Glossa a journal of general linguistics

Lin, Jing. 2017. Distributionally constrained items in child language: the acquisition of superweak NPI shenme 'a/some' in Mandarin Chinese. *Glossa: a journal of general linguistics* 2(1): 15. 1–23, DOI: https://doi.org/10.5334/gjgl.173

RESEARCH

Distributionally constrained items in child language: the acquisition of superweak NPI *shenme* 'a/some' in Mandarin Chinese

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This paper presents new experimental results obtained from 88 Mandarin speaking children (2; 11 – 4; 09; M = 3; 11; SD = 0; 6; 44 girls) in their acquisition of *shenme* 'a/some', a prototypical superweak Negative Polarity Item (NPI) that survives in nonveridical contexts only (cf. Lin Jing et al. 2014). The existence of NPIs like *shenme* leads to a learnability problem. Without being confronted with negative evidence, such as corrective feedback or explicit instructions on *shenme*'s ungrammaticality in contexts that are not nonveridical, how can children detect *shenme*'s distributional constraint? By analysing children's performance in an elicited imitation task, this paper investigates the learnability of the superweak NPI in Mandarin Chinese. The results suggest a learning process in which Mandarin children initially analyse *shenme* as a mere *wh*-quantifier and reanalyse it as a referentially deficient quantifier later on. The *wh*-analysis gives rise to a distribution of *shenme* in *wh*-questions only, whereas the non-referential analysis generates *shenme*'s distribution in the whole array of nonveridical contexts. The investigation of the acquisition of the Mandarin NPI *shenme* shows that children are able to acquire distributionally constrained items in the absence of negative evidence: they start out with a strict assumption (i.e. the *wh*-analysis) and switch to a less strict and generalising analysis (i.e. the non-referential analysis) later on.

Keywords: distributional constraint; first language acquisition; Mandarin *shenme*; Negative Polarity Items (NPIs); nonveridicality

1 Introduction

Natural languages exhibit words or expressions that cannot freely occur in any configurations. For instance, English temporal adverb *yet* can only appear in negative contexts, such as in the scope of sentential negation or a negative indefinite as shown in (1a) and (1b), but is not allowed in simple affirmative contexts as demonstrated in (1c).

(1) a. Max has not finished yet.
b. Nobody has finished yet.
c. *Mary has finished yet.

Words or expressions that show a constrained distribution only in negative contexts are called *Negative Polarity Items* (NPIs) (cf. Ladusaw 1979). *Yet* is an NPI; other well-studied examples of NPIs involve English *any*-terms. As shown in (2), *any*-terms can survive in a wide range of negative contexts that are categorised as *downward entailing* (DE) in the literature (Fauconnier 1975; 1978; 1980; Ladusaw 1979). Examples of DE-contexts are in the scope of sentential negation, negative indefinites, or semi-negative expressions like

few, the restriction of a universal quantifier, conditional clauses, etc.[1] However, contexts that do not exhibit DE-ness, such as the simple past tense or in the scope of an epistemic modal adverb, do not sanction *any*-terms, as shown in (3).

(2) a. Max did not kiss anybody yesterday.
b. Nobody bought anything for Max's birthday.
c. Few students have read any papers for the lecture today.
d. Every parent that prepared anything for the party can park free of charge.
e. If Mary has seen any robins yesterday, she would tell Max.

(3) a. *Max saw any girls yesterday.
b. *Mary has probably brought anything for Max's birthday.

NPIs form a cross-linguistic phenomenon (see Haspelmath 1997 and Horn 1989 for a non-exhaustive overview) and are attested in Mandarin Chinese as well. An example is *shenme* 'a/some'. As observed for all NPIs, *shenme* exhibits a limited distribution in certain negative environments only (e.g. Huang Cheng-Teh 1982; Li Ye-Hui 1992; Cheng Lai-Shan 1994; Lin Jo-Wang 1996; 1998). Recently, Lin Jing et al. (2014) and Xie Zhi-Guo (2007) have demonstrated that this NPI is in fact attested in the whole array of *nonveridical* contexts, a superset of the set of DE contexts.

Informally speaking, nonveridical contexts are contexts that do not entail the truth of an embedded proposition, such as conditional clauses, questions (*wh*- or polar), subjunctive modal contexts, and imperfectives. Given its broad distribution in all kinds of nonveridical contexts, Lin Jing et al. (2014), following Zwarts' typology of NPIs in terms of strengths (1981; 1986; 1995), categorise Mandarin *shenme* as a prototypical *superweak* NPI, restricted by nonveridicality only. Adopting Giannakidou (1998; 2011), Lin Jing et al. (2014) further argue that *shenme* is a superweak NPI because it is a *referentially deficient quantifier*, due to the presence of a *dependent variable* (explained in more detail below in Section 2).

The existence of NPIs such as the superweak NPI *shenme* in Mandarin gives rise to a learnability challenge for language-acquiring children. In the absence of negative evidence, such as corrective feedback or explicit instructions on its ungrammaticality in contexts that are not nonveridical, how are Mandarin children able to detect *shenme*'s distributional constraint based on positive evidence only?

Nonetheless, the acquisition of NPIs has attracted little attention in the literature so far – let alone that of the superweak NPI *shenme* in Mandarin Chinese. Research on the learnability of NPIs is merely restricted to English *any* (Tieu Lyn 2010; 2013; 2015; Tieu Lyn & Lidz 2016), Dutch *hoeven* 'need' (Koster & van der Wal 1996; van der Wal 1996; Lin Jing et al. 2015), Dutch *meer* 'more' (van der Wal 1996), and Mandarin Chinese *renhe* 'any' (Huang Ai-Jun & Crain 2014). This paper therefore explores the learnability of the NPI *shenme* by means of an experiment with an elicited imitation task.

Data obtained from 88 monolingual Mandarin children in the elicited imitation task (2; 11 – 4; 09; M = 3; 11; SD = 0; 6; 44 girls) give rise to the following developmental patterns. First, as early as the age of 2; 11, Mandarin children have already acquired *shenme* as a *wh*-word in *wh*-questions. Second, when they are older, children are developing their knowledge underlying *shenme*'s appearance in a wider range of nonveridical contexts than merely in *wh*-questions as well. Last but not least, children – independent of their

[1] Downward entailing contexts are defined based on their logico-semantic behaviour. For every arbitrary X, Y: if $f(X \cup Y) \Rightarrow f(X)$ and/or $f(X \cup Y) \Rightarrow f(Y)$, then the function f is downward entailing. This definition is adapted from van der Wouden (1997). Informally speaking, downward entailing contexts are those contexts in which the entailment relation goes from set to subset (see also Fauconnier 1975; 1978; 1980).

age – are aware of *shenme*'s distributional constraint that it cannot survive in veridical contexts like the perfect tense.

By taking different factors into account, such as input, children's semantic knowledge of (non)veridicality, and development of their working memory, I interpret the attested patterns as indicating a learning path in which Mandarin children reanalyse *shenme* as a non-referential quantifier after they first analyse it as a mere *wh*-quantifier in the initial phase. By analysing both the participants' imitation and non-imitation responses, I argue that in the absence of negative evidence, children are able to detect the restricted distribution of NPIs. Their solution to the learnability problem of the NPI is to employ a widening learning strategy, in which they start with a strict analysis, and weaken it to a less strict, generalising analysis later on (cf. Manzini & Wexler 1987; Snyder 2008; see also van der Wal 1996).

I organise the paper as follows. Section 2 briefly demonstrates the restricted distribution of Mandarin *shenme* to nonveridical contexts, its learnability problem, and some previous acquisition research. Section 3 introduces the current experiment, including method, design, participants and scoring. Results of the experiment are presented and interpreted in Section 4, followed by discussion in Section 5, and conclusion in Section 6.

