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## The Syntax and Acquisition of Mandarin Sluice-like Constructions

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## Abstract

*Sluicing* refers to an elliptical structure in which only a *wh*-phrase is overt in a CP, as in *Someone left. I don't know who*. In Mandarin, sluice-like strings ('S-strings') with argument *wh*-remnants require the presence of *shi*, a form that is ambiguous between a copula and a focus marker. This paper proposes a hybrid analysis of Mandarin S-strings as having two possible derivations, a sluice and a pseudo-sluice, unless one of the structures is independently forced. When *shi* is a copula, the S-string has a pseudo-sluice analysis, [*pro* be *wh*-phrase], involving neither movement nor ellipsis. When *shi* is a focus marker, the S-string is derived by focus movement followed by TP-ellipsis yielding a sluice analysis. Results from a comprehension experiment with 59 Mandarin-speaking children show that 3-4-year-olds have only a pseudo-sluice/copula analysis of S-strings. They acquire the sluice/focus movement derivation at approximately age 5 at which point they show the "subject advantage" typically associated with A'-movement structures in young children.

**Keywords:** Ellipsis acquisition, intervention, A'-movement, Mandarin sluicing, pseudo-sluicing

## 1. Introduction

Ellipsis – unpronounced yet understandable elements in a sentence – is a central component of human language. One such elliptical structure is 'sluicing' (first named by Ross 1969), in which only a *wh*-phrase is pronounced, as in the embedded clause in (1a). The sluiced structure in (1a) is semantically equivalent to its un-elided counterpart, the embedded *wh*-question such as *who you called* in (1b). The missing information in the sluice is recovered under semantic/syntactic conditions connecting it to the antecedent in the main clause.

- (1) a. You called someone, but I don't know *who*.  
b. You called someone, but I don't know *who you called*.

Merchant (2001), following Ross (1969), proposed a movement-ellipsis derivation for sluices: in this account, the *wh*-phrase moves to Spec CP, as in other *wh*-constructions, and the remnant TP is deleted at PF, as demonstrated in (2a). Contrary to this derivation, a pseudo-sluicing approach (e.g., Erteschik-Shir 1977 and Pollmann 1975) suggests that the

elliptical structure in (1a) is derived from a copula structure in which the subject and the copula are deleted, as shown in (2b).<sup>1</sup>

- (2) a. Sluice: You called someone, but I don't know [*CP who<sub>i</sub> [~~TP you called t<sub>i</sub>]~~].  
 b. Pseudo-sluice: You called someone, but I don't know *who it was*.*

Both the movement-ellipsis and the pseudo-sluicing approaches can potentially derive the surface structure in (1a). Nevertheless, in languages with *wh*-movement, syntactic evidence from case-marking, preposition stranding, and binding phenomena mainly supports the movement-ellipsis derivation (Merchant 2001). For instance, (3a) shows that the *wh*-remnant in a German sluice has to be in the same case as its un-elided counterpart in an embedded question (3b), indicating parallel structures between a sluice and an un-elided question.

- (3) a. *Er will jemandem schmeicheln, aber sie wissen nicht,*  
 he wants someone.DAT flatter but they know not  
 {*\*wer / \*wen / wem*}  
 who.NOM who.ACC who.DAT  
 'He wants to flatter someone, but they don't know who.'  
 b. *Sie wissen nicht, { \*wer / \*wen / wem } er schmeicheln will.*  
 They know not who.NOM who.ACC who.DAT he flatter wants  
 'They don't know who he wants to flatter.'

In *wh*-in-situ languages, a sluice-like string ('S-string' henceforth) can be different from sluices in languages with *wh*-movement. In Mandarin S-strings, an element *shi* precedes the *wh*-phrase, obligatory in argument S-strings (4a) but optional in adjunct S-strings (4b).

- (4) a. *Lisi jiao-le yi-ge ren, wo bu zhidao \*(shi) shei*  
 Lisi call-PERF one-CL person 1SG not know SHI who  
 'Lisi called someone. I don't know who.'  
 b. *Lisi jiao-le yi-ge ren, wo bu zhidao (shi) weishenme*

<sup>1</sup> There are analyses of sluices that involve ellipsis but no movement, including the *wh*-in-situ approach (Kimura 2010 and Abe 2015), as in (i), and the base-generation approach (Chung et. al 1995), as in (ii).

(i) You called someone but I don't know [<sub>CP</sub> C<sub>[Q]</sub> [<sub>TP</sub> ~~you called~~ who]

(ii) You called someone but I don't know [<sub>CP</sub> who<sub>i</sub> [<sub>TP</sub> ~~you called someone<sub>i</sub>~~]]

There are also analyses of sluices that involve neither ellipsis nor movement. For example, Culicover and Jackendoff (2005) proposed that the *wh*-phrase is the only daughter node of the S node that is the complement of the matrix verb:

(iii) You called someone but I don't know [<sub>S</sub> who ]

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Lisi call-PERF    one-CL    person    1SG not know    SHI    why  
 ‘Lisi called someone. I don’t know why.’

Importantly, *shi* is not only a copula, as shown in (5a), but it also functions as a focus marker (henceforth FM) that often appears in clefts, as in (5b).

- |  |   |
|--|---|
| (5) a. <i>na shi shei?</i><br>that <b>be</b> who<br>‘Who is that?’ | b. <i>shi Lisi jiao-le Mali</i><br><b>FM</b> Lisi call-PERF Mali<br>‘It is Lisi who called Mali.’ |
|--|---|

This ambiguity of *shi* ‘be/FM’ has led to a debate over whether such structures in Mandarin involve sluicing, as illustrated in (2a), or rather are pseudo-sluices as in (2b) (see section 2 for more details). In this paper, we investigate the Mandarin S-strings from both a theoretical and experimental perspective. We present the results of an experimental study testing Mandarin-speaking children’s interpretation of S-strings. Our results shed light on the acquisition of this kind of ellipsis – not previously tested in Mandarin – and also have direct implications for the sluice vs. pseudo-sluice debate of S-strings in adult Mandarin.

We begin in the following section by discussing the two competing theoretical accounts of Mandarin S-strings, including new data bearing on this debate. In Section 3, we discuss our acquisition experiment as well as a follow-up CHILDES corpus study. To anticipate our conclusions, we will propose that S-strings have both a sluice and pseudo-sluice derivation and that children acquire the two analyses at different points of development. The final section concludes this paper and discusses some potential future studies.

## 2. Syntactic Study: Sluice/Pseudo-sluice Ambiguity in Adult Mandarin

In Mandarin, sluice-like constructions with argument *wh*-phrases (such as *shei* ‘who’ and *shenme* ‘what’) require the presence of *shi*, a word that is ambiguous between a copula and a FM. This phenomenon has led syntacticians to two competing analyses of Mandarin S-strings: The pseudo-sluicing approach (as in (6)) posits a silent *pro* as the subject of the copula *shi* and involves neither movement nor ellipsis (Adams 2004; Wei 2009, 2011; Adams & Tomioka 2012; Li & Wei 2014, 2017), while the movement-ellipsis analysis (as in (7)) derives S-strings by focus movement, triggered by the FM *shi*, and TP ellipsis,

parallel to the English sluicing analysis involving *wh*-movement followed by TP ellipsis (Chen 2004; Wang & Wu 2006; Chiu 2007; Song & Yoshida 2017).

(6) The pseudo-sluicing analysis:

*Lisi jiao-le*      [*yi-ge ren*]<sub>i</sub>,    [*wo bu zhidao* [*pro*<sub>i</sub>    ***shi*** *shei*]]  
 Lisi call-PERF    one-CL person 1SG not know    *pro*    be who  
 ‘Lisi called someone<sub>i</sub>. I don’t know who (*pro*<sub>i</sub> is).’

(7) The movement-ellipsis analysis:

*Lisi jiao-le yi-ge ren...*  
 Lisi call-PERF one-CL person  
 ... *wo bu zhidao* [<sub>CP</sub> [<sub>C</sub> ***shi*** [<sub>FP</sub> *shei*<sub>i</sub> [<sub>F[+Foc]</sub> ~~*t<sub>i</sub>*~~ ~~*Lisi jiao-le t<sub>i</sub>*~~]]]]  
 1SG not know                      FM                      who                      < Lisi call-PERF >  
 ‘Lisi called someone, I don’t know who (it is that Lisi called).’

In the following sections, we compare these two competing analyses of Mandarin S-strings with respect to several properties, including island-insensitivity, *wh*-else S-strings, idiomatic reconstruction, strict/sloppy readings, the argument/adjunct asymmetry with regard to the presence of *shi*, and multiple S-strings. Based on these data, we will argue for a hybrid analysis of Mandarin sluice-like constructions: both the movement-ellipsis (i.e., sluicing) analysis and the pseudo-sluicing approach can derive S-strings and both are attested in different contexts. More specifically, in certain contexts there must be elided (‘hidden’) structure in an S-string, supporting a movement-ellipsis derivation (section 2.2). However, we will also present some prosodic evidence suggesting that there are cases where an S-string must be a pseudo-sluice (section 2.3). Therefore, we recognize the presence of both sluices and pseudo-sluices in Mandarin and conclude that a surface S-string can have two different derivations and is thus ambiguous between a sluice and a pseudo-sluice unless one of the derivations is blocked.<sup>2</sup>

<sup>2</sup> The use of the terms ‘pseudo-sluice/pseudo-sluicing’ in previous studies of Mandarin and Japanese is not consistent. In Japanese, a sluice-like construction is argued to be derived from clefts (e.g., Nishiyama, Whitman, & Yi, 1996, Kizu 1997, Merchant 1998, Saito 2004, and Hiraiwa & Ishihara 2012; cf. Takahashi 1994 for a sluicing analysis, and Nishigauchi 1998 for an LF-copying analysis). The main support for this non-movement, pseudo-sluicing analysis come from the parallels between Japanese clefts and sluice-like constructions, for example case-marking and island-sensitivities. Note that the ‘pseudo-sluicing analysis’ in Japanese usually refers to the reduced cleft analysis. For example:

(i) *John-wa* [*zibun-ga naze sikarareta*    *ka*] *wakatteinai*    *ga*,  
 John-TOP self-NOM why was.scolded Q know.not    though  
*Mary-wa* [~~*t<sub>i</sub>* *zibun-ga t<sub>i</sub> sikarareta*~~ ~~*no-ga*~~ *naze*<sub>i</sub> (*da*)    *ka*] *wakatteiru*  
 Mary-TOP                      self-NOM was.scolded    that-NOM why be.PRES Q know

## 2.1. The pseudo-slucing analysis vs. the movement-ellipsis analysis in Mandarin

According to the pseudo-slucing analysis, the internal structure of S-strings is [*pro* be *wh*-phrase] (see (6) above) and the silent pronoun *pro* is argued to be an E-type pronoun (Adams 2004, Wei 2011, Adams & Tomioka 2012). In this analysis, *pro* has a quantifier antecedent but is not bound by the quantifier.<sup>3</sup> However, in a *wh*-adjunct S-string (8b), *pro* cannot be an E-type pronoun because its antecedent is not clear.<sup>4</sup> Thus, in these cases, it is treated as an event-denoting pronoun (Wei 2011) or a sentential pronoun (Adams & Tomioka 2012), whose denotation is an event or a proposition.

### (8) a. *wh*-argument S-string

*Lisi jiao-le [yi-ge ren]<sub>i</sub> wo bu zhidao [pro<sub>i</sub> shi shei]*  
 Lisi call-PERF one-CL person 1SG not know *pro* be who  
 ‘Lisi called someone<sub>i</sub>. I don’t know who (*pro<sub>i</sub>* is).’

### b. *wh*-adjunct S-string

*[Lisi jiao-le yi-ge ren]<sub>i</sub> wo bu zhidao [pro<sub>i</sub> (shi) weishenme]*  
 Lisi call-PERF one-CL person 1SG not know *pro* be why  
 ‘[Lisi called someone]<sub>i</sub>. I don’t know why (*pro<sub>i</sub>* is).’

One argument supporting the pseudo-slucing analysis is that Mandarin is a *pro*-drop language and the silent pronoun *pro* in Mandarin sluices alternates with the overt pronoun *na* ‘that’ (Adams 2004), as in (9) (cf. (8)).

