

English vs. Mandarin Wh-Question Comprehension in Toddlers: Influence of Movement Type and Distance Effect

Chaowei Nie, Yi (Esther) Su, Stephanie Durrleman, and Letitia Naigles

1. Introduction

Wh-questions often involve non-canonical word order and non-local dependencies, and they display cross-linguistic variation (e.g., English as a *wh*-movement language, Mandarin as a *wh*-in-situ language), making them a particularly informative testing ground for theories of language development. Capitalizing on the typological differences between English and Mandarin *wh*-questions, the present study investigates how English and Mandarin-speaking toddlers comprehend *wh*-questions. The purpose is to evaluate whether *wh*-question acquisition across languages is regulated by Universal Grammar (UG), specifically by principles of movement and by language-specific parameters.

Languages can be categorized as either *wh*-ex-situ or *wh*-in-situ, depending on where *wh*-words appear in *wh*-questions. In *wh*-ex-situ languages (e.g., English), the *wh*-word moves overtly from its original position to the sentence-initial position. By contrast, in *wh*-in-situ languages (e.g., Mandarin), the *wh*-word stays in its original syntactic position without overt *wh*-movement. However, although the *wh*-word stays in situ in Mandarin, the *wh*-feature undergoes movement to the sentence-initial position to obtain its scope. From an acquisition perspective, *wh*-ex-situ questions are arguably more difficult than *wh*-in-situ questions, because the former require movement of the *wh*-word and *wh*-feature, whereas the latter involve only *wh*-feature movement (Shlonsky, 2012; see (1)).

- (1) a. [CP **wh**...[TP ...**wh**...]] (*wh*-ex-situ question)
 [+wh] {+wh}
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- b. [CP [+wh]...[TP ...wh...]] (*wh*-in-situ question)
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What hit the X? vs. *What did the X hit?*). Infants showed comprehension of subject *wh*-questions by 15 months and of both subject and object *wh*-questions by 20 months, consistent with an early advantage of subject *wh*-questions. The authors attributed the asymmetry at 15 months to greater structural complexity in English object *wh*-questions, including longer movement dependencies and the requirement of *do*-support. Using the same stimuli, Goodwin et al. (2012) conducted a longitudinal study comparing the comprehension and production of subject and object *wh*-questions in English-speaking toddlers. The sample included 18 toddlers (age range: 18-23 months, mean age = 20.63 months), who were visited at four-month intervals over three years. Comprehension was assessed with the Intermodal Preferential Looking (IPL) paradigm, in which children's understanding is inferred from their preference to look more quickly and for longer duration at the visual scene that matches the linguistic input (Naigles & Tovar, 2012). By 28 months, children reliably comprehended both subject (e.g., what hit the flower?) and object *wh*-questions (e.g., what did the apple hit), with no subject-object asymmetry. Similarly, Jyotishi et al. (2017) followed English-speaking toddlers longitudinally using IPL, but employed animate rather than inanimate characters in the stimuli to better match prototypical transitive events (e.g., a bird hugging a horse). Their results showed reliable comprehension of object *wh*-questions (e.g., what did the bird hug?) by 28 months and of subject *wh*-questions (e.g., what hugged the horse?) by 32 months, after which performance remained stable, and no subject-object asymmetry was observed. It remains unclear why these English-speaking children at 28 months showed an object advantage; note also that the subject/object asymmetry was not the focus of either Goodwin et al. (2012) or Jyotishi et al. (2017).

Compared to research on English *wh*-questions, studies on Mandarin *wh*-questions have mostly used offline methods and focused on preschoolers. These studies consistently report no subject-object asymmetry. For instance, Shi and Yang (2022) examined 3- to 5-year-old preschoolers' comprehension of Mandarin *wh*-questions involving both *who* and *which one* using a character-selection task and found no subject-object asymmetry, indicating comparable processing of subject and object *wh*-questions. To investigate whether younger children might demonstrate a subject-object asymmetry in *wh*-question acquisition, Su et al. (2022) used the online IPL paradigm with 1-3-year-old neurotypical toddlers (and also 3-6-year-old autistic preschoolers). Their results showed that Mandarin-speaking neurotypical toddlers (mean age = 31.82 months) comprehended both subject and object *wh*-questions. The authors noted that this pattern parallels findings from English-speaking toddlers of comparable ages (Jyotishi et al., 2017) and suggested that *wh*-question comprehension follows a similar developmental trajectory across languages, regulated by *wh*-movement within UG.