2 Background

Shenme is traditionally viewed as a *wh*-word similar to English *what* (see (4)), which also allows non-interrogative, existential interpretations comparable with English *a(n)* or *some* when appearing in certain non-*wh* contexts. Examples of such contexts are in the scope of sentential negation, conditional clauses, subjunctive configurations introduced by epistemic modal adverbs, polar questions, etc. (see (5a) to (5e) respectively) (Huang Cheng-Teh 1982; Li Ye-Hui 1992; Cheng Lai-Shan 1994; Lin Jo-Wang 1996; 1998; among many others).

(4) Mali zuotian mai-le shenme shu ne?
Mary yesterday buy-PERF *shenme* book Q-MARKER
'What kind of book has Mary bought yesterday?'

(5) a. Mali zuotian mei mai shenme shu.
Mary yesterday not buy *shenme* book
'Mary did not buy (a) book(s) yesterday.'

b. Ruguo Mali zuotian mai-le shenme shu ta yiding
if Mary yesterday buy-PERF *shenme* book she definitely
hui gaosu wo.
will tell me
'If Mary bought a book yesterday she will definitely let me know.'

c. Mali zuotian haoxiang mai-le shenme shu.
Mary yesterday probably buy-PERF *shenme* book
'Mary has probably bought a book yesterday.'

d. Makesi zuotian gei Mali mai-le shenme shu me?
Max yesterday for Mary buy-PERF *shenme* book Q-MARKER
'Has Max bought (a/some) book(s) for Mary yesterday?'

The Chinese literature has argued that *shenme* – when it is not assigned a question usage – exhibits NPI-like behaviour, since it is ungrammatical when appearing in simple affirmative contexts such as in the perfect tense, or in the complement clause of a factive predicate like *know* (Li Ye-Hui 1992; Cheng Lai-Shan 1994; Lin Jo-Wang 1996; Xie Zhi-Guo 2007; among others). This is shown in (6).

(6) a. *Makesi zuotian mai-le shenme shu.
Max yesterday buy-PERF *shenme* book
Intended: 'Max has bought (a) book(s) yesterday.'

b. *Wo zhidao Mali zuotian mai-le shenme shu.
I know Mary yesterday buy-PERF *shenme* book
Intended: 'I know that Mary has bought (a) book(s) yesterday.'

Recently, it has been proposed that *shenme* is an indefinite NPI allowed only in so-called *nonveridical* contexts irrespective of its *wh-* or non-*wh* usages (Xie Zhi-Guo 2007; Lin Jing et al. 2014; Giannakidou to appear; Giannakidou & Lin Jing 2016). Nonveridicality is defined in terms of truth (Zwarts 1986; 1998):

(7) A propositional operator F is veridical, iff Fp entails p: otherwise F is nonveridical.

Informally, nonveridical contexts can be interpreted as those that do not entail the truth of an embedded proposition. The complement clause of non-factive verbs such as *guess*, for instance, is nonveridical, since the truth of the proposition (8a) is not entailed by (8b). In the same vein, polar questions and epistemic uncertainty contexts are nonveridical, since both (8c) and (8d) do not necessarily entail (8a).

(8) a. Max kissed a girl yesterday.
b. I guess that Max kissed a girl yesterday.
c. Did Max kiss a girl yesterday?
d. Perhaps Max kissed a girl yesterday.

A *veridical* context, on the other hand, is a context in which the truth of a proposition is entailed. For instance, the complement clause of factive predicates such as *know* in (9b) is veridical, as it necessarily entails the truth of its embedded proposition (9a).

(9) a. Max kissed a girl yesterday.
b. I know that Max kissed a girl yesterday.

Lin Jing et al. (2014) examine all the contexts that sanction *shenme* in Mandarin Chinese, including *wh*-questions, and show that they are all nonveridical, as none of them entails the truth of an embedded proposition. Crucially, the authors also demonstrate that the contexts that do not favour *shenme* all turn out to be veridical.

Under the nonveridicality theory of polarity licensing (Zwarts 1995; 1998; Giannakidou 1997; 1998; 2002; 2011; Giannakidou & Zwarts 1998), nonveridical contexts represent even weaker negative environments than DE-contexts. In fact, nonveridical contexts are the weakest type of negative configurations in natural languages that may license NPIs (Giannakidou 1997; 1998; 2002; 2011). Given that English *any*-terms, restricted to DE-contexts, are categorised as *weak* NPIs in the typology of polarity items in terms of strengths (Zwarts 1981; 1986; 1995; see also van der Wouden 1994),[2] Lin Jing et al. (2014) conclude that *shenme* is a prototypical superweak NPI. Following Giannakidou's

[2] The strength of NPIs is categorised depending on the type of negative contexts in which it can and cannot be licensed (Zwarts 1986; 1995; 1998; Nam 1994; van der Wouden 1997; Hoeksema 2000). The nonveridicality theory of polarity licensing (cf. Giannakidou & Zwarts 1999) distinguishes four types of negative environments based on their logico-semantic behaviours: anti-morphic contexts, anti-additive contexts, downward entailing (DE) contexts and nonveridical contexts (see van der Wouden 1997 for the relevant definitions and examples). This gives rise to NPIs of four different strengths: *superstrong* NPIs restricted by anti-morphicity; *strong* NPIs licensed by anti-additivity; weak NPIs attested in DE-contexts only; and *superweak* NPIs requiring nonveridicality as sufficient licensing property (see Zwarts 1981; 1986; Nam 1994).

work on NPI-hood (Giannakidou 1998; 2011; Giannakidou & Quer 2013), the authors further argue that *shenme* is restricted by nonveridicality because it contains a dependent variable. Since dependent variables cannot introduce a discourse referent, unlike free or independent variables (cf. Giannakidou 2011), NPIs like *shenme*, which are argued to contain such a variable, are referentially deficient and thus survive in semantic configurations in which they are not forced to refer: nonveridical contexts (see also Giannakidou & Lin Jing 2016).

In fact, the non-referential approach to *shenme* echoes earlier claims in the Chinese literature on this NPI. For instance, Li Ye-Hui (1992) proposes that *shenme* is only acceptable in contexts where "the truth value of the proposition is not positively fixed in a definite manner" (Li Ye-Hui 1992: 134); Lin Jo-Wang (1998) argues that *shenme* appears when the existence of a referent satisfying its description given by the context is not entailed, i.e. the Non-Entailment-of-Existence Condition in his framework.

The restricted distribution of the NPI *shenme* to some but not all kinds of semantic configurations gives rise to a learnability problem. Based merely on positive evidence containing utterances like those in (4) and (5), how are Mandarin-acquiring children able to draw the adult-like conclusion that *shenme* cannot introduce any discourse referent and hence is subject to restricted distribution to nonveridical contexts? After all, absence of ungrammatical constructions with *shenme* in veridical contexts in the input, such as those in (6), does not necessarily entail *shenme*'s non-referentiality.

The learnability of the Mandarin NPI *shenme*, however, has attracted little attention. There are only a few studies that are somewhat related to this topic. Huang Ai-Jun (2014) and Zhou Peng (2011) report that children are able to distinguish the interrogative usage from the non-interrogative usage of Mandarin *wh*-words such as *shenme* around the age of four. Huang Ai-Jun & Crain (2014) find that children do not show target-like performance when confronted with *shenme* appearing in the scope of sentential negation until the age of eight. But these studies do not provide an answer to the learnability problem, nor do these studies explore the development of children's knowledge of the non-referential NPI over time – as they focus on the different usages of *shenme* by children of different ages. The only research thus far that tackles the learnability of the Mandarin NPI *shenme* is Lin Jing et al. (2014), in which the authors investigate the development of children's knowledge of the NPI through corpus research in the CHILDES database (MacWinney 2009).