### (9) a. *wh*-argument sluicing

*Lisi jiao-le [yi-ge ren]<sub>i</sub> wo bu zhidao na<sub>i</sub> shi shei*  
 Lisi call-PERF one-CL person 1SG not know that be who  
 ‘Lisi called someone<sub>i</sub>. I don’t know who *that<sub>i</sub>* is.’

### b. *wh*-adjunct sluicing

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‘John doesn’t know why he was scolded, but Mary knows why [he/she was scolded].’ (Saito 2004)

However, as we discuss in this paper, the ‘pseudo-slucing analysis’ of Mandarin S-strings does not posit any ellipsis in the S-string and proposes that the unspoken information is recovered by a silent subject *pro* in the syntax.

<sup>3</sup>Adams and Tomioka (2012) adopt Heim and Kratzer’s (1998) account of E-type pronouns (Evans 1977, 1980) according to which (i) there is an implicit definite determiner, and (ii) it also comes with indexed anaphor of a predicate type, whose semantic content is pragmatically recovered. They thus propose the internal structure of *pro* as [DP [+def] [NP e<sub>i</sub>]].

<sup>4</sup> To be consistent with the previous literature on sluice-like structures in Mandarin, we refer to all S-strings with adjunct *wh*-remnants as ‘*wh*-adjunct S-strings’. However, when the adjunct *wh*-remnant does not have an overt correlate in the antecedent clause, such as in (8b), the S-string would really be a case of ‘sprouting’ as opposed to sluicing. A more typical example of adjunct sluicing is the following:

- (i) *Lisi zai yi-ge difang jiao-le Mali, wo bu zhidao (shi) zai nali*  
 Lisi at one-CL place call-PERF Mali 1SG not know be at where  
 ‘Lisi called Mali at a place. I don’t know where.’

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[Lisi jiao-le yi-ge ren]<sub>i</sub>, wo bu zhidao **na**<sub>i</sub> shi weishenme  
 Lisi call-PERF one-CL person 1SG not know that be why  
 ‘[Lisi called someone]<sub>i</sub>. I don’t know why *that*<sub>i</sub> is.’

Another potential piece of evidence in favor of the pseudo-sludging analysis comes from the island-insensitivity of S-strings. As Ross (1969) first noticed for English, the extraction proposed by the movement-ellipsis analysis in sluicing is possible out of some syntactic islands. This is also the case in Mandarin sluices, such as complex NP islands (10), adjunct CP islands (11), sentential subject islands (12) and the left branch condition (13).

- (10) Lisi zhao-le [yi-ge hui shuo liang-men yuyan de ren],  
 Lisi find-PERF one-CL can speak two-CL language C person  
 ‘Lisi found a person who can speak two languages...’  
 dan wo bu zhidao [shi na liang-men (yuyan)]  
 but 1SG not know be which two-CL languages  
 ‘...but I don’t know which two (languages).’

- (11) Lisi<sub>i</sub> [yinwei <e<sub>i</sub>> kan-le yi-ge jiemu] hen shangxin,  
 Lisi because watch-PERF one-CL show very sad  
 ‘Lisi<sub>i</sub> was very sad because <he<sub>i</sub>> watched a show...’  
 dan wo bu zhidao [shi shenme/nage jiemu]  
 but 1SG not know be what/ which show  
 ‘...but I don’t know what/which show.’

- (12) [you yi-ge ren yao cizhi ] rang wo hen jingya  
 there.be one-CL person will resign make 1SG very surprised  
 ‘That a person will resign made me very surprised...’  
 dan wo bu zhidao [shi shei]  
 but 1SG not know be who  
 ‘...but I don’t know who.’

- (13) Lisi mai-le yi-tao [fangzi], dan wo bu zhidao [shi duo da]  
 Lisi buy-PERF one-CL house but 1SG not know be how big  
 ‘Lisi bought a house but I don’t know how big.’

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This phenomenon casts doubt on the movement-ellipsis analysis as it would require focus-movement out of syntactic islands. By contrast, the island-insensitivity of S-strings is not a problem for the pseudo-slucing analysis because under this approach there is no extraction.

Nonetheless, since Ross’s (1969) observation about the island-insensitivity of English sluices, some proponents of the movement-ellipsis analysis (e.g., Lasnik 2001 and Merchant 2001, following ideas of Ross 1969 and Chomsky 1972) have argued that islands are essentially a PF phenomenon and thus the PF deletion of the offending *wh*-copy/trace inside the island can repair an otherwise ungrammatical structure (‘salvation by deletion’). The more recent linearization theories (e.g., Fox & Pesetsky 2005) also provide a similar solution for this apparent problem of the movement-ellipsis analysis, claiming that islands are the result of spell-out rule violations, therefore they do not arise when the island is not spelled out.

## 2.2. Arguments for the movement-ellipsis analysis

In the previous subsection, we saw two arguments supporting the pseudo-slucing analysis: the overt pronoun alternation and the island-insensitivity of S-strings (cf. Lasnik 2001, Merchant 2001, and Fox & Pesetsky 2005). Let us turn now to the arguments that favor a movement-ellipsis derivation over a pseudo-slucing analysis. Because the pseudo-slucing analysis posits no hidden structure, it fails to account for a number of properties of Mandarin S-strings including *wh*-else S-strings, the behavior of idiomatic expressions, the strict/sloppy identity ambiguity, the argument-adjunct asymmetry with respect to *shi*, and multiple S-strings. We discuss these in turn.

### 2.2.1. The *wh*-else S-string

The Mandarin *wh*-else S-string is illustrated in (14). Note that the existential verb *you* ‘have’ is obligatory before the *wh*-phrase *shei* ‘who’.

- (14) *Lisi jiao-le Mali, wo bu zhidao hai \*(you) shei*  
 Lisi called Mali 1SG not know additionally have who  
 ‘Lisi called Mali. I don’t know who else.’  
 (lit. ‘I don’t know additionally have who.’)



The pseudo-sluicing analysis cannot account for *wh*-else S-string because *pro* cannot be the subject of the existential verb *you* ‘have’, which is non-thematic, and no matter what reference is assigned to *pro*, the intended meaning cannot be derived, as shown in (15a).<sup>5</sup> By contrast, the movement-ellipsis analysis successfully derives *wh*-else sluices if we assume that the existential verb *you* ‘there.be’ is also a trigger for the extraction of the *wh*-phrase from within the TP, as shown in (15b).<sup>6</sup>

(15) *Lisi<sub>i</sub> jiao-le Mali<sub>j</sub>, wo bu zhidao...*

Lisi called Mali 1SG not know

‘Lisi called Mali. I don’t know...’

- a. ...*pro*<sub>\*i/\*j/\*k</sub> *hai* *you* *shei*  
*pro* additionally have who

Intended: ‘...who else.’ (lit. ‘...*\*pro* additionally have who’)

- b. ... *hai* *you* *shei* [<sub>TP</sub> *Lisi jiao-le* \_\_\_ / \_\_\_ *jiao-le* *Mali*]  
 additionally have who Lisi call-PERF / call-PERF Mali  
 ‘...who else <Lisi called / called Mali>.’

### 2.2.2. The idiomatic reconstruction

A second argument in favor of ellipsis and against pseudo-sluicing comes from the idiomatic reconstruction in S-strings, as pointed out by Song and Yoshida (2017). The example in (16) contains the idiom *chi yi ge ren de cu* ‘be jealous of someone’ (lit. ‘eat a person’s vinegar’). The well-formedness of the S-string under the idiomatic interpretation shows that there must be an elided structure containing the verb *chi* ‘eat’ (16a); without that structure the DP (*shei de cu* ‘whose vinegar’) in the S-string loses its idiomatic interpretation. Under a pseudo-sluicing analysis, in which the null subject *pro* takes the DP *yi ge ren de cu* ‘a person’s vinegar’ as its antecedent, only the unintended literal interpretation is available, which is still the case even if the null subject *pro* is replaced by the overt pronoun *na* ‘that’, as shown in (16b).

<sup>5</sup> Wei (2017) treats the *wh*-else S-strings, what he calls ‘*you*-sluice’, as a variant of pseudo-sluice. In his analysis, *you* ‘have’ is a possessive verb as opposed to an existential verb, and takes a null subject *pro* (a nominal pronoun or an event pronoun) and the *wh*-phrase as its two arguments. However, *you* cannot be a possessive verb in an S-string. One bit of evidence is that *you* cannot be negated in this case, which is a property of the existential verb *you*, as opposed to the possessive verb *you*.

(i) Lisi jiao-le yixie ren, wo bu zhidao \*mei you shei  
 Lisi called PERF some people, 1sg not know not have who  
 Intended: ‘Lisi called some people. I don’t know who not.’

<sup>6</sup> See Huang (1988) for the parallel distribution of *shi* ‘be’ and *you* ‘have’ in Mandarin Chinese.

(16) *Lisi zai chi [yi-ge ren]-de cu...*

Lisi PROG eat [one-CL person]-GEN vinegar

‘Lisi is jealous of someone...’

a. ...*wo bu zhidao shi shei-de cu<sub>i</sub> ~~f<sub>TP</sub> Lisi zai chi t<sub>i</sub>~~*

1SG not know FM who-GEN vinegar Lisi PROG eat

‘I don’t know who <Lisi is jealous of>.’

(lit. I don’t know whose vinegar <Lisi is eating>.)

b. ...*wo bu zhidao pro/na shi shei-de cu*

1SG not know *pro/that* be who-GEN vinegar

‘I don’t know whose vinegar that is.’

(≠ Intended: ‘I don’t know who Lisi is jealous of.’)

### 2.2.3. Sloppy identity

Another argument showing that there must be elided structure in S-strings comes from the strict/sloppy identity ambiguity, or more precisely, the availability of sloppy readings in Mandarin S-strings. The sentence in (17), in which both strict and sloppy readings are possible, is illustrative:

(17) *Lisi<sub>i</sub> zhidao shei tou-le ta<sub>i</sub>-de qian,*

Lisi<sub>i</sub> know who steal-PERF 3SG<sub>i</sub>-GEN money

‘Lisi<sub>i</sub> knows who stole his<sub>i</sub> money...’

*Mali ye zhidao shi shei*

Mali too know be/FM who

a. strict reading: ‘...Mali<sub>j</sub> also knows who (stole his<sub>i</sub> (=Lisi’s) money).’

b. sloppy reading: ‘...Mali<sub>j</sub> also knows who (stole her<sub>j</sub> (=Mali’s) money).’

The availability of a sloppy reading for the S-string in (17), i.e., (17b) indicates the presence of the 3SG pronoun *ta* inside the elided structure, as in (18), that takes the local *Mali* as its antecedent. The strict reading is also available under an ellipsis analysis when *ta* refers to the distant antecedent *Lisi*. The ambiguity introduced by the pronoun in the elided structure is demonstrated in (18).

(18) ...*Mali<sub>j</sub> ye zhidao shi shei ~~f<sub>TP</sub> tou-le ta<sub>i/j</sub>-de qian~~*

Mali<sub>j</sub> too know FM who steal-PERF 3SG<sub>i/j</sub>-GEN money

‘...Mali<sub>j</sub> also knows who (stole his<sub>i</sub>/her<sub>j</sub> money).’ (strict reading; sloppy reading)

On the other hand, the pseudo-sluiice analysis must posit that the ambiguity comes from the *pro* subject of the dependent clause (cf. 6). But if *pro* in the pseudo-sluiice is the null counterpart of *na*, as we have assumed (following Adams 2004), then like *na* it should have only a strict reading, referring to the one and only pragmatically prominent antecedent; in the case of (19), *na* must be the person who stole Lisi's money and cannot be interpreted as the person who stole Mali's money:

- (19) ... *Mali ye zhidao na shi shei*  
 Mali too know that be who  
 '...Mali also knows who that is.' (strict reading; \*sloppy reading)

Thus, the availability of the sloppy reading shows that the S-string has more covert structure than a simple copular structure with a null subject. This is consistent with the movement-ellipsis analysis but not the pseudo-sluiicing derivation.<sup>7</sup>

#### 2.2.4. Other arguments

Further evidence in favor of the movement-ellipsis analysis regards the argument/adjunct asymmetry associated with *shi*, as well as the behavior of multiple S-strings.

