Journal of Linguistics (2026), 1–43
doi:10.1017/S0022226726101297

Journal of Linguistics
CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

The learnability of bridge effects

Jiayi Lu[1], Julie Anne Legate[2] and Charles Yang[2]

[1]Northwestern University
[2]University of Pennsylvania
Corresponding author: Jiayi Lu; Email: jiayi.lu@northwestern.edu

Received: 12 November 2025 UTC; **Revised:** 19 May 2026 UTC; **Accepted:** 20 May 2026 UTC

Keywords: bridge effect; island effect; learnability; long-distance dependency; the Tolerance Principle

Abstract
The distinction between bridge verbs, which allow long-distance questions out of their CP complement, and non-bridge verbs, which do not, is found in a range of languages. In the previous literature, this distinction has been variably attributed to the lexical semantic/discourse properties of the CP-embedding verbs, or the syntactic positioning of the dependent CP. In this study, we provide evidence for an alternative, learning-based account, whereby positive input evidence is needed for children to acquire the possibility of *wh*-dependencies across a CP-embedding verb, and to further generalize this property to all such verbs. We examine the bridge/non-bridge distinction in English and Mandarin, with a corpus analysis of child-directed speech and experimental evidence provided for each language. We demonstrate that while English shows a clear bridge/non-bridge distinction, Mandarin CP-embedding verbs are all bridge verbs for both argument and adjunct *wh*-dependencies. These findings are predicted by a difference in the structure of the input data available to English versus Mandarin children as they acquire long-distance *wh*-dependencies, along with the proposed learning-based account of the bridge effect.

1. Introduction

Comparative research on syntactic movement has revealed a wide range of variation across languages with respect to movement. Complicating the picture further is the fact of variation within a single language, posing additional challenges to a comprehensive theory of syntactic movement. The phenomenon of bridge verbs, a central topic in Chomsky's influential treatment of *wh*-movement (1977), is a case in point.

A'-movement (*wh*-movement, relativization, etc.) can in principle cross finite complement clause boundaries in English; however, not all finite clauses are equally transparent to movement. Consider the contrast shown in (1). The verbs *say* and *forget* in (1a,b) both take finite CP complements, but only *say* allows a *wh*-element that originates in its complement to move across it. Verbs like *say* are categorized as *bridge verbs* in English (they act like bridges that allow elements to move across the clausal boundary), and verbs like *forget* are categorized as *non-bridge verbs.* The contrast between sentences like (1a) and (1b) is called the *bridge effect.*

© The Author(s), 2026. Published by Cambridge University Press. This is an Open Access article, distributed under the terms of the Creative Commons Attribution-NonCommercial licence (http://creativecommons.org/licenses/by-nc/4.0), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original article is properly cited. The written permission of Cambridge University Press or the rights holder(s) must be obtained prior to any commercial use.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

(1) a. Where did the professor say that the student was?
b. *Where did the professor forget that the student was?

Chomsky's (1977) discussion of bridge verbs, based on observations in Erteschik-Shir (1973), pointed out two additional significant facts that must be taken into consideration. First, there are languages where *wh*-movement is clause-bound independently of the identity of the clause-embedding verb; Chomsky mentions German[1] and Russian.[2] Second, even the grammatical status of bridge verbs in English is not clear-cut; Chomsky provides the following examples:

(2) a. *What did John complain that he had to do this evening?
b. *What did Mary quip that John saw?
c. ?Who did Mary murmur that John saw? (Chomsky 1977, p. 85)

In the current study, based on corpus and experimental evidence drawn from English and Mandarin Chinese, we propose an account for the bridge effect that allows for variation, both across languages and across verbs within a single language. Our proposal, explained in detail in Section 2, is a learning-theoretic one: the bridge status of verbs results from learning and generalization from positive evidence in the input that long-distance *wh*-dependencies are possible across certain verbs. This approach is inspired by early learning-based accounts, dating back to Chomsky (1977).

Chomsky's (1977) treatment of bridge verbs is essentially one of lexical learning. Clause-embedding verbs are by default non-bridge, which accounts for the lack of movement out of an embedded 'that' clause across a bridge verb in Russian, (varieties of) German, and other languages that pattern similarly. For English, a speaker's bridge verbs are those that they have encountered as bridges in their linguistic experience, which accounts for the uncertainty and variability about the judgments in 2.

Indeed, the subset of bridge verbs in English appears very small, as shown by research in recent years that attempts to provide a more comprehensive assessment of bridge effects. For example, Richter & Chaves (2020) provide a list of 135 relatively common clause-embedding verbs, but identify only those listed below as bridge verbs.

(3) a. believe, claim, comment, decide, declare, establish, feel, hope, remark, reply, report, respond, say, think, write

An account based solely on lexical learning also faces challenges. Since it is highly unlikely for a speaker to exhaustively encounter all clause-embedding verbs used as bridge verbs during acquisition,[3] we should predict no language where all clause-embedding verbs

[1] There seems to be some variation among varieties of German; see, e.g. Featherston 2004 for experimental evidence, and Salzmann 2020 for general discussion. Apparent extraction out of embedded V2 is possible, but this has been argued to involve a matrix parenthetical; see cited references for discussion.

[2] For details, see Stepanov & Georgopoulos 1997; Stepanov 2001; Dyakonova 2009. Later research has found additional languages in this category; for example, Warlpiri (Pama-Nyungan: Northern Territory, Australia) does exhibit embedded finite clauses (Legate 2011), and yet does not allow long distance wh-movement (Granites et al. 1976). See also discussion of Hindi, below.

[3] At least for any language with a non-trivial number of clause-embedding verbs.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

are bridge verbs by default under a lexical learning account, without the help of a process of productive generalization. However, to preview the findings of the current study, Mandarin appears to be such a language. Therefore, an account of the bridge effect based solely on lexical learning is inadequate.

Various other accounts of the bridge effect that depart from Chomsky's original approach have also been proposed in the literature. One class of accounts attributes the bridge/non-bridge distinction to the discourse functions of the clause-embedding verbs as determined by their lexical meanings (Erteschik-Shir 1973, 2007; Ambridge & Goldberg 2008; Lu et al. 2025). For example, factive verbs (e.g. *know*, *regret*, *discover*), as part of their lexical entries, encode the speakers' commitment to the truth of their complement clauses (i.e. their complements are presupposed) (Kiparsky & Kiparsky 1970). It is thus pragmatically odd to form a *wh*-question seeking information about something that the speaker already commits to as true by virtue of using a factive verb in the utterance. Similar accounts have also been used to explain the non-bridge status of manner-of-speaking verbs in English (e.g. *whisper*, *yell*). For example, Erteschik-Shir (1973) claims that compared to the bridge verb *say*, manner-of-speaking verbs like *whisper* and *yell* encode an extra manner component in their lexical meanings; this extra manner component makes manner-of-speaking verbs more likely to be interpreted as focused, and in turn their complements as presupposed. As a result, the complements of manner-of-speaking verbs are opaque to movement in the same way that the complements of factive verbs are. Since this class of accounts all explain the bridge effect with the pragmatic ill-formedness of questioning presupposed contents, we shall call these accounts the "pragmatic accounts" for ease of discussion.

Unlike the lexical learning approach, the pragmatic accounts make it possible for speakers to acquire a verb as a bridge verb without directly observing it being used as a bridge verb. Based on the lexical meaning of a newly acquired clause-embedding verb, speakers should be able to derive its bridge status: verbs that fall inside the non-bridge verb classes (e.g. factive verbs) should be non-bridge verbs, and those that do not are bridge verbs. Therefore, the pragmatic accounts predict that the lexical meaning of verbs dictates their bridge status. Unfortunately, this prediction is not borne out. Focusing on just English for a moment, large-scale behavioral studies have shown that while discourse and processing factors may improve acceptability ratings, they do not eliminate the independent grammatical effect of bridgeability (Huang et al. 2025; Lu et al. 2025). For example, while it may be pragmatically odd to form a *wh*-question out of factive verbs such as *know*, that does not explain why a number of verbs that are neither factive nor manner-of-speaking are nevertheless non-bridge verbs – *maintain*, *suppose*, *assert*, to name a few from Richter & Chaves (2020) – while others are bridge verbs, such as *believe*, *claim*, and *hope* in 3. Moving beyond English, we find that clause-embedding verbs in other languages do not necessarily share the bridge status of their English counterparts. For example, the Polish verb *myśleć* "think" (Witkoś 1995) has been reported to be a non-bridge clause-embedding verb, even though its English counterpart *think* is clearly a bridge verb.[4] Conversely, Jordanian Arabic also exhibits a bridge/non-bridge distinction, but

[4] Witkoś 1995 reports that while extraction from finite indicative CPs headed by *że* "that" is generally impossible in Polish, thus patterning with the Russian and German discussed above, some speakers marginally allow extraction across *mówić* "say" and *powiedzieć* "tell," and yet still do not allow extraction across *myśleć* "think."

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

categorizes *ʃakk* "doubt" and *zann* "guess" as bridge verbs (Jarrah 2019), whereas English does not (Richter & Chaves 2020).

On the flip side, we also have languages in which there appears to be no factive island effect. For example, Schurr & Kandybowicz (2023) argue that Shupamem (Eastern Grassfields: Cameroon) is such a language, and provide illustrative data demonstrating that, as expected, the CP complement of *ʃáʔá ŋwàt* "regret" is presupposed, and yet behaves as a bridge verb.[5] The pragmatic accounts clearly cannot capture such crosslinguistic variation in the bridge effect: *think* is predicted by these accounts to be a bridge verb given its lexical meaning and discourse function in English and Polish alike; similarly, factive verbs should always be non-bridge verbs regardless of whether the language is English or Shupamem. Finally, we should note that not only is factivity a poor predictor for a verb's bridge status, but the category of factive verbs as a verb class is also poorly defined. Experimental findings by Degen & Tonhauser (2022) show that verbs traditionally labeled as factive are in fact more heterogeneous than assumed by previous literature, and the binary division between factive and non-factive verbs may not even be cognitively real; see also Hazlett (2010).

Another class of accounts attributes the bridge effect to a special syntactic status of the CPs selected by the non-bridge verbs (Tsai 1994; Kayne 1981; Cinque 1990; Kiparsky & Kiparsky 1970; Rooryck 1992; Adams 1985; Rizzi 1990). For example, Cinque (1990) posits that the embedded CPs introduced by factive and manner-of-speaking verbs are not structural complements of the verbs, but are adjoined. Similarly, Rizzi (1990), following Kiparsky & Kiparsky (1970) and Adams (1985) among others, posits that the embedded CP introduced by factive verbs is structurally adnominal: factive verbs select a nominal projection under which the CP is embedded. Under such analyses where the embedded CP is not a structural complement of a verb, movement out of that CP is expected to be degraded, particularly for *wh*-adjuncts. For example, in the terminology of Chomsky (1981), any *wh*-adjunct trace occupying the specifier position of such a CP would not be properly governed, and thus the movement of *wh*-adjuncts across that CP would be ruled out by the Empty Category Principle (the ECP: Chomsky 1981). Along similar lines, Adams (1985) posits that factive verbs assign a nominal feature [+N] to the head of the embedded CP, which in turn blocks the antecedent government of any lower *wh*-adjunct trace by the intermediate trace at the [+N] CP edge, violating the ECP.

Tsai (1994) extends this analysis to Mandarin and beyond factive verbs. In Mandarin, a *wh*-in situ language, *wh*-elements do not undergo overt movement. For simplicity of discussion, we follow Huang (1982) and assume that *wh*-elements undergo covert *wh*-movement in Mandarin, so the bridge effect would then be a restriction on this covert movement. This assumption is not core to our discussion: one can alternatively assume that the dependencies between *wh*-elements and their scope positions are achieved without

One may wonder whether the complement of *myśleć* is in fact presupposed, unlike the complement of its English counterpart *think*. This is not the case, as shown in the example below from our Polish consultant.

(i) On myśli że wszystko jest w porządku. Ale nie jest.
He think.3SG that all.NOM be.3SG in order But NEG be.3SG
"He thinks that everything is in order, but it is not."

[5] See Schurr et al. 2024 for further discussion of islands in Shupamem. See also Korsah & Murphy 2024 on Asante Twi (Kwa: Ghana), where the factive verb *nímˊ* "know" and the interrogative verb *bisa* "ask" both behave as bridge verbs for nominals (but not PPs or VPs). See further Hein 2024 on Limbum (Eastern Grassfields: Cameroon), which shows the same behavior for the factive verb *rɨ́ŋ* "know."

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

movement (e.g. through unselective binding, Pesetsky 1987, i.a.); the bridge effect would then be a verb-specific restriction on this *wh*-scope dependency formation. Whatever the mechanism employed to derive the scopal interpretation of in situ *wh*-phrases across an embedding verb, from the current perspective, it is important to note that *wh*-in situ languages do show a range of behaviors for the bridge phenomenon, just like *wh*-movement languages. Some *wh*-in situ languages, like Hindi, exhibit no bridge verbs, disallowing wh-movement out of finite clauses regardless of the identity of the embedding verb (see Mahajan 1990, Srivastav 1991, Dayal 1996, i.a.). Other languages, like Japanese, exhibit a bridge/non-bridge distinction (see Fukui 1988, Butler 1989, i.a.). According to Tsai (1994), Mandarin also has non-bridge verbs, all of which select for [+N] complement CPs, blocking covert movement of *wh*-adjuncts from within.[6] Bridge verbs, on the other hand, select for [-N] complement CPs, allowing *wh*-adjunct traces to occupy their specifier positions. An example from Tsai (1994) is provided in (4). Even though the *wh*-element *weishenme* "why" does not overtly move, the clause-embedding verb *tongyi* "agree" appears to prevent it from taking scope in the matrix specifier of CP, just as non-bridge verbs block overt *wh*-movement in English. Nevertheless, one should note that the data point in (4) does not definitively show that there is a bridge effect in Mandarin. Previous experimental work has shown that long-distance covert movement of *weishenme* is overall degraded (possibly due to a processing penalty), regardless of the type of structure spanned by the movement (Lu et al. 2020; Kim et al. 2023). Furthermore, *tongyi* "agree" is not a natural clause-embedding verb in Mandarin: sentence (5a), in which *tongyi* takes a finite complement clause without *wh*-dependency, sounds less acceptable than (5b), the same sentence but with *tongyi* replaced by the canonical bridge verb *shuo* "say." In the current study, we shall show how this apparent "bridge effect" in Mandarin can be explained by a combination of an overall penalty on long-distance *weishenme* dependencies, and penalties on verbs taking finite embedded clauses.[7]

(4) Claimed bridge effect for *wh*-in situ in Mandarin
*Ni tongyi [Lisi weishenme cizhi]?
you agree Lisi why resign
"What is the reason *x* you agree that Lisi resigned for *x*?" (Tsai 1994, p140)

(5) a. *tongyi* taking a finite complement clause
?Zhangsan tongyi Lisi yinwei jiating yuanyin cizhi le
Zhangsan agree Lisi because family reason resign ASP
"Zhangsan agrees that Lisi resigned because of family reasons."
b. *shuo* taking a finite complement clause
Zhangsan shuo Lisi yinwei jiating yuanyin cizhi le
Zhangsan say Lisi because family reason resign ASP
"Zhangsan says that Lisi resigned because of family reasons."

[6] As we shall see below, our experimental results do not support the existence of non-bridge verbs in Mandarin.

[7] Clauses lack overt tense marking in Mandarin, so standard tense-based diagnostics for finiteness do not apply. Following Huang (1984, 1989), we instead use overt aspect marking as a diagnostic for finiteness: embedded clauses whose verbs bear aspect markers are treated as finite. In this light, it is important that our Mandarin stimuli in the experiments discussed below all include aspect marking in the embedded clause. We note, however, that the existence of a finiteness distinction in Mandarin is somewhat controversial; see Hu et al. (2001) for arguments against such a distinction, and Zhang (2016), Sybesma (2017), Huang (2022), Li (2024), i.a. for counterarguments.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

In addition to claiming a bridge effect in Mandarin, Tsai (1994) also provides an explicit account of how the bridge/non-bridge distinction is acquired. During acquisition, learners by default assume that all clause-embedding verbs select for [+N] complement CPs (i.e. they are non-bridge verbs by default), until they see positive evidence for cross-clausal *wh*-adjunct movement, at which point they acquire the clause-embedding verb as a bridge verb that selects for [-N] complement CPs. Despite the differences in implementation, Tsai's approach is a return to Chomsky's account of lexical learning: bridge verbs are the result of experience and language acquisition. We believe this approach to be on the right track: lexical learning is clearly necessary in acquiring the bridge/non-bridge distinction, especially since the bridge/non-bridge status of verbs cannot be entirely derived from lexical meaning. Nevertheless, it inherits the limitation of Chomsky's lexical learning account that we discussed earlier: it fails to capture generalization of the bridge property beyond the input data.