Lin Jing et al.'s corpus exploration analyses spontaneous speech data of more than 40 monolingual Mandarin children aged between one and five years, taken from a total of 734 CHAT files of three subcorpora in the CHILDES database (MacWhinney 2009): Beijing *2* (Tardif 1993; 1996), Zhou 1 and Zhou 2 (Zhou Jing 2004a; b). Based on the distributional patterns of *shenme* in child Mandarin development, the authors hypothesise that there are two developmental stages in the acquisition of the NPI. Children start using *shenme* as a mere question word in *wh*-questions, but after the age of four they also use *shenme* in a variety of other nonveridical contexts. More importantly, the authors do not find that Mandarin children overuse the NPI in veridical contexts. Assuming that each developmental stage represents a unique analysis of the target NPI in child language development, the authors conclude that Mandarin children start with a *wh*-analysis of *shenme,* and reanalyse *shenme* as a superweak NPI shortly after the age of four.

Lin Jing et al.'s CHILDES study provides a first glance into the learnability of the Mandarin NPI, but is restricted to the observation of spontaneous production only. But what children produce in their spontaneous speech does not always equal the exact range of their acquired linguistic knowledge. Bearing this in mind, it becomes questionable whether the absence of utterances containing *shenme* in veridical contexts in child language indeed

indicates children's awareness of *shenme*'s distributional constraint. In the same vein, the authors do not find that older children spontaneously use *shenme* in, e.g. polar questions, a nonveridical context in which the NPI is allowed in adult language (i.e. (5d)). Is such absence of evidence problematic for the proposed reanalysis of *shenme* that generates its appearance in the whole array of nonveridical environments? The methodological shortcoming of the previous corpus research thus motivates the current experiment.

Since *shenme* is a prototypical superweak NPI, which is of a different strength compared to the NPIs previously investigated (e.g. English *any*, Dutch *hoeven*, and Mandarin *renhe*), the current exploration of the acquisition of *shenme* can provide the literature with a typologically comparative view of NPI acquisition. As NPIs belong to the category of words or expressions that have restricted distributions, the current investigation can moreover shed light on how language learners acquire distributionally constrained items in general.

3 The experiment

3.1 Method

An elicited imitation task was carried out to investigate children's knowledge of the superweak NPI *shenme* in Mandarin. An elicited imitation task is a research method that is often employed in different linguistic domains to assess acquisition by children below the age of six, such as (morpho-)syntax and semantics (Carrow 1974; Montgomery et al. 1978; Scholl & Ryan 1980; Keller-Cohen 1981; Fujiki & Brinton 1987; Lust et al. 1996; Panitsa 2001; among others). Van der Wal (1996), one of the first studies to address the learnability of NPIs, also employed the elicited imitation task. I therefore followed van der Wal (1996) in using this experimental method.[3]

In an elicited imitation task, children are required to listen carefully to pre-recorded stimuli first, and then to repeat the stimuli as precisely as they can (Lust et al. 1996; Vinther 2002; Eisenbeiss 2010; among others). When repeating a stimulus, children are claimed to make use of the grammatical rules they have established so far to reconstruct their own mental representation of the stimulus before "repeating" it (Chomsky 1964; Scholl & Ryan 1980; Keenan & Hawkins 1987; Panitsa 2001; Eisenbeiss 2010). If a stimulus is in agreement with the children's own grammar, they repeat the stimulus immediately after hearing it (Scholl & Ryan 1980); if, on the other hand, a stimulus is not compatible with their grasp of the grammar of the target language, they correct it in accordance with their own grammatical system, give an irrelevant response such as *I don't know*, or do not give a response at all (Keeney & Wolfe 1972; Brown 1973; Panitsa 2001; Vinther 2002). In the current research, this means that children only provide an imitation response if the appearance of *shenme* in the manipulated context of a stimulus is in agreement with the analysis of *shenme* that they have established thus far.

As an elicited imitation task requires children to repeat pre-recorded stimuli, working memory turns out to be of crucial importance in explaining their imitation performance (Hamayan et al. 1977; Montgomery et al. 1978; Gallimore & Tharp 1981; Fujiki & Brinton 1983; Lust et al. 1996; Eisenbeiss 2010; among others). Therefore, the length of stimuli needs to be controlled, in order to avoid children giving a repetition response from memory alone, without first establishing their own mental representation of a stimulus (e.g. Montgomery et al. 1978). Stimuli have to be sufficiently long to override children's memory capacity, but short enough for comprehension, because children must be able to reconstruct their own mental representations of the stimuli without omitting too many words.

As suggested by Montgomery et al. (1978), for instance, stimuli containing six to seven words are short and thus easy for children between four and six years old, whereas those

[3] One of the anonymous reviewers suggests a grammaticality judgement task to approach children's knowledge of the licensing of *shenme*. I did not opt for this method because children under age five are not able to give an explicit grammatical judgment on NPI-licensing, as reported by van der Wal (1996).

containing nine to ten words are of a medium length and are more difficult for children of the same age range, and stimuli containing twelve to thirteen words are of a maximum length. The current experiment did not opt to use the maximum length of twelve to thirteen words, because otherwise the stimuli would be too difficult for the three-year-olds to comprehend, reconstruct, and produce. To decide between using either the short or the medium length, two pilot experiments were carried out. Results of the two pilot studies (3; 01 – 4; 11, N = 19) showed that the short length of six to seven words was too easy for both the three- and four-year-olds, as they were able to repeat literally every single word of the stimuli, and sometimes even the intonation; whereas the children's imitation performance was more target-like while confronted with stimuli containing nine to ten words. Therefore, the stimuli length, in terms of words, was set at ten. In order to compare the imitation performance by participants of different ages, the stimuli length was kept equal for all participants. However, under the assumption that working memory increases with age, this may mean that the length of ten words is just too short to override older participants' working memory capacity, yielding better imitation performance by older participants when confronted with ungrammatical stimuli.

3.2 Design

The experiment manipulated five kinds of nonveridical contexts as licensing conditions for *shenme,* to examine the range of children's knowledge of the licensing of the NPI. These contexts are (i) negative contexts introduced by sentential negation, (ii) conditional clauses, (iii) epistemic uncertainty contexts introduced by modal adverbs such as *keneng* 'probably', (iv) polar questions, and (v) *wh*-questions. To investigate whether children are aware of *shenme*'s distributional constraint that it cannot survive in veridical contexts, the experiment also included an unlicensed test condition by placing *shenme* in the perfect tense.

Each of the above-mentioned (un)licensed condition contained four items. This led to 24 test stimuli in total. Additionally, to neutralise the effect that every test stimulus involved the same word *shenme*, 18 fillers were added, of which four contained a word order error caused by a post-positioned restriction of the universal quantifier *dou* 'all'.[4] An overview of the current experimental design is given in Appendix C. Examples of each test and filler condition are provided in Appendix D.

As mentioned earlier, all test and filler stimuli were controlled for the same length of ten words. Crucially, all the manipulated licensing structures are systematically and/or frequently attested in spontaneous speech data of Mandarin three-year-olds (see Appendix B).[5] This means that Mandarin three-year-olds have no difficulties using various licensing structures without *shenme* in their spontaneous speech, which strongly suggests that Mandarin children have already acquired the manipulated licensing structures at age three, at least. This will exclude the lack of knowledge of diverse sentence structures involved in the experiment as an explanation for possible poor imitation performance. Nonetheless, one may still question to what extent participants' imitation performance may be influenced by different structural complexities involved in different test conditions. Following Montgomery et al. (1978), I assume that structural complexity is far less important than sentence length when explaining children's imitation performance in elicited imitation tasks.

[4] Mandarin *dou* 'all' is a universal quantifier that quantifies over a phrase or a clause that precedes it (Lee Hun-Tak 1986; Chiu Bonnie 1990; Cheng Lai-Shan 1995; Lin Jo-Wang 1998; Wu Jian-Xin 1999; Pan HaiHua 2006). This means that the restriction of this universal precedes rather than follows it, different from other universal quantifiers in Mandarin, like *meige* 'every', or their English or Dutch counterparts. Thus, a post-positioned restriction of *dou* gives rise to a violation of word order.