The presence of *shi* is obligatory when the *wh*-remnant is an argument, as in (20a), but *shi* is optional when the *wh*-remnant is an adjunct, as in (20b).

- (20) a. *Lisi jiao-le yi-ge ren, dan wo bu zhidao \*(shi) shei*  
 Lisi call-PERF one-CL person but 1SG not know be/FM who  
 'Lisi called someone but I don't know who.'  
 b. *Lisi jiao-le yi-ge ren, dan wo bu zhidao (shi) weishenme*  
 Lisi call-PERF one-CL person but 1SG not know be/FM why  
 'Lisi called someone but I don't know why.'

<sup>7</sup> But cf. Adams and Tomioka (2012) who propose that *pro* could behave like the so-called 'paycheck' pronoun *it* in English which can have a sloppy interpretation, as illustrated by the following example (Jacobson 2000:87 (11)):

(i) The woman<sub>i</sub> who<sub>i</sub> deposited her<sub>i</sub> paycheck in the bank is wiser than the woman<sub>j</sub> who<sub>j</sub> deposited *it* in the Brown University Employees' Credit Union.

Adams and Tomioka thus argue that the pseudo-sluiice analysis can also derive the sloppy reading of S-strings. Note, however, that their analysis does not provide a clear explanation for the fact that a paraphrased sluiced sentence with an overt pronoun *na* 'that' never produces sloppy interpretations (cf. 19). On the sluiice analysis, there is no *pro* in the structure, hence the referential properties of the *na* counterpart are irrelevant.

Adams (2004), following the pseudo-slucing approach, explains this asymmetry by claiming that *wh*-adjuncts are predicative, while the two *wh*-arguments (*shei* ‘who’ and *shenme* ‘what’) are not. Observing that *shi* is obligatory in argument fragment answers (21a), but not required in adjunct fragment answers (21b), Adams concludes that *wh*-arguments require the copula *shi* ‘be’ in order to predicate a property of the null subject *pro*, while *wh*-adjuncts can predicate a property of *pro* directly.

- (21) Speaker A: *mama zhu-le yi-pan haochi-de cai* (Adams 2004)  
 mom cook-PERF one-CL delicious-DE dish  
 ‘Mom cooked a delicious dish.’
- a. Speaker B: *\*(na/pro shi) shenme?*  
 that/*pro* be what  
 ‘What \*(was it)?’
- b. Speaker B: *(na/pro shi) shenme shihou?*  
 that/*pro* be what time  
 ‘When (was it)?’

However, a counterexample to this claim is illustrated in (22), in which the *wh*-argument *shei* ‘who’ is grammatical in a fragment answer with or without *shi*.

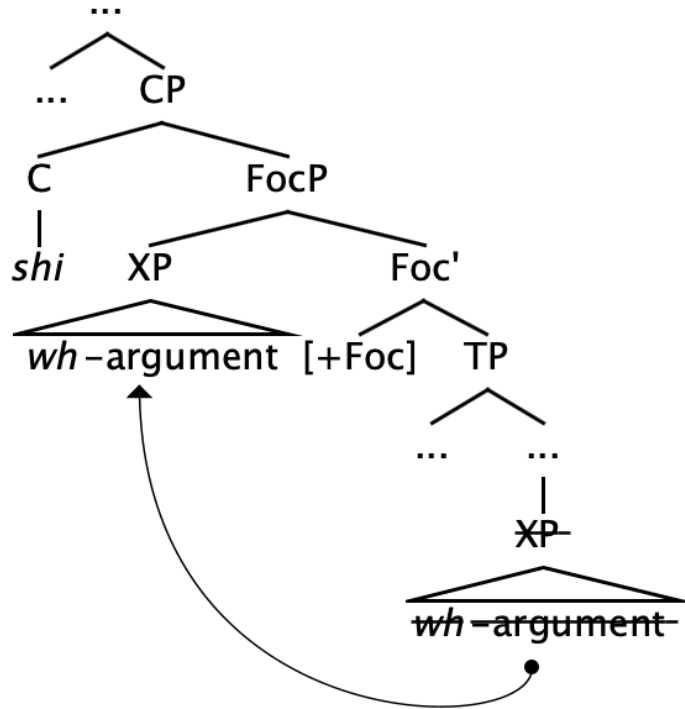
- (22) Speaker A: *mama jian-le yi-ge ren*  
 mom meet-PERF one-CL person  
 ‘Mom met someone.’
- Speaker B: *(shi) shei?*  
 be/FM who  
 ‘Who?’

If Adams’ (2004) argument is correct and the ability to stand alone in a fragment answer is the criterion for being predicative, given (22) we would also expect *shei* to be predicative and thus that *shi* would be optional in an S-string with *shei*, contrary to fact. As noted above, *shi* is obligatory in S-strings with *shei* ‘who’ and *shenme* ‘what’.

Alternatively, following a movement-ellipsis derivation, we propose that the argument-adjunct asymmetry with respect to the presence of *shi* results from the different positions of *wh*-arguments and *wh*-adjuncts: *wh*-arguments are within TP while the *wh*-adjuncts, that

show optionality with the presence of *shi*, are adjoined to it.<sup>8</sup> To escape the TP, a *wh*-argument has to be extracted, as happens, for example, through the focus movement triggered by the FM *shi*, as shown in (23).<sup>9</sup> That is why *shi* is always present with argument S-strings such as (20a). Absent *shi*, the argument *wh*-phrase would not be able to escape the TP-ellipsis.

(23) *wh*-arguments extracted out of the TP via focus movement:

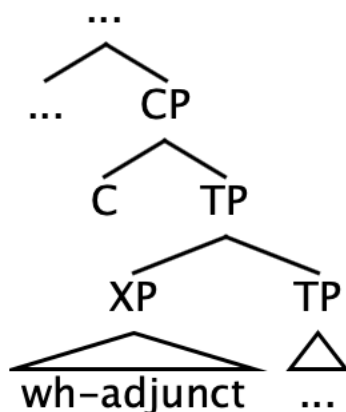


By contrast, *wh*-adjuncts like *weishenme* ‘why’ are adjoined to TP at the point of TP-ellipsis (which deletes the TP that they are adjoined to, but does not include them). *Shi* is optional for those *wh*-adjuncts because the focus movement triggered by *shi* is not necessary for them to escape the elided TP. In other words, focus movement of those *wh*-adjuncts is optional: when the adjunct moves to Spec-FocP the structure is (24b); otherwise the structure is (24a).

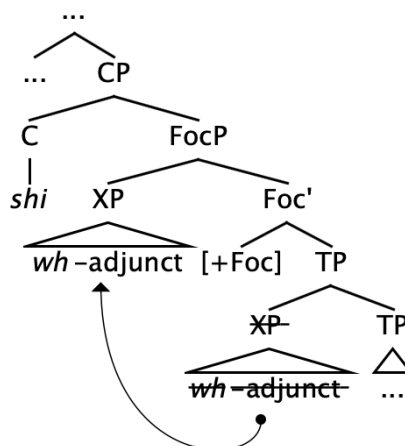
<sup>8</sup> The *wh*-adjuncts are adjoined to the TP, at least at the point the TP-ellipsis happens, regardless of whether they are base-generated as TP-adjuncts or moved from within TP.

<sup>9</sup> The existential verb *you* ‘have’ can also trigger a movement of this sort, which is briefly mentioned in (14) but will not be expanded in details in this paper. That is why the existential verb *you* is also obligatory in the *wh*-else S-strings like (14).

(24) a.



b.



The movement-ellipsis derivation also accounts for the behavior of multiple S-strings in Mandarin. The sentences in (25) illustrate two properties of multiple S-strings: (i) the *wh*-argument must precede, not follow the *wh*-adjunct (25a), and (ii) the FM *shi* only occurs before the first *wh*-phrase but is not allowed before the second (25b).<sup>10</sup>

(25) *Lisi da-le yi-ge ren...*

Lisi beat-PERF one-CL person

a. ... \**dan* *wo bu zhidao shi zai-nali shi shei*  
but 1SG not know FM at-where FM who

b. ... *dan* *wo bu zhidao \*(shi) shei (\*shi) zai-nali*  
but 1SG not know FM who FM at-where

‘Lisi beat someone but I don’t know who and where.’

These two requirements are a natural result of the movement-ellipsis derivation in (23). The *wh*-argument precedes the adjunct in multiple S-strings because the former is in the higher focus position and the latter is in its original position. That *shi* only occurs before the *wh*-argument but not before the *wh*-adjunct derives from the fact that there is only one *shi* projection in (23).

On the other hand, the pseudo-slucing analysis cannot explain these two properties of multiple S-strings. This analysis posits a null subject in the S-string. Hence, in multiple S-

<sup>10</sup> If there is an intonational break (i.e., a pause) between the two *wh*-phrases in the multiple S-string, then the second *shi* is also acceptable. Indeed, with intonational breaks between *wh*-phrases, there can be not only two, but also a list of *wh*-phrases in the multiple S-string. But in those cases, the structure is more likely to be a conjunction or a list of two or more clauses, as opposed to one multiple S-string (i.e., one S-string with multiple *wh*-phrases).

---

strings, there should be multiple null subjects, one referring to the antecedent DP *mouren* ‘someone’ and one referring to the antecedent event ‘Lisi beat someone’, as follows:

- (26) [*Lisi da-le yi-ge ren<sub>i</sub>*]<sub>j</sub> *dan wo bu zhidao...*  
 Lisi beat-PERF one-CL person but 1SG not know  
 ...*pro<sub>i</sub> \*(shi) shei pro<sub>j</sub> \*(shi) zai-nali*  
*pro be who pro be at-where*  
 ‘[Lisi beat someone]<sub>j</sub> but I don’t know who (was *pro<sub>i</sub>*) and where (was *pro<sub>j</sub>*).’

Thus, this hypothesis fails to explain why only one *shi* is allowed, or why the order of the *wh*-argument and the *wh*-adjunct phrases cannot be reversed. Both problems are solved by a movement-ellipsis derivation.

### 2.2.5. Interim summary

Summarizing the discussion thus far, we have seen that the movement-ellipsis derivation provides a better explanation for the argument/adjunct asymmetry with regard to *shi* and the two properties of multiple S-strings. More importantly, because the pseudo-sluicing analysis does not posit ellipsis in S-strings, it fails to account for various phenomena that require the presence of hidden structure: *wh*-else S-strings, idiomatic reconstruction, and the strict/sloppy ambiguity of Mandarin S-strings. Finally, the island-repair effect of S-strings – perhaps the strongest argument in favor of the pseudo-sluicing analysis, is not fatal to the movement-ellipsis derivation insofar as various syntactic solutions are available to account for the extraction out of islands.

## 2.3. Prosodic evidence for pseudo-sluices

The preponderance of evidence presented to this point supports the focus movement-ellipsis analysis of Mandarin S-strings (as opposed to the pseudo-sluicing approach). However, in this section we discuss cases in which a surface S-string is in fact a pseudo-sluice, that is, a copular sentence with a null subject *pro* [*pro* be *wh*-phrase].

We have seen that one crucial difference between these two derivations is how they analyze the ambiguous *shi*. The movement-ellipsis derivation recognizes *shi* as a FM of the same kind we find in clefts, whereas the pseudo-sluicing analysis treats it as a copula linking the silent subject and the *wh*-phrase. In this section, we discuss a prosodic

difference between the FM *shi* and the copula *shi*: the former cannot be accented while the latter can. Since the *shi* in an S-string itself is ambiguous, we will use un-elided structures to show this difference. Example (27) shows that before the cleft-pivot *Lisi* the FM *shi* cannot be accented in un-elided clefts.

- (27) \**SHI*    *Lisi*    *jiao-le*    *Mali*  
       FM        *Lisi*        call-PERF    *Mali*  
       ‘\*It WAS Lisi that called Mali.’

By contrast, the accent in a copular sentence can be realized on the copula *shi*, as shown in (28), especially when *shi* ‘be’ is contrastive with its negative form *bu shi* ‘be not’, for example (29).<sup>11</sup>

- (28) *jiao-le*        *Mali*    *de ren*    *queshi*        *SHI*    *Lisi*  
       call-PERF    *Mali*    C    person    indeed        be        *Lisi*  
       ‘The person who called Mali (indeed) WAS Lisi.’

