Cross-linguistic comparisons on distributive universal quantification:
Each vs. *every* vs. *mei*

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Abstract. This paper discusses differences between *each* and *every* with regard to (a) pair-list readings; (b) subject/object asymmetries seen with *every* but not with *each*; and (c) the long-held intuition that *each* is more individualistic whereas *every* is friendlier to groups. We propose that these phenomena can be captured by prior accounts of the Mandarin Chinese distributive universal quantifier *mei*. In particular, we consider the double variable hypothesis (the idea that in DUQ, for every x, there must be a y) (S.-Z. Huang 1995; 1996), and the Skolemized topicality hypothesis (the idea that topical quantifiers are Skolemized, resulting in the required x-y pairings) (S.-Z. Huang 2022b). We argue that (a') pair-list answers to questions with quantifiers are derivable from the double variable hypothesis; (b') the subject/object asymmetry seen in *every* is due to its positionally-varied association with the double variable hypothesis, while *each* is always subject to Skolemized topicality due to its inherent topicality; and (c') the individualistic interpretation of *each* can be described as stemming from its intrinsically Skolemized topicality as well. Results from experimental works will be brought to bear on the theoretical proposals.

Keywords. universal quantification; pair-list readings; subject/object asymmetry; topicality; Skolem function; event semantics; semantic experiments; Mandarin Chinese

1. Introduction. Distributive universal quantification (DUQ), exemplified by English *each* and *every*, has been studied in a rich body of literature (see citations in Table 1). The Mandarin Chinese (henceforth Chinese) universal quantifier *mei* also has been investigated in numerous works (e.g., Lee 1986; Liu 1990; S.-Z. Huang 1996; Li 1997; Lin 1998; Cheng 2009; Li 2014). Here, we investigate DUQ through a comparison between English and Chinese. We sketch how some general patterns of *each* and *every* – summarized in Table 1 – can be viewed afresh through the lens of Chinese, based on two related proposals for *mei*: the double variable hypothesis (DVH) on DUQ, which states that in DUQ, for every x, there must be a y such that the interpretation of y depends on that of x (S.-Z. Huang 1995; 1996); and the Skolemized topicality hypothesis (STH), which states that topical quantifiers are Skolemized, and that Skolemization leads to the required x-y pairings (S.-Z. Huang 2022b). Given the complexity of these proposals and the richness of the cross-linguistic data used to motivate them, we can only offer a first sketch of how the views that were initially developed to account for the behavior of *mei* can fruitfully be applied to the behavior of DUQ in English.

Section 2 introduces the double variable hypothesis (DVH) on DUQ and its motivation from Chinese. Section 3 supplements the DVH with the Skolemized topicality hypothesis (STH), on the basis of additional Chinese data. Section 4 illustrates how pair-list readings in English DUQ can be seen as the DVH at work. In Section 5, we enhance Krifka (2001)'s intrinsic topicality treatment of *each* to bring it under the STH and discuss differences between *each* and *every* along these lines. The leading idea is that *each* is intrinsically topical, and thus intrinsically Skolemized. Section 6 reviews results from recent psycholinguistic experiments (vi-viii in Table 1) and their relation to the DVH and the STH. Section 7 reports a pilot judgment study of tenseless English sentences (*Joe wash dishes? Not in a million years*!), which offers initial empirical support for the applicability of the DVH in English.

Differences	*each*	*every*	Data	Source(s)
i. Pair-list readings	yes	not in object position	*Which book did you lend to each/every student?*	Krifka (2001); Beghelli (1997); Surányi (2003); Szabolcsi (2010); Achimova et al. (2016)
ii. Out-scoping other operators such as questions	yes	not in object position	(i) *Which dish did each/every guest bring?* (ii) *Which guest brought each/every dish?*	Krifka (2001)
iii. Scoping out of finite clauses or islands (relative clauses)	yes	no	*A timeline poster should list the different ages/periods (Triassic, Jurassic, etc.) and some of the dinosaurs or other animals/bacteria that lived in each/#every one*	Surányi (2003); Szabolcsi (2010)
iv. Group reading as the object of a collectivizing verb	no	Yes	*We hope to combine each/every theory of quantification.*	Landman (2003)
v. Generic interpretation	no	Yes	*Each/Every martini has an olive.*	Beghelli & Stowell (1997); Knowlton, Trueswell, & Papafragou (2023)
vi. Recalling individual properties	*each* > *every*		*Each circle is green.* What color was that circle?	Knowlton (2021); Knowlton et al. (2023b)
vii. Recalling group properties	*each* < *every*		*Every circle is green.* How many circles were there?	Knowlton (2021); Knowlton et al. (2022)
viii. Preferences about set size	*each* < *every*			Knowlton, Trueswell, & Papafragou (2023); Knowlton & Gomes (2022)
ix. Structural topicalization	yes	No	*Each/#Every boy, he loves his mother.*	