To recap, previous studies on English *wh*-questions show that English-speaking young children begin to comprehend subject and object *wh*-questions during infancy (Seidl et al., 2003), but their comprehension remains unstable until the toddler period (e.g., Goodwin et al., 2012; Jyotishi et al., 2017). The acquisition results regarding a subject-object asymmetry of *wh*-questions have

been mixed. We consider this may be related to the instability of early comprehension in English-speaking one-year-olds, which is resolved during their third year. In addition, studies of older Mandarin-speaking preschool children or toddlers have consistently reported the comprehension of both subject and object *wh*-questions. Notably, no prior study has directly compared whether this difference exists between toddlers acquiring English and Mandarin *wh*-questions.

The current study explores whether *wh*-question acquisition across languages is constrained by UG, including the influence of principles and parameters. Specifically, while English *wh*-questions involve the movement of both *wh*-words and *wh*-features, Mandarin *wh*-questions only involve the movement of *wh*-features. That is, both languages exhibit movement (principle), but the movement mechanism is language-specific (parameter). If *wh*-question acquisition is regulated by UG, then a comparison between English and Mandarin *wh*-questions is expected to reveal that children's performance in both languages is influenced by the principle (movement) and language-specific properties (pied-piping movement in English vs. feature-only movement in Mandarin).

2. The current study

This study compares the comprehension of *wh*-questions in English- and Mandarin-speaking toddlers to examine whether typological differences in *wh*-questions—namely, *wh*-ex-situ in English versus *wh*-in-situ in Mandarin—give rise to cross-linguistic differences in performance. Based on this, we formulated the following research questions and predictions.

Research Question 1

Do typological differences between *wh*-ex-situ and *wh*-in-situ languages affect *wh*-question comprehension in English- and Mandarin-speaking toddlers?

Prediction 1

English *wh*-questions will be harder to comprehend than Mandarin *wh*-questions.

Research Question 2

Do cross-linguistic differences in *wh*-question comprehension emerge for both subject and object *wh*-questions?

Prediction 2a

English *wh*-questions will be more difficult to comprehend than Mandarin *wh*-questions in both subject and object *wh*-questions.

Prediction 2b

English *wh*-questions will be more difficult to comprehend than Mandarin *wh*-questions in object *wh*-questions only.

The prediction for Research Question 1 is motivated by the underlying differences in movement mechanisms between the two language types. In *wh*-ex-situ questions, both the *wh*-word and its *wh*-feature undergo pied-piping movement, whereas in *wh*-in-situ questions, only the *wh*-features move. If this

contributes to processing difficulty, *wh*-ex-situ questions are expected to impose greater processing demands than *wh*-in-situ questions. However, typological differences may not affect all *wh*-questions uniformly. Subject and object *wh*-questions differ in the length of the *wh*-dependency: subject *wh*-questions involve shorter dependencies, whereas object *wh*-questions involve longer ones in both English and Mandarin, as illustrated in example (2). Thus, for Research Question 2, if dependency length interacts with movement type, cross-linguistic differences may be more likely to emerge in object *wh*-questions than in subject *wh*-questions.

2.1. Participants

We included 17 English-speaking children (age range: 30.40-35.03 months, mean age = 31.70 months) and 18 Mandarin-speaking children (age range: 28.04-35.18 months, mean age = 32.33 months). The two groups were matched on age ($t(31) = 1.21, p = .237$) and expressive vocabulary level ($t(32) = -0.29, p = .770$; Table 1). Expressive vocabulary was assessed using standardized parental-report measures. For English-speaking children, we employed the MacArthur Communicative Development Inventories (MCDI; Fenson et al., 1993), whereas for Mandarin-speaking children, we used the Putonghua Communicative Development Inventories (PCDI; Tardif et al., 2008), a Chinese adaptation of the MCDI. Because the MCDI (680 items) and PCDI (799 items) differ in lexical inventory size, raw vocabulary scores were converted to proportions (MCDI score/680; PCDI score/799) to allow cross-linguistic comparability. All children were reported by their parents to have normal hearing and no history of language or developmental disorders. English-speaking toddlers were recruited from families in Connecticut through birth announcements in local newspapers; they comprise a subset of the participants reported in Jyotishi et al. (2017). The Mandarin-speaking group was recruited from BlueSky Art Kindergarten in Changsha and through word of mouth in the local community. For both groups, MCDI in English and PCDI in Mandarin confirmed that the children were monolingual. All parents signed consent forms prior to their participation.