- (29) Context: Speakers A and B are waiting for Lisi. They see a man who looks like him but are not sure whether he is Lisi or not.

- a. Speaker A:    *pro/ta/na*<sup>12</sup>    *haoxiang*    ***bu shi***    *Lisi*  
                          *pro/3SG/that* seemingly    not be    *Lisi*  
                          ‘Seemingly, <it>/he/that is not Lisi.’
- b. Speaker B:    *bu, ni*    *cuo-le.*        *pro/ta/na*    ***SHI***    *Lisi*  
                          no, you wrong-PERF *pro/3SG/that* be        *Lisi*  
                          ‘No, you’re wrong. <It>/He/That IS Lisi.’

In S-strings, *shi* is usually not accented because it is typically the *wh*-phrase that bears the focus accent. If *shi* does get accented, it is a sign that the surface S-string is a pseudo-slurice because copula *shi* can be accented while FM *shi* cannot. (30) is an example of an accented *shi* in a S-string, where *shi* ‘be’ is being contrasted with *bu shi* ‘not be’.

- (30) Context: Someone stole Lisi’s money. I don’t know who did it but I know who didn’t

<sup>11</sup> This accent realization on *shi* might be a case of ‘verum focus’ (named by Höhle 1992). Verum focus refers to the accent that, instead of focusing the accent-bearing expression, is used to emphasize the truth of the propositional content of a sentence. Although there is a debate on whether verum focus is a focus (e.g., Zimmermann & Hole 2008, Stommel 2012; Gutzmann & Miró 2011, Repp 2013), it does not change our argument here: the (verum) focus accent can only be realized on a copula *shi* but not a FM *shi*.

<sup>12</sup> As mentioned in Section 2.1 the overt pronoun *ta* ‘3sg’ or *na* ‘that’ can alternate with a silent pronoun *pro* due to the *pro*-drop property of Mandarin.



(because they have an alibi).

*Mouren tou-le Lisi-de qian...*  
someone steal-PERF Lisi-GEN money

‘Someone stole Lisi’s money...’

*wo bu zhidao SHI shei, dan wo zhidao BU SHI shei*  
1SG not know be who but 1SG know not be who

‘I don’t know who *pro* WAS, but I know who *pro* WAS NOT.’

In this example, the S-string must be a pseudo-sluiice [*pro* SHI *shei*] because *shi* is accented. We therefore derive a prediction: in those cases where *shi* is accented (hence necessarily a pseudo-sluiice structure), a sloppy reading of the S-string should be unavailable, as shown in (19) above. As we see in (31), this prediction is borne out.

(31) *Lisi zhidao shi shei tou-le ta-de qian,*  
Lisi know FM who steal-PERF 3SG-GEN money

‘Lisi knows who<sub>i</sub> is it that stole his money...’

*Mali ye zhidao SHI shei / Mali zhidao BU SHI shei*  
Mali too know be who Mali knows not be who

a. strict reading: ‘Mali also knows who *pro<sub>i</sub>* IS.

/ Mali knows who *pro<sub>i</sub>* IS NOT.’

b. sloppy reading: ‘#Mali<sub>j</sub> also knows who (stole her<sub>j</sub> money)

/ #Mali<sub>j</sub> knows who did not (steal her<sub>j</sub> money).’

In (30) and (31), the accented *shi* forces a pseudo-sluiice interpretation of the S-string.<sup>13</sup> It follows that a pseudo-sluiicing analysis must be available in Mandarin and hence that an S-string is ambiguous between a sluiice (derived by movement-ellipsis) and a pseudo-sluiice (a copula structure with a null subject), unless one of the structures is blocked. For example,

<sup>13</sup> Another piece of evidence that *shi* is the copula here is that it can be negated when it is followed by a *wh*-phrase, as in *bu shi shei* ‘not be who’. The FM in clefts cannot be negated when followed by a *wh*-pivot, as shown in (i), but there is no such restriction on the copula *shi*, as shown in (ii).

- (i) *(\*bu) shi shei jiao-le Mali?* (ii) *jiao-le Mali de (ren) (bu) shi shei?*  
not FM who call-PERF Mali call-PERF Mali C person not be who  
‘Who was (\*not) it that called Mali?’ ‘Who isn’t the person that called Mali?’

When the pivot is not a *wh*-phrase, negative clefts are acceptable, as below:

- (iii) *bu shi Lisi jiao-le Mali*  
not FM Lisi call-PERF Mali  
‘It is not Lisi who called Mali.’

idiomatic reconstruction would not be possible under a pseudo-slucing derivation, which does not posit elided structure, while an accented *shi* would not be derivable on a movement-ellipsis derivation since only when *shi* is a copula can it be accented.

## 2.4. Summary

In this section, we have discussed two syntactic accounts of Mandarin S-strings: the movement-ellipsis analysis treats *shi* as a FM and proposes that S-strings derive from focus-movement of the *wh*-remnant and TP-ellipsis; whereas the pseudo-slucing analysis treats *shi* as a copula that links a null subject *pro* and the *wh*-phrase, postulating no movement or elided structure.<sup>14</sup>

We argued that the sloppy readings, idiomatic reconstruction, and *wh*-else S-strings supports the presence of hidden structure, hence ellipsis, in S-strings. However, the fact that *shi* can be accented also indicates that S-strings can be analyzed as containing a copula *shi*. We thus propose a hybrid analysis in which Mandarin S-strings are structurally ambiguous between a sluice and a pseudo-slucice, unless one or the other derivation is forced in certain contexts.

## 3. Experimental Study: S-strings in Child Mandarin

In the previous section, we compared the movement-ellipsis analysis and the pseudo-slucing analysis with regard to several properties of Mandarin S-strings. In fact, these two analyses also make different predictions with respect to Mandarin-speaking children's acquisition of S-strings.

<sup>14</sup> Theoretically speaking, there can be two alternative analyses, which are not proposed in previous studies on the derivation of Mandarin S-strings. We will call them the 'reduced cleft' and the 'reduced pseudo-cleft' analyses. The following table lays out the differences among the four analyses:

|                         | structure of S-string  | <i>shi</i> | ellipsis    | movement                  |
|-------------------------|--|------------|-------------|---------------------------|
| a. pseudo-slucing       | [ <i>pro</i> be <i>wh</i> -phrase]   | copula     | no ellipsis | no movement               |
| b. movement-ellipsis    | [FM <i>wh</i> -phrase <sub>i</sub> [ <sub>TP</sub> ...t <sub>i</sub> ...]]                                     | FM         | TP ellipsis | <i>wh</i> -focus movement |
| c. reduced cleft        | [FM <i>wh</i> -phrase [ <sub>XP</sub> OP <sub>i</sub> ...[ <sub>TP</sub> ...t <sub>i</sub> ...]]]              | FM         | XP ellipsis | covert OP movement        |
| d. reduced pseudo-cleft | [ [ <sub>CP</sub> [ <sub>TP</sub> ...t <sub>i</sub> ...]] C [ <sub>OP</sub> <sub>j</sub> be <i>wh</i> -phrase] | copula     | CP ellipsis | covert OP movement        |

The reduced cleft analysis proposes that the S-strings derive from clefts. It is similar to the movement-ellipsis analysis, except for that the *wh*-phrase is an in-situ focus in the cleft, as opposed to a focus moved from within the elided TP. The reduced pseudo-cleft analysis suggests that S-strings derive from pseudo-clefts with the ellipsis of the relativized CP, a free relative clause that is the subject of the copula *shi*. For reasons of space, we will not discuss these alternative approaches. (To anticipate our discussion on the acquisition of S-strings in Mandarin, these two analyses would make the same predictions as the movement-ellipsis analysis since they both posit OP movement in the derivation, parallel to the focus movement in the movement-ellipsis analysis.)

Mateu, Hyams, and Winans' (2017) study of the acquisition of sluicing in English found that children aged 3;0-6;11 ( $M = 5;03$ ) comprehend subject sluices significantly better than object sluices – what we henceforth refer to as the “subject advantage”. Their finding is consistent with the predictions of the Intervention Hypothesis (Friedmann, Belletti, & Rizzi, 2009; cf. also Hyams & Snyder 2005; Snyder & Hyams 2015), viz., that A'-dependencies that cross another potential A'-moving element are harder for children.<sup>15</sup> According to this hypothesis, the subject advantage results from the movement-ellipsis derivation of English sluices. As shown in (32a), there is no intervener in the movement of *who* in the subject sluice, while the embedded subject *John* intervenes the movement of *who* in the object sluice (32b).<sup>16</sup>

- (32) a. Someone pushed John, but I don't know [<sub>CP</sub> *who*<sub>i</sub> [<sub>TP</sub> *t<sub>i</sub>* pushed John]] (subject sluice)  
 b. John pushed someone, but I don't know [<sub>CP</sub> *who*<sub>i</sub> [<sub>TP</sub> John pushed *t<sub>i</sub>*]] (object sluice)
- 

Since the movement-ellipsis analysis of Mandarin S-strings postulates (focus) movement of the *wh*-remnant, it also predicts that Mandarin-speaking children will show the same subject advantage, which is to say that they would perform better on subject S-strings than on object S-strings. On the other hand, the pseudo-sluicing analysis, which proposes no movement in the derivation of Mandarin S-strings, makes no such prediction. All else being equal, children should show no subject (or object) advantage in their comprehension of S-strings.

<sup>15</sup> The effects of intervention are also observed in other constructions that derive from A'-movement of an object. For example, children up to the age of six experience difficulties with object relative clauses (Friedmann, Belletti, & Rizzi, 2009; Friedmann & Novogrodsky, 2004; McKee, McDaniel, & Snedeker 1998), object *wh*-questions (de Vincenzi, Arduino, Ciccarelli, 1999; Friedmann et al. 2009), object topicalization (Friedman & Lavi, 2006), as well as A-dependencies such as passives and raising (Hyams & Snyder 2005; Snyder & Hyams 2015), etc.

<sup>16</sup> Studies of adult English speakers' on-line comprehension of sluices find an asymmetry in the opposite direction: When both the subject and object in the antecedent clause of the sluice are potential correlates (i.e. indefinite DPs) for the *wh*-remnant, participants prefer to associate the *wh*-remnant with the object (arguably due to the default focus alignment, see Frazier & Clifton 1998; Carlson et al. 2009). An eye-tracking experiment also found greater interference effects from a distractor (underlined) in object position, as in (b), than in subject position, as in (a) (potentially due to Locality Bias, see Harris 2015).

- (a) The tourists sampled some wine(s), but I don't know which {wines/ones}.
- (b) Some tourist(s) sampled the wines, but I don't know which {tourists/ones}.

These results seem to contradict those found in English-speaking children's comprehension of sluicing. However, we believe that the intervention effects triggered by the A'-movement from an object position are robust enough that they mask any effects of default focus assignment or Locality Bias in processing. We suspect that the object advantage observed for adults would be apparent in older children, once they fully master whatever syntactic operation (e.g., smuggling) allows them to circumvent intervention.

This experiment is designed to investigate whether the subject advantage exists for 3- to 6-year-old Mandarin-speaking children. Our results should provide us with a better understanding of the acquisition of the Mandarin S-strings construction as well as its syntax.

### 3.1. Methods

#### 3.1.1. Subjects

A total of 59 native Mandarin-speaking children aged 3;0-6;8 ( $M = 4;10$ ) were tested, 15 in each year interval except for the 3-year-old group which had 14 subjects. Forty-seven of the children were recruited in Changsha, Hunan, China and the remaining twelve in Los Angeles, California, all of whom had at least 80% exposure to Mandarin according to parents' reports. Fourteen additional subjects were tested but excluded because they failed five or more out of the twelve control trials, namely the full *wh*-questions.<sup>17</sup>

#### 3.1.2. Design and Materials

This experiment had 24 trials with a  $2 \times 2 \times 2$  design crossing three factors: S(sentence)Type (S-strings vs. full (unsluiced) *wh*-questions (as control trials)), Position (subject vs. object), and Animacy (animate vs. inanimate arguments). Three out of the four transitive verbs were used in each condition: *zhui* 'to chase', *tui* 'to push', *ya* 'to be on the top of', and *kao* 'to lean on'.