Table 1. Properties of *each* and *every* observed by various authors

2. The double variable hypothesis (DVH). In a nutshell, the DVH states that DUQ implicates a double-variable pairing, namely, that for every x (in the restriction of the quantifier) there must be a y (within the scope of the quantifier), such that the value of y depends on the value of x. The

data that initially motivate the DVH come from the Chinese quantifier *mei* (S.-Z. Huang 1995; 1996). As seen in (1), *mei* generally requires an accompanying instance of the adverb *dou*.

(1)   Mei-ge   xuesheng *(dou) biye-le.
      every-CL student   DOU   graduate-ASP   (ASP = aspect, CL = classifier, DOU = *dou*)
      'Every student graduated.'

However, as seen in (2-3), *mei* can occur without *dou* if there is a variable within the predicate in the form of a singular indefinite (either an argument or an adjunct).[1]

(2)   Mei-ge   haizi (dou) mi   yi-ge   gexing.
      every-CL child DOU   fancy one-CL pop.star
      'Every child fancies a pop star.'

(3)   Mei-ge   gexing   (dou) hong-le   yi   nian.
      every-CL pop-star DOU   popular-ASP one year
      'Every pop star was popular for a year.'

So, *dou*, while generally required to license *mei,* becomes optional in the presence of an indefinite (or reflexive; see footnote 2) in its scope. The DVH proposes that DUQ requires two variables in a dependent relationship. The second variable can be introduced, e.g., by an indefinite as in (2-3), but otherwise has to be provided by *dou*, as in (1). If we take the DVH to be general across languages, including English, the question arises why no additional *dou*-like element is needed to license the use of *each* or *every*, as seen in the English translations of (1-3).

S.-Z. Huang (1995, 1996) suggests that the English translation of (1) meets the DVH due to tense, which constrains the event variable for quantificational purposes, in the current case, as the variable y for DVH.[2] In Chinese, which has no systematic overt tense marking (Chao 1968; Li & Thompson 1981), the unconstrained event variable is not available for quantification unless the adverb *dou* "activates it" to participate in the x-y pairing. To formally capture this idea, S.-Z. Huang (2005) treats *dou* as a sum operator marking the least upper bound of the summation of events which are then mapped into the denotation of the predicate. But setting aside the formal details, the general idea is that the contrast between (1) and (2-3) in Chinese, as well as the contrast between Chinese and English versions of (1), can be accommodated by adopting the two hypotheses in (4) and (5).

(4)   English (1) satisfies the double variable requirement due to overt tense marking, which constrains the event variable and makes it available for the x-y pairing.

(5)   Having no systematic overt tense marking, the event variable in Chinese (1) is not available unless the adverb *dou* is present to make it so; therefore *mei* requires *dou* or a different source of the second variable (i.e., a variable-introducing element in its scope).

One might wonder what happens when both *dou* and an indefinite object phrase are present with a *mei* subject. Consider again the sentence in (2), which one might initially expect to have a

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[1] A bound variable introduced by the reflexive *ziji* 'self' has the same effect in the scope of *mei* (S.-Z. Huang 1995; 1996; 2022a).

