CLF little-pig BEI catch PRF
'A pig was caught.'

b. Short passive; Mismatched in Number (trial 32)

yi-**xie** huli bei zhua-dao le
one-CLF_{PL} fox BEI catch PRF
'Some fox(pl.) were caught.'

c. Short passive; Mismatched in lexical properties (trial 44)

yi-**tiao** xiao-she bei zhua-dao le
one-CLF little-snake BEI catch PRF
'A snake was caught.'

Given that children cannot use an adjectival strategy in Mandarin (Section 1.4), they must establish the dependency between the surface subject and its gap in order to understand the short passives. Therefore, if Mandarin-speaking children perform well with short passives, it means that neither this dependency itself (i.e., when it does not cross a structural intervener), nor the passive marker *bei*, causes difficulty in child Mandarin.

6.3.2. Procedure

Similar to Experiment 1, this experiment also included a pre-test training session to familiarize the child with the task of sentence-picture matching and with the animal characters, including those in Figure 5.1 (repeated below as Figure 6.2) if the child did not participate in Experiment 1, as well as the new animals in Figure 6.3.[4]

In addtion, a pre-test session with novel nouns was conducted to ensure the child understood the grammatical requirements of the three classifiers in our experiment, *-ge*, *-xie*, and *-tiao*. The

[4]The NPs tested in Experiment 2 included *xiaozhu* 'pig', *xiaogou* 'dog', *xiaoyang* 'sheep', *xiaoniu* 'cow', *houzi*, 'monkey', *daxiang* 'elephant', *xiaomao* 'cat', *huli* 'fox', *xiaoshe* 'snake', *xiaoyu* 'fish', *yazi* 'duck', *xiaolong* '(Chinese) dragon', and *qingwa* 'frog'. A complete list of test trials is provided in Appendix C.

Figure 6.2: Animal characters in the training session

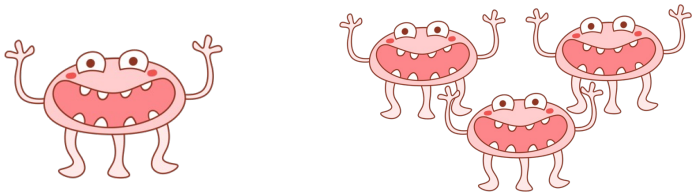
Figure 6.3: Animal characters in the training session (specific for Experiment 2)

children were first told that they were to see some aliens with unfamiliar names and presented with Figure 6.4 showing various alien creatures. They were then instructed to choose a picture that matched the pre-recorded sentences, which were all intransitive active sentences with a novel subject. The novel nouns in this test all contained two phonologically well-formed Mandarin syllables: *mi*^{21}*la*^{55}, *hu*^{35}*pa*^{51}, *bu*^{51}*na*^{51}, and *li*^{21}*la*^{55} (the numbers represent Mandarin tones).

To pass this novel noun task, they need to apply their knowledge of the relevant classifiers correctly. For example, the general classifier *-ge* in (13a) is used for a singular individual; the plural classifier *-xie* in (13b) is used for multiple entities despite of the numeral *yi* 'one'; and the

Figure 6.4: Picture of the alien creatures in the novel noun test

specified classifier *-tiao* in (13c) is only compatible with entities with narrow or long-shaped body, such as the alien on the left in Figure 6.5b, but not the one on the right. In the rare cases when the child made an error in the novel noun test, the experimenter corrected them and explained the usage of the relevant classifiers.



(a) Pictures for (13b) with classifier ***-xie*** *'I see that some hupas are laughing.'*

(b) Pictures for (13c) with classifier ***-tiao*** *'I see that a buna is sleeping.'*

Figure 6.5: Example pictures in the novel noun test

(13) a. wo kanjian zhiyou yi-**ge** mila zai pao
I see only one-CLF mila PROG run
'I see that only one mila is running.'

b. wo kanjian yi-**xie** hupa zai xiao
I see one-CLF_{PL} hupa PROG laugh
'I see that some hupas are laughing.'

c. wo kanjian yi-**tiao** buna zai shuijiao
I see one-CLF buna PROG sleep
'I see that a buna is sleeping.'

The main session consisted of 54 trials in a semi-random order, ensuring the same sentence types or the same verbs were never adjacent. The session included aself-paced break after the 27^{th} trial, splitting the session into two equal halves. Other aspects of the test followed the same procedure as Experiment 1 (see Section 5.2.4). Note that the novel nouns discussed above were only used in the pre-test training session. All NPs in the test session were familiar nouns to children (see footnote 4 on page 124).

6.3.3. Subjects

Data were collected from 80 monolingual Mandarin-speaking 3- to 6-year-olds. All except 5 of them also participated in Experiment 1 prior to this experiment on the same day in different (online) sessions. As in Experiment 1, all of the children were recruited from the city of Changsha, Hunan Province, China, and its surrounding areas and none of them had a history of language or cognitive impairment. None of the data were excluded as all children showed above-chance performance with the control trials (i.e., more than 13 correct out of the 18 Actives). Table 6.2 gives the ages of the children.

Table 6.2: Age information of subjects in Experiment 2

Age	Age Range	Mean	Number
3-year-olds	3;01-3;11	3;08	19
4-year-olds	4;01-4;11	4;05	22
5-year-olds	5;00-5;11	5;05	19
6-year-olds	6;00-6;08	6;04	20
All subjects	**3;01-6;08**	**4;11**	**80**

6.3.4. Results

In our model, Age (in months) was treated as a continuous variable. Nonetheless, we provide the break-down of our results by age in Table 6.3 for a clearer exposition.

Table 6.3: Experiment 2 results[a]

Age	Actives			Long passives			Short passives			Ave
	Match	NumMis	ShMis	Match	NumMis	ShMis	Match	NumMis	ShMis	
3	96.49%	97.37%	98.25%	83.33%	86.84%	85.09%	90.35%	92.11%	97.37%	**91.91%**
4	97.73%	97.73%	96.97%	81.06%	82.58%	83.33%	96.97%	95.45%	96.21%	**92.00%**
5	99.12%	97.37%	97.37%	78.07%	86.84%	79.82%	96.49%	99.12%	96.49%	**92.30%**
6	99.17%	96.67%	98.33%	83.33%	90.83%	90.83%	97.50%	99.17%	96.67%	**94.72%**
Ave	**98.13%**	**97.29%**	**97.71%**	**81.46%**	**86.67%**	**84.79%**	**95.42%**	**96.46%**	**96.67%**	**92.73%**
		97.71%			**84.31%**			**96.18%**		

[a] NumMis = Number Mismatch; ShMis = Shape Mismatch

Similar to Experiment 1, we used a mixed-effects logistic regression model with Response as a binary dependent variable (correct vs. incorrect Response) and Sentence Type (Actives, Long Passives, and Short Passives), Featural Condition (Match, Number Mismatch, and Shape Mismatch), and Age (in months) and their interactions as fixed effects. The model includes random intercepts for participants and verb items. The significance of each fixed and random effect was tested with step-wise model comparisons using the *anova()* function in R.