Sentences (33) and (34) demonstrate the four conditions (2 Positions  $\times$  2 Types) with animate arguments. Under the animate condition, the *wh*-phrase used was *shei* 'who'. The (a) examples illustrate the S-string, and the (b) examples the full *wh*-question control:

#### (33) Subject extraction with animate arguments

Antecedent clause:

*wo neng kanjianyi-ge ren zai zhui hongse yifu-de nansheng...*  
 1SG can see one-CL person PROG chase red clothes-DE boy  
 'I can see that someone is chasing the boy in red...'

- a. ...*ni neng kanjian shi shei ma?*  
 2SG can see be/FM who Q  
 '...can you see who?'

<sup>17</sup> In total, there were nine 3-year-olds, four 4-year-olds, and one 5-year-old were excluded for this reason.

- 
- b. ... *ni neng kanjian shei zai zhui hongse yifu-de nansheng ma?*  
 2SG can see who PROG chase red clothes-DE boy Q  
 ‘...can you see who is chasing the boy in red?’

(34) Object extraction with animate arguments

Antecedent clause:

*wo neng kanjian hongse yifu-de nansheng zai zhui yi-ge ren...*  
 1SG can see red clothes-DE boy PROG chase one-CL person  
 ‘I can see that the boy in red is chasing someone...’

- a. ...*ni neng kanjian shi shei ma?*  
 2SG can see be/FM who Q  
 ‘...can you see who?’
- b. ... *ni neng kanjian hongse yifu-de nansheng zai zhui shei ma?*  
 2SG can see red clothes-DE boy PROG chase who Q  
 ‘...can you see who the boy in red is chasing?’

Our experiment also had trials with inanimate arguments to cancel a potential effect observed in previous studies, viz. that children generally prefer animate DPs to be subjects and inanimate DPs to be objects (e.g., Dahl 2000 for Swedish, Øvrelid 2004 for Norwegian, Scott & Fischer 2009 for English). More specifically, in the S-string trials such as (33a) and (34a), if children are affected by the tendency in natural language for *shei* ‘who’ questions to be subject *wh*-questions and the more general trend of animate DPs to be subjects, there will be a bias towards a subject answer in the S-string trials, potentially resulting in a subject advantage. Therefore, we manipulated Animacy so that the trials with animate arguments and inanimate arguments were balanced.<sup>18</sup> Sentences (35) and (36) exemplify the four conditions with inanimate arguments. In the inanimate conditions, the *wh*-phrase used was *shenme* ‘what’. As before, the (a) examples are the S-string, and the (b) examples the full *wh*-question control.

(35) Subject extraction with inanimate arguments

Antecedent clause:

*wo neng kanjian yi-ge dongxi zai zhui huangse-de che...*

---

<sup>18</sup> In our experiment, there were no animacy mismatch trials – either both subject and object were animate or both inanimate. Some previous studies showed that the intervention effects are stronger when the moved element shares the same feature as the intervening element (see Friedmann et al. 2009, Gutierrez-Mangado 2011, Belletti, Friedmann, Brunato & Rizzi 2012, a.o. for the effects of mismatched features in A'-movement constructions and especially Mateu & Hyams 2018 for animacy mismatch effects in English sluice acquisition).

1SG can see one-CL thing PROG chase yellow-DE car

‘I can see that something is chasing the yellow car...’

a. ...*ni neng kanjian shi shenme ma?*

2SG can see be/FM what Q

‘...can you see what?’

b. ...*ni neng kanjian shenme zai zhui huangse-de che ma?*

2SG can see what PROG chase yellow-DE car Q

‘...can you see what is chasing the yellow car?’

### (36) Object extraction with inanimate arguments

Antecedent clause:

*wo neng kanjian huangse-de che zai zhui yi-ge dongxi ...*

1SG can see yellow-DE car PROG chase one-CL thing

‘I can see that the yellow car is chasing something...’

a. ...*ni neng kanjian shi shenme ma?*

2SG can see be/FM what Q

‘...can you see what?’

b. ...*ni neng kanjian huangse-de che zai zhui shenme ma?*

2SG can see yellow-DE car PROG chase what Q

‘...can you see what the yellow car is chasing?’

As discussed earlier (Section 2.2.4), S-strings with argument *wh*-phrases such as *shei* ‘who’ and *shenme* ‘what’ require the presence of *shi*, regardless of the Position. However, in full *wh* questions in Mandarin, *shi* is optional in subject(-cleft) *wh*-questions (37a) but unacceptable in object(-cleft) *wh*-questions (37b).

(37) a. (*shi*) *shei zai zhui wo?*

FM who PROG chase 1SG

‘Who is chasing me?’/ ‘Who is it that is chasing me?’

b. *wo zai zhui (\*shi) shei?*

1SG PROG chase FM who

‘Who am I chasing?’ / ‘\*Who is it that I am chasing?’

To avoid introducing another variable into the experiment (i.e. the presence of *shi* in subject but not object full *wh*-questions), we did not include *shi* in either the subject or object *wh*-question controls.

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### 3.1.3. Procedure

The children were shown images on a screen and were then asked pre-recorded questions by a cartoon character, Miss Donkey. Figures 1 and 2 are examples of these images, in which three characters/items perform the same actions (e.g., chase, push, etc.) on one other. The children were required to answer the questions, illustrated in (33)-(36) above, by answering ‘yes/no’ or pointing to one character/item in the image.<sup>19</sup> In half of the images, one character/item was partially hidden so that when asked if they could see the target character/item, the children were not biased towards always responding ‘yes’ (or ‘no’).<sup>20</sup>

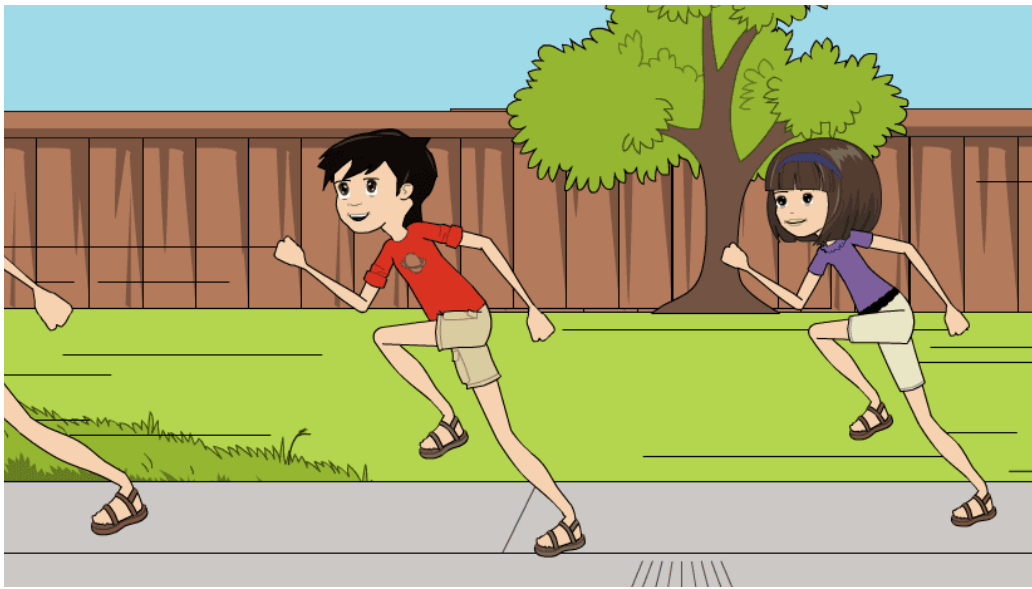


Figure 1. Chasing event with animate characters

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<sup>19</sup> During the tests, most children tended to point to the characters/items as opposed to verbally responding to the questions.

<sup>20</sup> The partially hidden character/item was either the leftmost or the rightmost one of the three, but not necessarily the correct answer and the *yes/no* answers were equally divided into the images with hidden characters/items.

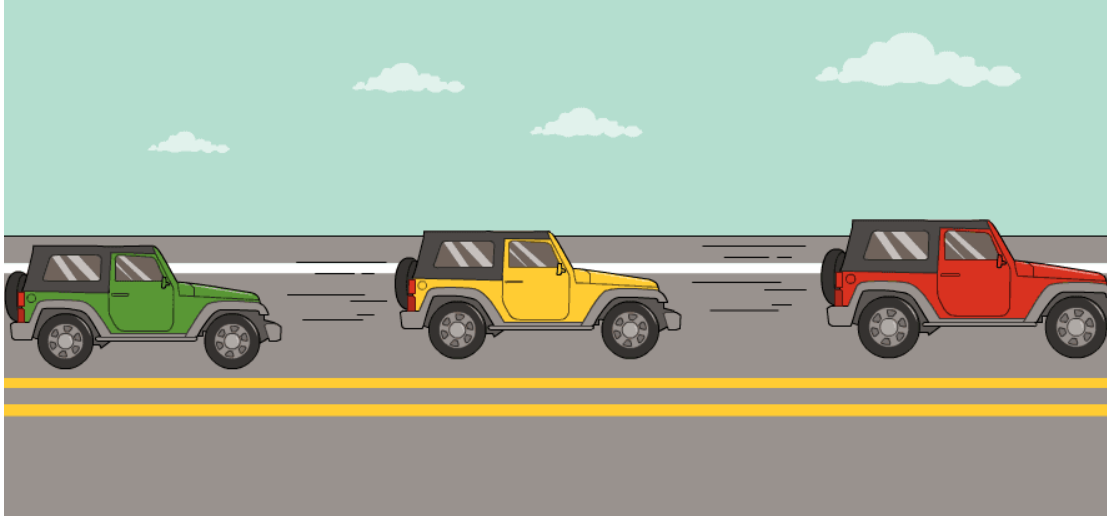


Figure 2. Chasing event with inanimate items

For example, in Figure 1, the girl in purple is chasing the boy in red, who is in turn chasing someone who is partially hidden. Miss Donkey would ask, for example (35a), ‘I can see that someone is chasing the boy in red, can you see who?’ A correct response to this question would be either to point to the girl in purple or to verbally answer ‘yes (the girl in purple)’. Other responses (e.g., pointing to another character or saying ‘no’) were counted as incorrect.<sup>21</sup>

The test started with a brief color-naming test which eliminated one subject who failed this pretest. Next was the training session that contained 9 items designed to familiarize the children with the task. No child had to be excluded due to misunderstanding of the task. There were 24 test sentences in the  $2 \times 2 \times 2$  design, as described previously. Any child who became tired or lost interest in the tasks was given a short break. The full set of the training and testing items is provided in Appendix B.

### 3.2. Results

Table 1 (plotted in Figures 3 and 4) lays out the mean percentages of correct responses under four conditions ( $\{\text{subject, object}\} \times \{\text{full } wh\text{-questions, S-strings}\}$ ) and the numbers of children who performed significantly above chance in each age group.<sup>22</sup>

<sup>21</sup> When a child responded ‘yes’, s/he was asked to point out which. When a child responded ‘no’, s/he was asked to explain why.

<sup>22</sup> Since there were three characters/items in each image for a child to choose from, chance performance would be 33% correct and a response of 23% - 43% correct would be non-significant from chance performance.