Table 1. Participant information by language group

	English (N = 17)		Mandarin (N = 18)	
	M (SD)	Range	M (SD)	Range
Age (months)	31.70 (1.35)	30.40-35.03	32.33 (2.49)	28.04-35.18
CDI raw score	456.06 (136.69)	250-679	557.33 (251.02)	7-799
CDI proportion*	0.67 (0.20)	0.37-1.00	0.70 (0.31)	0.01-1.00

Note. MacArthur-Bates Communicative Development Inventories vocabulary production proportions for the English group; Putonghua Communicative Development Inventories vocabulary production proportions for the Mandarin group.

2.2. Materials and procedure

In the IPL task, children watched two side-by-side videos while listening to a central audio track that corresponds to only one of the videos. Stimuli were

projected onto a portable 150 cm × 120 cm screen using a laptop connected to a projector. A centrally positioned speaker, discreetly located behind the screen, delivered the audio, while a digital camcorder mounted on a small tripod just below the screen recorded the children’s faces. Researchers recorded and coded the children’s gaze direction and duration as indicators of comprehension.

The current study used the same videos to test English and Mandarin *wh*-questions, with the only modifications being the audio, which was dubbed in English and Mandarin, respectively. We selected *shenme* (Mandarin)/*what* (English) and *nali* (Mandarin)/*where* (English) questions as audio stimuli. Each video featured four events: *mo* (“tickle”), *xi* (“wash”), *bao* (“hug”), and *bei* (“carry”). Each event consisted of four phases. Taking one trial in the English video as an example (see Table 2), the *wash* event begins with a control-baseline trial that introduces a costumed bird and a costumed horse. This is followed by a familiarization trial, during which the horse and bird enact the washing event “the bird washed the horse”. Next, in the *what*-test trial, the two characters appear side by side while an audio prompt—in the form of either an object *wh*-question “what did the bird wash?” or a subject *wh*-question “what washed the horse?”—directs the child’s attention, thereby testing their comprehension of the *wh*-question. Finally, the *where*-control trial includes *where* questions, such as “where is the bird?”, for comparison with the *what*-test trials.

Table 2. Sample layout of *wh*-question video

Trial	Video 1	Audio	Video 2
Baseline	Horse	They are both on screens!	Bird
Familiarization	The bird washed the horse	See this?	Blank
Familiarization	Blank	Look at this!	The bird washed the horse
Test-object what	Bird	What did the bird wash?	Horse
Familiarization	The bird washed the horse	Look at this!	Blank
Familiarization	Blank	See this?	The bird washed the horse
Test-subject what	Bird	What washed the horse?	Horse
Control	Bird	Where is the horse?	Horse

2.3. Data analysis plan

To analyze toddlers’ comprehension of *wh*-questions, separate 2 (trial type: where vs. what) × 2 (group: English vs. Mandarin) mixed-design ANOVAs were conducted for subject and object *wh*-questions. To examine whether each language group demonstrated successful comprehension, within-group comparisons were conducted using paired-samples *t*-tests (one-tailed) to compare

looking proportions between *where* and *what* trials for subject and object *wh*-questions. Following previous IPL studies (e.g., Jyotishi et al., 2017), successful comprehension was defined as significantly greater looking at the named item during *where* trials than during *what* trials. Specifically, children's looking proportions toward the named item (e.g., the bird) during *what* test trials (e.g., "What pushed the bird?") were compared with their looking proportions toward the same item during the corresponding *where* control trials (e.g., "Where is the bird?"). In *where* trials, the named item was the clear visual target, while in *what* trials, children needed to recognize that the named item was no longer the focus of the event, resulting in decreased attention to that item. To compare performance accuracy across language groups, between-group comparisons were conducted on the proportion of looking to the matching item for subject and object *wh*-questions.

3. Results

For both subject and object *wh*-questions, mixed ANOVAs showed significant main effects of trial (subject-*wh*: $F(1, 34) = 17.134, p < .001$; object-*wh*: $F(1, 34) = 21.761, p < .001$) and group (subject-*wh*: $F(1, 33) = 8.946, p < .01$; object-*wh*: $F(1, 33) = 22.645, p < .001$). We then conducted within-group analyses for subject and object *wh*-questions in each language group. Within-group comparisons (*what* vs. *where*) showed that both English- and Mandarin-speaking toddlers looked significantly longer at the named item during *where* trials than during *what* trials for subject (English: $t(16) = -3.730, p < .01$; Mandarin: $t(17) = -1.983, p < .05$) and object *wh*-questions (English: $t(16) = -3.672, p < .01$; Mandarin: $t(17) = -2.889, p < .01$). Both groups demonstrated solid comprehension of these two types of *wh*-questions (Table 3 and Figure 1).