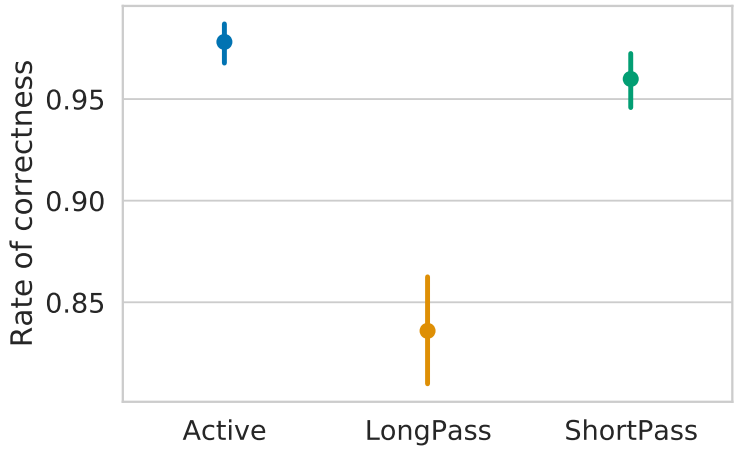


Figure 6.6: Rates of children's correct response for the three Sentence Types in Experiment 2

We first analyzed the entire set of data. Age (in months) was not a significant predictor of children's correct responses ($\chi^2(7) = 8.526, p = .289$). There was a significant effect of Sentence Type ($\chi^2(6) = 188.86, p < .001$). As shown in Figure 6.6, children's performance on Long Passives was significantly worse than on Short Passives (z-value $= -10.198, p < .001$) and Actives (z-value = $-7.243, p < .001$), consistent with the prediction of the Intervention Hypothesis. On the other hand, children's performance with Short Passives was not significantly different from Actives (z-value $= -1.888, p = .059$).

To examine the effects of featural manipulations between the IA and the EA, we then looked at data from trials with both arguments (i.e., excluding Short Passives). Results (Figure 6.7) shows that Featural Condition was not a significant predictor ($\chi^2(8) = 7.235, p = .516$). Children's performance did not improve when the two arguments mismatched in Number (z-value $= -1.236, p = .216$) or Shape features (z-value $= -0.951, p = .341$). The interaction between Sentence Type and Featural Condition was also not significant ($\chi^2(2) = 3.395, p = .183$), suggesting that featural manipulation did not make a difference in Long Passives compared to Actives.

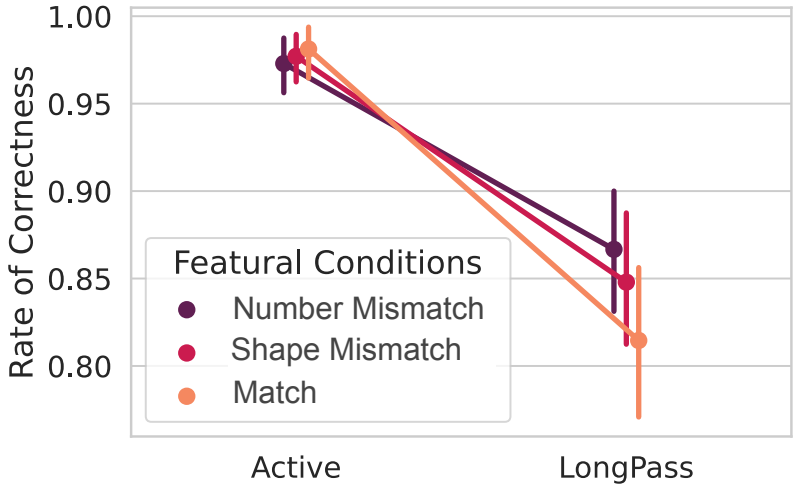


Figure 6.7: Children's performance with Actives and Long Passives under three Featural Conditions in Experiment 2

6.4. Discussion

Both Experiments 1 and 2 yielded significantly worse performance on long bei-passives compared to short *bei*-passives and actives., while children's performance on short passives was not significantly different from actives. We propose that the long $<$ short passive asymmetry in Mandarin-speaking children's comprehension is due to the structural intervention triggered by the EA that is only projected in the long but not short *bei*-passives – an intervention effect.

In Experiment 2, we manipulated the different classifiers in the EA and the IA of the verb to examine the effects of Number and Shape features in child Mandarin passives. Three hypotheses were considered, as repeated below:

(14) a. Hypothesis I: All linguistic features, including morphosyntactic as well as lexico-semantic features, are relevant for intervention.

b. Prediction of Hypothesis I: The mismatch of either the Number or Shape feature will facilitate children's comprehension of long passives, compared to the all-matched trials, because both Number and Shape are morphologically realized on Mandarin classifiers.

(15) a. Hypothesis II: Only morphosyntactic features (e.g., Number) – but not lexico-semantic features (e.g., Shape) – are relevant for intervention, even if they are not overtly realized on the inflectional head.

b. Prediction of Hypothesis II: We will observe an improvement in children's interpretation of long passives with a Number mismatch but not a Shape mismatch.

(16) a. Hypothesis III: Only features triggering syntactic movement (as evidenced by verbal inflection) are represented in the computation of intervention locality.

b. Prediction of Hypothesis III: Neither Number nor Shape will show mismatch facilitation effects because neither of these two features is instantiated in the verb in Mandarin.

We found that *neither* a mismatch of Number nor Shape improved children's performance

with long passives, suggesting that not all features are equally relevant in the comprehension of a syntactic dependency. Though Number and Shape are encoded on classifiers in Mandarin, neither is relevant for calculating intervention in child Mandarin.