Note that although the class of structural accounts discussed above differ in the particular syntactic analyses of clausal complements they adopt, they all attribute the islandhood of non-bridge verb complements to the ECP. As a result, they all make the same prediction that the bridge/non-bridge distinction should only hold for *wh*-adjuncts but not *wh*-arguments (i.e. an "argument-adjunct asymmetry"). Nevertheless, this prediction may not actually hold even in English: in a large-scale experimental survey, Huang et al. (2025) showed that different clause-embedding verbs induce a varying degree of extraction penalty for *wh*-arguments, with a number of verbs showing a high extraction penalty, e.g. *complain, disagree, and stutter.* This demonstrates that the bridge effect does apply to *wh*-arguments in English, contrary to what the ECP-based accounts predict. In the rest of the paper, we will also present experimental evidence against an argument-adjunct asymmetry in the bridge effect for Mandarin.

In the coming sections, we will present a novel account of the bridge effect and provide supporting corpus and experimental evidence from English and Mandarin. Our proposal retains the key intuition of Chomsky's (1977) and Tsai's (1994) accounts. Lexical learning should be the consequence of some *other* learning procedure reached by the child based on the language-specific input data. More specifically, this procedure holds that clause-embedding verbs are by default non-bridge verbs, the bridge status is the result of learning. When applied to languages such as English and Polish, it should inform the learner that the bridge verbs must be learned lexically. But for some other languages – such as Mandarin, as we show in the present paper – it may reach the conclusion that the bridge effect is productive: all clause-embedding verbs are bridge verbs. Section 2 presents such a learning procedure, through which we also explain the productive generalization of bridge status. In Sections 3–6, we will present evidence from corpus analyses of English and Mandarin, as well as a post hoc analysis of an existing experiment on English and three experiments on Mandarin that support our account and challenge the competing pragmatic and ECP-based accounts.

2. Learning Generalizations about Movement

Our approach to bridge effects builds on important insights from Chomsky (1977), Fodor (1992), Tsai (1994), and others. These authors recognize the arbitrariness of bridge verbs within and across languages, which in turn suggests that the speaker's learning experience with language must play a critical role in the choice of bridge verbs: an embedding verb is

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

lexicalized as a bridge verb if the speaker has encountered its usage as such, presumably sufficiently frequently. It must be noted, however, that lexical learning is by definition bound by the input. It must be embedded in a general theory of language acquisition that extends beyond the input, when appropriate, for otherwise the infinite productivity of language cannot be accounted for.

Such a general theory of learning is the main innovation of our theory of bridge effects. It is built around a computational mechanism that identifies productive generalizations when possible but resorts to lexicalization when necessary. As we will see, the situation of bridge verbs in English results from the failure to discover productive properties in the input data – lexicalization becomes the only option. In the case of Mandarin, however, the same mechanism detects a productive generalization, from a finite sample of input data, whereby *all* clause-embedding verbs are bridge verbs, and we report the results from three experimental studies in support of this conclusion.

2.1. A threshold for generalization

Learning a language requires discovering rules that correctly generalize beyond a finite sample of data. The Tolerance Principle (TP) is a theory of how such generalizations are formed (Yang 2005, 2016). Specifically,

(6) Let a rule R be defined over a set of N items (e.g. words). R is productive (i.e. can generalize to novel instances) if and only if e, the number of items among N that do not support R, does not exceed θ_N:

$$e \leq \theta_N = \frac{N}{\ln N}$$

If e exceeds θ_N, the learner can only memorize the attested items as following R but will not generalize beyond.

The TP is a parameter-free learning model. Productivity is determined by two input values (i.e. N and e), which are cardinality values in an individual learner's experience: a categorical prediction is then made without additional degrees of freedom. By its very nature, the TP is only concerned with the *provisional* coverage of a hypothesis with respect to the learner's experience such as vocabulary. This proves especially important for the language acquisition process. It is now well established that the core properties of the grammar must be learned on a very modest vocabulary. Research has shown that across languages, the vocabulary size for two-year-olds is only in the range of 200–300 words, and the most advanced three-year-olds may have up to 1,000 words (Fenson et al. 1994; Bornstein et al. 2004); the categories (e.g. verbs, prepositions) over which syntactic operations are defined are even smaller. The TP has the mathematical property that a smaller value of N, the set of lexical items over which a rule is defined, requires a proportionally smaller amount of positive evidence to warrant productivity. It is therefore easier for learners to learn rules when their vocabulary size is small, as is the case for young children. Furthermore, the early vocabulary is strongly correlated with frequencies of usage (Goodman et al. 2008): high-frequency words are, of course, more likely to be attested in the syntactic processes they support, thereby effectively enhancing the evidence available to the child learner to form generalizations.

Because of its simplicity, the TP has been widely applied to learning problems in phonology, morphology, and syntax, and has been shown to have implications for language

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

change (e.g. Björnsdóttir 2021; Hsieh 2021; van Tuijl & Coopmans 2021; Pearl & Sprouse 2021; Trips & Rainsford 2022; Dresher & Lahiri 2022; Henke 2022; Kodner 2023; Belth 2023, 2025; Thoms et al. 2025; Kanampiu et al. 2025; Nowenstein 2026). All these studies use corpus data to approximate the vocabulary of learners/speakers and to calculate productivity predictions, and they are supported with converging evidence from experiments, naturalistic production, dialectal surveys, historical sources, etc. Additional evidence for the TP comes from artificial language and pattern learning studies: the experimental stimuli and their frequencies are under strict control and the outcome of learning (i.e. the status of rules) can be assessed and tested precisely. For example, Schuler et al. (2016) show that the TP correctly predicts generalization when a rule covers 5 out of 9 items in the training data ($\theta_9 = 4$) and no generalization when a rule covers only 3 out of 9. Shi & Emond (2023) provide an even more stringent test. Fourteen-month-old infants with no experience with the Russian language heard 16 three-word Russian sentences (denoted as ABC) playing in the background while playing in the lab. Some of the sentences were followed by a word order alternation that switched the order of two words (e.g. ABC → BAC). For one group of infants, 11 of the 16 sentences were attested with the alternation; for the other group, only 10 were. When tested on novel ABC sentences, only the former but not the latter group recognized the alternation in the training data. The results were predicted by the TP: $\theta_{16} = 5$,[8] thus only 11/16 constitutes sufficient evidence for generalization but not 10/16, despite being the clear majority. Recall that the infants had no knowledge of Russian and were otherwise engaged with other activities: the TP must be a general learning principle independent of its domain of operation (see Guilbeault et al. 2026 for an application to decision-making under uncertainty).

At the moment it is not clear why the TP should work as well as it does. Nor is it clear how the brain actually implements something like the TP. Quite importantly, the experimental results show that unlike the dominant approach to learning (e.g., Russell & Norvig 2004), generalization is not probabilistic. For example, a rule that applies with a probability 0.56 (5/9; Schuler et al. 2016) generalizes, but one that applies with a probability 0.63 (10/16; Shi & Emond 2023) does not.[9] It is critical that the learner tracks both the numerator and denominator values. It is unclear how ratio tracking is implemented in the neurological system although behavioral evidence for such quantitative processing is ubiquitous across tasks and species (e.g. Aslin & Newport 2012) as is the evidence for threshold-like principles of learning and decision-making (e.g. Gold & Shadlen 2007).

2.2. Generalizing movement

Our approach to bridge verbs can be viewed as a case study in an alternative approach to movement phenomena in language (Legate & Yang 2025). The traditional view, as indicated by terms such as "islands," seeks to identify both universal principles and language-particular choices (e.g. Chomsky 1981; Rizzi 1982; Chomsky 1986) that restrict movement,

[8] While counts such as N and e are integers, the threshold θ_N inevitably yields a real number. For example, $\theta_{16} = 16/\ln 16 \approx 5.77$. It is important to take the floor of $\theta_N - 5$ for $N = 16$ – as opposed to the usual practice of rounding to 6, which of course exceeds 5.77.

[9] The non-probabilistic nature of learning is unique to our approach and will be contrasted with other learning-based approaches to movement (e.g. Pearl & Sprouse 2013) in the concluding part of our paper.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

which is by itself free and unlimited ("Move alpha"). Language acquisition is about learning what is impossible.

Our alternative view, as developed in Legate & Yang (2025), is that language acquisition is about learning what is possible. Instead of identifying conditions that prohibit movement, this theory aims to characterize the conditions that *allow* movement, and more precisely, how children discover them. The underlying intuition is that children must receive positive input to determine what is possible in their language. From this perspective, that clause-embedding verbs are by default non-bridge does not need to be stated as an independent property of the grammar. By default, nothing is possible, until the child encounters positive evidence that it is possible; hence, long-distance wh-movement (for a wh-movement language) or construal (for a wh-in situ language) is impossible until the child encounters evidence that it is.

For languages that lack bridge verbs altogether (e.g. certain varieties of German and Russian), the learner presumably will never encounter wh-questions across a clause-embedding verb, and so will never consider the possibility for their language. For a language that does exhibit long-distance questions, like English or Mandarin, the child presumably will encounter such questions in the input. Our proposal assumes only that a key component of the child's acquisition of such questions is centered around the identity of the matrix verb; this much seems inescapable. The theoretical explanation of this is immaterial – it could be due to the selectional properties of the matrix verb (selecting a CP complement versus adjunct, selecting a DP versus CP, etc.), or the need to learn a movement/construal step from the embedded CP to the matrix VP (adopting the long-standing insight that non-local dependencies are composed of local steps), or something else. Regardless, the task of the child is to determine which verbs allow for long-distance wh-questions across them. Initially, the child will hear some clause-embedding verbs attested as bridge verbs, supporting lexically specific categorizations, for example, Vthink allows bridging.[10] As the child encounters more long-distance questions, the task becomes to determine whether a sufficient number of clause-embedding verbs are attested as bridges, calculated according to the Tolerance Principle, to justify generalizing the bridging property, either to an easily identifiable natural class of clause-embedding verbs, or to the category of clause-embedding verbs as a whole. In the coming section, we present two corpus analyses examining the use of clause-embedding verbs in English and in Mandarin child-directed speech. We shall see that the input available to children justifies generalizing the bridge property to the class of clause-embedding verbs as a whole in Mandarin, but not in English, where the bridge property remains lexically specific.

3. Corpus analysis

3.1. English CHILDES

We conducted a principled examination of the use of clause-embedding verbs in child-directed English from the CHILDES corpus (MacWhinney 2000). Our study makes use of a 13-million-word (2.7-million-utterance) corpus of child-directed speech, which corresponds to about two to three years of linguistic input for typical child learners. The corpus has been

[10] Again, staying neutral as to how this is formalized.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

lemmatized and part-of-speech tagged (MacWhinney 2000). While the annotation is not perfect, it does facilitate effective extraction of sentential patterns, aided by the fact that child-directed sentences are very simple – the average sentence length is about 5 words – so that even hierarchically organized structures can be approximated by linear string-based searches. The automatic search results were submitted for manual inspection and correction when necessary. The corpus contains approximately 188,000 wh-questions. Of these, just over 500 are long-distance questions, where extraction originates from an embedded CP, corresponding to a frequency of roughly one every other day. English-learning children start to produce long-distance wh-questions relatively early, at a mean age of 2;10, albeit still about six months after the emergence of matrix questions. As in adult speech, long-distance questions are also relatively rare in children's speech: only 200 out of a total of 12,000 wh-questions (Stromswold 1995).

Approximately 80 of the clause-embedding verbs from Richter & Chaves (2020) appeared at least once in declarative sentences in the child-directed corpus, including 10 out of the 15 bridge verbs in the above list. Even if all ten were attested in long-distance extraction, this would be nowhere near the threshold for generalization (which is 62 out of 80), predicting that the attested bridge verbs are simply lexically memorized. The actual data is even sparser: only five bridge verbs are attested with long-distance extraction in the child-directed input corpus at all. Recall that there are only just 500 long-distance questions to begin with. Given the statistical sparsity of linguistic structures (e.g. Yang 2013), it is not surprising to find that *think*, followed by *say*, constitute the majority of the sample. The other three bridge verbs were, in fact, used exactly once each, reproduced below:

(7) What do you suppose tigers eat then?
What are we going to decide they are?
What would you recommend that I take?

There is no chance for bridgeability to ever emerge as a productive process. Nor do the attested bridge verbs seem to form any coherent lexical class: factivity, for example, is clearly inadequate as discussed earlier. Limiting the verbs to children's vocabulary yields similar results, while providing a more developmentally appropriate illustration of the learning process: after all, not all clause-embedding verbs, some of which are fairly low in frequency, will be learned as such by children. By the age of acquiring long-distance *wh*-questions, children should have approximately 20 clause-embedding verbs in their vocabulary (Li 2023; Diessel & Tomasello 2001). For there to be a productive rule that all clause-embedding verbs are bridge verbs, one needs at least 14 out of the 20 clause-embedding verbs to be explicitly used as bridge verbs in the input. The mere 5 bridge verbs that appear in the English CHILDES corpus do not suffice. Therefore, the learner lexicalizes the attested bridge verbs but does not generalize beyond – the state of the grammar as originally described by Chomsky (1977).

3.2. Mandarin CHILDES

A search for Mandarin clause-embedding verbs in the Mandarin section of the Chinese CHILDES corpus (henceforth the Mandarin CHILDES) yields drastically different results from English. We took all adult utterances from the corpus (approximately 3.6 million words), all of which are dependency parsed. We identified verbs that take embedded CP complements based on the dependency parsing, and then manually verified that they were

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 1. The top 20 most frequent clause-embedding verbs in the Mandarin CHILDES corpus

Attested with both *wh*-argument and *wh*-adjunct questions	*kan* (see), *shuo* (say), *zhidao* (know), *juede* (feel/think) *gaosu* (tell), *jiang* (speak), *xiwang* (hope), *tingshuo* (hear), *xiang* (think), *pa* (worry), *jide* (remember), *jiandao* (see), *cai* (guess), *ganjue* (feel)
Attested only with *wh*-argument questions	*shuoming* (explain), *faxian* (discover), *xihuan* (like), *haipa* (fear), *xie* (write)
Not attested with *wh*-questions	*jiazhuang* (pretend)

genuinely used as CP-embedding verbs in the corpus. There are a total of 48 CP-embedding verbs in the corpus. Select examples of CP-embedding verbs in the Mandarin CHILDES corpus are shown in (8). We then collected the most frequent 20 CP-embedding verbs: we are not aware of any study that specifically targets Mandarin-learning children's vocabulary of CP-embedding verbs, so we used the estimates from English-learning children's vocabulary discussed earlier (Diessel & Tomasello 2001; Li 2023) in light of the robust findings that children's vocabulary size and composition develop at comparable rates across languages including Mandarin (Hao et al. 2008; Bornstein et al. 2004). The list of verbs is shown in Table 1.

We then searched for long-distance *wh*-questions among the sentences with the verbs in Table 1 taking finite complement clauses, where the *wh*-elements originate inside the complements of these verbs. Select examples from the corpus of CP-embedding verbs used as bridge verbs are shown in (9). Since the previous literature on bridge effects in Mandarin makes a distinction between argument and adjunct *wh*-questions, we conducted the search for the two *wh*-types separately. Among the 20 verbs, 19 are attested with *wh*-argument questions, 14 are attested with *wh*-adjunct questions, and there is only one (*jiazhuang*, "pretend") that does not appear in long-distance *wh*-questions of either type.

Assuming the Tolerance Principle, a rule that applies to 20 items is productive if it holds for at least 14 items (following the equation in (6), the generalization threshold for 20 items is $20 - \theta_{20}$ or 14). Our counts for both *wh*-argument and *wh*-adjunct clear the threshold of productive generalization. Mandarin-speaking children should thus posit a productive rule that all clause-embedding verbs are bridge verbs.

In the following sections, we put this prediction to the test in a series of acceptability judgment experiments with Mandarin speakers.

(8) Select examples of CP-embedding verbs in the Mandarin CHILDES

a. wo jide wo you yi ci gen pengyou chuqu chifan
I remember I have one time with friend go.out eat
"I remember that I once went out for a meal with friends."

b. wo zhidao ni hen bang
I know you very good
"I know that you are very good."

c. ta xiwang naxie haoxin ren jiandao xiao maomi
he hope those good.hearted people pick.up little kitten
"He hopes that those good hearted people picked up the little kitten."

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

(9) Select examples of CP-embedding verbs used as bridge verbs in the Mandarin CHILDES

a. ni jide na ci fasheng le shenme shiqing?
you remember that time happen ASP what matter
"What do you remember that happened that time?"

b. ta zhidao nali you da yaoguai ya?
he know where have big monster PRT
"Where does he know that there are big monsters?" (What is the place *x* such that he knows that there are big monsters at *x*?).

c. ni xiwang ta de shenme bing?
you hope he get what disease
"What disease do you hope that he gets?"