Table 3. Percent looking to the named item during control (*where*) and test (*what*) trials by language group

Percent looking to the named item (%)	English (N = 17)		Mandarin (N = 18)	
	Control M (SD)	Test M (SD)	Control M (SD)	Test M (SD)
Subject <i>wh</i> -Q	78.35 (17.17)	53.76 (13.73)	62.22 (15.87)	51.06 (14.41)
Object <i>wh</i> -Q	78.35 (17.17)	55.41 (11.15)	62.22 (15.87)	45.56 (13.00)

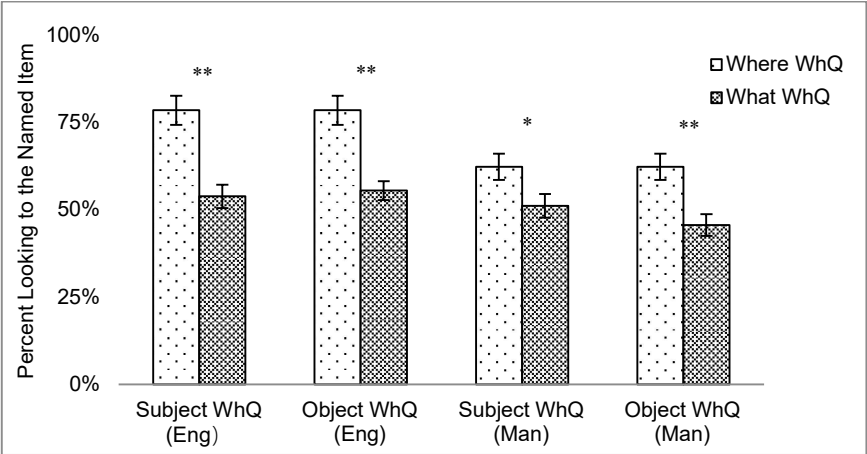


Figure 1. Both English- and Mandarin-speaking toddlers looked longer at the named item in *where* than in *what* trials

We further explored whether comparable comprehension patterns across the two language groups would also be reflected in similar performance accuracy levels. To address this, we conducted between-group comparisons focusing on children’s looking proportions to the matching item in subject and object *wh*-questions. Between-group comparisons showed that Mandarin-speaking toddlers’ looking to the match was significantly longer than English-speaking toddlers in object *wh*-questions (Mandarin: 54.44%±13.00% vs. English: 44.59%±11.15%, $t(33) = -2.328$, $p < .05$), but not in subject *wh*-questions (Mandarin: 48.94%±14.41% vs. English: 46.24%±13.73%, $t(33) = .236$, $p = .407$) (Figure 2).

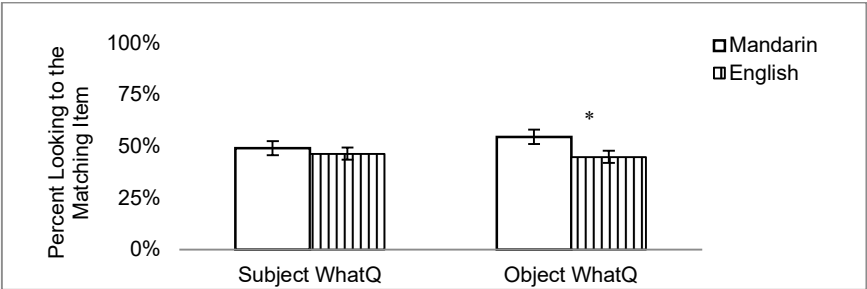


Figure 2. Mandarin-speaking toddlers looked longer at the matching item in object (but not subject) *wh*-questions than English-speaking toddlers

4. Discussion and conclusion

Our results suggest that first, both English- and Mandarin-speaking toddlers comprehend both subject and object *wh*-questions. Moreover, English-speaking

toddlers looked significantly less at the matching items than their Mandarin-speaking peers, for object *wh*-questions but not subject *wh*-questions.