[2] The notion of event-variable constraining comes from Parsons (1990), who treats an untensed verb as having an unconstrained event variable, resulting in an un-instantiated event (e.g., *He cry* versus *He cried*; only the latter has the event variable constrained by tense to provide an instantiated crying event). Temporal modifiers of verbs offer further instantiation of the event variable in Parsons's logic.

reading on which *every child* out-scopes *a pop star* (for each child, there's some pop star that child likes) and another on which *a pop star* out-scopes *every child* (e.g., Taylor Swift is liked by every child).[3] But in fact, this scopal ambiguity is possible only when *dou* is present. Without it, (2) only has a narrow scope reading of the indefinite object, as predicted by the DVH: Given the need for an *x-y* pairing, the DVH requires narrow scope for the indefinite as it is the only source of the second variable *y*. On the other hand, when *dou* is present, it makes the event variable available, so the indefinite is not restricted to narrow scope and can have a wide scope vis-à-vis *mei*. Note that the general point here holds independent of whether one takes the wide scope reading of the indefinite object to involve a specific reading: the fact remains that the "wide-scope" reading is absent when *dou* is absent, because the indefinite is needed for contributing variable *y* for *mei* under the mechanism of the DVH. In other words, when *dou* is absent, the indefinite object cannot have a specific reading.[4]

3. The Skolemized topicality hypothesis (STH). Another aspect of *mei*'s behavior is a subject/object asymmetry, which the DVH does not account for. In particular, while the double variable condition holds for *mei* in (1-3), it does not apply to *mei* in object position:

(6)   Zongtong (*dou) jiejian-le   mei   yi-wei xinren   dashi.
        president DOU   receive-ASP every one-CL newly-appointed ambassador
        'The President received every new ambassador.'

In fact, when *mei* is used in the object position, *dou* is ungrammatical.[5] There are differences in meaning as well: It is generally assumed that object *mei* has a strong group reading (see, e.g., Zhang & Pan 2019 and references cited therein). To account for the asymmetry, S.-Z. Huang (2022b) introduces the Skolemized topicality hypothesis (STH), which centrally claims that topichood is intrinsically associated with a Skolem function for topical quantifiers.[6] By way of illustration, consider what happens when a topical indefinite undergoes Skolemization on standard theories: the Skolem function replaces the variable introduced by the indefinite with a Skolem constant, so that a topicalized indefinite results in a specific reading that meets the referentiality condition of a topic. This accounts for the general pattern that although Chinese disfavors indefinites in the subject/topic position (Zhu 1982), when they do appear in the subject/topic position (often with topic markers), they receive specific readings.[7] Skolemization of a topical universal quantifier is similarly defined by the Skolem function "looking for" a variable *y* to replace, effectively "pairing" it with the variable *x*, creating a dependency between the two. If being in the subject/topic position inherently invites Skolemization of this sort, then it follows that *mei* only needs to meet the double-variable condition when it appears in that position;[8] when *mei* is not topicalized, it is subject to no such condition.

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[3] See S.-Z. Huang (1996), where data are presented with more context, making the scope interpretations more natural.

[4] We are not considering *ziji* 'self' nor the adverbial indefinites for this discussion, as the bound nature of *ziji* and the quantity nature of, say, the duration phrase prevent them from scoping out of *mei*.

[5] The full story of why *dou* is barred with an object *mei* is beyond the scope of this paper, but is not problematic to the account of *mei* adopted here.

[6] Chinese is well-known as a topic-comment language (Chao 1968; Li & Thompson 1981). S.-Z. Huang (2022b) treats all subjects in (1)-(3) as topical.

[7] For a fuller account with data with topical indefinites, interested readers are referred to S.-Z. Huang (2022b).

[8] In S.-Z. Huang (2022b), topichood is viewed structurally as taking the Spec of TopicP position, which is outside of and above the IP for Chinese. We will not get into detailed structural specifications here.

We hope we have made the central idea of the STH clear: that the subject/topic position in Chinese is intrinsically associated with a Skolem function, which in turn gives rise to subject-*mei*'s double variable requirement. With the DVH and STH in place, we now turn to how the two apply to English DUQ.