4. Experiment 1

In this experiment, we examine the prediction that Mandarin lacks a bridge/non-bridge distinction by testing the acceptability of extraction from the complements of a variety of clause-embedding verbs in Mandarin. Among the verbs tested, there are three that were classified as bridge verbs by Tsai (1994): *shuo* "say," *cai* "guess," and *renwei* "think," which we shall refer to as the three canonical bridge verbs in Mandarin. This classification is also supported by corpus results: both *shuo* "say" and *cai* "guess" appear in *wh*-questions as bridge verbs in the Mandarin CHILDES corpus (examples shown in (10a,b)). Although the CHILDES corpus lacks examples for *renwei* "think," a search in other corpora returns plenty of examples of *renwei* used as a bridge verb (example (10c), taken from the BLCU Chinese Corpus (Xun et al. 2016)). Sentences in (10) also sound perfectly acceptable to Mandarin speakers.

(10) Naturally occurring examples of the three canonical bridge verbs

a. Ni **shuo** ta weishenme you wang waimian kan?
You say he why again towards outside look
"Why did you say that he looked outside again?" (What is the reason *x* such that you said he looked outside again because of *x*)? (Mandarin CHILDES)

b. Ni **cai** ta weishenme dao-le
you guess it why fall-PFV
"Why do you guess it fell?" (What is the reason *x* such that you guess it fell because of *x*)? (Mandarin CHILDES)

c. Ni **renwei** Zhou Jielun weishenme bu xuanze Cai Yilin
you think Zhou Jielun why not choose Cai Yilin
"Why do you think that Zhou Jielun didn't choose Cai Yilin?" (what is the reason *x* such that you think Zhou Jielun didn't choose Cai Yilin because of *x*)?" (BLCU Chinese Corpus)

Therefore, in this study, we assume these three verbs are bridge verbs, and compare the other unclassified verbs against these three canonical bridge verbs. If there is no bridge/non-bridge distinction as predicted, we should expect the extraction penalty induced by the unclassified

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

verbs to show no significant difference from, or to be smaller than, the extraction penalty induced by the three canonical bridge verbs.

4.1. Methods

4.1.1. Participants

We recruited 240 self-reported native speakers of Mandarin on the online crowdsourcing platform Prolific. We excluded 31 participants based on the following pre-registered exclusion criteria: (i) more than one incorrect response to any of the practice trials (rating a grammatical practice item below the midpoint of the scale, or rating a word salad practice item above the midpoint of the scale), or (ii) overlapping of the 95% confidence intervals of their ratings of the acceptable fillers and the word salad fillers.

4.1.2. Materials

Example stimuli sentences are shown in 11. All stimuli sentences are declaratives with three clausal layers. The matrix verb is *xiangzhidao* "wonder," which necessarily selects for an interrogative CP and thus anchors the scope of the embedded *wh*-element at the edge of the intermediate CP. The intermediate CP contains a clause-embedding verb taking another finite CP as its complement. A total of 14 clause-embedding verbs were tested: *shuo* "say," *cai* "guess," *renwei* "think," *juede* "feel/think," *xiwang* "hope," *shuoming* "explain," *xiang* "think/presume," *pa* "worry/fear," *xihuan* "like," *jide* "remember," *jiazhuang* "pretend," *haipa* "fear," *ganjue* "feel," and *xie* "write." The verbs were chosen from the top 20 most frequent clause-embedding verbs attested in the Mandarin CHILDES corpus, excluding ones that are not compatible with *why* questions (*kan* "see," *tingshuo* "hear," *jiandao* "see," *zhidao* "know," *faxian* "discover"), and one verb that requires a direct DP object and is therefore incompatible with the experimental design (*gaosu* "tell"). Among the 14 verbs tested, Tsai (1994) classifies *shuo* "say," *cai* "guess," and *renwei* "think" as bridge verbs, whereas the rest of the verbs are not classified.

(11) Example stimuli for the clause-embedding verb *shuo* "say"

a. WH-ARGUMENT, SHORT
faguan xiangzhidao shei shuo jingcha shenwenle xuesheng
judge wonders who say police interrogated student
"The judge wonders who said that the police officer interrogated the student."

b. WH-ARGUMENT, LONG
faguan xiangzhidao lüshi shuo jingcha shenwenle shei
judge wonders lawyer say police interrogated who
"The judge wonders who the lawyer said that the police officer interrogated."

c. WH-ADJUNCT, SHORT
faguan xiangzhidao lüshi weishenme shuo jingcha shenwenle xuesheng
judge wonders lawyer why say police interrogated student
"The judge wonders why the lawyer said that the police officer interrogated the student." (asking why the lawyer said so)

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

d. WH-ADJUNCT, LONG
faguan xiangzhidao lüshi shuo jingcha weishenme shenwenle xuesheng
judge wonders lawyer say police why interrogated student
"The judge wonders why the lawyer said that the police officer interrogated the student." (asking why the police officer interrogated the student)

We manipulated two factors: *wh*-type (argument vs. adjunct), and dependency length (short vs. long). The wh-argument condition sentences contain the *wh*-element *shei* "who," and the wh-adjunct condition sentences contain the *wh*-element *weishenme* "why." In the short dependency sentences, the *wh*-phrase originates and takes scope in the intermediate clause. In the long dependency sentences, the *wh*-phrase originates in the most embedded clause, but takes scope in the intermediate clause; hence, the *wh*-dependency crosses the boundary of the finite CP that the clause-embedding verb takes as its complement. Unlike English wh-adjunct questions, which are often ambiguous because the origination site of the *wh*-element is not marked, the Mandarin stimuli sentences in this experiment are all unambiguous: the origination site of the *wh*-element is marked by its surface position, since Mandarin is a *wh*-in situ language, and its scopal position is anchored by the matrix predicate *xiangzhidao* "wonder," which selects for an embedded interrogative. For each verb, the acceptability contrast between the short and long dependency conditions represents the penalty of moving a *wh*-element across that clause-embedding verb. If an unclassified verb behaves like a bridge verb, the movement penalty it induces should be similar to or less than that of the three canonical bridge verbs; by contrast, if an unclassified verb behaves like a non-bridge verb, its movement penalty should be larger than that of the canonical bridge verbs.

4.1.3. Procedures

The stimuli sentences were presented to the participants one at a time, and the participants were asked to rate how acceptable the sentences sound to them using a continuous sliding scale. The left end of the scale was labeled *completely unacceptable*, and the right end was labeled *completely acceptable* in Mandarin. An example trial is shown in Figure 1.

Each participant was tested on 8 verbs: 2 bridge verbs and 6 unclassified verbs, randomly sampled from the pool of 3 bridge verbs and 11 unclassified verbs.

4.2. Results

All ratings on the sliding scale were transformed to a numeric value between 0 and 1, with 0 representing the *completely unacceptable* end of the scale, and 1 representing the *completely acceptable* end. Figure 2 shows the average acceptability ratings for sentences containing the three canonical bridge verbs. Figure 3 shows the average acceptability ratings for sentences with each unclassified verb, compared to the average ratings for the bridge verb sentences.

First, we fitted a linear mixed effect regression model predicting the acceptability ratings of the bridge verb sentences with the sum-coded fixed effects of dependency length (short vs. long), *wh*-type (argument vs. adjunct), and their interaction. The model also includes the maximal by-participant and by-item random effect structure. There is a significant main effect of dependency length ($\beta = 0.063$, SE = 0.0093, t = 6.77, $p < 0.001$) where the long dependency sentences were rated lower than the short dependency ones. There is also a significant main effect of *wh*-type ($\beta = -0.021$, SE = 0.0073, t = -2.88, $p < 0.01$) where the

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press



Figure 1. Example experimental interface.

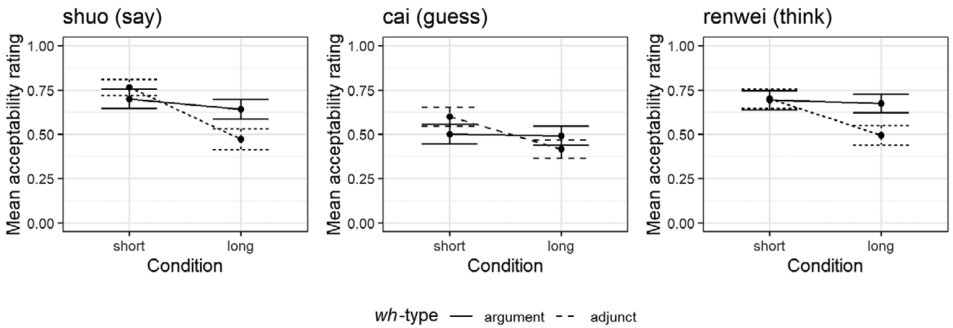


Figure 2. Acceptability ratings for the bridge verb sentences in Experiment 1.

wh-adjunct sentences were rated lower than the *wh*-argument ones. Crucially, there is also a significant interaction of dependency length and *wh*-type ($\beta = 0.050$, SE = 0.0075, t = 6.60, $p < 0.001$), where the length penalty is larger for the *wh*-adjunct sentences than for the *wh*-argument sentences. This suggests that there is an "argument-adjunct asymmetry" in extraction penalty even for the three canonical bridge verbs.

Then, for each of the unclassified verbs we tested, we fitted a linear mixed effect regression model predicting the acceptability ratings with the sum-coded fixed effects of dependency length (short vs. long), *wh*-type (argument vs. adjunct), and their interaction, as well as the maximal by-participant and by-item random effect structure allowing convergence. The model estimates are shown in Table 2. The dependency length main effect is significant for all unclassified verbs except for *haipa* "fear" (for which the effect is marginally significant), where the long dependency conditions are rated lower than the short dependency conditions. The *wh*-type main effect is significant for only one unclassified verb: *jiazhuang* "pretend," where sentences with *wh*-adjuncts are rated lower than those with *wh*-arguments. The interaction effect is significant for six of the unclassified verbs: *juede* "feel/think," *xiwang* "hope," *pa* "worry," *jiazhuang* "pretend," *haipa* "fear," and *ganjue* "feel," where the extraction length penalty is greater for the *wh*-adjunct sentences than for the *wh*-argument sentences.

Next, we move on to examine whether the unclassified verbs behave like bridge verbs or not. Since there is a possibility that the bridge status of verbs may be specific to a particular

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

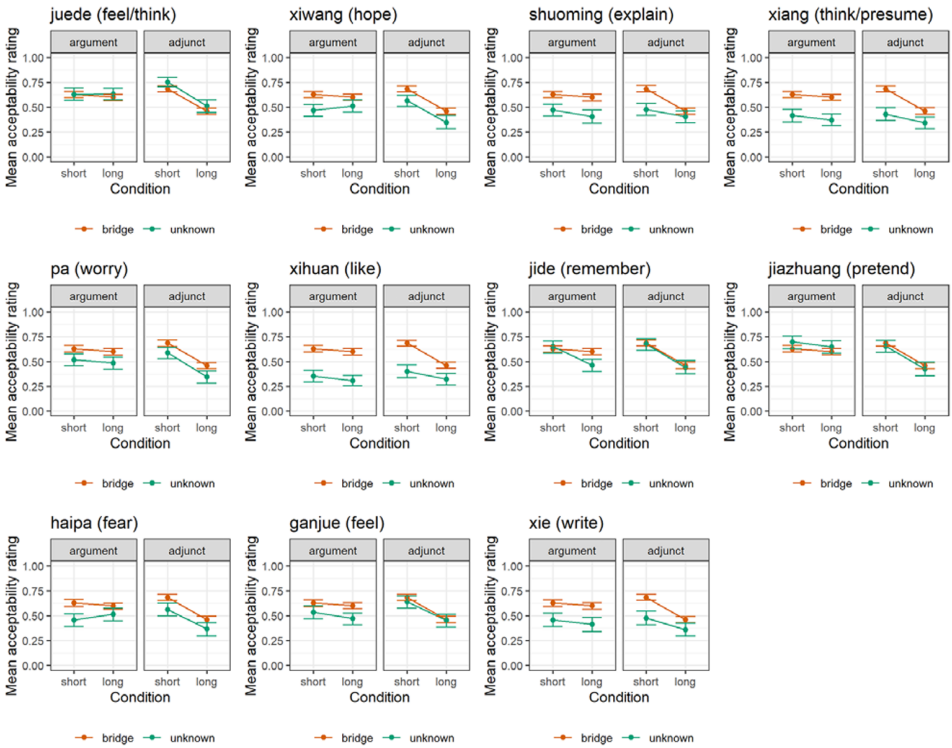


Figure 3. Acceptability ratings for the unclassified verb sentences compared against the bridge verb sentences in Experiment 1.

type of *wh*-element, the following analysis was done for the *wh*-argument conditions and the *wh*-adjunct conditions separately. For each of the unclassified verbs tested, we pooled all the sentence ratings for that verb together with the ratings for the bridge verb sentences, and fitted a linear mixed-effects regression model predicting acceptability with the fixed effects of verb type (bridge vs. unclassified), dependency length (short vs. long), and their interaction. Also included were the maximal by-participant and by-item random effect structures allowing convergence. The regression model estimates are shown in Table 3, with significant effects shaded gray.

For a variety of verb/*wh*-type combinations, there are significant main effects of dependency length and/or verb type, where the long dependency sentences are rated as less acceptable than the short dependency sentences, and the sentences with unclassified verbs are rated lower than those with the three canonical bridge verbs. There are also significant interaction effects of dependency length and verb type for the following four verb/*wh*-type combinations: *shuoming* "explain" with *wh*-adjunct, *xiang* "think/presume" with *wh*-adjunct, *pa* "worry" with *wh*-argument, and *jide* "remember" with *wh*-argument. For the first three verb/*wh*-type combinations, the interaction effect is in the direction where the length penalty is greater for the canonical bridge verbs than for the unclassified verbs. For *jide* "remember" with *wh*-argument, the length penalty is greater for *jide* than for the canonical bridge verbs. There is no significant interaction between dependency length and verb type for any of the other verb/*wh*-type combinations.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 2. Estimates for LMER models predicting the acceptability of Exp.1 sentences containing each unclassified verb with sum-coded fixed effects of dependency length (short vs. long), wh-type (argument vs. adjunct), and their interaction, as well as the maximal by-participant and by-item random effect structures allowing convergence. Shaded boxes represent statistically significant effects

	Dependency Length				*Wh*-type				Interaction			
	β	SE	t	p	*β*	SE	t	p	*β*	SE	t	p
juede (feel/think)	0.060	0.014	4.12	<0.001	0.0027	0.017	0.16	0.87	0.062	0.016	3.96	<0.001
xiwang (hope)	0.041	0.014	2.97	<0.01	–0.016	0.015	–1.06	0.30	0.067	0.014	4.72	<0.001
shuoming (explain)	0.032	0.013	2.57	<0.05	0.00078	0.011	0.070	0.94	–0.00044	0.011	–0.040	0.97
xiang (think/presume)	0.033	0.014	2.29	<0.05	–0.0057	0.013	–0.46	0.65	0.0011	0.012	0.91	0.37
pa (worry)	0.068	0.012	5.67	<0.001	–0.016	0.013	–1.21	0.23	0.051	0.012	4.31	<0.001
xihuan (like)	0.034	0.014	2.42	<0.05	0.014	0.014	1.03	0.31	0.0073	0.014	0.54	0.60
jide (remember)	0.11	0.016	6.42	<0.001	–0.00067	0.014	–0.047	0.96	0.013	0.014	0.89	0.39
jiazhuang (pretend)	0.071	0.018	4.06	<0.001	–0.066	0.015	–4.44	<0.001	0.045	0.013	3.45	<0.01
haipa (fear)	0.032	0.017	1.84	0.076	–0.0094	0.017	–0.55	0.59	0.061	0.017	3.56	<0.01
ganjue (feel)	0.062	0.015	4.13	<0.001	0.024	0.016	1.49	0.15	0.033	0.014	2.30	<0.05
xie (write)	0.047	0.017	2.88	<0.01	–0.011	0.017	–0.64	0.53	0.024	0.017	1.39	0.17

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 3. Estimates for LMER models predicting the acceptability of Exp.1 sentences containing the bridge verbs and each unclassified verb with sum-coded fixed effects of dependency length (short vs. long), verb type (bridge vs. unclassified), and their interaction, as well as the maximal by-participant and by-item random effect structures allowing convergence. Shaded boxes represent statistically significant effects