Table 1. Percentage of correct responses (standard errors in parentheses) and numbers of above-chance participants in each age group

|         | Full <i>wh</i> -question controls |                        |                    | S-strings           |                    |                    |
|---------|-----------------------------------|------------------------|--------------------|---------------------|--------------------|--------------------|
|         | Subject<br><i>wh</i> -Q           | Object<br><i>wh</i> -Q | # above-<br>chance | Subject<br>S-string | Object<br>S-string | # above-<br>chance |
| Age 3   | 73.81% (6.2)                      | 69.05% (3.7)           | 13/14              | 63.10% (6.8)        | 59.52% (6.1)       | 10/14              |
| Age 4   | 85.56% (6.0)                      | 90.00% (4.4)           | 15/15              | 75.56% (8.4)        | 84.44% (6.7)       | 13/15              |
| Age 5   | 93.33% (5.6)                      | 94.44% (2.8)           | 15/15              | 92.22% (3.2)        | 81.11% (4.6)       | 15/15              |
| Age 6   | 92.22% (5.6)                      | 97.78% (2.6)           | 15/15              | 93.33% (3.2)        | 81.11% (5.8)       | 15/15              |
| Average | 86.23% (3.6)                      | 87.82% (2.5)           | -                  | 81.05% (3.8)        | 76.55% (3.6)       | -                  |
|         | 87.02%                            |                        | -                  | 78.80%              |                    | -                  |

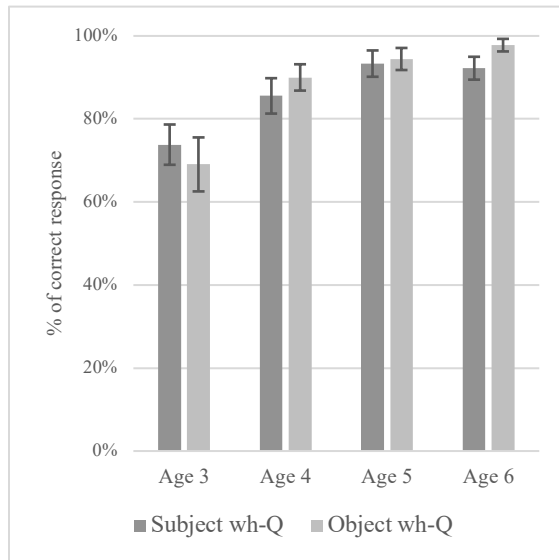


Figure 3. Mean percentages of correct responses for full *wh*-questions by age. (Error bars indicate standard errors in figures 3 and 4.)

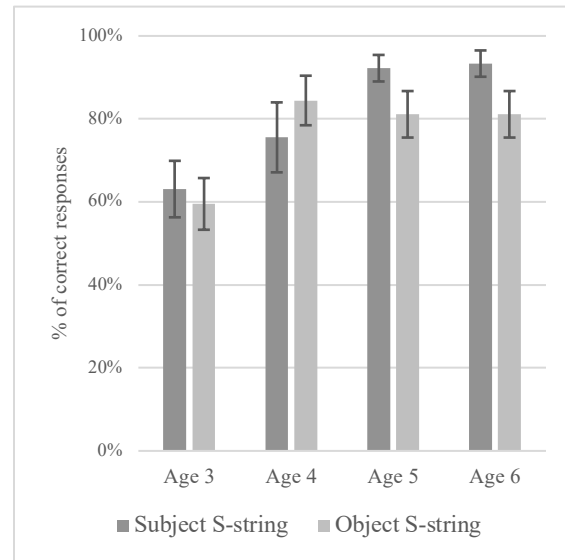


Figure 4. Mean percentages of correct responses for S-strings by age.

Data analysis was conducted in R version 3.5.0 (R Development Core Team 2014). Because responses were binary (either correct or incorrect), a mixed-effect logistic regression (using the lme4 package, Bates & Maechler 2009) modeled the dependency of correct responses to Age, SType, Position, Animacy, the SType-Position interaction, and the Animacy-Position interaction, with Verb and Participant as random intercepts. Our results show that Age ( $\chi^2(1) = 20.484, p < 0.001$ ) and SType ( $\chi^2(2) = 25.495, p < 0.001$ )

both contributed significantly to the model fit according to a likelihood-ratio test, while Animacy ( $\chi^2(2) = 5.595, p = 0.061$ ) and Position ( $\chi^2(3) = 1.057, p = 0.787$ ) did not, neither did the Animacy-Position interaction ( $\chi^2(1) = 0.700, p = 0.403$ ) nor the SType-Position interaction ( $\chi^2(1) = 0.353, p = 0.553$ ). Since neither Animacy nor its interaction with Position contributed significantly to the model and is not directly relevant to our research question, we henceforth exclude it from the model. The results of all conditions including Animacy, are shown in Appendix A.

In the simplified logistic regression model with only Age, SType, Position and the SType-Position interaction as fixed effects and Verb and Participant as random intercepts, we found significant effects of Age ( $p < 0.001$ ) and SType ( $p < 0.001$ ). The conclusions drawn from these results are that (i) older children performed better than younger children, and that (ii) children performed better with full *wh*-questions than S-strings.

As can be seen in Figures 3 and 4, the performance of children was different across age. To better explore this age effect, the data were divided into the younger (3- and 4-year-old) and the older (5- and 6-year-old) groups. The first difference between these two groups is the interaction between SType and Position, which is not significant in the younger group ( $p = 0.673$ ) but significant in the older group ( $p = 0.026$ ). The interaction in each group is demonstrated in Figures 5 and 6.

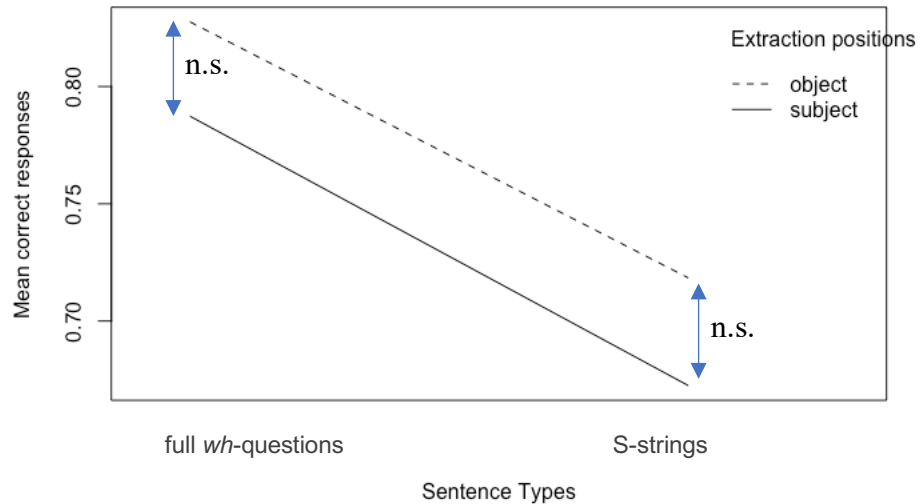


Figure 5. The STyPe-Position interaction in the younger group (3- and 4-year-olds).

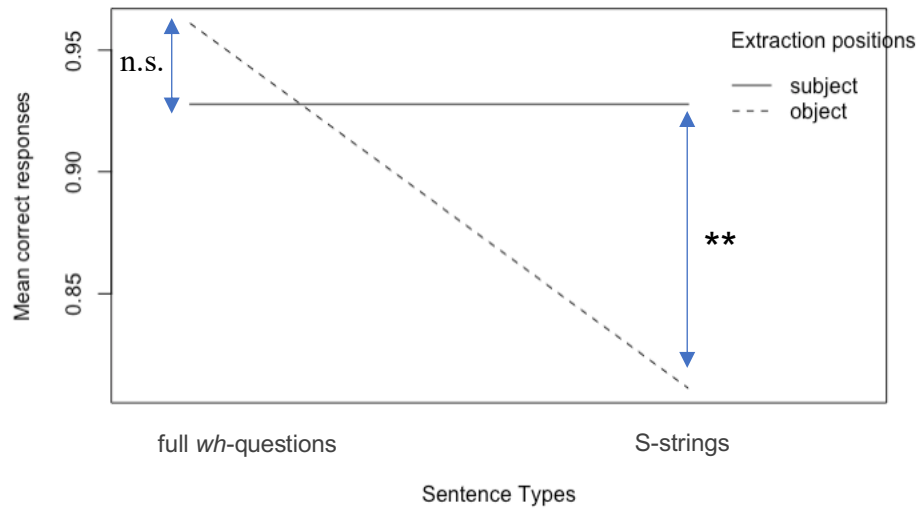


Figure 6. The STYPE-Position interaction in the older group (5- and 6-year-olds).

As shown in Figures 5 and 6, the younger children showed no difference in performance between subject/object trials in either S-strings or full *wh*-question controls ( $p = 0.489$  and  $0.301$  for full *wh*-questions and S-strings, respectively), whereas the older children showed no difference in performance on subject/object *wh*-questions ( $p = 0.841$ ), but performed significantly better on subject S-strings than on object S-strings ( $p = 0.004$ ). In other words, the younger children (3- and 4-year-olds) did not show any subject/object asymmetry in either sentence type, while the older children (5- and 6-year-olds) showed a significant subject advantage in their comprehension of S-strings.

### 3.3. Discussion

Our primary goal was to determine whether there is a subject advantage in Mandarin-speaking children's comprehension of S-strings. Recall the different predictions of the two analyses of S-strings: If only a pseudo-slucing analysis is available to these children, they should not show subject/object asymmetry in their interpretation of S-strings; however, given the intervention effect observed in English sluices (and other A'-movement structures, see fn. 15), we expect that if a movement-ellipsis derivation is also part of their grammar, children will perform better on subject S-strings than on object S-strings (the subject advantage).

Our results show a clear subject advantage in older Mandarin-speaking children (ages 5-6). This finding supports the hypothesis that these children, and (a fortiori) Mandarin-speaking adults, have focus movement-ellipsis as part of their grammar. In this respect our

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results parallel those found for English. However, the subject advantage is not observed in younger Mandarin-speaking children (ages 3-4). Thus, another important finding of our study concerns the delayed appearance of a subject advantage in Mandarin as compared to English. As discussed earlier, Mateu et al. (2017) found that by age 3 English-speaking children show a subject advantage in their comprehension of sluices, becoming adult-like (i.e., losing the subject > object asymmetry) only at around age 5. On the other hand, using similar materials, the Mandarin experiment shows a subject advantage only in the 5- and 6-year-old groups.

Why do Mandarin-speaking children show a subject advantage later than English-speaking children? Our hypothesis is that the presence of *shi* with its copula/FM ambiguity introduces a structurally simpler, non-movement derivation for Mandarin S-strings that does not exist for English sluices. We propose that Mandarin-speaking children first analyze *shi* uniquely as a copula, thereby deriving only the pseudo-sluice. Later, they learn that *shi* is also a FM, at which point a movement-ellipsis derivation of the S-string also becomes available. Because children initially have only a copula analysis of *shi* (Stage 1), there is no movement at this stage, hence no intervention and no subject advantage. Once they acquire the focus property of *shi*, the movement-ellipsis derivation also becomes available and the subject advantage emerges as an effect of intervention (Stage 2).

In addition to the age effect just described, our experiment also shows a full *wh*-question>S-string asymmetry, viz. that the children performed better on *wh*-questions than on S-strings. This asymmetry is unsurprising: Children must recover unspoken information in the S-string (be it the elided structure in sluices or the reference of the null subject *pro* in pseudo-sluices) in order to assign an interpretation, while this is not an issue in the full *wh*-questions.

We found no subject/object asymmetry in full *wh*-questions at any age. One possible explanation is that Mandarin is a *wh*-in-situ language, viz., there is no overt *wh*-movement, thus the intervention effect is not triggered in full *wh*-questions. However, in a *wh*-movement language like English, there is also no intervention effect in full *wh*-questions among 3- 6-year olds either (Mateu et al. 2017). Therefore, a more plausible account is that by age 3 children are fully adult-like with respect to *wh*-questions, and hence show no intervention effect, i.e. no subject/object asymmetry.<sup>23</sup>

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<sup>23</sup> However, see Yoshinaga (1996) who found in an elicited production task that 2- to 3-year-old English-speaking children show a very strong subject bias in *wh*-questions (subject *who*-questions: 100% and 97.2% correct, respectively;

### 3.4. A Follow-up Corpus Study

To further test this two-stage hypothesis, we followed up with a corpus study which included 457 children (age 0;08-6;11) from the CHILDES data-base (MacWhinney 2000).<sup>24</sup> We conducted a search of all instances of *shi*. The expectation given our two-stage model is that children will not produce sentences with FM *shi* until a later age, while copula *shi* should be present quite early.

As predicted, our results show that Mandarin-speaking children produce copula *shi* from an early age.<sup>25</sup> For illustrative purposes, we provide several early examples in (38).

- (38) a. *Xueer shi nvsheng* (1;03)                      c. *zhe shi shenme* (1;10)  
           Xueer be girl                                      this be what  
           ‘Xueer is a girl.’                                ‘What is this?’
- b. *zhe shi da qiqiu* (1;05)                      d. *wo shi ni-de laoshi* (2;03)  
           this be big balloon                            1SG be 2SG-GEN teacher  
           ‘This is a big balloon.’                      ‘I am your teacher.’