4. Pair-list readings and the DVH. Since May (1985), a large body of work has discussed the availability of pair-list answers to questions like (7).[9]

(7)　　Which item did every guest bring?
    a.　　Every guest brought food.
    b.　　Amy brought cake, Bill brought wine, …

Of particular interest has been the apparent subject/object asymmetry: while (7) permits a pair-list response, like (7b), (8) seems to resist such an answer:

(8)　　Which guest brought every item?
    a.　　George brought every item.
    b.　　#Amy brought cake, Bill brought wine, …

Though also of note is the observation that replacing *every* with *each* increases the acceptability of (8b) (and, for that matter, of (7b) too) (see e.g., Beghelli 1997; Surányi 2003; Szabolcsi 2010; Achimova et al. 2016). There are thus two facts to explain: first, that pair-list answers to questions with subject-*every* are permitted to a greater extent than pair-list answers to questions with object-*every*; and second, that pair-list answers are, in general, more acceptable given *each* than given *every*.

If pair-list answers for questions with quantifiers are viewed as a subcase of *x-y* pairings induced by the double variable requirement on DUQ, then the first pattern – the subject/object asymmetry – can easily be derived from the DVH.[10] In (7), subject-*every* has in its scope a variable *y* in the form of the trace/copy of the *wh*-phrase that covaries with it, as is required under the DVH. Thus, an *x-y* pairing obtains for (7), which is informally represented in (9).

(9)　　For every *x*, *x* is a guest, there is a *y*, *y* is something *x* brought, what is *y*?

With *every* in the object position in (8), there is no variable *y* in its scope that can covary with it, and thus there is no *x-y* pairing. As a consequence, pair-list answers are ruled out as an option. And as the DVH predicts, the subject/object asymmetry holds only if there is no variable in the scope of object-*every*. If there is a variable open for covariation with *every x*, then the ability to offer a pair-list answer is viable, even when *every* is in object position:

(10)　　What did Bella give every guest?
    a.　　Bella gave every guest a party favor.
    b.　　Bella gave Zoe flowers, Abigail wine, Paul a book…

But there is more to the story of questions with quantifiers than just this asymmetry. Bumford (2015:1) offers the following characterizations of "distributional universals":

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[9] One of the early works that deal with pair-list readings from a cross-linguistic perspective is Aoun & Li (1993).

[10] See Agüero-Bautista (2000) for an earlier work that notes the importance of having the restriction of the wh-phrase "reconstructed below the quantifier".

(i) matrix interrogatives that contain them accept pair-list answers; (ii) indefinites and disjunctions in their scope may assume arbitrary functional readings; and (iii) they permit sentence-internal interpretations of a wide range of comparative adjectives, like new and different.

As we have seen, (i) has been directly confirmed as derivable from DVH, with subject/object asymmetry accounted for. Would DVH account for Bumford's (ii) and (iii) as well? While there is no space for a full account, the quick answer seems to be "yes". Just like indefinites, disjunctions are also viable sources for the second variable in the scope of the universal quantifier for distributive interpretation (to form an x-y pairing). For one thing, indefinites and disjunctions are treated as the same type in the algebraic model of semantics under Keenan & Faltz (1986): both are interpretable by join. Under the DVH/STH, pair-list answers are derivable from the functional readings, a position similar to Chierchia (1993), but under different mechanisms. The sentence-internal interpretations of comparative adjectives, which are treated as anaphora in Bumford (2015), also fall under the DVH/STH, as anaphoric expressions are bound by their antecedents. With a universal quantifier as the binder, the anaphoric expressions covary with them (S.-Z. Huang 1996, 2022a, 2022b), ensuring an x-y pairing.[11]

Turning to the *each*/*every* contrast, the fact to be explained is the lack of subject/object asymmetry for *each* with regard to pair-list answers: *each* allows pair-list readings even in cases where *every* does not. This contrast does not fall out of the DVH directly. But with a further assumption, outlined in the next section, the behavior of both *each* and *every* can be captured by the DVH.

5. Intrinsic topicality (*each*) vs. positional topicality (*every* and *mei*). The crucial assumption, initially defended in Krifka (2001), is that *each* is intrinsically topical. Under the STH, this means *each* is defined in terms of an x-y pairing through a Skolem function, which guarantees individual interpretation of each member of the restrictor set, regardless of its syntactic position. Put another way, the requirement for an x-y pairing is inherent in the semantic DNA of *each*; topicality – and the Skolemization that comes with it – is part of its lexical meaning. In contrast, *every* is a distributive universal quantifier, but gets its Skolemized interpretation only when in topic position (as per the STH). This puts *every* on par with Chinese *mei*, which also shows a similar subject/object asymmetry (as discussed in Section 3).