Our findings thus align best with a language-specific grammatical account, such as Hypothesis III in (16), which posits that only features triggering syntactic movements in a specific language are represented in the computation of intervention in children acquiring that language. We propose that children need syntactic evidence – not mere morphological realization – in their input to determine which features are activated in their grammar (and therefore relevant for intervention). Because in Mandarin, neither Number nor Shape is instantiated in the verb, children are not exposed to any syntactic evidence that these features participate in any syntactic processes (i.e., movement and/or agreement). Consequently, in child Mandarin, these two features do not contribute to establishing a syntactic dependency and do not play a role in intervention – at least not to the same degree as has been observed in studies of other languages using similar methodologies, such as Number in English (Adani et al. 2014), Italian (Adani et al. 2010, Belletti et al. 2012), Spanish (Mateu 2022), or French (Bentea & Durrleman 2017). In these languages, Number is relevant due to its involvement in subject-verb agreement, which provides children with evidence that this feature is syntactically active and hence relevant for intervention.[5]

Based on our results, we predict that in languages lacking verbal agreement of a morphosyntactic feature X, the mismatch of X between the intervening and moved elements will not facilitate children's comprehension of intervention constructions, such as Number or Person in Vietnamese (Thompson 1988), Korean (Sohn 2001), Japanese (Hinds 2003), Māori (Bauer 2003), etc.

One apparent exception to our prediction is Animacy, a morphosyntactic feature that has been shown to modulate children's intervention effects in languages with no verbal inflection for Ani-

[5] Yet another possibility is that Number is actually relevant for intervention in child Mandarin, while our test, which manipulated the plural vs. non-plural classifiers in the IA and EA, did not capture this fact because both arguments have the Cl^0 projection (be it plural or non-plural). Since classifiers have an individualizing function and are the locus of Number in Mandarin (e.g., Cheng & Sybesma 1999, 2012), there is reason to believe that, if Number is relevant for intervention (contrary to what we found here), a mismatch in the presence vs. absence of classifier between the two arguments would improve children's comprehension of long passives. Future studies should investigate the effects of different NP types (e.g., with or without classifiers) using the same methodology as outlined above.

macy (e.g., Italian, Arosio et al. 2011; French, Durrleman et al. 2016, Bentea et al. 2016; English, Mateu & Hyams 2020, 2021). As discussed in the previous Section 5.3.2, the Animacy mismatched trials in these previous studies (and also our Experiment 1 in Chapter 5) contained only animate agents/subjects and inanimate themes/objects, but not the other way around (cf. Mateu & Hyams 2020, 2021). Consequently, children's better performance with the Animacy mismatched trials, compared to the matched ones, might result from "prototype effects", i.e., Themes/objects are more canonically inanimate than animate (e.g., Slobin 1982, Childers & Echols 2004).

To conclude, our findings suggest that long, but not short, *bei*-passives cause difficulties for children's comprehension, a surprising outcome given that long passives are more frequently produced and received by children (Chapter 4). We argue that the comprehension difficulty with long passives is a result of intervention by the EA, reflecting children's stricter intervention locality constraint in children compared to adults, as per the Intervention Hypothesis.

Our results are most compatible with a grammatical approach to intervention effects in child languages, in that there seems to be a grammatical criterion (i.e., triggering certain syntactic processes) of what may count as a relevant feature for intervention – not all morphologically realized features count and mere morphophonological or semantic dissimilarity does not significantly improve children's intervention difficulties (e.g., the classifier differences in our experiment with respect to Number and Shape).

Therefore, our results are most consistent with theories that view intervention as a grammar-specific rather than a general cognitive phenomenon (e.g., memory-based accounts). They also align with theories predicting crosslinguistic variation based on the status of individual morphosyntactic features in each language. We discuss these two points in general discussion (Sections 7.2.2 and 7.2.3).

CHAPTER 7

Summary and discussion

7.1. Summary and implications

The overarching question of our research program asks how syntactic locality constraints, especially intervention locality, are represented in child grammar. In this dissertation, we focused on the Intervention Hypothesis, which is an application of (featural) Relativized Minimality (fRM) in child grammar. This hypothesis claims that children are subject to a stricter version of fRM: even a partial featural overlap between the moved element and the intervener causes comprehension difficulties. We examined this hypothesis with L1 acquisition data from Mandarin, which is a morphologically restricted language, unlike the languages that have been investigated thus far in the intervention literature.

Our investigation benefits from the unique morphosyntactic properties of Mandarin *bei*-passive constructions. In **Chapter 2**, we explored three important syntactic properties of *bei*-passives and discussed previous analyses of this construction. First, island effects observed in both long and short passives show that there is syntactic movement of the internal argument (IA) to the edge of the *bei*-complement phrase, whether the IA is a null operator, as suggested by the null operator (NOP) movement analysis, or a full NP, as proposed by the NP movement analysis. Second, the surface subject (SS) of *bei*-passives is in an A-position, as evidenced by its ability to bind anaphors in the complement of *bei* in both long and short passive constructions, as well as the absence of weak crossover and reconstruction effects in long passives. Lastly, the external argument (EA) in long *bei*-passives is an argument – more specifically, an embedded subject – as evidenced by its ability to bind anaphors and subject-oriented logophors in an object position. Conversely, the EA

in short *bei*-passives is not projected in the syntactic structure, even as a null pronoun, because it cannot be bound or controlled, cannot license secondary predicates, and cannot control into (non-purpose) adjuncts. Instead, it is interpreted existentially (i.e., as 'someone'). Taken together, these three characteristics of *bei*-passives lead us to predict that children will face intervention difficulties in comprehending long, but not short, *bei*-passives, based on the Intervention Hypothesis.

(1) a. Long *bei*-passives:

$\ldots [_{beiP}$ Op/NP BEI $[_{VoiceP}$ (NP) $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$]]]

Intervention difficulties

b. Short *bei*-passives:

$\ldots [_{beiP}$ Op/NP BEI $[_{VoiceP}$ $[_{VP}$ V $(\ldots)$ *t* $(\ldots)$]]]

No intervention difficulties

Moreover, in Mandarin there is no verbal/adjectival passive homophones that could facilitate children's comprehension of short passives. In some other languages, such as English, children can utilize an adjectival strategy to circumvent the difficulty of establishing a movement dependency in passive comprehension (Borer & Wexler 1987, 1992). Therefore, in order to correctly understand *bei*-passives, children acquiring Mandarin must establish the dependency between the IA and its gap, which crosses an intervening argument in long (but not short) passives.