On the other hand, FM *shi* appears later and is far less frequent, also as predicted.<sup>26</sup> Of 6235 tokens of *shi* only 13 are FMs (0.21%). Table 2 provides the total number of FMs produced by the children in our corpus study at one-year age intervals.

Table 2. The number of FM *shi* produced by age in two structures in Mandarin

|  | Age 3 | Age 4 | Age 5 | Age 6 |
|--|-------|-------|-------|-------|
|--|-------|-------|-------|-------|

object *who*-questions: 8.3% and 41.7% correct, respectively). By age 4, the correct production of object *who*-questions (79.6%) almost equals that of subject *who*-questions (88.6%). The discrepancy between Yoshinaga’s results and Mateu’s may be due to the fact that the former was a production study and the latter a comprehension study.

<sup>24</sup> The corpora we searched were Chang1 (*N* = 24; ages 3-6), Chang2 (*N* = 16; ages 3-4), Context (*N* = 25; age 2), LiZhou (*N* = 80; ages 3-6), Tong (*N* = 1; ages 1;7-3;4), Zhou1 (*N* = 15; ages 3-6), Zhou2 (*N* = 15; ages 3-6), Zhou3 (*N* = 1; ages 0;8-4;5), ZhouDinner (*N* = 80; ages 3-6), and ZhouNarratives (*N* = 200; ages 3-6).

<sup>25</sup> The earliest production of the copula *shi* we found in the CHILDES corpora is the following:

(i) *Xueer shi laoshu* ‘Xueer is a mouse’ (0;08) (file location: childe/Chinese/Mandarin/Zhou3/980606.cha/)

However, without any audio or video support, we find it suspicious that an 8-month-old child is capable of producing a complete sentence with five syllables.

<sup>26</sup> In this corpus study, we investigated only the sentence-initial FM *shi* but not vP/VP peripheral *shi*, such as in (i). The reasons are two-fold: First, the movement-ellipsis derivation suggests that the FM in S-strings is at the CP periphery, which is higher than the *shi* in (i) but might be the same element as the sentence-initial FM *shi* in clefts, which we take to be the trigger for FM development in children. Additionally, the readings in (i), shown in (a)-(d), heavily rely on contextual or prosodic information and it is not straight-forward whether *shi* is a FM or not in readings like (a) and (d).

- (i) Lisi shi tui-le Mali  
       Lisi SHI push-PERF Mali  
       a. Accenting *shi*: ‘Lisi INDEED pushed Mali.’  
       b. Accenting the verb: ‘Lisi PUSHed Mali (not kicked, pulled, beaten, etc...)’  
       c. Accenting the object: ‘Lisi pushed MALI (not others).’  
       d. No accenting: ‘What Lisi did was to push Mali.’

|   |   |   |   |   |
|---|---|---|---|---|
| # of sentence-initial FM <i>shi</i> in clefts | 1 | 5 | 5 | 2 |
| # of FM <i>shi</i> in S-strings               | 0 | 0 | 0 | 0 |

Note that all instances of FM *shi* that we found appeared in clefts, for example (39). There were no occurrences of argument S-strings in Mandarin-speaking children’s spontaneous productions through the age of 6;11.

(39) a. ***shi*** *shenme zai xiang a* (age 3 (month unknown))

FM what PROG make.sound SFP

‘What is it that is making a sound?’

b. Child 1: *dao-le* (age 4;03)

fall-PERF

‘(It) fell down.’

Child 2: *zenme nong de?*

how do DE

‘What happened?’

Child 1: ***shi*** *ni nong de a*

FM you do DE SFP

‘It was you (who did it).’

As Table 2 shows, we found only one occurrence of FM *shi* among the 3-year-olds, given in (39a) (this one production might be an “isolate”, see fn. 26) and the exact age of this child is unknown (only the year but not the month is provided).<sup>27</sup> The next example appears at age 4;03, shown in the exchange in (39b). Thus, it is only after 4-years old that the FM *shi* becomes somewhat productive, with 5 examples, the same number as produced at age 5.

Thus, consistent with our hypothesis, Mandarin-speaking children produce FM *shi* much later and far less frequently than copula *shi*, supporting the claim that the focus property of *shi* is acquired relatively late. Moreover, the fact that there were no S-strings

<sup>27</sup> To decide whether the single token found in age 3 is an “isolate” (due to transcription error or the child’s use of a memorized routine) or rather evidence that children have acquired clefts by this age, we borrowed the criterion for acquisition of a construction used in longitudinal studies: “First clear use, followed soon after by Repeated Use” (FRU, Snyder 2007:77). More specifically, if a potential first use of a construction is not followed soon afterwards (the criterion of Snyder is within one month) by repeated use, then we cannot rely on it and it needs to be excluded as an “isolate”. By this criterion, the one occurrence of clefts at age 3 should be an isolated production. However, it is not clear to what extent a criterion used in longitudinal studies can apply to the current corpus study, which contains data from both longitudinal studies and cross-sectional ones.

in the corpus data, even at age 6, highlights the difficulty of this structure for Mandarin-speaking children.<sup>28</sup> This is consistent with our experimental results: when presented with an S-string in the experiment the younger children assign the only interpretation (pseudo-slucing) available in their grammar – with *shi* as a copula.<sup>29</sup> Sometime between 4 and 5 years old, the focus property of *shi* is acquired (as evidenced by the production of clefts) and the movement-ellipsis derivation also becomes available. At that point, the subject advantage emerges as a result of the intervention effects triggered by focus movement. In the comprehension experiment, we see this effect in age groups 5 and 6.

It is reasonable to ask at this point why the Mandarin-speaking child who already has the structurally simpler pseudo-slucing analysis (with copula *be*) would add the more complex movement-ellipsis derivation. One possibility is that this development is driven by input data that are not analyzable under a pseudo-slucing analysis but which require “hidden” structure, for example, the sloppy reading cases, idiomatic reconstruction, and *wh*-else structures discussed in Section 2.2 (among other data). This kind of input could trigger the development from Stage 1 to Stage 2, in which both sluice and pseudo-slucice analyses are applied to S-strings.

Another, and perhaps more likely explanation, is that the movement-ellipsis analysis is grammatically-driven: Children may acquire the focus movement associated with *shi* on the basis of clefts and then extend the possibility of a movement analysis to S-strings which also contain *shi*. In an S-string of the sort in (35a), repeated as (40), the focus movement of the *shei* ‘who’ when *shi* is analyzed as a FM, requires an extraction site, which entails a hidden TP structure. Thus, in this way children add a movement-ellipsis (slucing) derivation to the pseudo-slucing derivation already established in their grammar.

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<sup>28</sup> By contrast, English argument sluices appear quite early in children’s speech (Mateu et al. 2017):

(i) a. MOT: *I don’t know what happened.* b. MOT: *Tell daddy what you did in school today.*  
 CHI: *You never know what.* (2;04) CHI: *Do you know what?* (2;08)

In total, Mateu et al. (2017) found 24 argument sluices in the production of English-speaking children aged 0;10-10;2, as well as 99 adjunct sluices. As for Mandarin, the results of a search for *shi* does not necessarily include adjunct S-strings because the presence of *shi* is not required in those cases. Future study is needed to decide whether there is spontaneous production of adjunct S-strings in this age range.

As for the age difference in sluice production in English- vs. Mandarin-speaking children, English sluices require *wh*-movement, a very early acquisition (Klima & Bellugi 1966 a.o.) while Mandarin sluices require focus movement, a later acquisition, as evidenced by the cleft data. However, the question remains as to why Mandarin-speaking children do not produce pseudo-slucices (with copula *shi*) early on. At present we have no proper explanation for this.

<sup>29</sup> We might refer to this as the ‘captive audience effect’. In experimental settings (as in natural language contexts) if children are presented with structures beyond their grammatical capacity, they will assign some interpretation consistent with their grammar. Sometimes this involves a non-target-like reanalysis of the input (see the *think/be* strategies used by children in raising *seem* experiments, e.g., Hirsch et al. 2007). In the case at hand, there is a derivation fully compatible with the input string accessible to children that happens to be part of the adult grammar of Mandarin.

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- (40) *wo neng kanjian hongse yifu-de nansheng zai zhui yi-ge ren...*  
 1SG can see red clothes-DE boy PROG chase one-CL person  
 ‘I can see that the boy in red is chasing someone...’
- ...*ni neng kanjian shi shei ma?*  
 2SG can see be/FM who Q  
 ‘...can you see who?’

Under this proposal, it is the acquisition of *shi* as a FM in clefts that triggers focus movement, and leads to a focus movement-ellipsis analysis. This “grammar-internal” trigger for sluicing seems the most likely given the relative frequency and accessibility of structures containing FM *shi*, such as clefts, over sentences involving sloppy identity, *wh*-else structures, and idiomatic reconstruction which would force a sluicing analysis.

Note that under either scenario, at Stage 2 both derivations are possible (except for cases where one or the other is blocked (see sections 2.2 and 2.3). When the child commits to a movement-ellipsis analysis this gives rise to the intervention difficulties associated with long-distance dependencies. When a pseudo-sluicing analysis is generated no asymmetry arises. There does not seem to be any obvious way to predict for any individual S-string what analysis the child (or adult) will choose. The choice may be random or determined by a variety of discourse and other factors.

### 3.5. Summary

The primary finding of our experiment is a subject advantage (subject > object) in the interpretation of S-strings among older Mandarin-speaking children. The implicatures of this finding are two-fold: First, the subject advantage observed in the older groups supports a movement-ellipsis analysis of Mandarin S-strings. Second, the delay of such a subject advantage suggests a two-stage development for Mandarin-speaking children: they initially analyze *shi* as a copula, hence apply a simpler, pseudo-sluicing derivation, and only later acquire the focus properties of *shi*. At that point, the movement-ellipsis derivation enters their grammar and the subject advantage emerges as an effect of intervention. A follow-up corpus study shows that the development of FM *shi* is later than that of a copula *shi*, consistent with the hypothesis of a two-stage development of *shi* and (pseudo-)sluicing in Mandarin.

## 4. Conclusion and future studies



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This paper discusses the syntax and L1 acquisition of Mandarin sluice-like constructions (S-strings). The derivation of Mandarin S-strings has been controversial because of the presence of *shi*, an element that is ambiguous between a copula and a FM.

The syntactic investigation led us to a hybrid analysis in which an S-string has two possible derivations: a sluice (derived by focus movement and TP ellipsis) and a pseudo-sluice (a copula structure with a null subject), unless one of the structures is forced. In some cases, an S-string must have elided structure, e.g. in order to derive sloppy readings, idiomatic reconstructions or *wh*-else sluices, whereas an accented or negated *shi* forces a pseudo-sluice interpretation.

The comprehension experiment with Mandarin-speaking children (3;00-6;08,  $M = 4;10$ ), as well as a follow-up corpus study, support a two-stage acquisition model and thus provides converging evidence for a hybrid analysis: Mandarin-speaking children initially analyze *shi* as a copula, hence have a simpler, pseudo-sluice interpretation, and only later fully acquire the focus properties of *shi* and the sluice interpretation derived by focus movement-ellipsis at which point a subject advantage emerges as an effect of intervention. Evidence from both adult syntax and from acquisition point to the same conclusion: Mandarin S-strings have both a sluice and pseudo-sluice derivation.

There are several avenues to pursue in future studies in order to further elucidate the properties of (pseudo-)sluices in Mandarin. For example, our findings can be followed up with studies looking at adult speakers' online processing of Mandarin S-strings. In particular, we are interested any potential subject/object asymmetry in adults, and also the relation between focus accent and strict/sloppy readings.

With respect to the S/O asymmetry, insofar as one of the two derivations of the ambiguous S-strings is parallel to the movement-ellipsis derivation of sluices in languages with *wh*-movement, we predict that Mandarin-speaking adults' performance on S-strings will show an 'object advantage' due to linear intervention between the indefinite and the remnant in subject sluices (see fn. 16) as has been found in English, Spanish and Portuguese (e.g., Frazier & Clifton 1998, Carlson et al. 2009, Harris 2015 on English; Lawn & Harris 2017 on Spanish; Lawn & Harris 2019 on Portuguese).