As a consequence of its intrinsic Skolemized topicality, *each* is guaranteed to give rise to pair-list readings, even when it occupies a syntactic position that would otherwise not invite such readings. This idea could also make sense of various other *each*/*every* differences noted in Table 1. For instance, consider the apparent fact that *each* seems to prefer to always take widest scope, out-scoping other operators such as questions, and even scoping out of finite and relative clauses (Kroch 1974; Beghelli & Stowell 1997; Szabolcsi 2010). The reason that *each* does so, under the DVH/STH, is that *each* needs a variable y in its scope, so has no choice but to scope high. This explanation receives indirect support from Chinese, where topics have also been argued to be able to escape relative clauses (C.-T. J. Huang 1984).

By the same token, consider Landman (2003)'s contrast between **In this talk I combine each theory of plurality* and *In this talk I combine every theory of plurality*. When in object position, the restrictor of *every* seems to be "summed up" into a group, allowing it to combine with verbs like *combine,* a fate to which *each* is seemingly immune. Under the DVH/STH, the

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[11] Recall from Footnote 2 that the Chinese reflexive *ziji* is a partner with *mei* for the x-y pairing under DVH.

behavior of *each* in contrast to *every* is due to *each*'s intrinsic association with Skolemized topicality, something *every* only acquires in preverbal positions and only under certain conditions.

We adopt this intrinsic topicality view from Krifka (2001), with one modification about how to meet the referentiality requirement of topichood. For Krifka, distributive universal quantifiers meet the referentiality requirement on topics because "the predication is about the elements in the restrictor set of the quantifier, and the universal determiner expresses that each element is subjected to the predication expressed in the comment. Hence the determiner denotes a relation between the topic set and the predication expressed by the comment" (Krifka 2001:26). This would work if such a quantifier is *each* since its ability to denote a relation between the topic set and the predication doesn't vary with its position in a sentence (and we know that *each* tends to take the widest scope so its intrinsic topicality is matched with its structural position). But this way of placing the "referentiating" power on the quantifier determiner doesn't work with *every*. We have seen that *every N* can gain topical readings in preverbal positions, but not so in postverbal positions. This variability of topicality for *every* is the reason we have treated *each* with intrinsic Skolemized topicality and *every* with positional Skolemized topicality. But if not through the quantificational determiner, how do topical universal quantifier phrases headed by *each* and *every* meet the referentiality condition? S.-Z. Huang (2022b) places the "referentiating" power of creating topic worthy quantifier phrases (both existential and universal) on the Skolem function that a topic position is intrinsically equipped with. Skolemizing a universal quantifier means "individuating" each member of the restrictor set of the quantifier, as the Skolem function goes through this set one member at a time "looking for" a second variable to match with it. While *each N* obtains an individualistic reading fulfilling the referentiality condition unfailingly because of its intrinsic topichood, *every N* meets the referentiality only if it is in the right position (a preverbal position).

6. Individualistic vs. group-friendly representations. A long-held intuition, originating with Vendler (1962), is that *each* is in some sense 'more individualistic' whereas *every* is somehow 'friendlier to groups'. A recent body of psycholinguistic work demonstrates a particular ramification of this intuition: processing sentences with *each* causes speakers to deploy a cognitive system for individuation, whereas processing matched sentences with *every* causes them to instead deploy a cognitive system for grouping individuals. We briefly summarize these results before asking how they might be captured under the DVH/STH.