[5] Data were collected in three Mandarin subcorpora in the CHILDES database (MacWhinney 2009): Beijing 2 (Tardif 1993; 1996), Zhou 1 and Zhou 2 (Zhou Jing 2004a; b).

To keep participants concentrated and interested in the experiment, visual support was employed by presenting them with a picture of familiar cartoon figures on a laptop screen before each stimulus. All stimuli were developed after selecting or designing the pictures, with the hope of ensuring that each picture supported the corresponding stimulus as much as possible. Participants first saw a picture on a laptop screen, immediately after which they heard a corresponding audio stimulus. The experiment lasted an average of fifteen minutes per participant.

3.3 Participants and procedure

A total of 88 monolingual children participated in the current experiment (2; 11 – 4; 09; M = 3; 11; SD = 0; 6; 44 girls).[6] They were recruited via two kindergartens in the Liaoning province, which is a Mandarin-speaking area in China. The experiment was conducted individually and took place in a quiet (class)room in the kindergartens.

Two experimenters were present during the experiment. One experimenter first invited the child from a class for a game. She then introduced the four figures in the experiment, and explained how the game would proceed and what the child was expected to do. Each child was presented with four trials to get familiar with both the experimenter and the experiment. When the child proved to be able to understand what was expected of it after the trials, the experiment started. The other experimenter recorded the responses and filled in answer sheets.

3.4 Data categorisation and scoring

Responses to the stimuli were divided into two main categories: *imitation* and *non-imitation*. In principle, imitation responses refer to instances in which the participants repeated the manipulated stimuli. However, since the length of the stimuli was designed so that the participants needed to first establish their own mental representations of the stimuli, it was hardly ever the case that they were able to repeat every word unit in a stimulus. Therefore, responses were considered imitation responses when participants produced a manipulated *shenme* noun phrase (e.g. *shenme dangao* 'a cake' or *shenme wanju* 'a toy'), in a manipulated licensing condition (e.g. in polar questions).

Based on these criteria, both (12b) and (12c) were categorised as instances of imitation of the stimulus (12a). Although both (12b) and (12c) did not contain all lexical units employed in the stimulus, both responses do contain the manipulated *shenme* noun phrase (namely *shenme gushi shu* 'a storybook') in the manipulated licensing condition, which is an epistemic uncertainty context, introduced by the modal adverb *keneng* 'probably'.

(12) a. Tiaotiaohu he Weinixiong keneng zhengzai kan shenme
Tiger with Winnie the Pooh probably PROG read *shenme*
gushi shu.
story book
'Tiger and Winnie the Pooh are probably reading a storybook.'

b. Tiaotiaohu keneng zai kan shenme gushi shu.
Tiger probably PROG read *shenme* story book
'Tiger is probably reading a storybook.'

c. Tiaotiaohu Weinixiong keneng kan shenme gushi shu.
Tiger Winnie the Pooh probably read *shenme* story book
'Tiger, Winnie the Pooh probably read a storybook.'

[6] The experiment has been approved by the Ethics Committee of the Amsterdam Institute of Humanities Research (AIHR, University of Amsterdam), with reference number of 2013–12.

Other responses were regarded as *non-imitation*. If the participants did not give a response at all, or provided an irrelevant response such as *Mei ting jian* '(I've) not heard (the stimulus)' or *Bu zhidao* '(I've) no idea', an instance of *non-imitation* was counted. If the participants reconstructed a stimulus and gave an own version of it, by replacing the manipulated *shenme* noun phrase by its bare or plain counterpart, for example, an instance of *non-imitation* was counted as well. This is illustrated in (13) as response to (12a).[7]

(13) Tiaotiaohu he Weinixiong keneng zhengzai kan (yi-ge) gushi shu.
Tiger with Winnie the Pooh probably PROG read (one-CL) story book
'Tiger, Winnie the Pooh probably read a storybook.'

To be able to perform logistic regression analyses, each imitation response was assigned a value of 1, and each non-imitation response was assigned a value of 0. More on the regression models will be reported in the next section.

4 Results and interpretation

In order to assess children's knowledge of the licensing of *shenme* at different ages, I performed mixed-effect logistic regression analyses in R, based on the raw imitation scores. To model the development of the participants' knowledge underlying *shenme*'s appearance in different kinds of (non)veridical contexts, a regression analysis was performed for each of the six manipulated test conditions. The ages of the participants were modelled as a fixed factor, and individual participants and test items were modelled as two random factors. These three factors were combined to predict the participants' imitation scores in the current experiment. This regression design, conducted on the cross-sectional data, made it possible to generalise over the development of children's knowledge of the NPI *shenme* in different (non)veridical contexts.

The results of the regression analyses are presented in Figure 1 (see Appendix E for model summaries). The x-axis represents the ages of participants, whereas the y-axis indicates the imitation probabilities predicted by the regression models. The interpolation lines demonstrate the mean values of the predicted probabilities.

Two developmental patterns can be distinguished based on whether a significant age effect is attested in the participants' imitation performance. One pattern concerns the test condition of *wh*-questions, which displays a fairly flat interpolation line. On average, the participants are predicted to show a repetition probability of 0.91 (SD = 0.03) throughout the whole investigated age range from 2; 11 to 4; 09. No significant difference between the imitation performances of the participants of different ages is attested (cf. Appendix E: I). Given the rationale behind an elicited imitation task (cf. Subsection 3.1), the pattern attested for the condition of *wh*-questions strongly suggest that Mandarin speaking children have acquired the knowledge that *shenme* can appear as a *wh*-word in *wh*-interrogatives already before age three (see Fan Li 2012 and Lin Jing et al. 2014 for similar findings).

Compared to the *wh*-question condition, the other test conditions clearly display a different pattern. Instead of a fairly flat interpolation line, the other test conditions all turn

[7] Generally speaking, non-imitation responses in a well-designed elicited imitation task suggest that the child has not yet developed a grammar that is compatible with the manipulated stimuli (cf. Section 3.1). As pointed out by an anonymous reviewer, a child might in theory still give responses like (13a) and (13b), which do not contain the target NPI *shenme*, although he or she has already established the grammar that allows *shenme* to appear in the corresponding licensing condition. Given the rationale of elicited imitation tasks, the question why the child would not give target-like responses like (12) then arises – if his or her grammar does generate *shenme* in that licensing context. My interpretation of such performance would be that the child does not prefer to use *shenme* in the corresponding context, or does not feel comfortable with such sentences containing *shenme*. I would take this as evidence that the child is not yet confident with the target-like analysis of the NPI, which could be newly developed by the child.

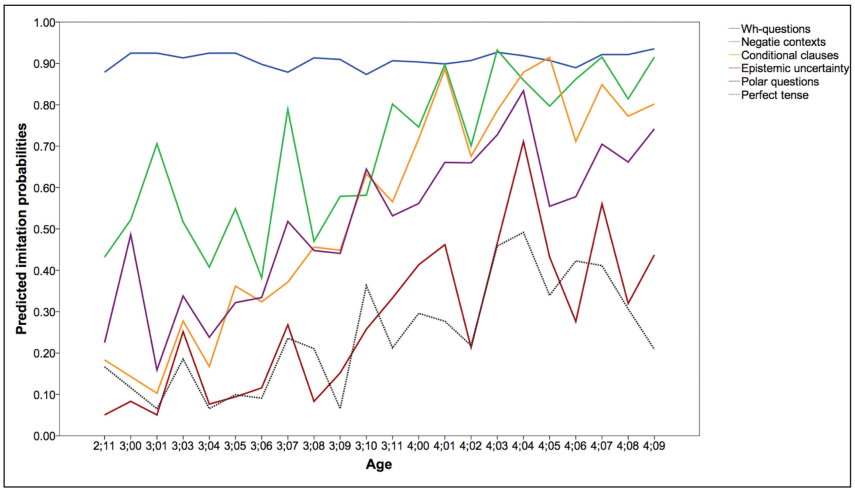

Figure 1: Development of children's imitation probabilities for each test condition.

out to exhibit a rising interpolation line. Moreover, a significant age effect is attested in each of these non-*wh* test conditions (cf. Appendix E: II to VI): the participants are predicted to be able to repeat the relevant stimuli significantly more often when they are older. Since the manipulated (non)veridical contexts turn out to be frequently and systematically attested already with Mandarin speaking three-year-olds (cf. Subsection 3.2; see also Appendix B), the significant improvement in the participant's imitation performance does not seem to be a consequence of an increase in the participants' vocabulary or syntactic knowledge required for the manipulated non-*wh* test conditions. Therefore, it is assumed that the significant increase in the five non-*wh* conditions indicates a significant change in the participant's underlying knowledge of *shenme*. That is, the participants are developing their knowledge of *shenme*, which allows the NPI in various non-*wh* environments in addition to *wh*-interrogatives.