The finding that English-speaking toddlers (mean age = 31.70 months) comprehended both subject and object *wh*-questions is consistent with previous IPL studies (Goodwin et al., 2012; Jyotishi et al., 2017), demonstrating that reliable comprehension of both *wh*-question types is in place by this age. Previous studies, however, suggest that the comprehension of subject and object *wh*-questions in English is not uniformly stable at earlier stages. For example, also using a preferential looking paradigm, Seidl et al. (2003) showed that English-speaking infants comprehended subject *wh*-questions but not object *wh*-questions at 15 months, whereas comprehension of both types was observed by 20 months. In contrast, Jyotishi et al. (2017) reported that at 28 months, children successfully comprehended object *wh*-questions but did not yet comprehend subject *wh*-questions. The subject advantage observed at 15 months (Seidl et al., 2003) and the object advantage observed at 28 months (Jyotishi et al., 2017) suggest that English-speaking children exhibit a period of instability in the comprehension of subject and object *wh*-questions during early development. Moreover, Jyotishi et al. (2017) reported that stable comprehension of both subject and object *wh*-questions emerges around 32 months, as children consistently demonstrated comprehension of both question types at 32, 37, and 41 months. Our finding that English-speaking toddlers at a mean age of 31.70 months (a subset of those studied by Jyotishi et al.) successfully comprehended both *wh*-question types provides converging evidence for this developmental milestone, supporting the view that approximately 32 months marks a point at which English-speaking children achieve stable comprehension of *wh*-questions. Importantly, a parallel pattern was observed for Mandarin-speaking toddlers. At a mean age of 32.33 months, Mandarin-speaking children in the present study also demonstrated comprehension of both subject and object *wh*-questions. This finding extends previous offline studies on Mandarin *wh*-question comprehension, which reported ceiling-level performance only in preschool-aged children (Shi & Yang, 2022), by demonstrating that robust comprehension is evident at the toddler stage, consistent with Su et al. (2022). Beyond this age-related extension, the parallel emergence of stable comprehension of subject and object *wh*-questions around 32 months in English- and Mandarin-speaking children suggests a shared developmental trajectory, despite cross-linguistic differences in *wh*-movement mechanisms.

The second finding is that Mandarin-speaking toddlers showed an advantage over their vocabulary-matched English-speaking peers in understanding object *wh*-questions, but not subject *wh*-questions. This asymmetry suggests that while subject *wh*-questions are processed similarly across the two language groups, object *wh*-questions pose different processing demands on movement type. We propose that this difference is related to the longer dependency in object *wh*-questions. In subject *wh*-questions, the dependency is short in both languages, as the *wh*-element base-generates in a structurally high position and then moves to the sentence-initial position with minimal distance. As a result, the processing demand imposed by subject *wh*-questions is comparatively low and similar across languages. In contrast, object *wh*-questions involve a longer dependency in both

languages, as the *wh*-element base-generates within the VP and then moves to the sentence-initial position. However, the nature of this dependency differs across languages. In English, object *wh*-questions involve pied-piping movement of both *wh*-words and *wh*-features, whereas in Mandarin, only the *wh*-feature undergoes movement while the *wh*-word remains in situ (Sholonsky, 2012). This may suggest that the combination of a longer dependency and the movement of multiple elements in English increases processing demands in object *wh*-questions relative to Mandarin, where movement is limited to the *wh*-feature.

To conclude, the present findings demonstrate that both English- and Mandarin-speaking toddlers comprehend subject and object *wh*-questions. More broadly, the convergence of results across the two languages suggests that the development of *wh*-question comprehension follows a largely shared developmental trajectory, despite cross-linguistic differences in *wh*-movement mechanisms. In particular, the present findings, together with previous work (Jyotishi et al., 2017; Su et al., 2022), indicate that around 32 months of age marks a point at which English-speaking children achieve stable comprehension of both subject and object *wh*-questions. For Mandarin-speaking children, although longitudinal evidence is not yet available, robust comprehension at a comparable age suggests that a similar developmental milestone may also be reached around this age (see also Su et al., 2022). Moreover, the observed advantage for Mandarin-speaking toddlers in object *wh*-questions reveals that *wh*-question comprehension is constrained by the principle (movement) and the language-specific parameters (pied-piping movement in English vs. feature-only movement in Mandarin). In English, *wh*-dependencies involve the movement of both *wh*-words and *wh*-features, while in Mandarin, only the *wh*-feature moves to form *wh*-dependencies. When dependencies are short, as in subject *wh*-questions, processing demands are low and similar across languages. However, when dependencies are longer, as in object *wh*-questions, the nature of movement becomes crucial. Thus, pied-piping movement in English imposes greater processing demands than feature-only movement in Mandarin, in line with Durrleman et al. (2016). In sum, this study contributes to our understanding that *wh*-questions are regulated by UG. Specifically, both English and Mandarin *wh*-questions follow a typical developmental pattern, and their comparison reveals the constraints imposed by universal principles and language-specific parameters.

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