Knowlton et al. (2022) presented participants with scenes consisting of circles of various colors and sizes and asked them to evaluate simple sentences like *each big circle is blue* and *every big circle is blue*. After answering these questions, participants were then asked to recall how many circles there were, a property that holds of the group as a whole and not of any one individual circle. Participants who initially evaluated sentences with *every* were better able to recall the circles' cardinality than those who saw the very same images but initially evaluated sentences with *each*.[12] Knowlton (2021) likewise asked children between 5 and 8 years of age to complete a similar task probing the group of circles' center of mass, another fundamentally group-based property. Again, those who initially evaluated a sentence with *every* showed

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[12] Using the partitive frame with *each*, as in *each of the circles is blue*, seems to bring *each* closer to *every* in terms of promoting memory for certain kinds of properties but not others. Though this strikes us as relatively unsurprising, given that the plural definite *the circles* likely triggers group representation to a greater extent than the singular *circle*. The partitive with *every* has not been explicitly tested, as it requires support from *one*: *every *(one) of the frogs is green*; but it would not surprise us to learn that *one* pushed *every* closer to *each* in such experiments.

superior memory for the group's center. Knowlton et al. (2023b) test the opposite prediction: evaluating an *each* sentence should make participants better at recalling individual properties than an *every* sentence. Indeed, they report that participants who evaluated sentences like *each circle is green* were better able to succeed at a subsequent change detection task in which one circle's hue changed. Ongchoco, Knowlton & Papafragou (2023) showed that these results also extend to auditory objects (by asking what participants recall after evaluating sentences like *each/every sound is pleasant* with respect to sequences of tones).

The effects of *each* biasing activation of the cognitive system for individuation and *every* biasing activation of the cognitive system for group-formation are not limited to sentence verification tasks. Knowlton, Trueswell & Papafragou (2023) show that participants prefer to use *each* to quantify over small domains, and prefer to use *every* to quantify over large domains in contexts where all else is held equal. And when asked to imagine the size of the domain, participants given a sentence in which DUQ is indicated with *each* reliably offer estimates of two or three items; participants given a matched sentence using *every* more often offer estimates of far higher cardinalities. Knowlton & Gomes (2022) show that this same pattern emerges in naturalistic speech to children: parents use *each* to quantify over small numbers of physically present things far more often than they do so with *every* or *all*. This set size difference is a well-known signature of the difference between using the cognitive systems for individuation and for grouping: the system for individuation builds high-fidelity representations, and is thus subject to stricter working memory constrains.

Broadly speaking, then, the fact to account for is that *each* triggers activation of the mind's system for individuation whereas *every* triggers activation of the mind's system for group formation. We might suppose that under the STH, this contrast could be captured by proposing a link between *each*'s intrinsic topicality – and hence Skolemization – and the cognitive system for individuation. However, there is a wrinkle. If preverbal *every* is always topical, then Skolemization applies to it, as it does to *each* intrinsically. Under the STH, both quantifiers would receive individualistic readings in such cases, not just *each*. In the contexts tested, both quantifiers were in subject position. If this further implies that both quantificational phrases were topical, then both should have given rise to the same performance.

A more nuanced differentiation between *each* and *every* thus has to be made to capture these experimental results under the DVH/STH. This can be done if we recognize a difference between topic and subject. While *every* is in subject position in the experiments cited above, it might not be topical. And if *every* is in the subject position but non-topical, this allows for the STH to account for why subject-*every* invites speakers to turn to the mind's system for group representation: Skolemization does not kick in to call for individuation. With *each*, being intrinsically topical, such individuation is unavoidable regardless of syntactic position. Of course, making this case would require independent evidence that *every* is indeed not topical in the cases tested.

One potential avenue for future work along these lines relates to the idea that *every*'s topicality – or lack thereof – might be able to be manipulated based on whether Stage Level or Individual Level predicates are used. In the experiments cited above, Individual Level predicates were used (e.g., *be green*). Such predicates might not be conducive for coercing topical *every*, thus allowing subject-*every* to remain un-topicalized (and, as such, un-Skolemized) and retain its group-friendly interpretation. After all, Individual Level predicates have been argued to carry a generic operator (Chierchia 1995), and generic statements could be thought to be quintessential non-topic/comment structures (S.-Z. Huang 2024). So perhaps using Stage Level predicates

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would invite topicalizing *every* and make the observed *each*/*every* contrast disappear. We leave empirical testing of this suggestion for future work.