In **Chapter 3**, we provided an overview of the relevant literature concerning the L1 acquisition studies of passives. The first major finding in the literature was that passives with actional verbs are acquired earlier than passives with non-actional (especially subject-experiencer) verbs. Second, compared to short passives, long passives are rarer in children's production and, in some languages, cause more difficulties in children's comprehension. We also explored existing theories concerning two major factors affecting children's acquisition of passives – the lexical semantics of the verb and the syntactic mechanisms required in deriving this construction – as well as other factors such as input, pragmatics, and processing. The lexical semantics accounts propose that children have an adult-like passive grammar but have difficulties with passives of certain types of verbs due to lexical semantic restrictions. The grammar-based proposals attribute children's difficulties with passives to their non-adult-like/developing syntactic mechanisms necessary to derive passives.

Our corpus study in **Chapter 4** examined both these factors in the acquisition of Mandarin *bei*-passives, examining spontaneous production data by Mandarin-speaking children aged 2-6 (N = 1,182) and their caretakers. Our results replicated the cross-linguistically robust findings on the actional > non-actional passives asymmetry. However, unlike what has been observed in other languages, in Mandarin, long passives are much more frequent than short passives in both children's production and their input. Since the child data are not different from their input in this aspect, we suggest that the long > short passive production might be an input effect or some Mandarin-specific factor that affects both children and adults. What is more interesting for our research questions is that children – but not adults – overwhelmingly produce long passives with two arguments that mismatch in Animacy features.

Our experimental studies in **Chapters 5 and 6** examined Mandarin-speaking children's comprehension of passives with regard to two main questions. First, do Mandarin-speaking children perform better with short passives than long passives, arguably due to intervention? The answer is yes. Despite the significantly higher frequency of long passives in both child spontaneous speech and their input, children's comprehension of long passives is worse than short passives in both of our experiments, providing supporting evidence for the Intervention Hypothesis. Moreover, despite the lack of an adjectival strategy in Mandarin, children understand short passives as well as actives in both experiments, suggesting that the dependency between the IA surface subject and its gap is not difficult for children when it does *not* cross a structural intervener, as shown in (1b). The converging evidence suggests that Mandarin-speaking children's poorer performance in interpreting long passives is triggered by the structural intervention of an EA, as shown in (1a), and not due to difficulty with the morphology (passive marker *bei*) or the dependency between the IA and its gap *per se* (i.e., when there is no intervention).

Our second question asks what features enter into the computation of intervention in child grammar. If a feature is relevant for intervention, a mismatch in this feature between the IA and EA should improve children's performance on the long passive trials (compared to the feature-matched ones), but not the active trials. We specifically tested three different features in Mandarin:

Animacy (Exp 1), a morphosyntactically active feature though not encoded in the DP domain as a designated marker; Number (Exp 2), a morphosyntactic feature encoded on the classifier; and Shape (Exp 2), a non-morphosyntactic, lexico-semantic feature that is also encoded on the classifier. None of these features are realized on the inflectional head (i.e., as verb agreement). We tested three hypotheses that have been entertained in previous literature:

(2) a. Hypothesis I: All linguistic features, including morphosyntactic as well as lexico-semantic features, are relevant for intervention.

b. Hypothesis II: Only morphosyntactic features – but not lexico-semantic features – are relevant for intervention, even if they are not overtly realized on the inflectional head.

c. Hypothesis III: Only features triggering syntactic movement (as evidenced by verbal inflection) are represented in the computation of intervention locality.

The results showed that Animacy mismatch improved children's performance on long passives (Experiment 1), whereas mismatch in Number or Shape did not (Experiment 2). One possibility we consider is that the Animacy mismatch effects in Experiment 1 resulted from children's defaulting on a "canonical event" interpretation in which the Agent is animate and the Theme is inanimate over events in which both arguments are equally animate when faced with a complex structure, such as a long passive. If this is the case, our results are most compatible with Hypothesis III in (2c), viz. that only features that trigger syntactic movement (as evidenced by verbal inflection) are represented in the computation of intervention locality (e.g., Belletti et al. 2012, Angelopoulos et al. 2022, Biondo et al. 2022).

In brief, our experiments found intervention effects in children's comprehension of long but not short *bei*-passives, as predicted by the Intervention Hypothesis. Our manipulation of these three features in Mandarin – namely Animacy, Number, and Shape – sheds light on what linguistic features participate in forming a syntactic dependency. We propose, following Belletti et al. (2012), that only morphosyntactic features that trigger syntactic movement are calculated for intervention and that there is cross-linguistic variation in terms of which features are actively involved in this process.

7.2. General discussion and open questions

7.2.1. Understanding featural representations in intervention computation

Our experiments found intervention by the EA in children's comprehension of long *bei*-passives. Interestingly, this intervention seems to be unaffected by factors such as Number or Shape, although Animacy may potentially play a role.

We propose that the intervention is triggered by a shared [+NP] feature between the IA and the EA, as shown in (3).[1] In addition, because the dependency exhibits A′-properties in both long and short *bei*-passives (such as inducing weak island effects for *wh*-adjuncts and allowing long-distance dependency; see Section 2.1.1), we put forth the hypothesis that the IA possesses some A′-feature that is absent on the EA. Consequently, the featural makeup of these two arguments, as shown in (3a), do not match completely, but only partially overlap – an *Inclusion* relation on the featural distinctness hierarchy (Rizzi 2018).

(3) a. Long *bei*-passives:

$$\underbrace{\text{IA}_{[+\text{NP}][\text{A}']}\ \text{BEI}\ [_{\text{VoiceP}}\ \boxed{\text{EA}}_{[+\text{NP}]}\ [_{\text{VP}}\ \text{V}\ (\ldots)\ t\ (\ldots)\ ]\ ]\ ]}_{\text{Intervention difficulties}}$$

b. Short *bei*-passives:

$$\underbrace{\text{IA}_{[+\text{NP}][\text{A}']}\ \text{BEI}\ [_{\text{VoiceP}}\ [_{\text{VP}}\ \text{V}\ (\ldots)\ t\ (\ldots)\ ]\ ]\ ]}_{\text{No intervention}}$$

Another plausible stipulation is to consider the source of intervention to be an A-feature, within the context of Rizzi's (1990) structural typology (i.e., distinction between head, A-positions, and A′-positions). The reasoning behind this proposition is that, in the case of long passives, the EA resides in an A-position (as an embedded subject), and the IA similarly ends up in an A-position, assuming we follow an NP movement analysis (see Sections 2.1.2 and 2.1.3). In either case, the [+NP] or A-feature is part of the featural complex that triggers the movement of the IA out of

[1] This is independent of the debate in the syntactic literature on whether the IA is a null operator (e.g., Huang 1999, Bruening & Tran 2015) or an NP (e.g., N. Liu & Huang 2016, F. Chen 2021, 2023) (see discussion in Chapter 2).

the VoiceP, and therefore the EA bearing this feature in the long *bei*-passives causes intervention difficulty for children's comprehension.