The assumption made above leads to an expectation that the younger participants, i.e. those aged between 2; 11 and 3; 06, exhibit fairly poor imitation performance in the non-*wh* test conditions – as they are assumed to be just starting to develop the relevant knowledge. But this is not what the regression models predict. When confronted with *shenme* appearing in polar questions, conditional clauses, epistemic uncertainty contexts, and the perfect tense, these participants are predicted to repeat the relevant stimuli between 11% and 32% of the time; and in the test condition of negative contexts, they are even predicted to give repetition responses 48% of the time. The relevant results are given in Table 1.

The imitation performance of the younger children in the test conditions of polar questions, conditional clauses, epistemic uncertainty contexts, and perfect tense may be

Experimental conditions	**Predicted imitation probabilities**	
	Mean	**SD**
Negative contexts	0.48	0.25
Polar questions	0.32	0.18
Conditional clauses	0.25	0.18
Epistemic uncertainty contexts	0.11	0.14
Perfect tense	0.11	0.07

Table 1: Predicted imitation probabilities for children under 3; 06 (N = 27) in the non-*wh* test conditions.

explained by some memory effect, which seems to be at play in elicited imitation tasks in general (cf. Subsection 3.1). Yet, their imitation probability of 0.48 in the negative condition does not seem to suggest some working memory effect only. If we look at the standard deviations (SD) of the results in the table above, it turns out that the condition of negative contexts has the largest SD. This indicates larger individual differences in this test condition compared to the other non-*wh* test conditions. This may lead to the assumption that some of the younger participants have already acquired the knowledge underlying *shenme*'s appearance in the scope of sentential negation. This assumption seems to be supported by the individual results: 16 out of the 26 younger participants exhibit an imitation probability of at least 0.52, of which nine show an imitation probability of 0.71 or even higher.

If from age 2; 11, the participants start developing their knowledge underlying *shenme*'s appearance in a wider range of semantic environments than merely *wh*-questions, at what age have they acquired the relevant knowledge? A closer look at the regression results shows that the participants above age 4; 06 (N = 9) exhibit a predicted imitation probability of at least 0.70 in three out of the five manipulated non-*wh* environments, specifically the test conditions of negative contexts, conditional clauses, and polar questions (see Table 2 for the relevant data). Thus, it can be assumed that the participants have acquired the knowledge that *shenme* can also appear in various non-*wh* contexts around age 4; 06.

However, the assumption that the participants have already acquired the knowledge underlying *shenme*'s occurrence in different kinds of non-*wh* contexts around age 4; 06, gives rise to two further questions. Since epistemic uncertainty contexts belong to the same semantic category as negative contexts, conditional clauses, and polar questions (they are all non-*wh* nonveridical), why are the older participants predicted to give repetition responses to the relevant stimuli merely 44% of the time? The most straightforward way to understand this is to assume that the older participants have not yet acquired the lexical knowledge required in the corresponding test conditions. However, as will be shown in the next section, such a vocabulary-based account does not seem to be on the right track; instead, an explanation based on a methodological shortcoming of the experiment will be suggested.

Another question concerns the older participants' imitation performance when confronted with *shenme* in the perfect tense. From the perspective of adult speakers, *shenme*'s occurrence in the perfect tense is ungrammatical (cf. Section 1 and 2). The older participants' imitation probability of 0.31 in this condition is therefore unexpected. They seem to have undergone a development away from adult-likeness, which leads to overuse of *shenme* in non-licensing environments. Are the older participants then unable to detect *shenme*'s distributional constraint? I argue that there is no development away from adult-likeness. The improvement in the participants' imitation performance in the perfect tense condition could be a consequence of their increasing working memory capacity, as I will discuss in the next section.

Experimental conditions	**Predicted imitation probabilities**	
	Mean	**SD**
Negative contexts	0.88	0.11
Conditional clauses	0.81	0.16
Polar questions	0.70	0.17
Epistemic uncertainty contexts	0.44	0.24
Perfect tense	0.31	0.17

Table 2: Predicted imitation probabilities for children above age 4; 06 (N = 9) in the non-*wh* test conditions.

To summarise, the results obtained in the experiment suggest a learning process, which can be described as follows. As early as age 2; 11, children have already acquired the knowledge that *shenme* can appear in *wh*-interrogatives. After age 2; 11, children start developing their knowledge of *shenme*, which allows it to appear in a number of non-*wh* nonveridical contexts as well. Around age 4; 06, children have developed the knowledge underlying *shenme*'s appearance in various nonveridical environments, including *wh*-interrogatives. The development hypothesised here leads to further questions. What is children's initial knowledge of *shenme*, and where does this knowledge come from? What does children's knowledge consist of after age 4; 06, and what is the development between 2; 11 and 4; 06, which may give rise to this knowledge? All these questions will be addressed in the next section. The older participants' imitation performance with the epistemic uncertainty stimuli and the perfect tense stimuli will be discussed as well.

5 Discussion

5.1 Shenme *is a mere* wh-*quantifier before 2; 11*

Mandarin children acquire the knowledge underlying *shenme*'s occurrence in *wh*-interrogatives as early as age 2; 11. Following the previous corpus investigation by Lin Jing et al. (2014), I assume that before this age, children analyse *shenme* as a *wh*-quantifier. Since the data presented in Section 4 suggest that children start developing their knowledge underlying *shenme*'s occurrence in non-*wh* nonveridical environments after age 2; 11, I moreover assume – in line with Lin Jing et al. – that children's initial knowledge of *shenme* only contains the *wh*-analysis. The data presented in Section 4 suggest that children start developing their knowledge underlying *shenme*'s occurrence in non-*wh* nonveridical environments after age 2; 11. But where does this analysis come from?

In order to answer this question, a distribution-based learning approach is adopted, which was originally proposed for category learning in early language acquisition (Cartwright & Brent 1997; Redington et al. 1998; Mintz 2002; Mintz et al. 2002). Following this approach, I assume that children's first attempt to analyse the superweak NPI *shenme* relies merely on their investigation of the distributional properties of input data they received and processed thus far. As reported in Lin Jing et al. (2014), *shenme* is attested in *wh*-questions in more than 97% of the input. Given its overwhelming occurrence as a question word in the input, it is far from surprising that Mandarin children initially analyse *shenme* as a mere *wh*-quantifier and do so before age 2; 11.