		Dependency Length				Verb Type				Interaction			
		β	SE	t	p	*β*	SE	t	p	*β*	SE	t	p
juede (feel/think)	Argument	0.0034	0.013	0.27	0.79	–0.0069	0.013	–0.55	0.59	0.0099	0.012	0.82	0.42
	Adjunct	0.12	0.013	8.90	<0.001	–0.033	0.012	–2.75	<0.05	–0.0044	0.010	–0.42	0.67
xiwang (hope)	Argument	–0.0080	0.012	–0.68	0.50	0.064	0.016	4.07	<0.001	0.021	0.012	1.75	0.095
	Adjunct	0.11	0.013	8.53	<0.001	0.051	0.013	3.88	<0.001	0.00068	0.0098	0.069	0.95
shuoming (explain)	Argument	0.023	0.010	2.25	<0.05	0.079	0.014	5.82	<0.001	–0.010	0.010	–0.96	0.34
	Adjunct	0.073	0.012	6.11	<0.001	0.063	0.012	5.19	<0.001	0.040	0.0099	4.05	<0.001
xiang (think/presume)	Argument	0.016	0.011	1.50	0.14	0.11	0.014	8.03	<0.001	–0.0023	0.012	–0.19	0.85
	Adjunct	0.077	0.011	6.71	<0.001	0.090	0.013	7.05	<0.001	0.036	0.011	3.24	<0.01
pa (worry)	Argument	0.068	0.012	5.67	<0.001	–0.016	0.013	–1.20	0.23	0.051	0.012	4.31	<0.001
	Adjunct	0.013	0.011	1.23	0.23	0.059	0.012	4.79	<0.001	0.00028	0.011	0.026	0.98
xihuan (like)	Argument	0.021	0.012	1.72	0.097	0.14	0.013	10.98	<0.001	–0.0074	0.012	–0.63	0.53
	Adjunct	0.075	0.011	7.15	<0.001	0.11	0.014	7.67	<0.001	0.037	0.011	3.45	<0.001
jide (remember)	Argument	0.052	0.013	4.18	<0.001	0.030	0.014	2.17	<0.05	–0.039	0.012	–3.33	<0.01
	Adjunct	0.11	0.014	8.09	<0.001	0.0097	0.012	0.83	0.41	–0.0010	0.013	–0.080	0.94
jiazhuang (pretend)	Argument	0.021	0.012	1.78	0.076	–0.015	0.013	–1.20	0.24	–0.0080	0.013	–0.63	0.53
	Adjunct	0.11	0.014	8.06	<0.001	0.012	0.014	1.44	0.15	–0.0020	0.012	–0.16	0.88
haipa (fear)	Argument	–0.0061	0.012	–0.50	0.62	0.054	0.015	3.72	<0.001	0.020	0.011	1.73	0.086
	Adjunct	0.11	0.015	7.14	<0.001	0.055	0.014	4.01	<0.001	0.0069	0.013	0.55	0.58
ganjue (feel)	Argument	0.019	0.012	1.58	0.12	0.062	0.012	5.04	<0.001	–0.0069	0.012	–0.60	0.55
	Adjunct	0.10	0.012	8.70	<0.001	0.019	0.014	1.32	0.19	0.0085	0.013	0.68	0.50
xie (write)	Argument	0.020	0.014	1.38	0.17	0.087	0.014	6.20	<0.001	–0.0069	0.014	–0.49	0.63
	Adjunct	0.091	0.015	6.16	<0.001	0.077	0.016	4.67	<0.001	0.022	0.012	1.77	0.082

Table 4. Bayes factors for the Dependency Length * Verb Type interaction terms of the models reported in Table 3, estimated using the BayesFactor package in R (Morey et al. 2015)

		Prior width		
Verb	Wh-type	Medium	Wide	Ultra-wide
juede (feel/think)	Argument	0.12	0.096	0.066
	Adjunct	0.11	0.082	0.068
xiwang (hope)	Argument	0.35	0.22	0.17
	Adjunct	0.12	0.087	0.057
shuoming (explain)	Argument	0.15	0.11	0.076
xiang (think/presume)	Argument	0.12	0.10	0.059
pa (worry)	Argument	0.11	0.076	0.056
	Adjunct	0.12	0.090	0.061
xihuan (like)	Argument	0.13	0.11	0.062
jide (remember)	Adjunct	0.12	0.057	0.057
jiazhuang (pretend)	Argument	0.14	0.10	0.066
	Adjunct	0.13	0.088	0.057
haipa (fear)	Argument	0.16	0.10	0.071
ganjue (feel)	Argument	0.15	0.099	0.070
	Adjunct	0.18	0.11	0.075
xie (write)	Argument	0.15	0.095	0.067

To further confirm that the unclassified verbs are indeed bridge verbs, we verified the null interaction between dependency length and verb type with a Bayes factor analysis. Using the R package BayesFactor (Morey et al. 2015), we estimated the Bayes factors comparing the regression models reported in Table 3 with ones that are otherwise identical but lack the interaction term, using three different prior width settings (medium, wide, and ultra-wide). The Bayes factor estimates are shown in Table 4.

Following previous conventions, we take BF < 0.3 as evidence for the null hypothesis (Rouder et al. 2009). All Bayes factors calculated are below 0.3, except for one: the verb *xiwang* "hope" with *wh*-argument under a medium prior width setting, where BF = 0.35, suggesting an inconclusive result. But we should note that the interaction effect for *xiwang* with *wh*-argument is numerically in the direction where the length penalty for *xiwang* is smaller than the length penalty for the canonical bridge verbs. Even if the experiment is underpowered and we failed to detect a significant effect for *xiwang*, the verb *xiwang* should still be classified as a bridge verb since it induces a significantly smaller penalty than the canonical bridge verbs.

4.3. Discussion

There are two main takeaways from Experiment 1.

First, there is no clear bridge/non-bridge distinction among the verbs tested in Experiment 1. If an unclassified verb behaves like a non-bridge verb, the length penalty (i.e. the acceptability degradation of having a *wh*-dependency crossing the verb) should be greater

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

for the unclassified verb than for the canonical bridge verbs. Among all twenty-two combinations of unclassified verbs and *wh*-types tested in Experiment 1, we only found *jide* "remember" to behave like a non-bridge verb when the *wh*-element moving across it is a *wh*-argument. Three combinations (*shuoming* "explain" with *wh*-adjunct, *xiang* "think/presume" with *wh*-adjunct, *pa* "worry" with *wh*-argument) showed smaller length penalty than the canonical bridge verbs, and all other combinations showed no significant difference in length penalty compared to the bridge verbs. The null effects are further confirmed by a Bayes Factor analysis. These results suggest that with the sole exception of *jide* "remember," all the unclassified verbs tested should be classified as bridge verbs.

As for *jide*, it also does not display the properties one would expect for a non-bridge verb in Mandarin. Note that *jide* only behaves like a non-bridge verb with respect to *wh*-arguments. When the *wh*-element moving across it is a *wh*-adjunct, *jide* behaves bridge-like. This pattern is in fact the opposite of the previous generalization by Tsai (1994): non-bridge verbs in Mandarin are claimed to restrict *wh*-adjuncts but not *wh*-arguments. Although our account cannot explain why *jide* restricts *wh*-arguments but not *wh*-adjuncts, this puzzling observation poses a challenge for alternative accounts of the bridge effects alike. Furthermore, *jide* is in fact attested as a bridge verb with *wh*-arguments in CHILDES despite the bridge-like effect observed in the experiment. One naturally occurring example in CHILDES was shown earlier as (9a). The existence of such examples suggests that the bridge-like effect with *jide* should be considered a *subliminal island effect*: an effect where the movement penalty is statistically detectable, but sentences affected are still naturally produced and perceived as marginally or even fully acceptable by speakers (Keshev & Meltzer-Asscher 2019; Almeida 2014; Tanaka 2025). Subliminal island effects arguably reflect processing-level penalties, as opposed to true grammatical constraints (Keshev & Meltzer-Asscher 2019). If so, *jide* should still be considered a bridge verb.[11]

The second key takeaway from Experiment 1 concerns the argument-adjunct asymmetry of the bridge effect. Our findings reject the existence of such an asymmetry: among the verbs we tested, there is simply no bridge effect for all but one verb; the only verb that induces a potential bridge effect is *jide* "remember," and it restricts *wh*-arguments as opposed to *wh*-adjuncts, the opposite of the claimed asymmetry. But this does not mean that the previous generalizations were entirely spurious: we did find significant interaction effects between dependency length and *wh*-type for a majority of the verbs we tested, suggesting that *wh*-adjunct induces a greater extraction penalty than *wh*-argument. However, this effect also applies to the three canonical bridge verbs, and thus simply reflects a general penalty on long-distance *wh*-adjunct dependencies and is orthogonal to the bridge effect. This general penalty on long-distance *wh*-adjunct dependencies in Chinese has been attested in previous experimental studies (Lu et al. 2020; Kim et al. 2023). The exact source of this penalty is unclear. Here we offer two speculations: first, this asymmetry possibly arises due to the lower frequency of embedded clausal questions with *wh*-adjuncts like *why*, versus *wh*-arguments like *who*. Alternatively, there could be a higher processing cost associated with long-distance *wh*-adjunct questions than *wh*-argument questions, since a *wh*-adjunct question shares the same argument structure as its *wh*-argument counterpart but contains one extra adjunct,

[11] It is perhaps worth also considering the behavior of *jide* from a different angle. The three canonical bridge verbs in Mandarin exhibit an argument/adjunct asymmetry in long-distance movement, whereby adjuncts exhibit a larger length penalty than arguments, as discussed immediately below. The behavior of *jide* differs in that it does not exhibit this asymmetry.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

which may add to complexity and processing cost. Further psycholinguistic work is needed to pinpoint the source of this penalty on long-distance *wh*-adjunct dependencies.

In sum, Experiment 1 shows no evidence for a clear bridge/non-bridge division among the verbs tested, and challenges the argument-adjunct asymmetry of the bridge effect claimed in the previous literature. These results provide support for our account of the bridge effect: based on the corpus analysis, we found that a vast majority of clause-embedding verbs are used as bridge verbs in Mandarin child-directed speech for both *wh*-argument dependencies and *wh*-adjunct dependencies, clearing the threshold for children to acquire a productive rule that all clause-embedding verbs in Mandarin are also bridge verbs for both types of *wh*-elements. This prediction is verified by the findings of Experiment 1.

One caveat of Experiment 1 is that the verbs we tested are relatively high in frequency and are likely acquired early by children, since they all appear at least once in the Mandarin CHILDES corpus. It is possible that Mandarin-speaking children have direct exposure to these verbs being used as bridge verbs in their input, and thus have acquired their bridge status directly through lexical learning, as opposed to through a productive rule as we hypothesized. To tease apart this alternative possibility from our account, we need to examine verbs that are highly infrequent: ones that are unlikely to be present in children's input even in declarative sentences, let alone in sentences with long-distance *wh*-dependencies. If the findings in Experiment 1 are solely the result of lexical learning, we would expect at least some of the infrequent verbs to remain non-bridge verbs; if Mandarin speakers acquire a productive rule that all clause-embedding verbs are bridge verbs, infrequent verbs that are acquired late in the acquisition process should also gain bridge status. We test these predictions in Experiment 2.

5. Experiment 2

Experiment 1 established that the clause-embedding verbs appearing in CHILDES are acquired as bridge verbs, even those that do not appear as bridges for that type of wh-dependency in CHILDES (wh-adjunct with *shuoming* "explain," *xihuan* "like," *haipa* "fear," and *xie* "write"), and even *jiazhuang* "pretend," which is not attested as a bridge in CHILDES at all. In Experiment 2, we move on to less frequent clause-embedding verbs that do not appear in CHILDES; if Mandarin-learning children lexically learn the bridge status of each verb independently, then these verbs would be predicted to pattern as non-bridge. If, however, Mandarin-learning children acquire a productive rule that all clause-embedding verbs are bridge verbs, such less frequent clause-embedding verbs acquired after their grammars have become fairly stable should automatically gain bridge status due to the productive rule. Therefore, we predict that the low-frequency verbs tested in Experiment 2 should pattern as bridge verbs, just as the verbs tested in Experiment 1.

5.1. Methods

5.1.1. Participants

We recruited 240 self-reported native speakers of Mandarin on the online crowdsourcing platform Prolific. We applied the same exclusion criteria as in Experiment 1, and a total of 18 participants were thereby excluded.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

5.1.2. Materials

A total of 14 clause-embedding verbs were tested: the three canonical bridge verbs (*shuo* "say," *cai* "guess," *renwei* "think"), and 11 unclassified verbs: *huaiyi* "doubt," *jiancheng* "maintain," *fouren* "deny," *baoyuan* "complain," *chengren* "concede," *jieshou* "accept," *baozheng* "assure," *toulu* "disclose," *zhengshi* "verify," *chongshen* "reiterate," and *rentong* "agree." The 11 unclassified verbs satisfy all of the following criteria: first, each of them appears at least once taking a finite complement clause in Penn Chinese Treebank 9.0 (Xue et al. 2016), a corpus of approximately 2 million words of parsed written text such as news articles, government documents, and magazine articles. Although we are not aware of studies on adult Mandarin speakers' vocabulary, we draw support from the well-established practice in the study of English that words appearing at least once per million can be regarded as familiar to typical speakers (Nagy & Anderson 1984). This establishes that the verbs tested in Experiment 2 are clause-embedding verbs in adult grammar. Second, the unclassified verbs do not appear in the Mandarin CHILDES corpus as clause-embedding verbs. This suggests that they are relatively infrequent in child-directed speech compared to the verbs tested in Experiment 1, and thus are likely acquired later by children. Third, their English counterparts are non-bridge verbs based on the classification by Richter & Chaves (2020). We further confirmed the non-bridge status of their English counterparts through a post hoc analysis of Huang et al. (2025). In a large-scale acceptability rating experiment, Huang et al. (2025) tested sentences such as (12a, b).

(12) Example stimuli from Huang et al. (2025), for the verb *think.*
   a. SHORT: Who **thought** that the duchess would invite the arrogant knight?
   b. LONG: Who did the princess **think** that the duchess would invite?

The contrast between the LONG and SHORT conditions in Huang et al. (2025) represents the penalty of extracting a *wh*-element across the clause-embedding verb. We compared the extraction penalties of the English counterparts of each of the unclassified verbs tested in Experiment 2 against two uncontroversial bridge verbs in English, *say* and *think.* For each unclassified verb, we fitted a linear mixed-effect regression model predicting sentence acceptability z-score with the sum-coded fixed effects of dependency length (long vs. short), verb type (unclassified vs. bridge), and their interaction, as well as a random by-participant intercept. The model outputs are shown in Table 5. For every unclassified verb, there is a significant interaction between dependency length and verb type, suggesting that the length penalty is significantly larger for the unclassified verb than for the canonical bridge verbs *say* and *think.* This further verifies that the English counterparts of the unclassified verbs tested in Experiment 2 are indeed non-bridge verbs.

5.1.3. Procedures

Experiment 2 adopts the exact same design as Experiment 1.

5.2. Results

Like in Experiment 1, all ratings on the sliding scale were transformed to a numeric value between 0 and 1, with 0 representing the *completely unacceptable* end of the scale, and 1 representing the *completely acceptable* end. Figure 4 shows the average acceptability

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 5. Post hoc analysis results of Huang et al. (2025). The table shows the estimates for LMER models predicting the acceptability of the test sentences containing the two canonical bridge verbs in English (say, think), and each unclassified verb with sum-coded fixed effects of dependency length (short vs. long), verb type (bridge vs. unclassified), and their interaction, as well as a random by-participant intercept

	Dependency length				Verb type				Interaction			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
doubt	0.67	0.088	7.54	<0.001	0.59	0.079	7.41	<0.001	–0.48	0.11	–4.25	<0.001
maintain	0.42	0.080	5.25	<0.001	0.55	0.079	7.07	<0.001	–0.23	0.10	–2.29	<0.05
deny	0.57	0.097	5.92	<0.001	0.72	0.088	8.21	<0.001	–0.38	0.12	–3.15	<0.01
complain	0.80	0.092	8.76	<0.001	0.87	0.084	10.35	<0.001	–0.61	0.12	–5.21	<0.001
concede	0.54	0.08	6.46	<0.001	0.55	0.076	7.21	<0.001	–0.35	0.11	–3.27	<0.01
accept	0.73	0.096	7.60	<0.001	0.82	0.088	9.37	<0.001	–0.54	0.12	–4.45	<0.001
assure	0.85	0.092	9.24	<0.001	0.82	0.086	9.52	<0.001	–0.66	0.12	–5.43	<0.001
disclose	0.75	0.090	8.32	<0.001	0.57	0.081	7.05	<0.001	–0.56	0.11	–4.89	<0.001
verify	0.52	0.074	6.96	<0.001	0.37	0.071	5.17	<0.001	–0.33	0.096	–3.39	<0.001
reiterate	0.41	0.085	4.79	<0.001	0.47	0.080	5.94	<0.001	–0.22	0.11	–2.04	<0.05
agree	0.43	0.078	5.53	<0.001	0.29	0.074	3.97	<0.001	–0.24	0.099	–2.47	<0.05

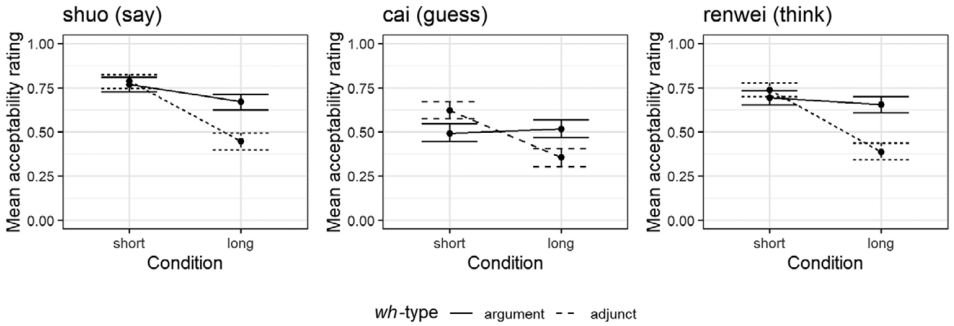


Figure 4. Acceptability ratings for the bridge verb sentences in Experiment 2.

ratings for sentences containing the three canonical bridge verbs. Figure 5 shows the average acceptability ratings for sentences with each unclassified verb, compared to the average ratings for the bridge verb sentences.