We propose that Number and Shape do not influence intervention locality in Mandarin because they do not participate in the syntactic movement in passivization (3) or in any other context in the language. The role of Animacy, however, is subject to debate. Our findings indicate that it might influence children's intervention difficulties, echoing previous research conducted on languages like English (Garaffa & Grillo 2008, Mateu & Hyams 2021), Italian (Arosio et al. 2011), and French (Durrleman et al. 2016). In Section 5.1, we demonstrated that Animacy is a morphosyntactically active feature in Mandarin, albeit not being overtly marked in the nominal or verbal domain, mirroring the status of Animacy in English, Italian, and French.

There are two ways to interpret the data from these languages. The first involves ascribing it to a confounding factor, namely the canonical event strategy, as discussed in Section 5.3.2. This hypothesis is that children are predisposed to assign an Agent role to an animate NP and a Theme role to an inanimate NP. Therefore, they do not need to establish the movement dependency as shown in (3) when tasked with picture selection in an Animacy-mismatched trial (i.e., with an animate Agent and inanimate Theme). An alternate explanation is that Animacy does participate in the computation of intervention, by virtue of being a candidate for ϕ-features. If this is the case, Belletti et al.'s (2012) hypothesis (and also our Hypothesis III) may be too strong. A potential revision could be that all candidates for ϕ-features (Person, Number, Gender, and Animacy) have roles in intervention. Notably, this hypothesis does not hinge on the criterion of verbal inflection.[2] We defer further exploration of these hypotheses to future studies.

7.2.2. Grammar vs. processing

As discussed in Section 1.3, memory-based processing models assume that interference is linear, contrasting with grammatical accounts that rely on structurally defined intervention, determined

[2]However, Number is also cross-linguistically a candidate for ϕ-features, yet our study did not find its effects. It is possible that Number, like Animacy, is actually relevant for intervention in child Mandarin, but our test did not capture this fact. Future investigation of Number is needed, with different methods (e.g., eye-tracking) or different materials (e.g., with a different way of manipulating Number).

by c-command relations. Grammatical approaches suggest that children adhere to stricter locality constraints compared to adults, whereas processing models ascribe children's intervention difficulties to their limited memory capacity, without positing any discrepancy between the grammars of children and adults. Another notable difference between grammar-based and memory-based approaches is that structural intervention is triggered by overlapping morphosyntactic features, whereas memory interference can arise from similarities in (resumably) any dimension. These dimensions can span beyond morphosyntactic features to include semantic properties or phonological similarities.

Our study proposes that children's intervention difficulties are primarily grammatical/structural in nature and cannot be solely attributed to children's limited processing capacity. If processing capacity was the primary factor, differences in the Number or Shape between the IA and EA in long *bei*-passives should have also improved children's performance, compared to the matched conditions. Although memory-based models may in principle be able to explain the intervention difficulties observed in child data, they would need to take into account the role of verb agreement in sentence processing (and its absence in Mandarin), which is essentially a grammatical factor.

Structural intervention often coincidentally aligns with linear intervention. For instance, in English object RCs, the dependency between the relativized noun and its gap, which is at the object position in the RC, is *both* structurally and linearly intervened by the embedded subject. Are there instances of purely linear intervention independent of structural intervention? We turn briefly to constructions where these two types of intervention do not align. Gerard et al. (2017) observed linear interference by NPs that are matched in Gender (4a) or Number (5a) in children's comprehension of adjunct control during a picture selection task. In this construction, since the PRO in the adjunct clause is not c-commanded by either of the subject or object NPs, the relative difficulties of the Gender- or Number-matched sentences (compared to the mismatched ones) demonstrate purely linear inference effects, aligning with the Similarity-based Interference hypothesis (e.g., Gordon et al. 2001).

(4) a. [$\text{Mickey}_{\text{MALE}}$ washed $\text{Diego}_{\text{MALE}}$] [before PRO eating the red apple] .

b. [Dora$_{\text{FEMALE}}$ washed Diego$_{\text{MALE}}$] [before PRO eating the red apple] .

(5) a. [The girl$_{\text{SINGULAR}}$ washed the boy$_{\text{SINGULAR}}$] [before PRO eating the red apple] .

b. [The girl$_{\text{SINGULAR}}$ washed the boys$_{\text{PLURAL}}$] [before PRO eating the red apple] .

Mandarin relative clauses (RCs) also offer a good testing ground to differentiate between structural intervention effects (e.g., fRM) and linear interference effects (e.g., similarity-based interference), due to its typologically rare word order. While Mandarin generally has SVO order, its RCs are pre-nominal, meaning they linearly precede the relativized noun head. Structural intervention would predict a subject advantage, viz. that children perform better with subject RCs (6a) than object RCs (6b), given that objects are hierarchically deeper in the structure. Conversely, linear intervention would predict the opposite, an object RC advantage due to the object being linearly closer to the gap.

(6) a. Mandarin subject RC: [$_{\text{CP}}$ [$_{\text{IP}}$ ___$_i$ V O] *de*] S$_i$

zhi-chu [$_{\text{CP}}$[$_{\text{IP}}$ ___$_i$ yao le xiaomao] de] xiaogou$_i$
point-out bite PRF cat REL dog
'Point out the dog$_i$ [that [___$_i$ bit the cat]].'

b. Mandarin object RC: [$_{\text{CP}}$ [$_{\text{IP}}$ (S) V ___$_i$] *de*] O$_i$

zhi-chu [$_{\text{CP}}$[$_{\text{IP}}$ (xiaomao) yao le ___$_i$] de] xiaogou$_i$
point-out cat bite PRF REL dog
'Point out the dog$_i$ [that [(the cat) bit ___$_i$]].'

However, previous studies examining children's comprehension and adult's online processing of Mandarin RCs have yielded conflicting results. Some studies have reported a subject advantage both in child (e.g., S. Hu et al. 2016, Tsoi et al. 2019) and adult (e.g., Jäger et al. 2015, Xiong et al. 2019) Mandarin-speakers. In contrast, some studies have observed an object advantage with both children (e.g., He et al. 2017) and adults (e.g., Wu & Juffs 2016, K. Xu et al. 2019). Moreover, some processing studies with adult speakers have found no significant contrast between these two types of RCs (e.g., Mansbridge et al. 2017, Yao 2018). A comprehensive review by Lau and Tanaka (2021) addresses this in more detail.