5.2 Shenme *is a referentially deficient quantifier after 4; 06*

As suggested in Section 4, around age 4; 06 Mandarin children seem to have acquired the knowledge underlying *shenme*'s occurrence in a wider range of nonveridical environments than *wh*-interrogatives only. What would this knowledge consist of? Two approaches may be possible in this respect. One approach is to assume that the child's knowledge of *shenme* after age 4; 06 consists of multiple analyses, which are established via distribution-based learning, as is assumed for the development of the initial knowledge of *shenme*. In particular, this would mean that children have a *wh*-analysis for *shenme*'s occurrence in *wh*-interrogatives, a "negative" analysis for its occurrence in the scope of sentential negation, a "conditional" analysis for its appearance in conditional clauses, etc. Another approach is to assume that the child's knowledge of *shenme* after age 4; 06 contains just one generalising analysis (cf. Lin Jing et al. 2014), that is, *shenme* is a non-referential quantifier in late child Mandarin, which is restricted to the whole array of nonveridical environments, covering all those contexts mentioned above. The two possible approaches to the child's knowledge of *shenme* after age 4; 06 can be represented in Figure 2.

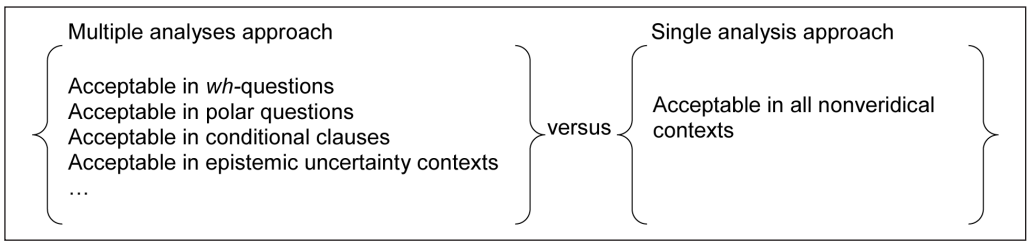

Figure 2: Two possible approaches to *shenme* in late child Mandarin.

The multiple analyses approach has two advantages. First, the initial analysis of *shenme* as a mere *wh*-word is entirely maintainable. Children do not need to undergo any reanalysis process, but only add additional analyses explaining *shenme*'s appearance in more types of semantic contexts, such as conditional clauses or polar questions. Second, the multiple analyses approach does not require Mandarin children to acquire the semantic knowledge of (non)veridicality, or *shenme*'s referential deficiency. What children need to acquire merely involves superficial occurrences of *shenme* in a variety of semantic configurations. They do not have to detect the common semantic property underlying the different licensing conditions for *shenme*; nor do they have to unravel the reason why *shenme* is subject to limited distribution in certain but not all semantic environments.

But this approach is confronted with two challenges. First, how can new, specific analyses be established? In the child-directed speech, *shenme* is attested in conditional clauses or polar questions only 0.3% of the time, and 0.4% of the time in epistemic uncertainty contexts.[8] Given the extremely small amounts of input containing *shenme* licensed in various semantic configurations that are not *wh*-questions, it is questionable that Mandarin children receive sufficient input to be able to establish the corresponding analysis in a distribution-based learning model.

A second problem concerns generalisability. As the multiple analyses approach basically assumes that the child's knowledge of *shenme* after age 4; 06 contains specific analyses, each of which only explains *shenme*'s occurrence in one particular type of nonveridical context, it would be a coincidence to observe a distributional pattern of the NPI in all kinds of nonveridical environments in adult Mandarin Chinese (cf. Xie Zhi-Guo 2007; Lin Jing et al. 2014; see also Section 2). Moreover, this approach does not entail that all speakers acquire the full set of possible licensing conditions for *shenme,* and the distributional patterns of the NPI by individual speakers are expected to influence acquisition. Since the child is assumed to establish each specific analysis based on input evidence only (e.g. if a child does not hear *shenme* in conditional clauses, he or she will not establish the corresponding analysis), and does not require any insight into the underlying semantic property of the corresponding context, the multiple analyses approach predicts the acquisition of *shenme* to be successive, individually distinct, and dependant on the distribution in the input. This implies the existence of variation among adult Mandarin speakers with respect to the set of possible licensing conditions for *shenme*.

However, this does not seem to challenge the single analysis approach. In this approach, *shenme* is treated as a non-referential quantifier in late child Mandarin. This non-referential analysis generates a distribution of superweak NPIs restricted to nonveridical contexts only, as is observed in adult language use (see again Section 2). The single analysis approach hypothesised as such relates *shenme*'s limited distribution in nonveridical environments to its non-referentiality, and therefore does not easily allow individual variation. In this scenario, the fact that *shenme* is restricted to a unified set of nonveridical

[8] Relevant data are collected in the child-directed speech in three Mandarin corpora in the CHILDES database (MacWhinney 2009), namely Beijing 2 (Tardif 1993; 1996), Zhou 1, and Zhou 2 (Zhou Jing 2004a; b); see further Appendix A.

contexts in adult Mandarin is not attributed to coincidence either. Therefore, I adopt the single analysis approach because of its generalisability. Under this approach, *shenme* is analysed as a referentially deficient quantifier. But how do Mandarin children develop this non-referential analysis of *shenme* from their initial assumption that *shenme* is a mere *wh*-quantifier? What is the contribution of language input, children's nonveridical vocabulary, etc., in this respect?

5.3 Between 2; 11 and 4; 06: From a wh- *to a referentially deficient quantifier*

The development of children's knowledge of *shenme* as hypothesised above can be schematically presented in Figure 3. Before age 2; 11 children initially analyse *shenme* as a mere *wh*-quantifier, whereas after age 4; 06 they reanalyse *shenme* as a referentially deficient quantifier. This subsection will explore a possible reanalysis pathway, which may give rise to the establishment of the non-referential analysis of *shenme* around age 4; 06.

As discussed above, children's initial assumption of *shenme* as a mere *wh*-word is triggered by the overwhelming occurrence of the NPI in *wh*-questions in the input, i.e. more than 97% of the time (see also Appendix A). Let us assume that when a child utters or hears *shenme* in a *wh*-question, he or she has the same semantic analysis of the question quantifier involved as their parents. Otherwise, how could the communication between parents and children proceed or be successful? Thus, when a child asks *Mama chi le shenme shuiguo ne*? 'What kind of fruit did mama eat?', for example, he or she is assumed to analyse *shenme* as containing a dependent variable. This means that the child has acquired the knowledge that *shenme* cannot be assigned a fixed value in the discourse, unlike free variables (Giannakidou 2011; Giannakidou & Quer 2013); instead, it introduces a set of possible edible things that the mother has probably eaten (cf. Hamblin 1973). This means that once children have established the *wh*-analysis of *shenme*, they also have access to the knowledge that *shenme* contains a dependent variable, and hence is referentially deficient.

In fact, the presence of a dependent variable not only generates a distribution of shenme in *wh*-questions; it also gives rise to its distribution in all kinds of nonveridical environments, e.g. the complement clause of non-factive verbs, polar questions, and conditional clauses. This is because nonveridical contexts (both *wh*- and non-*wh* ones) do not necessarily require the existence of a discourse referent, and hence sanction a lexical item that contains a dependent variable (cf. Giannakidou 2011; see also Section 2). The awareness of the presence of a dependent variable in *shenme* then becomes a sufficient condition for children to extend *shenme*'s distribution to the whole array of nonveridical environments. Thus, it is possible that children come up with an updated assumption that *shenme* is subject to a distributional pattern in all kinds of nonveridical contexts – including *wh*-interrogatives – due to its non-referentiality. This assumption, however, requires support from the language input.

As reported earlier (see also Appendix A), more than 97% of the input contains *shenme*'s occurrence in *wh*-interrogatives, and in the remaining input data *shenme* is attested in a number of non-*wh* nonveridical contexts, such as epistemic uncertainty contexts (0.3%), imperfectives (0.3%), polar questions (0.4%), etc. Although the input in which *shenme* appears in non-*wh* nonveridical contexts amounts to only 2.3%, it does support the assumption that *shenme* is subject to a distributional pattern in various nonveridical contexts (and thus not merely in *wh*-questions) due to the presence of a dependent variable.