First, we fitted a linear mixed effect regression model predicting the acceptability ratings of the bridge verb sentences with the sum-coded fixed effects of dependency length (short vs. long), *wh*-type (argument vs. adjunct), and their interaction. The model also includes the

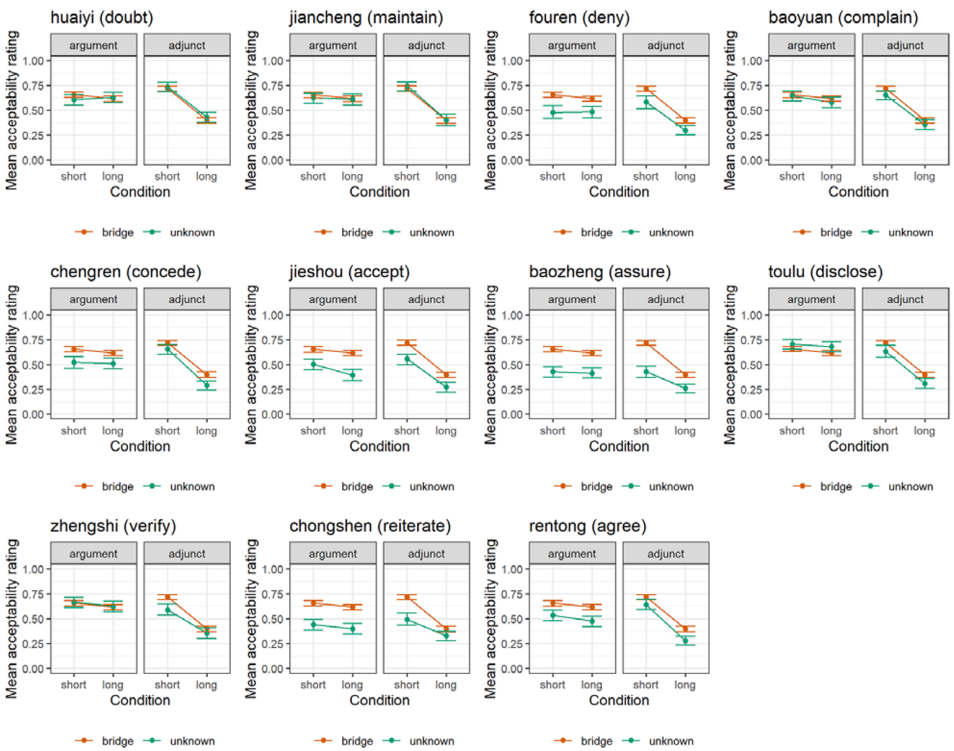


Figure 5. Acceptability ratings for the unclassified verb sentences compared against the bridge verb sentences in Experiment 2.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

maximal by-participant and by-item random effect structure. There is a significant main effect of dependency length ($\beta = 0.090$, SE = 0.0080, t = 11.20, $p < 0.001$) where the long dependency sentences were rated lower than the short dependency ones. There is also a significant main effect of *wh*-type ($\beta = -0.039$, SE = 0.0064, t = –6.09, $p < 0.001$) where the *wh*-adjunct sentences were rated lower than the *wh*-argument ones. Crucially, there is also a significant interaction of dependency length and *wh*-type ($\beta = 0.070$, SE = 0.0061, t = 11.44, $p < 0.001$), where the length penalty is larger for the *wh*-adjunct sentences than for the *wh*-argument sentences. This suggests that there is an argument-adjunct asymmetry in extraction penalty for the three canonical bridge verbs. These results are qualitatively the same as in Experiment 1.

Then, for each of the unclassified verbs we tested, we fitted a linear mixed effect regression model predicting the acceptability ratings with the sum-coded fixed effects of dependency length (short vs. long), *wh*-type (argument vs. adjunct), and their interaction, as well as the maximal by-participant and by-item random effect structure allowing convergence. The model estimates are shown in Table 6. All unclassified verbs tested showed significant main effects of dependency length, where long dependency sentences were rated lower than short dependency sentences. Four of the unclassified verbs also showed significant main effects of *wh*-type, where *wh*-adjunct sentences were rated lower than *wh*-argument sentences. Crucially, all unclassified verbs showed significant interaction effects between dependency length and *wh*-type: the dependency length effect is greater when the *wh*-element is a *wh*-adjunct than a *wh*-argument. Just like the three canonical bridge verbs, the unclassified verbs in Experiment 2 also demonstrate an argument-adjunct asymmetry in extraction penalty.

We then examine whether the unclassified verbs behave like bridge verbs or not. Just like in Experiment 1, the following analysis was done for the *wh*-argument conditions and the *wh*-adjunct conditions separately. For each unclassified verb/*wh*-type combination, we pooled all the sentence ratings for that verb together with the ratings for the bridge verb sentences, and fitted a linear mixed-effect regression model predicting acceptability with the fixed effects of verb type (bridge vs. unclassified), dependency length (short vs. long), and their interaction. Also included were the maximal by-participant and by-item random effect structures allowing convergence. The regression model estimates are shown in Table 7, with significant effects shaded gray.

There are three verb/*wh*-type combinations that showed significant interaction effects between dependency length and verb type: *baozheng* "assure" with *wh*-adjunct, *zhengshi* "verify" with *wh*-adjunct, and *chongshen* "reiterate" with *wh*-adjunct. The significant interaction effects were all in the direction such that the unclassified verbs induced a smaller length penalty than the canonical bridge verbs, suggesting that the unclassified verbs are also bridge verbs. For all other verb/*wh*-type combinations tested, there is no significant interaction between dependency length and verb type. This suggests that there is no evidence for any of the tested verbs being non-bridge verbs.

Since our argument for bridge status of the tested verbs depends on null effects, we further verified the null interaction effects reported in Table 7 with a Bayes factor analysis. Using the R package BayesFactor (Morey et al. 2015), we estimated the Bayes factors comparing the regression models reported in Table 7 with ones that are otherwise identical but lack the interaction term, using three different prior width settings (medium, wide, and ultra-wide). The Bayes factor estimates are shown in Table 8.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 6. Estimates for LMER models predicting the acceptability of Exp.2 sentences containing each unclassified verb with sum-coded fixed effects of dependency length (short vs. long), wh-type (argument vs. adjunct), and their interaction, as well as the maximal by-participant and by-item random effect structures allowing convergence. Shaded boxes represent statistically significant effects

	Dependency Length				*Wh*-type				Interaction			
	β	SE	t	p	*β*	SE	t	p	*β*	SE	t	p
huaiyi (doubt)	0.070	0.014	5.10	<0.001	–0.017	0.013	–1.31	0.21	0.081	0.012	7.04	<0.001
jiancheng (maintain)	0.089	0.014	6.45	<0.001	–0.020	0.013	–1.57	0.12	0.081	0.011	7.59	<0.001
fouren (deny)	0.069	0.014	4.63	<0.001	–0.022	0.014	–1.54	0.13	0.072	0.013	5.66	<0.001
baoyuan (complain)	0.090	0.012	7.34	<0.001	–0.057	0.013	–4.47	<0.001	0.060	0.011	5.39	<0.001
chengren (concede)	0.094	0.013	6.99	<0.001	–0.012	0.014	–1.66	0.11	0.088	0.012	7.49	<0.001
jieshou (accept)	0.10	0.012	8.13	<0.001	–0.014	0.014	–0.99	0.33	0.043	0.013	3.36	<0.01
baozheng (assure)	0.048	0.015	3.13	<0.01	–0.038	0.013	–2.93	<0.01	0.038	0.012	3.11	<0.01
toulu (disclose)	0.087	0.012	7.23	<0.001	–0.11	0.013	–8.89	<0.001	0.073	0.012	6.35	<0.001
zhengshi (verify)	0.069	0.013	5.16	<0.001	–0.087	0.013	–6.82	<0.001	0.049	0.011	4.23	<0.001
chongshen (reiterate)	0.050	0.013	3.77	<0.001	–0.0063	0.013	–0.49	0.63	0.039	0.011	2.61	<0.05
rentong (agree)	0.11	0.015	7.09	<0.001	–0.021	0.013	–1.67	0.098	0.077	0.013	5.89	<0.001

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 7. Estimates for LMER models predicting the acceptability of Exp.2 sentences containing the bridge verbs and each unclassified verb with sum-coded fixed effects of dependency length (short vs. long), verb type (bridge vs. unclassified), and their interaction, as well as the maximal by-participant and by-item random effect structures allowing convergence. Shaded boxes represent statistically significant effects

		Dependency Length				Verb Type				Interaction			
		β	SE	t	p	*β*	SE	t	p	*β*	SE	t	p
huaiyi (doubt)	Argument	0.0075	0.012	0.65	0.53	0.015	0.012	1.22	0.23	0.013	0.0098	1.33	0.19
	Adjunct	0.15	0.011	13.57	<0.001	–0.0062	0.011	–0.55	0.59	0.0051	0.0098	0.52	0.60
jiancheng (maintain)	Argument	0.014	0.0095	1.45	0.15	0.0060	0.010	0.59	0.56	0.0060	0.010	0.57	0.57
	Adjunct	0.17	0.012	14.10	<0.001	–0.014	0.0098	–1.42	0.16	–0.0060	0.010	–0.57	0.57
fouren (deny)	Argument	0.010	0.011	0.93	0.35	0.073	0.013	5.71	<0.001	0.0096	0.010	0.95	0.34
	Adjunct	0.15	0.013	12.23	<0.001	0.059	0.0097	6.08	<0.001	0.0049	0.011	0.45	0.65
baoyuan (complain)	Argument	0.025	0.0095	2.65	<0.05	0.0096	0.011	0.91	0.37	–0.0056	0.0091	–0.61	0.54
	Adjunct	0.16	0.010	14.90	<0.001	0.023	0.0094	2.50	<0.05	0.0045	0.0090	0.49	0.62
chengren (concede)	Argument	0.013	0.011	1.15	0.25	0.058	0.011	5.15	<0.001	0.0071	0.010	0.69	0.49
	Adjunct	0.17	0.011	15.43	<0.001	0.043	0.0097	4.45	<0.001	–0.010	0.0094	–1.09	0.28
jieshou (accept)	Argument	0.035	0.0097	3.62	<0.001	0.11	0.013	8.49	<0.001	–0.015	0.0096	–1.61	0.11
	Adjunct	0.15	0.011	13.37	<0.001	0.076	0.011	6.88	<0.001	0.011	0.012	0.91	0.37
baozheng (assure)	Argument	0.014	0.011	1.33	0.19	0.10	0.012	9.07	<0.001	0.0055	0.011	0.51	0.62
	Adjunct	0.12	0.011	11.15	<0.001	0.11	0.010	10.56	<0.001	0.037	0.0099	3.65	<0.001
toulu (disclose)	Argument	0.017	0.0095	1.74	0.087	–0.027	0.0098	–2.80	<0.01	0.0035	0.0086	0.41	0.68
	Adjunct	0.16	0.011	14.35	<0.001	0.044	0.010	4.21	<0.001	0.00081	0.0091	0.089	0.93
zhengshi (verify)	Argument	0.020	0.0097	2.07	<0.05	–0.0031	0.0099	–0.31	0.76	–0.00027	0.0098	–0.028	0.98
	Adjunct	0.14	0.012	11.68	<0.001	0.043	0.012	3.64	<0.001	0.021	0.0094	2.25	<0.05
chongshen (reiterate)	Argument	0.020	0.0091	2.16	<0.05	0.10	0.012	8.54	<0.001	0.00016	0.0086	0.019	0.99
	Adjunct	0.12	0.012	9.88	<0.001	0.071	0.011	6.70	<0.001	0.039	0.010	3.73	<0.001
rentong (agree)	Argument	0.024	0.012	1.93	0.065	0.066	0.012	5.34	<0.001	–0.0043	0.011	–0.40	0.69
	Adjunct	0.17	0.011	15.73	<0.001	0.047	0.0092	5.13	<0.001	–0.011	0.0098	–1.14	0.26

Table 8. Bayes factors for the Dependency Length * Verb Type interaction terms of the models reported in Table 7, estimated using the BayesFactor package in R (Morey et al. 2015)

		Prior width		
Verb	Wh-type	Medium	Wide	Ultra-wide
huaiyi (doubt)	Argument	0.31	0.20	0.15
	Adjunct	0.12	0.078	0.061
jiancheng (maintain)	Argument	0.16	0.087	0.065
	Adjunct	0.13	0.092	0.066
fouren (deny)	Argument	0.18	0.14	0.095
	Adjunct	0.18	0.12	0.080
baoyuan (complain)	Argument	0.10	0.098	0.065
	Adjunct	0.13	0.087	0.059
chengren (concede)	Argument	0.13	0.090	0.061
	Adjunct	0.17	0.22	0.093
jieshou (accept)	Argument	0.29	0.25	0.18
	Adjunct	0.18	0.11	0.083
baozheng (assure)	Argument	0.12	0.090	0.057
toulu (disclose)	Argument	0.11	0.079	0.055
	Adjunct	0.11	0.077	0.059
zhengshi (verify)	Argument	0.12	0.077	0.054
chongshen (reiterate)	Argument	0.11	0.076	0.051
rentong (agree)	Argument	0.12	0.077	0.061
	Adjunct	0.18	0.12	0.099

Following previous conventions, we take BF < 0.3 as evidence for the null hypothesis (Rouder et al. 2009). All Bayes factors calculated are below 0.3, except for one: the verb *huaiyi* "doubt" with *wh*-argument under a medium prior width setting, where BF = 0.31, suggesting an inconclusive result. But the interaction effect under question is in fact numerically in the opposite direction of a bridge effect: the length penalty for *huaiyi* is smaller than the length penalty for the three canonical bridge verbs. Therefore, the Bayes factor analysis provides further support for the lack of a bridge/non-bridge distinction among the verbs tested in Experiment 2.

5.3. Discussion

Experiment 2 replicates the results of Experiment 1. The two main conclusions of Experiment 1 are further confirmed with Experiment 2: first, there is no clear bridge/non-bridge verb distinction among the clause-embedding verbs in Mandarin; second, the so-called argument-adjunct asymmetry of the bridge effect in Mandarin simply reflects a general penalty on long-distance *wh*-adjunct dependencies, which is orthogonal to the bridge effect.

Experiment 2 also goes one step beyond Experiment 1 by testing clause-embedding verbs that are low in frequency. These verbs are most likely acquired much later than the verbs tested in Experiment 1, since none of the unclassified verbs in Experiment 2 appear in the

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Mandarin CHILDES corpus. These verbs are used in adult speech as clause-embedding verbs, but rarely in sentences with *wh*-dependencies. We checked the distribution of these verbs in two corpora of written text and adult speech: the Penn Chinese Treebank 9.0 (approximately 2 million words), and the BLCU Chinese Corpus (15 billion characters, approximately 8 billion words). In these two corpora, none of the unclassified verbs tested appear along with long-distance *wh*-dependencies. It is highly unlikely that children would ever encounter these verbs directly used as bridge verbs in the input during acquisition. Therefore, their bridge status strongly supports our hypothesis that during acquisition Mandarin speakers acquire a productive rule that all clause-embedding verbs are bridge verbs, and this rule applies to every clause-embedding verb acquired thereafter, including ones without direct evidence for their bridge status in the input.