These conflicting results suggest that *both* grammar-based/structural intervention effects and memory-based/linear interference are at play in children's comprehension and adults' (and children's) online processing of this construction. The complexity of these findings indicates that further research on this topic is needed.

7.2.3. Intra- and cross-linguistic variations

Our study highlights the importance of cross-linguistic investigation. We posit that although children are universally subject to a stricter version of fRM than adults and encounter difficulties when establishing a syntactic dependency across an intervener, this intervention difficulty is modulated by language-specific features, determined by their morphosyntactic status within that particular language.

Our study did not replicate the Number effects in children's comprehension of intervention constructions in languages with subject-verb agreement of Number, such as English (Adani et al. 2014), Italian (Adani et al. 2010, Belletti et al. 2012), Spanish (Mateu 2022), and French (Bentea & Durrleman 2017). We propose this is due to the absence of subject-verb Number agreement in Mandarin, meaning that children do not receive syntactic evidence that this feature is active in their grammar, in contrast with the aforementioned languages. We further predict that in languages lacking verbal agreement of a particular morphosyntactic feature X, a mismatch of X between the intervening and moved elements will not significantly enhance children's comprehension of the intervention construction. This prediction extends to features such as Number or Person in languages like Vietnamese (Thompson 1988), Korean (Sohn 2001), Japanese (Hinds 2003), Māori (Bauer 2003), etc.

Our hypothesis builds on Belletti et al.'s (2012) account, which emphasizes the role that verbal inflection plays in determining what features are relevant for intervention in child grammar. For them, the hallmark of a feature triggering syntactic movement is its verbal inflection. However, in some languages, features triggering syntactic movement might not consistently be inflected on the verb, especially in passives.

For example, in Finnish, active verbs agree in Person and Number with the subject, as shown in (7a) and (8a). Based on Belletti et al.'s (2012) criterion, these two features are attractors for subject movement and should thus modulate children's intervention difficulties. However, passive verbs in Finnish do not exhibit Person or Number agreement, as in (7b) and (8b). The agreement asymmetry carries over to negative clauses as well. The negative auxiliary in Finnish, which consists of the root *e-*, inflects for person and number in active sentences but not in passive sentences, as shown in (9).

(7) a. Diane tappaa etana-n.
Diane.NOM kill.3SG slug-ACC
'Diane will kill the slug'

b. Etana tape-taan.
slug.NOM kill-PASS
'The slug will be killed.' (Manninen & Nelson 2004: ex.1)

(8) a. Pekka murhasi Jussi-n.
Pekka.NOM murdered.3SG Jussi-ACC
'Pekka murdered Jussi.'

b. Jussi murha-ttiin.
Jussi.NOM murder-PASS.PST
'Jussi was murdered.' (Manninen & Nelson 2004: ex. 51)

(9) a. Active:

1SG	*e-n*	1PL	*e-mme*
2SG	*e-t*	2PL	*e-tte*
3SG	*ei*	3PL	*ei-vät*

b. Passive: *ei* (Vilkuna 2015:460)

Furthermore, Keenan (1985) identifies three distinct patterns of variations in subject agreement between passive and active verbs. Firstly, in languages like Welsh, active verbs exhibit subject agreement while passive verbs do not. Secondly, languages like Latin demonstrate different agreement affixes for passive verbs compared to active verbs. Lastly, languages such as Maasai and

Kimbundu demonstrate that passive verbs agree with their subject as if they were the direct object of an active verb.

What would the Intervention Hypothesis predict for such languages in which active and passive verbs have different agreement rules? Does a mismatch of these features facilitate children's comprehension of passives because they contribute to triggering movement in active sentences? Or would such a mismatch not impact passives due to the absence of verbal agreement in this voice? We believe that acquisition data from these languages can shed light on the types of features truly involved in intervention locality – those that trigger syntactic movement or those realized in the clausal inflectional head as in verb agreement. We hope these questions will trigger further research in other languages.

Appendix A

Breakdown of children's passives in spontaneous speech

Table A.1: Different types of grammatical passives produced by Mandarin-speaking 2- to 6-year-olds

	2-year-olds			3-year-olds			4-year-olds		
	LongP	**ShortP**	**Total**	**LongP**	**ShortP**	**Total**	**LongP**	**ShortP**	**Total**
Actional verb	8	1	**9**	14	18	**32**	34	17	**51**
Non-actional verb	1	0	**1**	4	1	**5**	5	7	**12**
Light verb (Actional)	6	0	**6**	6	1	**7**	5	2	**7**
Total	**15**	**1**	**16**	**24**	**20**	**44**	**44**	**26**	**70**
	5-year-olds			**6-year-olds**			**All 2- to 6-year-olds**		
	LongP	**ShortP**	**Total**	**LongP**	**ShortP**	**Total**	**LongP**	**ShortP**	**Total**
Actional verb	47	39	**86**	53	29	**82**	**156**	**104**	**260**
Non-actional verb	14	7	**21**	13	12	**25**	**37**	**27**	**64**
Light verb (Actional)	3	1	**4**	5	3	**8**	**26**	**7**	**33**
Total	**64**	**47**	**111**	**71**	**44**	**115**	**218**	**138**	**356**

Appendix B

Exp 1 trials

(1) xiao-niu zhuang-dao le xiao-zhu
little-cow bump-into PRF little-pig
'The cow bumped into the little pig.'

(2) huli bei la-zhu le
fox BEI pull-hold PRF
'The fox was pulled.'

(3) da-xiangzi bei xiao-mao ya-dao le
big-box BEI little-cat pin_down PRF
'The box was pinned down by the cat.'

(4) daxiang lan-zhu le xiao-niu
elephant block PRF little-cow
'The elephant blocked the cow.'

(5) xiao-gou bei xiao-yang zhuang-dao le
little-dog BEI little-sheep bump-into PRF
'The dog was bumped by the sheep.'

(6) xiao-mao bei ya-dao le
little-cat BEI pin_down PRF
'The cat was pinned down.'

(7) xiao-zhu la-zhu le gongjiaoche
little-pig pull-hold PRF bus
'The pig pulled the bus.'

(8) huli bei xiao-mao ya-dao le
fox BEI little-cat pin_down PRF
'The fox was pinned down by the cat.'

(9) xiao-qiche bei la-zhu le
little-car BEI pull-hold PRF
'The car was pulled.'

(10) daxiang zhuang-dap le xiao-huoche
elephant bump-into PRF little-train
'The elephant bumped into the train.'

(11) xiao-yang bei lan-zhu le
little-sheep BEI block PRF
'The sheep was blocked.'