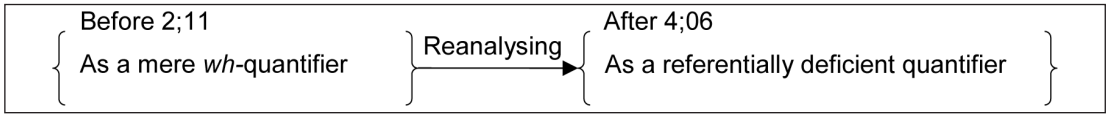

Figure 3: Development of Mandarin children's knowledge of *shenme*.

This leads children to reanalyse *shenme* as a referentially deficient quantifier, which is restricted by nonveridicality.

What is hypothesised above provides a possible explanation of how Mandarin children reach this generalisation, by means of reanalysis from their initial narrow assumption that *shenme* is a mere *wh*-word. In the reanalysis process as sketched above, language input seems to play an important role. Moreover, two kinds of semantic knowledge appear to be crucial as well.

First, before establishing the non-referential reanalysis, children are required to have acquired the knowledge hat *shenme* contains a dependent variable that cannot introduce a discourse referent. Without the acquisition of the presence of a dependent variable in *shenme*, children would not be able to come to the assumption that *shenme* may be subject to a distributional pattern in the whole array of nonveridical environments, as only dependent variables can be restricted by nonveridicality due to non-referentiality (cf. Section 2). As assumed above, children seem to have acquired the knowledge of the presence of a dependent variable in *shenme* when they are able to exchange *wh*-questions containing *shenme* with, for instance, their parents; but this requires further investigation.

Second, children need to have acquired nonveridicality before they can obtain any insight into the interplay between nonveridicality and non-referentiality to establish the reanalysis of *shenme*. However, little research has been reported on the acquisition of (non)veridicality. Nonetheless, given that nonveridicality is defined in relation to a set of worlds epistemically accessible to the speaker (cf. Giannakidou 2011; see also Giannakidou & Quer 2013), it can be assumed that nonveridicality represents the possibility of talking about different possible worlds, including the actual one. Thus, the development of Theory of Mind (ToM) may be argued to be relevant to children's knowledge on (non) veridicality. There is evidence, for instance, for the acquisition of the basis of ToM as early as age three, such as the difference between *know* (veridical knowledge) and *plan* (nonveridical intension), as well as the difference between *explanation* for veridical past and *prediction* for nonveridical future (Wellman & Estes 1986; Wellman & Woolley 1990; Leekam 1993; among others). Such findings from the development of ToM suggest that three-year-olds may already be able to distinguish nonveridical contexts from veridical ones, as they know that only nonveridical contexts do not entail the truth of an embedded proposition. The acquisition of (non)veridicality goes beyond the scope of this paper, and is therefore left for future exploration.

The hypothesised reanalysis process indicates that Mandarin children acquire the superweak NPI *shenme* via a *wh*-analysis. The transition from a *wh*-quantifier to a referentially deficient quantifier in acquisition is in line with Giannakidou's treatment of superweak NPIs (1998; 2002; 2010; 2011), which explains NPI-hood by referential deficiency – a consequence of the presence of a dependent variable. The reanalysis process of *shenme* can therefore be considered a modifying process that is based on input evidence within the same category of lexical deficient quantifiers, in particular, from *wh*- to non-referential quantifiers.

5.4 Poor imitation performance with epistemic uncertainty stimuli after 4; 06

As discussed above, after age 4; 06, Mandarin children have developed the non-referential analysis of *shenme*, which generalises its appearance to various nonveridical environments, including *wh*-questions. The question now arises as to why the reanalysis does not allow the older participants (i.e. those above age 4; 06; N = 9) to repeat *shenme* in epistemic uncertainty contexts – a kind of nonveridical context – as often as in the other non-*wh* nonveridical contexts manipulated in the experiment (see again Section 4). Before presenting possible explanations for the older children's poor imitation performance with the epistemic uncertainty stimuli, let us first look at what these older participants do

Type of responses		Count (%)
Imitation		15 (41.7%)
Non-imitation	change past perfect to progressive	10 (27.8%)
	change the stimuli into *wh*-questions	7 (19.4%)
	remove *shenme* from responses	3 (2.2%)
	no responses	1 (1.7%)
Total		**36**

Table 3: Response types by the participants above age 4; 06 (N = 9) in the epistemic uncertainty condition.

when they do not give an imitation response to the epistemic uncertainty stimuli. An overview of relevant data is presented in Table 3.

The frequency data presented in Table 3 show that the older participants, when they do not give imitation responses, mainly employ two kinds of strategies to reconstruct the manipulated stimuli containing *shenme* appearing in epistemic uncertainty contexts. These strategies are: changing the aspect of the stimuli from past perfect to progressive (47.6% of the time; 10 out of 21), or changing the stimuli into *wh*-questions by, for instance, adding a Q-marker (33.3% of the time; 7 out of 21). An example of the epistemic uncertainty stimuli is given in (14); and examples of children's responses to stimuli such as (14), in which these two strategies are employed, are given in (15a) and (15b), respectively.

(14) Tiaotiaohu he Weinixiong keneng zhengzai kan shenme gushi shu.
Tiger with Winnie the Pooh possibly PROG read *shenme* story book
'Tiger and Winnie the Pooh are possibly reading a storybook.'

(15) a. Tiaotiaohu he Weinixiong zhengzai kan shenme gushi shu.
Tiger with Winnie the Pooh PROG read *shenme* story book
'Tiger and Winnie the Pooh are reading a storybook.'

b. Tiaotiaohu he Weinixiong keneng zhengzai kan shenme gushi shu ne?
Tiger with Winnie the Pooh possibly PROG read *shenme* story book Q MARKER
'What kind of storybook are Tiger and Winnie the Pooh possibly reading?'

The two types of reconstruction strategies suggest that the participants' knowledge of *shenme* at older ages does not seem to allow it in the scope of epistemic modal adverbs such as *haoxiang* 'probably', or *keneng* 'possibly'. The most straightforward way to understand this is to assume that the older participants have not yet acquired the lexical knowledge required in the corresponding test conditions. If they do not know how to linguistically express epistemic uncertainty, namely if they have not yet acquired how to say e.g. *probably* in Mandarin Chinese, it logically follows that they would not be able to repeat the stimuli containing *shenme* licenced by such epistemic modal operators. As mentioned in Subsection 3.2 (see also Appendix B), however, Mandarin three-year-olds are already able to use epistemic modal adverbs frequently and systematically in their spontaneous speech. Thus, the vocabulary-based explanation does not seem to be on the right track.

Another possible explanation is that the experiment contained a discrepancy between the manipulated stimuli and the corresponding visual support in terms of epistemic (un)

certainty. Take again (14) as an example. Before hearing this stimulus, which conveys an epistemic uncertainty activity, the participants were presented a picture on a laptop screen in which Tiger and Winnie the Pooh are reading a storybook, which visually represents a factual event. Thus, the visual support did not in fact support the epistemic uncertainty stimuli.[9] This may have resulted in the older participants' poor imitation performance in the relevant test condition.[10]

5.5 Unable to detect shenme*'s distributional constraint?*

Finally, let us look at the older participants' imitation performance when confronted with *shenme* in the perfect tense. The question that arose from the interpretation of the regression results (i.e. in Section 4) is whether the participants are unable to detect the distributional constraint of *shenme*. Not being able to detect this constraint would account for the increase in imitation probabilities in the perfect tense condition predicted for the older participants. By discussing the production data obtained from the four-year-olds, I will argue in this subsection that their imitation performance in the perfect tense condition should be explained as a consequence of their increased working memory capacity.

As mentioned in Subsection 3.1, the choice of the same stimuli length for all participants, independent of their ages, may result in better imitation performance by the older participants – under the assumption that children's working memory increases with their age. Yet, the current experiment did not contain an objective measurement of the participants' working memory capacity. This makes it difficult to examine to what extent this capacity may have influenced their imitation performance. However, when looking at the production data from the four-year-olds (N = 45), there seems to be indirect evidence that there is an effect of expanding working memory capacity. It concerns an asymmetry between the (un)grammaticality of these participants' responses to the grammatical and the ungrammatical stimuli. The relevant data are given in Table 4.