Alternative accounts that attribute the bridge status of verbs to their lexical meaning cannot capture the results of Experiment 2. Recall that the English counterparts of the verbs tested in Experiment 2 are non-bridge verbs based on the classification by Richter & Chaves (2020) and a post hoc analysis of Huang et al. (2025). If the bridge status of a verb is determined solely by its lexical meaning (e.g. factors such as factivity), we would expect the Mandarin counterparts of non-bridge verbs in English to also be non-bridge verbs in Mandarin. Experiment 2 shows that the opposite is true.

6. Experiment 3

Experiment 3 examines the same set of clause-embedding verbs tested in Experiment 2, but with a slightly different design. In Experiments 1 and 2, the length penalty of extraction across clause-embedding verbs is done by comparing long-distance *wh*-questions with cross-clausal dependencies and sentences with short dependencies that do not span a finite clause boundary. The example sentences in (13), repeated from (11), illustrate this design.

(13) Example stimuli of Experiments 1 and 2, using the clause-embedding verb *shuo* "say."

a. WH-ARGUMENT, SHORT
faguan xiangzhidao shei shuo jingcha shenwenle xuesheng
judge wonders who say police interrogated student
"The judge wonders who said that the police officer interrogated the student."

b. WH-ARGUMENT, LONG
faguan xiangzhidao lüshi shuo jingcha shenwenle shei
judge wonders lawyer say police interrogated who
"The judge wonders who the lawyer said that the police officer interrogated."

c. WH-ADJUNCT, SHORT
faguan xiangzhidao lüshi weishenme shuo jingcha shenwenle xuesheng
judge wonders lawyer why say police interrogated student
"The judge wonders why the lawyer said that the police officer interrogated the student." (asking why the lawyer said so)

d. WH-ADJUNCT, LONG
faguan xiangzhidao lüshi shuo jingcha weishenme shenwenle xuesheng
judge wonders lawyer say police why interrogated student
"The judge wonders why the lawyer said that the police officer interrogated the student." (asking why the police officer interrogated the student)

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

In the *wh*-adjunct conditions of this design (sentences (13c,d)), there is a potential confound. The acceptability of sentence (13c) is affected by how well the clause-embedding verb *shuo* "say" combines with the *wh*-adjunct *weishenme* "why" that attaches to it. Sentence (13d), however, is not affected by the compatibility between the clause-embedding verb and the *wh*-element. If a clause-embedding verb is less compatible with the *wh*-adjunct *weishenme*, we might underestimate the acceptability contrast between the short and long conditions and run the risk of falsely classifying a non-bridge verb as a bridge verb.

To control for this potential confound, we replaced the short condition in the design with sentences simply without *wh*-dependencies. Experiment 3 tests the same batch of verbs as in Experiment 2, but with this updated design.

6.1. Methods

6.1.1. Participants

We recruited 240 self-reported native speakers of Mandarin on the online crowdsourcing platform Prolific. We applied the same exclusion criteria as in Experiments 1 and 2, and a total of 7 participants were thereby excluded.

6.1.2. Materials

Experiment 3 tests the same 14 clause-embedding verbs tested in Experiment 2: the three canonical bridge verbs (*shuo* "say," *cai* "guess," *renwei* "think"), and 11 low-frequency, unclassified verbs: *huaiyi* "doubt," *jiancheng* "maintain," *fouren* "deny," *baoyuan* "complain," *chengren* "concede," *jieshou* "accept," *baozheng* "assure," *toulu* "disclose," *zhengshi* "verify," *chongshen* "reiterate," and *rentong* "agree."

Since the potential confound that Experiment 3 addresses only arises in the *wh*-adjunct conditions, we only tested *wh*-adjunct sentences. Example stimuli are shown below. We manipulated *wh*-dependency type (declarative vs. long). Notice that the short dependency condition from Experiment 2 is replaced by sentences without a *wh*-dependency (i.e. the declarative condition). This way, we can control for the confound introduced by the variable compatibility between the clause-embedding verbs and the *wh*-adjunct *weishenme*. We take the contrast between the no *wh* condition and the long condition as the extraction penalty. If a verb behaves like a bridge verb, its extraction penalty should be equal to or smaller than the extraction penalty of the canonical bridge verbs. If a verb behaves like a non-bridge verb, its extraction penalty should be larger than that of the canonical bridge verbs.

(14) Example stimuli of Experiment 3, using the clause-embedding verb *shuo* "say."

a. DECLARATIVE
faguan zhidao lüshi shuo jingcha shenwenle xuesheng
judge knows lawyer say police interrogated student
"The judge knows that the lawyer said that the police officer interrogated the student."

b. LONG
faguan xiangzhidao lüshi shuo jingcha weishenme shenwenle xuesheng
judge wonders lawyer say police why interrogated student
"The judge wonders why the lawyer said that the police officer interrogated the student." (asking why the police officer interrogated the student)

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

6.1.3. Procedures

Experiment 3 adopts the same experimental procedures as Experiments 1 and 2.

6.2. Results

Like in Experiments 1 and 2, all ratings on the sliding scale were transformed to a numeric value between 0 and 1, with 0 representing the *completely unacceptable* end of the scale, and 1 representing the *completely acceptable* end. Figure 6 shows the average acceptability ratings for sentences containing the three canonical bridge verbs. Figure 7 shows the average acceptability ratings for sentences with each unclassified verb, compared to the average ratings for the bridge verb sentences.

First, we fitted a linear mixed effect regression model predicting the acceptability ratings of the bridge verb sentences with the sum-coded fixed effect of dependency type (declarative vs. long), and the by-participant and by-item random intercepts and slopes for the fixed effect. There is a significant main effect of dependency type ($\beta = 0.28$, SE = 0.020, t = 14.12, $p < 0.001$) where the long dependency condition was rated lower than the declarative condition. This suggests that even for the canonical bridge verbs, extracting *wh*-adjuncts from their complements leads to acceptability degradations.

Then, we move on to examine whether the unclassified verbs behave like bridge verbs or not. For each unclassified verb, we pooled all the sentence ratings for that verb together with the ratings for the bridge verb sentences, and fitted a linear mixed-effects regression model predicting acceptability ratings with the fixed effects of verb type (bridge vs. unclassified), dependency type (declarative vs. long), and their interaction. Also included were the maximal by-participant and by-item random-effect structures allowing convergence. The regression model estimates are shown in Table 9, with significant effects shaded gray.

There are five verbs that showed significant interaction effects between dependency length and verb type: *jieshou* "accept," *baozheng* "assure," *toulu* "disclose," *chongshen* "reiterate," and *rentong* "agree." The significant interaction effects were all in the direction such that the unclassified verbs induced a smaller extraction penalty than the canonical bridge verbs, suggesting that the unclassified verbs are also bridge verbs. For all other verbs tested, there is no significant interaction between dependency length and verb type. This suggests that there is no evidence for any of the tested verbs being non-bridge verbs.

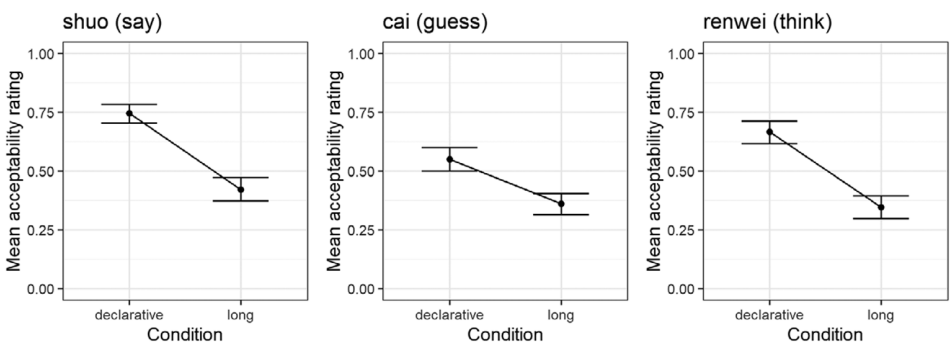


Figure 6. Acceptability ratings for the bridge verb sentences in Experiment 3.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

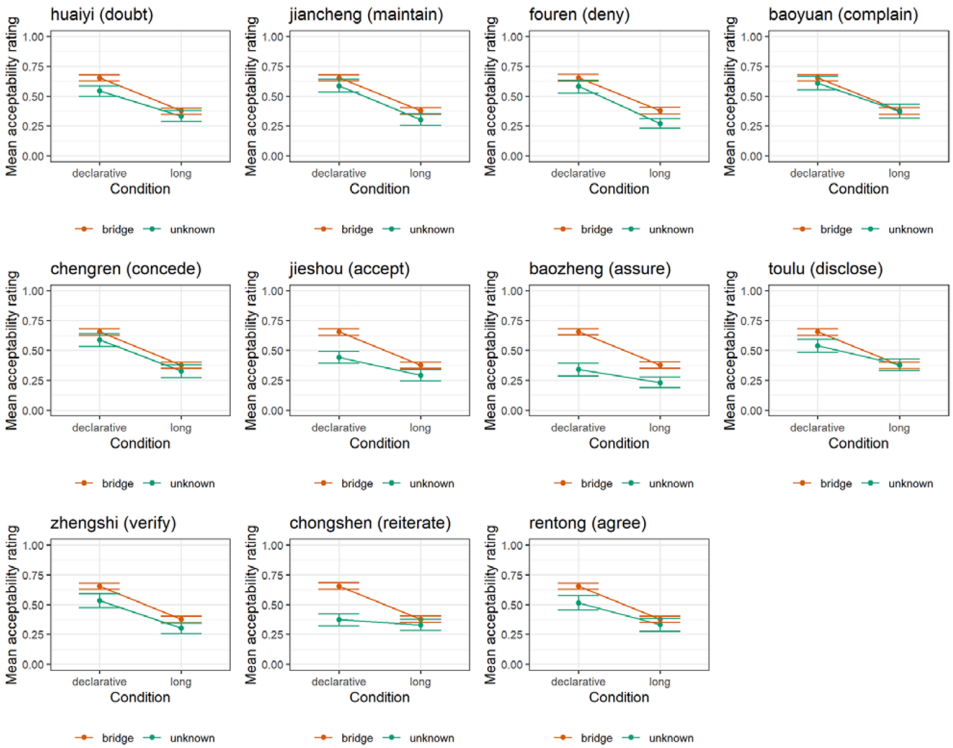


Figure 7. Acceptability ratings for the unclassified verb sentences compared against the bridge verb sentences in Experiment 3.

To further confirm the null interaction effects reported in Table 9, we conducted a Bayes factor analysis using the BayesFactor package in R (Morey et al. 2015). We estimated the Bayes factors comparing the regression models reported in Table 9 with ones that are otherwise identical but lack the interaction term, using three different prior width settings (medium, wide, and ultra-wide). The Bayes factor estimates are shown in Table 10.

Following previous conventions, we take BF < 0.3 as evidence for the null hypothesis (Rouder et al. 2009). All Bayes factors calculated are below 0.3, except for one: the verb *huaiyi* "doubt" under medium and wide prior width settings. But the interaction effect under question is in fact numerically in the opposite direction of a bridge effect: the length penalty for *huaiyi* is smaller than the length penalty for the three canonical bridge verbs. Therefore, the Bayes factor analysis provides further support for the lack of a bridge/non-bridge distinction among the verbs tested in Experiment 3.

6.3. Discussion

Experiment 3 replicates the findings of Experiment 2 while controlling for the confound resulting from the variable attachment compatibility between the clause-embedding verbs and the *wh*-adjunct *weishenme*. The unclassified verbs tested all induced extraction penalties similar to or smaller than those induced by the canonical bridge verbs, and thus should also

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Table 9. Estimates for LMER models predicting the acceptability of Exp.3 sentences containing the bridge verbs and each unclassified verb with sum-coded fixed effects of dependency type (declarative vs. long), verb type (bridge vs. unclassified), and their interaction, as well as the maximal by-participant and by-item random effect structures allowing convergence. Shaded boxes represent statistically significant effects

	Dependency type				Verb type				Interaction			
	β	SE	t	p	*β*	SE	t	p	*β*	SE	t	p
huaiyi (doubt)	0.12	0.011	11.20	<0.001	0.039	0.010	3.87	<0.001	0.017	0.011	1.55	0.13
jiancheng (maintain)	0.14	0.011	12.37	<0.001	0.031	0.0096	3.25	<0.01	–0.00043	0.011	–0.039	0.96
fouren (deny)	0.15	0.011	13.20	<0.001	0.039	0.0089	4.32	<0.001	–0.0090	0.0093	–0.97	0.33
baoyuan (complain)	0.12	0.012	10.64	<0.001	0.015	0.011	1.31	0.20	0.014	0.0096	1.42	0.16
chengren (concede)	0.13	0.011	11.65	<0.001	0.029	0.0090	3.22	<0.01	0.0061	0.010	0.61	0.55
jieshou (accept)	0.11	0.0095	11.10	<0.001	0.081	0.0091	8.86	<0.001	0.033	0.0090	3.63	<0.001
baozheng (assure)	0.097	0.011	8.99	<0.001	0.012	0.010	11.16	<0.001	0.042	0.0098	4.25	<0.001
toulu (disclose)	0.11	0.011	9.70	<0.001	0.025	0.0096	2.63	<0.05	0.030	0.0086	3.45	<0.001
zhengshi (verify)	0.13	0.011	11.23	<0.001	0.052	0.010	5.10	<0.001	0.012	0.0093	1.27	0.21
chongshen (reiterate)	0.081	0.010	8.01	<0.001	0.078	0.011	7.38	<0.001	0.058	0.0090	6.44	<0.001
rentong (agree)	0.12	0.013	8.90	<0.001	0.042	0.010	4.12	<0.001	0.023	0.0099	2.30	<0.05

Table 10. Bayes factors for the Dependency Length * Verb Type interaction terms of the models reported in Table 9, estimated using the BayesFactor package in R (Morey et al. 2015)

	Prior width		
	Medium	Wide	Ultra-wide
huaiyi (doubt)	0.43	0.31	0.23
jiancheng (maintain)	0.096	0.074	0.054
fouren (deny)	0.13	0.095	0.070
baoyuan (complain)	0.18	0.12	0.088
chengren (concede)	0.13	0.083	0.061
zhengshi (verify)	0.23	0.16	0.11

be categorized as bridge verbs. This finding supports our hypothesis that there is no bridge/non-bridge distinction in Mandarin.

7. General Discussion

The current study investigates the bridge/non-bridge distinction (more precisely, the lack thereof) in Mandarin with three acceptability judgment experiments. In Experiment 1, we showed that among the top clause-embedding verbs attested in the Mandarin CHILDES corpus, there is no bridge/non-bridge distinction. All clause-embedding verbs allow both *wh*-adjunct and *wh*-argument movements across them. Experiments 2 and 3 replicate the findings of Experiment 1 with a different set of clause-embedding verbs that are low in frequency, not attested at all in the Mandarin CHILDES corpus, never co-occurring with *wh*-dependencies in the Penn Chinese Treebank corpus, and whose English counterparts are non-bridge verbs. These verbs also show no bridge/non-bridge distinction, and permit *wh*-movements across them.

7.1. Implications for theories of bridge effect

Our findings have important implications for the theory of bridge effects. Recall our earlier discussion of the various accounts of the bridge effect. Pragmatic accounts attribute the bridge/non-bridge distinction to the lexical meaning and the discourse functions of the clause-embedding verbs (Erteschik-Shir 1973, 2007; Ambridge & Goldberg 2008; Lu et al. 2025). For example, factive verbs (e.g. *regret*, *discover*) encode the speakers' commitment to the truth of their complement clauses (i.e. their complements are presupposed) as part of their lexical entries (Kiparsky & Kiparsky 1970). As a result, it is pragmatically odd and hence unacceptable to form a *wh*-question seeking information about something embedded inside the complement of factive verbs. Our findings challenge these pragmatic accounts: if lexical properties such as factivity determined the bridge status of clause-embedding verbs, we would expect a very limited degree of crosslinguistic variation in the bridge/non-bridge distinction. Factive verbs like *regret* and *discover*, regardless of which language they are in, should encode factivity. However, we observed that in Mandarin, all clause-embedding verbs (including ones whose English counterparts are non-bridge verbs) are in fact bridge

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

verbs, contrary to the prediction of the pragmatic accounts. Notably, among the verbs tested in the current study, *jide* "remember," *xihuan* "like," *toulu* "disclose" behave like factive verbs: when they are used in sentences to take CP complements, the embedded content in the complements would be interpreted as presupposed.[12] This is shown in examples (15)–(17): native speakers interpret the embedded proposition "Wangwu hit Lisi" as presupposed in all six sentences. Importantly, the meaning projects over sentential negation in (15b), (16b), and (17b), a signature of presupposition. Despite the fact that their complements are interpreted as presupposed, *jide*, *xihuan* and *toulu* behaved as bridge verbs in our experiments,[13] and were attested as bridges in our corpus study.