(12) da-shitou bei xiao-niu ya-dao le
big-rock BEI little-cow pin_down PRF
'The rock was pinned down by the cow.'

(13) houzi la-zhu le xiao-mao
monkey pull-hold PRF little-cat
'The monkey pulled the cat.'

(14) xiao-qiche bei xiao-gou zhuang-dao le
little-car BEI little-dog bump-into PRF
'The car was bumped by the dog.'

(15) xiao-zhu bei ya-dao le
little-pig BEI pin_down PRF
'The pig was pinned down.'

(16) xiao-gou zhuang-dao le xiao-niu
little-dog bump-into PRF little-cow
'The dog bumped into the cow.'

(17) da-shu bei daxiang la-zhu le
big-tree BEI elephant pull-hold PRF
'The tree was pulled by the elephant.'

(18) xiao-huoche bei lan-zhu le
little-train BEI block PRF
'The train was blocked.'

(19) xiao-yang ya-dao le da-shu
little-sheep pin_down PRF big-tree
'The sheep pinned down the tree.'

(20) huli bei xiao-mao zhuang-dao le
fox BEI little-cat bump-into PRF
'The fox was bumped by the cat.'

(21) da-kache bei lan-zhu le
big-truck BEI block PRF
'The truck was blocked.'

(22) xiao-niu la-zhu le da-kache
little-cow pull-hold PRF big-truck
'The cow pulled the truck.'

(23) xiao-gou bei houzi lan-zhu le
little-dog BEI monkey block PRF
'The dog was blocked by the monkey.'

(24) xiao-yang bei zhuang-dao le
little-sheep BEI bump-into PRF
'The sheep was bumped.'

(25) daxiang lan-zhu le gongjiaoche
elephant block PRF bus
'The elephant blocked the bus.'

(26) da-xiangzi bei ya-dao le
big-box BEI pin_down PRF
'The box was pinned down.'

(27) xiao-niu bei daxiang la-zhu le
little-cow BEI elephant pull-hold PRF
'The cow was pulled by the elephant.'

(28) xiao-zhu ya-dao le da-shitou
little-pig pin_down PRF big-rock
'The pig pinned down the rock.'

(29) xiao-zhu bei huli lan-zhu le
little-pig BEI fox block PRF
'The pig was blocked by the fox.'

(30) xiao-gou bei la-zhu le
little-dog BEI pull-hold PRF
'The dog was pulled.'

(31) xiao-yang ya-dao le houzi
little-sheep pin_down PRF monkey
'The sheep pinned down the monkey.'

(32) xiao-qiche bei xiao-mao lan-zhu le
little-car BEI little-cat block PRF
'The car was blocked by the cat.'

(33) gongjiaoche bei zhuang-dao le
bus BEI bump-into PRF
'The bus was bumped.'

(34) huli lan-zhu le houzi
fox block PRF monkey
'The fox blocked the monkey.'

(35) xiao-qiche bei xiao-zhu la-zhu le
little-car BEI little-pig pull-hold PRF
'The car was pulled by the pig.'

(36) da-kache bei zhuang-dao le
big-truck BEI bump-into PRF
'The truck was bumped.'

Appendix C

Exp 2 trials

(1) yi-**ge** xiao-niu yao-zhu le
one-CLF little-cow bite PRF
yi-**ge** xiao-gou
one-CLF little-dog
'A cow bit a dog.'

(2) yi-**ge** qingwa bei ya-zhu le
one-CLF frog BEI pin_down PRF
'A frog was pinned down.'

(3) yi-**ge** houzi bei yi-**ge** huli
one-CLF monkey BEI one-CLF fox
zhuang-dao le
bump-into PRF
'A monkey was bumped by a fox.'

(4) yi-**xie** xiao-mao zhua-dao le
one-CLF_{PL} little-cat catch PRF
yi-**ge** xiao-gou
one-CLF little-dog
'Some cats caught a dog.'

(5) yi-**tiao** xiao-yu bei yi-**ge** qingwa
one-CLF little-fish BEI one-CLF frog
zhuang-dao le
bump-into PRF
'A fish was bumped by a frog.'

(6) yi-**xie** xiao-mao bei yao-zhu le
one-CLF_{PL} little-cat BEI bite PRF
'Some cats were bitten.'

(7) yi-**ge** huli ya-zhu le yi-**ge**
one-CLF fox pin_down PRF one-CLF
houzi
monkey
'A fox pinned down a monkey.'

(8) yi-**ge** xiao-niu bei zhua-dao le
one-CLF little-cow BEI catch PRF
'A cow was caught.'

(9) yi-**xie** huli bei yi-**ge** houzi
one-CLF_{PL} fox BEI one-CLF monkey
zhuang-dao le
bump-into PRF
'Some fox(pl.) were bumped by a monkey.'

(10) yi-**tiao** xiao-long yao-zhu le
one-CLF little-dragon bite PRF
yi-**ge** houzi
one-CLF monkey
'A dragon bit a monkey.'

(11) yi-**xie** huli bei yi-**ge** daxiang
one-CLF_{PL} fox BEI one-CLF elephant
ya-zhu le
pin_down PRF

'Some fox(pl.) were pinned down by an elephant.'

(12) yi-**ge** xiao-niu bei zhuang-dao le
one-CLF little-cow BEI bump-into PRF
'A cow was bumped.'

(13) yi-**ge** xiao-gou zhuang-dao le
one-CLF little-dog bump-into PRF
yi-**ge** xiao-mao
one-CLF little-cat
'A dog bumped into a cat.'

(14) yi-**tiao** xiao-she bei yi-**ge** huli
one-CLF little-snake BEI one-CLF fox
zhua-dao le
catch PRF
'A snake was caught by a fox.'

(15) yi-**ge** houzi bei yao-zhu le
one-CLF monkey BEI bite PRF
'A monkey was bitten.'

(16) yi-**ge** xiao-mao zhuang-dao le
one-CLF little-cat bump-into PRF
yi-**tiao** xiao-long
one-CLF little-dragon
'A cat bumped into a dragon.'

(17) yi-**ge** xiao-yang bei yao-zhu le
one-CLF little-sheep BEI bite PRF
'A sheep was bitten.'

(18) yi-**ge** xiao-mao bei yi-**ge**
one-CLF little-cat BEI one-CLF
xiao-gou ya-zhu le
little-dog pin_down PRF
'A cat was pinned down by a dog.'