When the four-year-olds are confronted with the ungrammatical stimuli containing *shenme* in the perfect tense, two response types are most frequent. On the one hand, ungrammatical responses (36.1%; 65 out of 180) signal imitation performance on the ungrammatical stimuli. On the other, grammatical responses, in which children correct the ungrammatical stimuli (57.2%; 103 out of 180), signal underlying knowledge of *shenme's* possible contexts. This pattern differs strongly from what we can observe with grammatical stimuli: in response to grammatical utterances, children almost always give

	Grammatical stimuli	**Ungrammatical stimuli**
Grammatical response	854 (94.9%)	103 (57.2%)
Ungrammatical response	18 (2%)	65 (36.1%)
No response	13 (1.4%)	6 (3.3%)
Incomplete response	15 (1.7%)	6 (3.3%)
Total	**900**	**180**

Table 4: Response types by the four-year-olds (N = 45) in the perfect tense condition.

[9] One of the anonymous reviewers points out that the hypothesised discrepancy may be present not only in the epistemic (un)certainty condition but also in other manipulated conditions. However, if this were the case, the discrepancy would result in poor repetition performance by the older participants' in all the conditions in the experiment. But this is not what the results, as presented in Figure 1, seem to suggest.

[10] The discrepancy between the visual support and the audio stimuli in terms of epistemic (un)certainty would bother the younger participants as well; however, since the younger children showed poor imitation performance in a number of non-*wh* nonveridical conditions (cf. Table 1 in Section 4), it is hard to pinpoint whether it is this discrepancy that explains their low repetition probabilities when confronted with the epistemic uncertainty stimuli.

grammatical responses (94.9%; 854 out of 900). This significant asymmetry leads to the generalisation that the children only overuse *shenme* in non-licensing conditions if the stimuli are themselves ungrammatical (χ^2 (3, N = 1080) = 256.308, p = .000). This asymmetry suggests that *shenme*'s appearance in veridical contexts such as the perfect tense is not in agreement with the older participants' knowledge of *shenme*; otherwise, they would also systematically produce *shenme* in non-licensing environments in their responses to the grammatical stimuli. This excludes the possibility that Mandarin children are unable to detect *shenme*'s distributional constraint.

Further evidence for the ungrammaticality of *shenme* appearing in the perfect tense in late child Mandarin involves the strategies that the four-year-olds employ to correct ungrammatical stimuli. Among the 103 non-imitation responses to the ungrammatical stimuli (namely the grammatical responses to the stimuli in the unlicensed test condition in Table 4), three main correction strategies are distinguished: substituting *shenme* by its bare or plain counterpart (i.e. 72.8%; 75 out of 103), changing the ungrammatical stimuli into an epistemic uncertainty context by adding a modal adverb like *haoxiang* 'probably' (i.e. 8.7%; 9 out of 103), and transforming the ungrammatical stimuli into a *wh*-question, for instance by adding a Q-marker (i.e. 10.7%; 11 out of 103). These strategies demonstrate that the four-year-olds are aware of *shenme*'s distributional constraint, since they either remove *shenme* from perfect tenses or make the veridical contexts nonveridical.

It is important to note that the CHILDES data reported in Lin Jing et al. (2014; see also Section 2) already reveal that monolingual Mandarin children do not overgeneralise *shenme* to veridical contexts in their spontaneous speech. The two kinds of production data – obtained from both experimental and corpus research – converge: they both show that children are able to acquire the restricted distribution of *shenme* in the target language.

The explanation based on working memory capacity, however, gives rise to a crucial question for understanding the significant improvement in the participants' imitation performance in the four non-*wh* test conditions. To what extent does it represent a development in the participants' underlying knowledge of *shenme*, rather than merely reflecting their increased working memory capacity? Here, I adopt Eisenbeiss (2010) and argue that, although working memory capacity is one of the factors that can affect children's performance in an elicited imitation task, it cannot explain the differences between different test conditions observed for the same participants. The effects of working memory should be similar for the same participant, independent of test conditions. This means that, if only working memory is at play in participants' imitation performance, no significant differences should be found across different test conditions. However, results of a repeated measure ANOVA confirm that this is not the case, as a significant within-subject effect is attested for the four-year-olds (F(5, 1074) = 47.882, p = .000). Thus, working memory is not the only factor that underlies the participants' good imitation performance in different test conditions at older ages.

6 Conclusions

By analysing the imitation performance of 88 monolingual Mandarin children (2; 11 – 4; 09; M = 3; 11; SD = 0; 6; 44 girls) in an elicited imitation task, I examined the learnability of the superweak NPI *shenme* in Mandarin Chinese, which is only allowed to appear in nonveridical contexts, including *wh*-questions. Following a previous corpus investigation of *shenme*'s learnability by Lin Jing et al. (2014), I argued for an acquisition pathway in which Mandarin children initially analyse *shenme* as a mere

wh-quantifier and reanalyse it as a referentially deficient quantifier later on. The mere *wh*-analysis generates *shenme*'s occurrence in *wh*-questions only, whereas the non-referential analysis gives rise to *shenme*'s distribution as a superweak NPI in the whole array of nonveridical contexts – including *wh*-questions. When is the reanalysis of *shenme* established? Based on their corpus data, Lin Jing et al. argue that this takes place shortly after the age of four; the regression results reported in this paper, however, seemed to suggest that the reanalysis of *shenme* is developed around age 4; 06. As for how the reanalysis of *shenme* is established, I hypothesised the following. By first analysing *shenme* as a mere *wh*-word, which is triggered by massive occurrence of *shenme* in *wh*-questions in the input, Mandarin children are able to establish that *shenme* contains a dependent variable. The knowledge of the presence of a dependent variable in *shenme*, in combination with input data that features *shenme* in non-*wh* but nonveridical contexts, enables Mandarin children to acquire the non-referentiality of *shenme* later on.

The learning path proposed in this paper leads to the conclusion that in the absence of negative evidence, such as corrective feedback or explicit instructions on NPIs' ungrammaticality in non-licensing conditions, children are able to detect their distributional constraints. Their solution to the learnability problem of NPIs such as *shenme*, then, is to employ a widening learning strategy in which they start with a strict assumption or analysis and weaken it to a less strict and generalising one at a later stage in acquisition (cf. Manzini & Wexler 1987; Snyder 2008).

Abbreviations

ADJ = adjectiviser, CL = classifier, GEN = genitive marker, OV = object-verb, PERF = perfect tense marker, PL = plural marker, PROG = progressive marker, Q MARKER = question marker, REL = relative clause marker, VO = verb-object

Additional Files

The additional files for this article can be found as follows:

- **Appendices.** https://doi.org/10.5334/gjgl.173.s1

Acknowledgement

I would like to thank Fred Weerman and Hedde Zeijlstra for their feedback during the preparations and revisions of the manuscript. I thank the anonymous reviewers for their useful comments, which helped to improve the article. I owe many thanks to Wei Liu, the director of Qiseguang Kindergarten in Dandong, China. Without her collaboration or the participation of Qiseguang, I would not have been able to collect all the data reported here. I want to say thank you to the little participants and their parents for their understanding and cooperation, and to Fang Fang and Feifei Sui for assistance during the data collection.

Competing Interests

The author has no competing interests to declare.

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How to cite this article: Lin, Jing. 2017. Distributionally constrained items in child language: the acquisition of superweak NPI *shenme* 'a/some' in Mandarin Chinese. *Glossa: a journal of general linguistics* 2(1): 15. 1–23, DOI: https://doi.org/10.5334/gjgl.173

Published: 01 March 2017

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