Another line of potential research concerns the availability of strict/sloppy readings. Because the prosodic information affects which structure is activated when we hear an S-string (see Section 2.3), we predict an interaction between the focus accent placement and the availability of a sloppy reading: If *shi* is accented, hearers should assign the S-string a pseudo-sluice analysis and the availability of a sloppy interpretation is predicted to

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significantly drop compared to when the focus accent falls on the *wh*-phrase. Relatedly, young children who have not yet acquired the movement-ellipsis analysis should fail to obtain sloppy interpretations in a controlled experiment.

Finally, there is the potential interaction between sloppy interpretation and adjunct/argument asymmetry. Adams and Tomioka (2012) (see fn. 7) proposed that, sloppy readings are easier to obtain with adjunct *wh*-remnants than argument *wh*-remnants. This should be tested with both older children and adults.

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## Appendix A. Results of all conditions.

Table 3. Percentages of correct responses by age and condition.

| Sentence Type             | S-strings (12 trials) |        |            |        | Full <i>wh</i> -questions (12) |        |            |         |
|---------------------------|-----------------------|--------|------------|--------|--------------------------------|--------|------------|---------|
| Extraction Position       | Subject (6)           |        | Object (6) |        | Subject (6)                    |        | Object (6) |         |
| Animacy                   | + (3)                 | - (3)  | + (3)      | - (3)  | + (3)                          | - (3)  | + (3)      | - (3)   |
| Age 3<br>( <i>N</i> = 14) | 59.52%                | 66.67% | 59.52%     | 59.52% | 71.43%                         | 76.19% | 71.43%     | 66.67%  |
|                           | 63.10%                |        | 59.52%     |        | 73.81%                         |        | 69.05%     |         |
|                           | 61.31%                |        |            |        | 71.43%                         |        |            |         |
|                           | 66.37%                |        |            |        |                                |        |            |         |
| Age 4<br>( <i>N</i> = 15) | 71.11%                | 80.00% | 80.00%     | 88.89% | 86.67%                         | 84.44% | 86.67%     | 93.33%  |
|                           | 75.56%                |        | 84.44%     |        | 85.56%                         |        | 90.00%     |         |
|                           | 80.00%                |        |            |        | 87.78%                         |        |            |         |
|                           | 83.89%                |        |            |        |                                |        |            |         |
| Age 5<br>( <i>N</i> = 15) | 91.11%                | 93.33% | 77.78%     | 84.44% | 97.78%                         | 88.89% | 93.33%     | 95.56%  |
|                           | 92.22%                |        | 81.11%     |        | 93.33%                         |        | 94.44%     |         |
|                           | 86.67%                |        |            |        | 93.89%                         |        |            |         |
|                           | 90.28%                |        |            |        |                                |        |            |         |
| Age 6<br>( <i>N</i> = 15) | 93.33%                | 93.33% | 77.78%     | 84.44% | 91.11%                         | 93.33% | 95.56%     | 100.00% |
|                           | 93.33%                |        | 81.11%     |        | 92.22%                         |        | 97.78%     |         |
|                           | 87.22%                |        |            |        | 95.00%                         |        |            |         |
|                           | 91.11%                |        |            |        |                                |        |            |         |

## Appendix B. Test materials.

### Training session

- a) *meige xiaohai chuan-zhe butong yanse-de yifu,*  
 every child wear-PROG different color-DE cloth  
*ni neng kanjian hongse yifu-de nansheng ma?*  
 2SG can see red cloth-DE boy Q  
 ‘Each child is wearing a different color. Can you see the boy in red?’
- b) *wo neng kanjian butong yanse-de che he butong yanse-de saoba,*

1SG can see different color-DE car and different color-DE broom  
*ni neng kanjian huangse-de che he huangse-de saoba ma?*

2SG can see yellow-DE car and yellow-DE broom Q

‘I can see cars in different colors and brooms in different colors. Can you see the yellow car and the yellow broom?’

c) *wo neng kanjian liang-ge nvsheng,*

1SG can see two-CL girl

*ni neng kanjian yi-ge nansheng ma?*

2SG can see one-CL boy Q

‘I can see two girls. Can you see a boy?’

d) *wo neng kanjian zise yifu-de nvsheng he fense yifu-de nvsheng,*

1SG can see purple cloth-DE girl and pink cloth-DE girl

*ni neng kanjian shei zai shu houmian ma*

2SG can see who at tree behind Q

‘I can see the girl in purple and the girl in pink. Can you see who is behind the tree?’

e) *wo neng kanjian yi-ge ren dai-zhe maozi*

1SG can see one-CL person wear-PROG hat

*ni neng kanjian shei dai-zhe maozi ma*

2SG can see who wear-PROG hat Q

‘I can see that someone is wearing a hat, can you see who is wearing a hat?’

f) *wo neng kanjian yi-ge ren zuo-zhe*

1SG can see one-CL person sit-PROG

*ni neng kanjian shei zuo-zhe ma*

2SG can see who sit-PROG Q

‘I can see that someone is sitting, can you see who is sitting?’

g) *wo neng kanjian yi-ge ren zai pao*

1SG can see one-CL person PROG run

*ni neng kanjian shei zai pao ma*

2SG can see who PROG run Q

‘I can see that someone is running, can you see who is running?’

h) *wo neng kanjian yi-ge ren zhan-zhe*

1SG can see one-CL person stand-PROG

*ni neng kanjian shi shei ma*

2SG can see be/FM who Q

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‘I can see that someone is standing, can you see who?’

- i) *wo neng kanjian yi-ge ren zai tiao*  
1SG can see one-CL person PROG jump  
*ni neng kanjian shi shei ma*  
2SG can see be/FM who Q

‘I can see that someone is running, can you see who?’

### **Test session**

#### **Animate subject S-strings**

- (1) *wo neng kanjian yi-ge ren zai tui lvse yifu-de nansheng,*  
I can see one-CL person PROG push green cloth-DEboy  
*ni neng kanjian shi shei ma?*  
you can see be/FM who Q

‘I can see that someone is pushing the boy in green, can you see who?’

- (2) *wo neng kanjian yi-ge ren zai zhui zise yifu-de nvsheng,*  
*ni neng kanjian shi shei ma?*

‘I can see that someone is chasing the girl in purple, can you see who?’

- (3) *wo neng kanjian yi-ge ren ya-zhe lvse yifu-de nansheng,*  
*ni neng kanjian shi shei ma?*

‘I can see that someone is on the top of the boy in green, can you see who?’

#### **Animate subject full *wh*-questions**

- (4) *wo neng kanjian yi-ge ren ya-zhe hongse yifu-de nansheng*  
I can see one-CL person be.on.top-PROG red cloth-DEboy  
*ni neng kanjian shei ya-zhe hongse yifu-de nansheng ma?*  
you can see who be.on.top-PROG red cloth-DEboy Q

‘I can see that someone is on the top of the boy in red, can you see who is on the boy in red?’

- (5) *wo neng kanjian yi-ge ren zai tui lvse yifu-de nansheng,*  
*ni neng kanjian shei zai tui lvse yifu-de nansheng ma?*

‘I can see that someone is pushing the boy in green, can you see who is pushing the boy in green?’

- (6) *wo neng kanjian yi-ge ren kao-zhe hongse yifu-de nansheng,*

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*ni neng kanjian shei kao-zhe hongse yifu-de nansheng ma?*

‘I can see someone is leaning on the boy in red, can you see who is leaning on the boy in red?’

### **Animate object S-strings**

- (7) *wo neng kanjian hongse yifu-de nansheng zai zhui yi-ge ren,*  
I can see red cloth-DE boy PROG chase one person  
*ni neng kanjian shi shei ma?*  
you can see be/FM who Q

‘I can see that the boy in red is chasing someone, can you see who?’

- (8) *wo neng kanjian hongse yifu-de nansheng kao-zhe yi-ge ren,*  
*ni neng kanjian shi shei ma?*

‘I can see that the boy in red is leaning on someone, can you see who?’

- (9) *wo neng kanjian fense yifu-de nvsheng ya-zhe yi-ge ren,*  
*ni neng kanjian shi shei ma?*

‘I can see that the girl in pink is on the top of someone, can you see who?’

### **Animate object full *wh*-questions**

- (10) *wo neng kanjian zise yifu-de nvsheng zai zhui yi-ge ren,*  
I can see purple cloth-DE girl PROG chase one-CL person  
*ni neng kanjian zise yifu-de nvsheng zai zhui shei ma?*  
you can see purple cloth-DE girl PROG chase who Q  
‘I can see that the girl in purple is chasing someone, can you see who the girl in purple is chasing?’

- (11) *wo neng kanjian hongse yifu-de nansheng ya-zhe yi-ge ren,*  
*ni neng kanjian hongse yifu-de nansheng ya-zhe shei ma?*  
‘I can see that the boy in red is on the top of someone, can you see who the boy in red is on the top of?’

- (12) *wo neng kanjian huangse yifu-de nvsheng zai zhui yi-ge ren,*  
*ni neng kanjian huangse yifu-de nvsheng zai zhui shei ma?*  
‘I can see that the girl in yellow is chasing someone, can you see who the girl in yellow is chasing?’

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### Inanimate subject S-strings

- (13) *wo neng kanjian yi-ge dongxi zai zhui huangse-de che,*  
I can see one-CL thing PROG chase yellow-DE car  
*ni neng kanjian shi sheme ma?*  
you can see be/FM what Q

‘I can see that something is chasing the yellow car, can you see what?’

- (14) *wo neng kanjian yi-ge dongxi kao-zhe lvse-de saoba,*  
*ni neng kanjian shi shenme ma?*

‘I can see that something is leaning on the green broom, can you see what?’

- (15) *wo neng kanjian yi-ge dongxi ya-zhe huangse-de che,*  
*ni neng kanjian shi shenme ma?*

‘I can see that something is on top of the yellow car, can you see what?’

### Inanimate subject full *wh*-questions

- (16) *wo neng kanjian yi-ge dongxi kao-zhe baise-de saoba,*  
I can see one-CL thing lean.on-PROG white-DE broom  
*ni neng kanjian shenme kao-zhe baise-de saoba ma?*  
you can see what lean.on-PROG white-DE broom Q  
‘I can see that something is leaning on the white broom, can you see what is leaning on the white broom?’

- (17) *wo neng kanjian yi-ge dongxi ya-zhe lvse-de che,*  
*ni neng kanjian shenme ya-zhe lvse-de che ma?*  
‘I can see that something is on the top of the green car, can you see what is on the top of the green car?’

- (18) *wo neng kanjian yi-ge dongxi zai tui huangse-de che,*  
*ni neng kanjian shenme zai tui huangse-de che ma?*  
‘I can see that something is pushing the yellow car, can you see what is pushing the yellow car?’

### Inanimate object S-strings

- (19) *wo neng kanjian huangse-de saoba kao-zhe yi-ge dongxi*  
I can see yellow-DE broom lean.on-PROG one-CL thing  
*ni neng kanjian shi shenme ma?*

---

you can see be/FM what Q

‘I can see that the yellow broom is leaning on something, can you see what?’

- (20) *wo neng kanjian huangse-de che ya-zhe yi-ge dongxi,*  
*ni neng kanjian shi shenme ma?*

‘I can see that the yellow car is on the top of something, can you see what?’

- (21) *wo neng kanjian baise-de che zai tui yi-ge dongxi,*  
*ni neng kanjian shi shenme ma?*

‘I can see that the white car is pushing something, can you see what?’

### Inanimate object full *wh*-questions

- (22) *wo neng kanjian lvse-de saoba kao-zhe yi-ge dongxi*  
I can see green-DE broom lean.on-PROG one-CL thing  
*ni neng kanjian lvse-de saoba kao-zhe shenme ma?*  
you can see green-DE broom lean.on-PROG what Q  
‘I can see that the green broom is leaning on something, can you see what the green broom is leaning on?’

- (23) *wo neng kanjian baise-de che zai tui yi-ge dongxi,*  
*ni neng kanjian baise-de che zai tui shenme ma?*  
‘I can see that the white car is pushing something, can you see what the white car is pushing?’

- (24) *wo neng kanjian huangse-de che zai zhui yi-ge dongxi,*  
*ni neng kanjian huangse-de che zai zhui shenme ma?*  
‘I can see that the yellow car is chasing something, can you see what the yellow car is chasing?’