(19) yi-**ge** xiao-zhu zhuang-dao le
one-CLF little-pig bump-into PRF
yi-**xie** xiao-yang
one-CLF_{PL} little-sheep
'A pig bumped into some sheep(pl.).'

(20) yi-**tiao** xiao-long bei yao-zhu le
one-CLF little-dragon BEI bite PRF
'A dragon was bitten.'

(21) yi-**ge** xiao-yang bei yi-**ge**
one-CLF little-sheep BEI one-CLF
xiao-zhu zhua-dao le
little-pig catch PRF
'A sheep was caught by a pig.'

(22) yi-**tiao** xiao-she ya-zhu le
one-CLF little-snake pin_down PRF
yi-**ge** xiao-mao
one-CLF little-cat
'A snake pinned down a cat.'

(23) yi-**ge** daxiang bei ya-zhu le
one-CLF elephant BEI pin_down PRF
'An elephant was pinned down.'

(24) yi-**tiao** xiao-long bei yi-**ge**
one-CLF little-dragon BEI one-CLF
xiao-niu zhua-dao le
little-cow catch PRF
'A dragon was caught by a cow.'

(25) yi-**ge** xiao-zhu ya-zhu le
one-CLF little-pig pin_down PRF
yi-**xie** xiao-mao
one-CLF_{PL} little-cat
'A pig pinned down some cats.'

(26) yi-**ge** xiao-zhu bei zhua-dao le
one-CLF little-pig BEI catch PRF
'A pig was caught.'

(27) yi-**ge** yazi bei yi-**tiao** xiao-she
one-CLF duck BEI one-CLF little-snake
ya-zhu le
pin_down PRF
'A duck was pinned down by a snake.'

(28) yi-**xie** houzi yao-zhu le
one-CLF_{PL} monkey bite PRF
yi-**ge** huli
one-CLF fox
'Some monkeys caught a fox.'

(29) yi-**ge** xiao-yang bei yi-**xie**
one-CLF little-sheep BEI one-CLF_{PL}
xiao-zhu zhua-dao le
little-pig catch PRF
'A sheep was caught by some pigs.'

(30) yi-**ge** xiao-niu bei zhuang-dao le
one-CLF little-cow BEI bump-into PRF
'A cow was bumped.'

(31) yi-**tiao** xiao-yu yao-zhu le yi-**ge**
one-CLF little-fish bite PRF one-CLF
qingwa
frog
'A fish bit a frog.'

(32) yi-**xie** huli bei zhua-dao le
one-CLF_{PL} fox BEI catch PRF
'Some fox(pl.) were caught.'

(33) yi-**xie** xiao-gou bei yi-**ge**
one-CLF_{PL} little-dog BEI one-CLF
xiao-niu ya-zhu le
little-cow pin_down PRF
'Some dogs were pinned down by a cow.'

(34) yi-**ge** houzi zhua-dao le
one-CLF monkey catch PRF
yi-**ge** huli
one-CLF fox
'A monkey caught a fox.'

(35) yi-**ge** xiao-niu bei yi-**tiao**
one-CLF little-cow BEI one-CLF
xiao-long ya-zhu le
little-dragon pin_down PRF
'A cow was pinned down by a dragon.'

(36) yi-**ge** xiao-yang bei zhuang-dao
one-CLF little-sheep BEI bump-into
le
PRF
'A sheep was bumped.'

(37) yi-**xie** xiao-gou yao-zhu le
one-CLF_{PL} little-dog bite PRF
yi-**ge** xiao-mao
one-CLF little-cat
'Some dogs bit a cat.'

(38) yi-**tiao** xiao-yu bei zhua-dao le
one-CLF little-fish BEI catch PRF
'A fish was caught.'

(39) yi-**ge** xiao-mao bei yi-**ge** houzi
one-CLF little-cat BEI one-CLF monkey
zhuang-dao le
bump-into PRF
'A cat was bumped by a monkey.'

(40) yi-**ge** yazi zhua-dao le yi-**tiao**
one-CLF duck catch PRF one-CLF
xiao-yu
little-fish
'A duck caught a fish.'

(41) yi-**xie** houzi bei ya-zhu le
one-CLF$_{PL}$ monkey BEI pin_down PRF
'Some monkeys were pinned down.'

(42) yi-**ge** xiao-zhu bei yi-**ge**
one-CLF little-pig BEI one-CLF
xiao-niu yao-zhu le
little-cow bite PRF
'A pig was bitten by a cow.'

(43) yi-**ge** xiao-niu zhuang-dao le
one-CLF little-cow bump-into PRF
yi-**ge** daxiang
one-CLF elephant
'A cow bumped into an elephant.'

(44) yi-**tiao** xiao-she bei zhua-dao le
one-CLF little-snake BEI catch PRF
'A snake was caught.'

(45) yi-**ge** yazi bei yi-**tiao** xiao-yu
one-CLF duck BEI one-CLF little-fish
yao-zhu le
bite PRF
'A duck was bitten by a fish.'

(46) yi-**ge** huli zhua-dao le yi-**xie**
one-CLF fox catch PRF one-CLF$_{PL}$
houzi
monkey
'A fox caught some monkeys.'

(47) yi-**ge** xiao-zhu bei ya-zhu le
one-CLF little-pig BEI pin_down PRF
'A pig was pinned down.'

(48) yi-**ge** xiao-mao bei yi-**xie** huli
one-CLF little-cat BEI one-CLF$_{PL}$ fox
yao-zhu le
bite PRF
'A cat was bitten by some fox(pl.).'

(49) yi-**ge** xiao-zhu ya-zhu le
one-CLF little-pig pin_down PRF
yi-**ge** xiao-yang
one-CLF little-sheep
'A pig pinned down a sheep.'

(50) yi-**ge** yazi bei zhuang-dao le
one-CLF duck BEI bump PRF
'A duck was bumped.'

(51) yi-**ge** daxiang bei yi-**xie**
one-CLF elephant BEI one-CLF$_{PL}$
xiao-niu zhua-dao le
little-cow catch PRF
'An elephant was caught by some cows.'

(52) yi-**ge** xiao-zhu bei zhuang-dao le
one-CLF little-pig BEI bump PRF
'A pig was bumped.'

(53) yi-**ge** daxiang ya-zhu le
one-CLF elephant pin_down PRF
yi-**tiao** xiao-long
one-CLF little-dragon
'An elephant pinned down a dragon.'

(54) yi-**ge** xiao-yang bei yi-**ge**
one-CLF little-sheep BEI one-CLF
houzi yao-zhu le
monkey bite PRF
'A sheep was bitten by a monkey.'

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