If such a prediction were borne out, it might also signal a new way of accounting for the fact that *every* is sometimes able to give rise to generic interpretations in situations where *each* cannot. For example, as Knowlton, Trueswell & Papafragou (2023) discuss, *each martini needs an olive* calls to mind (a small number of) particular cocktails in need of garnishes. But *every martini needs an olive* instead calls to mind something that one might encounter as part of a recipe: a claim about martinis in general. Knowlton & Lidz (2021) argue that a difference in usage along these lines is quite common in child directed speech: parents seem to use *every* mostly to make generic generalizations (e.g., *every time we go to the store, you cry*), which they seldom do for *each*. Both papers suggest that this apparently "generic" behavior of *every* stems from the fact that it triggers the cognitive system for group representation, which itself is friendlier to generalization than the system for individuation. An alternative view is that *every* sometimes receives generic readings because it scopes under the generic operator (Beghelli & Stowell 1997), whereas *each*, being intrinsically topical, always scopes above it.

7. Tenseless sentences and the applicability of DVH in English. Having offered a sketch of how the English contrasts in Table 1 can be accounted for under the DVH/STH, we now return to the contrast between English and Chinese DUQ. Recall that in (1), repeated here as (11), the Chinese version requires *dou*, but the English translation requires no such additional element.

(11) Mei-ge   xuesheng *(dou) biye-le.
      every-CL student   DOU   graduate-ASP
      'Every student graduated.'

Section 2 suggested that, in the English version, tense licenses the event variable, which in turn satisfies the double variable requirement of the DVH. In contrast, Chinese does not have the event variable at the ready, since the language does not have systematic tense marking, so *dou* (or some other source of the necessary second variable) is required. This account gives rise to a clear prediction: if an English DUQ sentence lacked overt tense marking, it would be unacceptable, just like Chinese, unless some other source of the second variable for DUQ is available.

Though infrequent, English does have a sentence structure that fits the bill: so-called "Mad Magazine" (MM) sentences,[13] such as *Joe wash dishes?! Not in a million years!* Though this is a marked sentence type, which requires specific contexts (often including some kind of explicit denial like *No way!* or *Yeah right!*), it is perhaps the closest we can get to tenseless sentences in English. DUQ is predicted to interact with MM sentences in the following way, first outlined in S.-Z. Huang (2005): MM sentences with subject-*every* (e.g., *Every doctor cure patients? Yeah right!*) fail to meet DVH because the event variable is not licensed as the needed variable *y*. Such sentences should thus be ungrammatical unless another source of variable *y* (such as an indefinite) is present (e.g., *Every doctor cure a patient? Yeah right!*). Furthermore, temporal adverbs should improve acceptability, since, like *dou*, they can be expected to make the event variable available (e.g., *Every doctor cure patients on time? Yeah right!*). On the other hand,

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[13] Akmajian (1984) is credited to be the first that analyses Mad Magazine Sentences, so-called because such sentences were popular in a magazine called *Mad*. Muffy Siegel brought the MM sentence type to the attention of the first author, and Amanda Payne provided the reference. Their contributions are gratefully acknowledged.

additional non-temporal modification should be of little help (e.g., *Every doctor cure patients thoroughly? Yeah right!*).

   To test these predictions, we asked 72 English-speaking participants (recruited on Prolific) to judge the acceptability of eight MM sentences on a 5-point scale. The MM sentences were presented as the final line of a short story that provided pragmatic support for the use of these marked constructions (see Figure 1).

progress

Larry is a new staff member in the mayor's office. He is responsible for scheduling the mayor's meetings with different city leaders. The mayor's chief of staff, Mabel, has a concern that a lot of local leaders are corrupt and will require bribes to agree to any meetings. Larry's confident he can get all the necessary meetings scheduled before the upcoming election.

Mabel objects to Larry's plan: Every meeting be arranged without bribery? Not in a million years!

very unnatural ○ ● ○ ○ ○ very natural
                1 2 3 4 5
               Continue

Figure 1. Example story. Participants judged the bolded objection on a 5-point naturalness scale.