(15) a. Zhangsan jide Wangwu da le Lisi
Zhangsan remember Wangwu hit ASP Lisi
"Zhangsan remembers that Zhangsan hit Lisi."
b. Zhangsan bu jide Wangwu da le Lisi
Zhangsan not remember Wangwu hit ASP Lisi
"Zhangsan doesn't remember that Wangwu hit Lisi."

(16) a. Zhangsan xihuan Wangwu da le Lisi
Zhangsan like Wangwu hit ASP Lisi
"Zhangsan likes that Wangwu hit Lisi."
b. Zhangsan bu xihuan Wangwu da le Lisi
Zhangsan not like Wangwu hit ASP Lisi
"Zhangsan doesn't like that Wangwu hit Lisi."

(17) a. Zhangsan toulu Wangwu da le Lisi
Zhangsan disclose Wangwu hit ASP Lisi
"Zhangsan likes that Wangwu hit Lisi."
b. Zhangsan mei toulu Wangwu da le Lisi
Zhangsan not disclose Wangwu hit ASP Lisi
"Zhangsan didn't disclose that Wangwu hit Lisi."

Our findings also show that the ECP-based accounts of bridge effects (Tsai 1994; Kayne 1981; Cinque 1990; Kiparsky & Kiparsky 1970; Rooryck 1992; Adams 1985; Rizzi 1990) do not apply to Mandarin. These accounts analyze the embedded CPs introduced by non-bridge verbs as syntactically distinct from the complement CPs of bridge verbs, by virtue of being adjuncts or adnominals, or bearing nominal features that regular CP complements to V lack. Despite their differences, these accounts all attribute the islandhood of non-bridge verb complements to the ECP: any *wh*-adjunct traces at the edge of these special CPs would not be properly governed. As a result, they all make the same prediction that the bridge/non-bridge distinction should only hold for *wh*-adjuncts but not *wh*-arguments. Whether or not this

[12] Note also that the factive verb *zhidao* "know" is attested as a bridge with both argument and adjunct questions in our corpus study, see Table 1.

[13] Exp.1 shows that the factive verb *jide* "remember" restricts *wh*-arguments but not *wh*-adjuncts. Note that this is the opposite pattern of what one would expect if *jide* were a non-bridge verb in Mandarin: according to Tsai (1994), *wh*-adjuncts are restricted by non-bridge verbs, while *wh*-arguments are universally unbounded.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

argument-adjunct asymmetry holds true in other languages aside, we did not find such an asymmetry in Mandarin. In Experiments 1 and 2, we showed that *wh*-adjunct extractions from clausal complements are rated lower than *wh*-argument extractions, but the contrast is driven by a general penalty on long-distance *wh*-adjunct dependencies which applies even to the canonical bridge verbs and is thus orthogonal to the bridge effect.

Notably, our results do not constitute a direct challenge to the ECP itself. The ECP could still apply in general, but the bridge status of verbs is not derived from the adjunct/complement status of the embedded clauses they introduce, and therefore the ECP does not apply to restrict extractions from embedded CPs.

Furthermore, although there is no argument-adjunct asymmetry of the bridge effect in Mandarin, there could still be such an asymmetry in other languages. Therefore, it is possible that the ECP-based accounts of bridge effects still apply to such languages where there is an argument-adjunct asymmetry. Note, however, that our learning-based account of the bridge effect can capture any asymmetries between types of wh-elements, based on their distributions in the input data. See Legate & Yang 2025 for related discussion compatible with the current approach.

7.2. Implications for theories of language acquisition

The study supports a learning-theoretical treatment of bridge effects, which is empirical and language specific. The bridge/non-bridge status of clause-embedding verbs in a speaker's grammar is determined by the type of input the speaker is exposed to and the generalizations, if any, they draw from the input. The input forms a relatively small vocabulary during the period of child language acquisition; the resulting knowledge is likely stable. For example, the CP-embedding verbs in Experiment 2 are quite rare and are only found in printed materials. Even though they are unattested as bridge verbs, subjects treat them as bridge verbs, just like the high-frequency bridge verbs attested in a modest child-directed corpus – exemplifying the productive extension of knowledge (Section 3.2). By contrast, their counterparts in English are judged as non-bridge verbs (Huang et al. 2025), since the set of bridge verbs is lexicalized and does not generalize, which is also learned during the period of language acquisition (Section 3.1).

It is important to stress that the learning-theoretic account requires positive evidence in the input data. As such, an argument-adjunct asymmetry in the bridge effect is not inherent: any *wh*-element, including *wh*-adjuncts, could be immune to the bridge effect as long as the learner witnesses enough positive evidence for a *wh*-element crossing (overtly or covertly) clause-embedding verbs to posit a productive rule that all clause-embedding verbs are transparent to that particular *wh*-element. In principle there could be a language without a bridge/non-bridge distinction among the clause-embedding verbs, or an argument-adjunct asymmetry in extraction penalty from clausal complements, a possibility not predicted by any other accounts discussed above. In this study, we show that Mandarin is such a language.

The contrast between Mandarin and English also highlights the importance of type frequency in the acquisition of the bridge effect. The current account assumes that the learners track the proportion of clause-embedding verbs (i.e. types) that are explicitly used as bridge verbs in the input as opposed to the token frequency. This contrasts with probabilistic approaches to movement that learn by calibration of token frequencies (Reali & Christiansen 2005; Perfors et al. 2011; Pearl & Sprouse 2013). For example, Pearl & Sprouse (2013) suggests that the ungrammaticality of syntactic island violations results from the low

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

probabilities of local dependencies defined over trigrams of successive projections. Because language acquisition consumes a finite amount of data, it is essential for the Pearl & Sprouse (2013) model to implement *smoothing*: a small amount of probability mass must be reserved for all trigrams, which will increase for the attested and decrease for unattested. In effect, the absence of evidence constitutes evidence of absence, and it becomes stronger when the sample size gets larger. The original study did not deal with lexical effects such as bridge phenomena, but a subsequent study on bridge verbs (Dickson et al. 2022) follows the same strategy: all CP-embedding verbs are asserted as bridge verbs with a baseline frequency of 0.5 in the corpus, which are then adjusted according to their empirical frequencies in the input data.[14] This approach may yield appropriate results for a language such as English: Only those attested as bridge verbs will steadily increase their probabilities. But baking in the assumption of lexical learning is effectively telling the child that they are acquiring a language like English, and runs into difficulties with a language like Mandarin, where even low-frequency verbs never attested in long-distance dependencies are treated as bridge verbs (Experiments 2 and 3). Lexical learning and generalization need to be a conclusion that the child learner discovers about their input language.

7.3. The origins of bridge verbs

Our distributional learning treatment of bridge verbs is inherently empirical. It detects their distributional regularity, or the lack thereof, in the input data but has nothing direct to say on the origin of their drastically different profiles between English and Mandarin, and indeed, across languages more generally. Here we enter some speculative grounds but our reasoning is still rooted in learnability considerations advocated throughout.

As discussed in Section 1 in the context of English, and then amplified across the three experiments in Mandarin, it is clear that the semantic properties of CP-embedding matrix verbs cannot provide a causal explanation for bridge effects. Nevertheless, semantic factors may still be reflected as tendencies across languages, at least for those that show the bridge vs. non-bridge distinction. We suggest that the crosslinguistic tendencies arise through the factors affecting language use, which will in turn have consequences on the grammar acquired and then transmitted to later generations in an iterative process. In the case of bridge verbs, such factors notably include the discourse functions of clause-embedding verbs, verb frequencies, and their interactions that were pointed out in previous studies.

If the complement of a verb is likely to be presupposed, the embedded contents are naturally less likely to be questioned since they are already in the common ground (Kroch 1989; Goldberg 2013; Oshima 2006). Therefore, clause-embedding verbs that allow for presupposition projection (i.e. the "presupposition holes": Karttunen 1973) have the tendency to be non-bridge verbs crosslinguistically. On our approach, however, these pragmatic properties are not grammatically determinative, but simply affect the likelihood of such a verb being used with a long-distance dependency. Such discourse-pragmatic tendencies are not absolute: given the right circumstances and context, some adult speaker may well use a presupposition-projecting verb in a long-distance *wh*-question, which has the potential of being internalized as positive evidence by the child language learner.

Verb frequency, a property of language use, is also likely to play a major role in shaping the bridge verbs within and across languages. High verb frequency provides more

[14] We put aside the underlying assumption of these studies that equates the probability of sentences to their grammatical status; see Sprouse et al. (2018) for critical discussion.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

opportunities for the verb to occur with a long-distance dependency in the learner's input. Their high frequencies will also make them more likely to be acquired by children and stably transmitted across generations. By contrast, verbs that are much lower in frequency rarely appear in young children's input at all, let alone appear with long-distance dependencies spanning them. As a result, they are more likely to be non-bridge verbs crosslinguistically. It is thus not surprising that for languages like English, the bridge verbs tend to be high in frequency (Liu et al. 2022) even though the frequency effects are by definition stochastic and there are plenty of high-frequency CP-embedding verbs that are not bridge verbs (e.g. *know*, *see*, *remember*, *forget*) as discussed in Section 1.

Tendencies are, of course, just tendencies. The item-by-item process by which a verb becomes a bridge or falls into disuse cannot account for the wholesale differences between Mandarin and English. In particular, recall that the ratio of bridge verbs in a language such as English is very low, even among the most frequent CP-embedding verbs that form the basis of language acquisition (Section 3.1): the profile of language use would have to change radically to turn English into a Mandarin-like language. An excavation into the history of these languages offers an interesting clue as to the source of the difference between them, although a full investigation must be left for future research.

So far as we know, the history of embedded clauses in English has been a matter of continuity. There have been occasional claims in prominent reference works (e.g. Mitchell 1985) that clausal embedding in English evolved over time, "(a)s the loose association of clauses (parataxis) gives way to more precise indications of logical relationship and subordination (hypotaxis)" (Baugh & Cable 2013, 238). However, the quantitative analysis of historical corpora finds no evidence to support such a claim as the ratio of clause embedding has remained largely stable from the earliest attested period of Old English onward (Walkden 2024).[15] Indeed, long-distance *wh*-movement can be found in Old English (Allen 1980). It is likely that English has always maintained a lexicalized bridge vs. non-bridge distinction, which is also implicated in various other syntactic processes across the Germanic family (e.g., Vikner 1995; Broekhuis & Corver 2016).

The diachrony of clausal embedding in Chinese is, by contrast, very different, which we believe may hold the key to the uniform availability of bridge verbs. Classical Chinese can be divided into the Archaic period and the Middle period demarcated by the Han Dynasty (second century BCE). It is well documented (e.g. Pulleyblank 1995) that CP-embedding was essentially absent in Archaic Chinese: the language employed multiple clauses (parataxis) or nominalized clauses with clause-internal markers such as *zhi* (18a) and *qi* (18b):

(18) a. … bu ru denggao **zhi** bojian ye (3rd C BCE; *Xunzi*, 1/7)
… not like climbing-high NMLZ broad-view PTCL
'… It was (not like the seeing all around of climbing up high =) not as good as climbing up high and seeing all around.

b. yi shi zhi **qi** tian ye (4-2nd C BCE; *Zhuangzi*, 3/13)
therefore COP know NMLZ Heaven PTCL
'By this I know that it was Heaven [that did it]' (adapted from Pulleyblank (1995, p66)

[15] See Axel-Tober (2017) for evidence that clausal embedding may be traced back to Proto-Germanic possibly even earlier.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

These markers began to disappear in Middle Chinese. The contrast can be seen in (19), which presents two very similar sentences in Archaic Chinese (19a) and Early Middle Chinese (19b).

(19) a. [Tianxia **zhi** wu dao ye] jiu yi. (5th C. BCE; *Analects*, Bayi)
world NMLZ not.have way COP long PERF
'It is a long time since the world has been without the proper way.'

b. [Tianxia wu dao] jiu yi. (1st C. CE; *Shiji*, Kongzi Shijia)
world not.have way long PERF
'It is a long time since the world has been without the proper way.' (Aldridge 2013, 59)

In the absence of the nominalizer, structures that were previously analyzed as nominalized would instead be analyzed as CP-embedding. If CP-embedding indeed emerged in Middle Chinese, it must have, as an incipient change, appeared with relatively few matrix verbs. Generalization is very easy for small *N*'s under the Tolerance Principle. Plausibly, a productive generalization that all CP-embedding verbs are bridge verbs was formed immediately and has been stably transmitted since: a novel CP-embedding verb, once incorporated into the language, was immediately treated as a bridge verb very much as we have demonstrated in Experiments 2 and 3.

8. Conclusion

In the current study, we propose that no clause-embedding verb is inherently a bridge verb or a non-bridge verb, but rather, verbs are acquired as bridge verbs based on direct evidence in the input of their use as bridge verbs. With enough clause-embedding verbs acquired as bridge verbs, speakers will be led to posit a productive rule that all clause-embedding verbs are bridge verbs, yielding a language without a bridge/non-bridge distinction. In the current study, we demonstrated that Mandarin Chinese is such a language. A corpus analysis shows that the vast majority of clause-embedding verbs found in child-directed speech are also explicitly used as bridge verbs, clearing the threshold for productive generalization. We therefore predict that Mandarin should not have a bridge/non-bridge verb distinction. This prediction is confirmed by a series of acceptability judgments: the verbs tested (including ones that are not attested as bridge verbs in CHILDES, and whose English counterparts are non-bridge verbs) induce similar or even smaller extraction penalties than the control verbs that are uncontroversially considered bridge verbs in the previous literature. This finding supports our learning-based account of the bridge effect, and challenges alternative proposals.

Acknowledgments. The authors are grateful to the three anonymous reviewers at the Journal of Linguistics, the Penn Syntax Lab, and the audiences at HSP 2025, Northwestern University, Pomona College, Harvard University, University of Massachusetts Amherst, Rutgers University, and California Institute of Technology for their constructive feedback at various stages of this project. All remaining errors are our own.

Data availability statement. Stimuli, data, and analysis scripts of the current paper can be found at https://github.com/lu-jiayi/chinese-bridge-effect.

Funding statement. This study was partially funded by the Integrated Language Sciences and Technology (ILST) Initiative Small Grant from the University of Pennsylvania.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

References

Adams, Marianne. 1985. Government of empty subjects in factive clausal complements. *Linguistic Inquiry.* 16(2). 305–313.

Aldridge, Edith. 2013. Survey of Chinese historical syntax part II: Middle Chinese. *Language and Linguistics Compass.* 7(1). 58–77.

Allen, Cynthia. 1980. Movement and deletion in Old English. *Linguistic Inquiry.* 11(2). 261–323.

Almeida, Diogo. 2014. Subliminal wh-islands in Brazilian Portuguese and the consequences for syntactic theory. *Revista da ABRALIN*. 13(2). 55–93.

Ambridge, Ben & Adele E Goldberg. 2008. The island status of clausal complements: Evidence in favor of an information structure explanation. *Cognitive Linguistics.* 19(3). 357–389.

Aslin, Richard N & Elissa L Newport. 2012. Statistical learning: From acquiring specific items to forming general rules. *Current Directions in Psychological Science.* 21(3). 170–176.

Axel-Tober, Katrin. 2017. The development of the declarative complementizer in German. *Language.* 93(2). e29–e65.

Baugh, Albert & Thomas Cable. 2013. *A history of the English language*. London: Routledge.

Belth, Caleb. 2023. A learning-based account of local phonological processes. *Phonology.* 40(1). 1–23.

Belth, Caleb. 2025. A learning-based account of phonological tiers. *Linguistic Inquiry.* 57(2). 229–265.

Björnsdóttir, Sigrídur Mjöll. 2021. Productivity and the acquisition of gender. *Journal of Child Language.* 48(6). 1209–1234.

Bornstein, Marc H, Linda R Cote, Sharone Maital, Kathleen Painter, Sung-Yun Park, Liliana Pascual, Marie-Germaine Pêcheux, Josette Ruel, Paola Venuti & Andre Vyt. 2004. Cross-linguistic analysis of vocabulary in young children: Spanish, Dutch, French, Hebrew, Italian, Korean, and American English. *Child Development.* 75(4). 1115–1139.

Broekhuis, Hans & Norbert Corver. 2016. *Syntax of dutch: Verbs and verb phrases*. *volume* 3. Amsterdam: Amsterdam University Press.

Butler, Hiroko Y. 1989. *Bridge & non-bridge verb asymmetries in Japanese*. M.A. thesis: The Ohio State University.

Chomsky, Noam. 1977. On wh-movement. In Peter W. Culicover, Thomas Wasow & Adrian Akmajian (eds.), *Formal syntax*, 71–132. New York: Academic Press.

Chomsky, Noam. 1981. *Lectures on government and binding: The Pisa lectures*. Holland: Foris Publications.

Chomsky, Noam. 1986. *Barriers*. Cambridge, MA: MIT press.

Cinque, Guglielmo. 1990. *Types of A'-dependencies*. Cambridge, MA: MIT Press.

Dayal, Veneeta. 1996. *Locality in WH Quantification: Questions and relative clauses in Hindi*, vol. 62 *Studies in Linguistics and Philosophy*. Dordrecht: Kluwer Academic Publishers.

Degen, Judith & Judith Tonhauser. 2022. Are there factive predicates? An empirical investigation. *Language.* 98(3). 552–591.

Dickson, Niels, Lisa Pearl & Richard Futrell. 2022. Learning constraints on wh-dependencies by learning how to efficiently represent wh-dependencies: A developmental modeling investigation with Fragment Grammars. In Allyson Ettinger, Tim Hunter & Brandon Prickett (eds.), *Proceedings of the society for computation in linguistics* 2022, 220–224. Online: Association for Computational Linguistics.

Diessel, Holger & Michael Tomasello. 2001. The acquisition of finite complement clauses in English: A corpus-based analysis. *Cognitive Linguistics.* 12(2). 97–141.

Dresher, B. Elan & Aditi Lahiri. 2022. The foot in the history of English: Challenges to metrical coherence. In Bettelou Los, Claire Cowie, Patrick Honeybone & Graeme Trousdale (eds.), *English historical linguistics: Change in structure and meaning*, 42–59. Amsterdam: John Benjamins.

Dyakonova, Marina. 2009. *A phase-based approach to Russian free word order.* Ph.D. dissertation: Universiteit van Amsterdam.

Erteschik-Shir, Nomi. 1973. *On the nature of island constraints.* Ph.D. dissertation: Massachusetts Institute of Technology.

Erteschik-Shir, Nomi. 2007. *Information structure: The syntax-discourse interface*. Oxford: Oxford University Press.

Featherston, Samuel. 2004. Bridge verbs and V2 verbs – the same thing in spades? *Zeitschrift für Sprachwissenschaft.* 23(2). 181–209.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Fenson, Larry, Philip S Dale, J Steven Reznick, Elizabeth Bates, Donna J Thal, Stephen J Pethick, Michael Tomasello, Carolyn B Mervis & Joan Stiles. 1994. Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 59 (1). 1–185.

Fodor, Janet Dean. 1992. Islands, learnability and the lexicon. In Helen Goodluck & Michael Rochemont (eds.), *Island constraints: Theory, acquisition and processing*, 109–180. Dordrecht: Kluwer.

Fukui, Naoki. 1988. LF extraction of naze: Some theoretical implications. *Natural Language & Linguistic Theory.* 6(4). 503–526.

Gold, Joshua I & Michael N Shadlen. 2007. The neural basis of decision making. *Annual Review of Neuroscience.* 30(1). 535–574.

Goldberg, Adele E. 2013. Backgrounded constituents cannot be "extracted." In Jon Sprouse & Norbert Hornstein (eds.), *Experimental syntax and island effects*, 221–238. Cambridge: Cambridge University Press.

Goodman, Judith C, Philip S Dale & Ping Li. 2008. Does frequency count? Parental input and the acquisition of vocabulary. *Journal of Child Language.* 35(3). 515–531.

Granites, Robin Japanangka, Ken L. Hale & David Odling-Smee. 1976. *Survey of Warlpiri grammar.* Ms., Massachusetts Institute of Technology.

Guilbeault, Douglas, Spencer Caplan & Charles Yang. 2026. A simple threshold captures the social learning of conventions. *Proceedings of the National Academy of Sciences.* 123(17). e2508061123.

Hao, Meiling, Hua Shu, Ailing Xing & Ping Li. 2008. Early vocabulary inventory for Mandarin Chinese. *Behavior Research Methods.* 40(3). 728–733.

Hazlett, Allan. 2010. The myth of factive verbs. *Philosophy and Phenomenological Research.* 80(3). 497–522.

Hein, Johannes. 2024. Category-sensitive escape from islands in Limbum and Asante Twi. *Languages.* 9(10). 317.

Henke, Ryan E. 2022. Rules and exceptions: A Tolerance Principle account of the possessive suffix in Northern East Cree. *Journal of Child Language.* 50(5). 1–36.

Hsieh, Feng-Fan. 2021. On the existence of word stress in Mandarin Chinese. *Studies in Prosodic Grammar.* 7(1). 27–58.

Hu, Jianhua, Haihua Pan & Liejiong Xu. 2001. Is there a finite vs. nonfinite distinction in Chinese? *Linguistics.* 39(6). 1117–1148.

Huang, C.-T. James. 1982. *Logical relations in Chinese and the theory of grammar.* Ph.D. dissertation: Massachusetts Institute of Technology.

Huang, C-T James. 1984. On the distribution and reference of empty pronouns. *Linguistic Inquiry.* 15(4). 531–574.

Huang, C.-T. James. 1989. Pro-Drop in Chinese: A generalized control theory. In Osvaldo A. Jaeggli & Kenneth J. Safir (eds.), *The null subject parameter*, vol. 15 Studies in Natural Language and Linguistic Theory, 185–214. Dordrecht: Kluwer Academic Publishers.

Huang, C.-T. James. 2022. Finiteness, opacity, and Chinese clausal architecture. In Andrew Simpson (ed.), *New explorations in Chinese theoretical syntax: Studies in honor of Yen-Hui Audrey Li*, 17–76. Amsterdam: John Benjamins.

Huang, Nick, Diogo Almeida & Jon Sprouse. 2025. A nearly exhaustive experimental investigation of bridge effects in English. *Language.* 101(1). 72–108.

Jarrah, Marwan. 2019. Factivity and subject extraction in Jordanian Arabic. *Lingua.* 219. 106–126.

Kanampiu, Patrick Njue, Alexander Martin & Jennifer Culbertson. 2025. Experimental evidence for semantic and morphophonological productivity in Kîîtharaka noun classes. *Glossa Psycholinguistics.* 4(1). 1–45.

Karttunen, Lauri. 1973. Presuppositions of compound sentences. *Linguistic Inquiry.* 4(2). 169–193.

Kayne, Richard S. 1981. ECP extensions. *Linguistic Inquiry.* 12(1). 93–133.

Keshev, Maayan & Aya Meltzer-Asscher. 2019. A processing-based account of subliminal wh-island effects. *Natural Language & Linguistic Theory.* 37(2). 621–657.

Kim, Nayoun, Ziying Li & Jiayi Lu. 2023. Island-sensitivity of two different interpretations of why in Chinese. *Frontiers in Psychology.* 13. 1059823.

Kiparsky, Paul & Carol Kiparsky. 1970. Fact. In Manfred Bierwisch & Karl E. Heidolph (eds.), *Progress in linguistics: A collection of papers*, 143–173. The Hague: Mouton.

Kodner, Jordan. 2023. What learning Latin verbal morphology tells us about morphological theory. *Natural Language & Linguistic Theory.* 41(2). 733–792.

Korsah, Sampson & Andrew Murphy. 2024. Tonal reflexes of movement in Asante Twi. *Natural Language & Linguistic Theory.* 38. 827–885.

Kroch, Anthony. 1989. Amount quantification, referentiality, and long wh-movement. *University of Pennsylvania Working Papers in Linguistics.* 5(2). 21–36.

Legate, Julie Anne. 2011. Warlpiri *wh*-scope marking. *Syntax.* 14. 97–121.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Legate, Julie Anne & Charles Yang. 2025. A null theory of movement. Manuscript, University of Pennsylvania.
Li, Daoxin. 2024. Controlling overt subjects in Mandarin. *Journal of East Asian Linguistics.* 33. 333–366.
Li, Karen. 2023. *The acquisition of complementizer variation in English-speaking children.* M.A. thesis: University of Pennsylvania.
Liu, Yingtong, Rachel Ryskin, Richard Futrell & Edward Gibson. 2022. A verb-frame frequency account of constraints on long-distance dependencies in English. *Cognition.* 222. 104902.
Lu, Jiayi, Dingyi Pan & Judith Degen. 2025. Evidence for a discourse account of manner-of-speaking islands. *Language.* 101(4). 627–659.
Lu, Jiayi, Cynthia K Thompson & Masaya Yoshida. 2020. Chinese wh-in-situ and islands: A formal judgment study. *Linguistic Inquiry.* 51(3). 611–623.
MacWhinney, Brian. 2000. *The CHILDES project: Tools for analyzing talk* (3rd edn). Mahwah, NJ: Lawrence Erlbaum Associates.
Mahajan, Anoop. 1990. *The A/A-bar distinction and movement theory.* Ph.D. dissertation: Massachusetts Institute of Technology.
Mitchell, Bruce. 1985. *Old english syntax: Concord, the parts of speech, and the sentence*. Oxford: Oxford University Press.
Morey, Richard D, Jeffrey N Rouder, Tahira Jamil & Maintainer Richard D Morey. 2015. R package BayesFactor.
Nagy, William E. & Richard C. Anderson. 1984. How many words are there in printed school English? *Reading Research Quarterly.* 19(3). 304–330.
Nowenstein, Iris Edda. 2026. *The acquisition of non-default rules: A case for exceptions*. Cambridge: Cambridge University Press.
Oshima, David Yoshikazu. 2006. *Perspectives in reported discourse.* Ph.D. dissertation: Stanford University.
Pearl, Lisa & Jon Sprouse. 2013. Syntactic islands and learning biases: Combining experimental syntax and computational modeling to investigate the language acquisition problem. *Language Acquisition.* 20(1). 23–68.
Pearl, Lisa & Jon Sprouse. 2021. The acquisition of linking theories: A Tolerance and Sufficiency Principle approach to deriving UTAH and rUTAH. *Language Acquisition.* 28(3). 294–325.
Perfors, Amy, Joshua B Tenenbaum & Terry Regier. 2011. The learnability of abstract syntactic principles. *Cognition.* 118(3). 306–338.
Pesetsky, David. 1987. Wh-in-situ: Movement and unselective binding. In Eric Reuland & Alice ter Meulen (eds.), *The representation of (in)definiteness*, 98–129. Cambridge, MA: The MIT Press.
Pulleyblank, Edwin George. 1995. *Outline of classical Chinese grammar*. Vancouver: University of British Columbia Press.
Reali, Florencia & Morten H Christiansen. 2005. Uncovering the richness of the stimulus: Structure dependence and indirect statistical evidence. *Cognitive Science.* 29(6). 1007–1028.
Richter, Stephanie & Rui Chaves. 2020. Investigating the role of verb frequency in factive and manner-of-speaking islands. *Proceedings of the Annual Meeting of the Cognitive Science Society.* 42. 1771–1777. Retrieved from https://escholarship.org/uc/item/9mg6k1sq.
Rizzi, Luigi. 1982. *Issues in Italian syntax*. Berlin: Walter de Gruyter.
Rizzi, Luigi. 1990. *Relativized minimality.* Cambridge, MA: The MIT Press.
Rooryck, Johan. 1992. Negative and factive islands revisited. *Journal of Linguistics.* 28(2). 343–374.
Rouder, Jeffrey N, Paul L Speckman, Dongchu Sun, Richard D Morey & Geoffrey Iverson. 2009. Bayesian *t* tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review.* 16. 225–237.
Russell, Stuart & Peter Norvig. 2004. *Artificial intelligence: A modern approach*. Englewood Cliffs, NJ: Prentice Hall.
Salzmann, Martin. 2020. Unbounded dependency constructions in Germanic. In Michael Putnam & Richard Page (eds.), *The cambridge handbook of Germanic linguistics*, 436–460. Cambridge University Press.
Schuler, Kathryn, Charles Yang & Elissa Newport. 2016. Testing the Tolerance Principle: Children form productive rules when it is more computationally efficient to do so. In *The 38th Cognitive Society Annual Meeting*, 2321–2326. Philadelphia, PA.
Schurr, Hagay & Jason Kandybowicz. 2023. Absence of clausal islands in Shupamem. Paper presented at *Locality in Theory, Processing, and Acquisition*, University of Pennsylvania.
Schurr, Hagay, Jason Kandybowicz, Abdoulaye Laziz Nchare, Tysean Bucknor, Xiaomeng Ma, Magdalena Markowska & Armando Tapia. 2024. Absence of clausal islands in Shupamem. *Languages.* 9. 1–35.
Shi, Rushen & Emeryse Emond. 2023. The threshold of rule productivity in infants. *Frontiers in Psychology.* 14. 10.3389/fpsyg.2023.1251124.

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press

Sprouse, Jon, Beracah Yankama, Sagar Indurkhya, Sandiway Fong & Robert C Berwick. 2018. Colorless green ideas do sleep furiously: gradient acceptability and the nature of the grammar. *The Linguistic Review.* 35(3). 575–599.

Srivastav, Veneeta. 1991. Subjacency Effects at LF: The case of Hindi WH. *Linguistic Inquiry.* 22(4). 762–769.

Stepanov, Arthur. 2001. *Cyclic domains in syntactic theory.* University of Conneticut dissertation.

Stepanov, Arthur & Carol Georgopoulos. 1997. An analysis of Russian long-distance wh-questions. In Martina Lindseth & Steven Franks (eds.), *Annual workshop on formal approaches to Slavic linguistics: The indiana meeting*, 1996, 275–294. Ann Arbor, MI: Michigan Slavic Publications.

Stromswold, Karin. 1995. The acquisition of subject and object wh-questions. *Language Acquisition.* 4(1-2). 5–48.

Sybesma, Rint. 2017. Finiteness in Chinese. In Rint Sybesma, Wolfgang Behr, Yueguo Gu, Zev Handel, C.-T.James Huang & James Myers (eds.), *Encyclopedia of Chinese language and linguistics*, vol. 2, 233–237. Leiden: Brill.

Tanaka, Nozomi. 2025. Subliminal island effects in Japanese complex NPs with argument wh-in-situ. *Linguistic Inquiry.* 1–24. Advance online publication.

Thoms, Gary, David Adger, Caroline Heycock, E Jamieson & Jennifer Smith. 2025. Explaining microvariation using the Tolerance Principle: plugging the *amn't* gap. *Journal of Linguistics.* 61(2). 369–396.

Trips, Carola & Thomas Rainsford. 2022. Tolerating subject-experiencers? Yang's Tolerance Principle applied to psych verbs under contact in Middle English. *Journal of Historical Syntax.* 6(12). 1–43.

Tsai, Wei-Tien Dylan. 1994. On nominal islands and LF extraction in Chinese. *Natural Language & Linguistic Theory.* 12(1). 121–175.

van Tuijl, Rosita & Peter Coopmans. 2021. The productivity of Dutch diminutives. *Linguistics in the Netherlands.* 38(1). 128–143.

Vikner, Sten. 1995. *Verb movement and expletive subjects in the germanic languages*. Oxford: Oxford University Press.

Walkden, George. 2024. Parataxis and hypotaxis in the history of English. In Moragh S. Gordon Porck & Caon Luisella (eds.), *Keys to the History of English: Diachronic linguistic change, morpho-syntax and lexicography. Selected papers from the 21st ICEHL*, 10–33. Amsterdam: John Benjamins.

Witkoś, Jacek. 1995. Wh-extraction from clausal complements in Polish: A minimality/locality account. *Folia Linguistica.* 29(3–4). 223–264.

Xue, Nianwen, Xiuhong Zhang, Zixin Jiang, Martha Palmer, Fei Xia, Fu-Dong Chiou & Meiyu Chang. 2016. Chinese Treebank 9.0.

Xun, Endong, Gaoqi Rao, XiaoyueXiao & Jiaojiao Zang. 2016. Dashuju beijing xia BCC yuliaoku de yanzhi [the construction of the BCC corpus in the age of big data]. *Yuliaoku Yuyanxue.* 3(1). 93–109.

Yang, Charles. 2005. On productivity. *Linguistic Variation Yearbook.* 5(1). 333–370.

Yang, Charles. 2013. Ontogeny and phylogeny of language. *Proceedings of the National Academy of Sciences.* 110(16). 6324–6327.

Yang, Charles. 2016. *The price of linguistic productivity: How children learn to break rules of language*. Cambridge, MA: MIT Press.

Zhang, Niina Ning. 2016. Identifying Chinese dependent clauses in the forms of subjects. *Journal of East Asian Linguistics.* 25(3). 275–311.

Cite this article: Lu, Jiayi, Legate, Julie Anne and Yang, Charles. 2026. "The learnability of bridge effects." *Journal of Linguistics*. doi:10.1017/S0022226726101297

https://doi.org/10.1017/S0022226726101297 Published online by Cambridge University Press