   Each test item was either tensed or untensed and either had no modifier, had a temporal modifier, or had a non-temporal modifier:

(12) a.   Every prescription arrive? No way!   (untensed, no modifier)
      b.   Every prescription arrive unnoticed? No way!   (untensed, non-temporal modifier)
      c.   Every prescription arrive on time? No way!   (untensed, temporal modifier)
      d.   Every prescription will arrive? No way!   (tensed, no modifier)

The untensed and unmodified (12a) is predicted to be less acceptable than the tensed (12d), as the latter meets the double variable requirement by virtue of overtly introducing an event variable with tense marking. Adding a non-temporal modifier to the untensed (12a), as in (12b), should do little to rescue the sentence and is thus also predicted to yield low acceptability, in line with (12a). In contrast, the addition of a temporal modifier, as in (12c), should "rescue" the tenseless sentence, thanks to the temporal adverb picking up on the predicate's event variable. In which case, (12c) should have higher acceptability, on par with (12d).

   These predictions were borne out (see Figure 2). Untensed sentences with a DUQ, like (6a), were judged as degraded by participants (2.6/5 on average). But such sentences could be rescued with the addition of a temporal adverbial, as in (6c), which were judged as more natural (3.2/5), on par with tensed sentences like (6d) (also 3.2/5). The addition of a non-temporal modifier, as in (6b), did not likewise rescue the tenseless sentences (2.8/5). We observe significant effects of tense ($\beta = -.56$ [-.84 to -.28], $p < .05$) and temporal modification ($\beta = .58$ [.32 to .83], $p < .05$) but not non-temporal modification ($p = .5$).
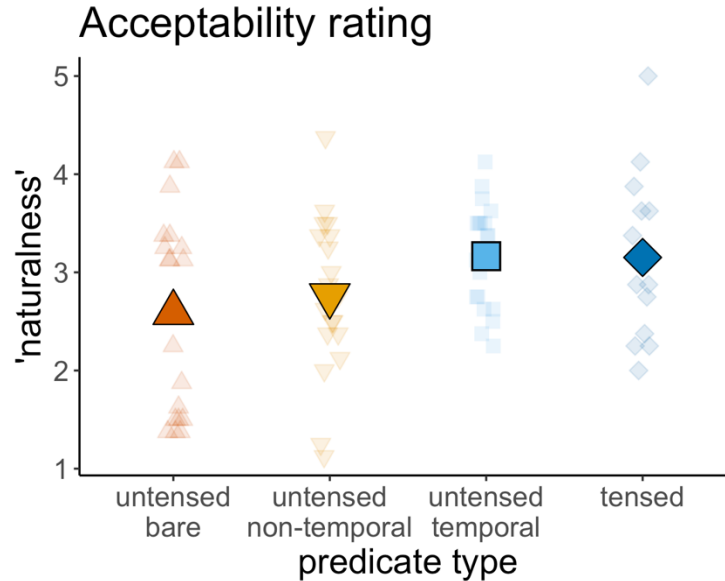
10

Figure 2. Acceptability rating by predicate type (untensed without a modifier; untensed with a non-temporal modifier; untensed with a temporal modifier; tensed without modification). Large solid points represent group means; small translucent points represent participant means.

With another batch of participants, we elicited acceptability judgements for non-quantificational versions of (12a-d), which used proper nouns instead of *every*-phrases. These control sentences were predicted to yield higher acceptability ratings than the DUQ versions in (12), since proper nouns are not subject to the double variable requirement and should thus not be affected by lack of tense to the same degree as DUQ. The NP-version of (12a), for example, was rated as numerically more acceptable than the DUQ version, though this comparison was only marginally significant (p=.054). Perhaps more importantly, we should expect that the addition of temporal or non-temporal modifications will have no additional effects on acceptability in the NP versions. This prediction was borne out: we observe no significant effects of tense (β = -.24 [-.05 to -.44], p = .21), temporal modification (β = .04 [-.19 to .27], p = .85), or non-temporal modification (β = -.14 [-.30 to .02], p = .40).

This overall pattern of results suggests that the presence of an event variable – either from overt tense marking or from the added temporal modification – is important for licensing DUQ in English. Untensed sentences with DUQ are rated as unacceptable – presumably because DUQ is not licensed – and merely adding additional modification does nothing to make them more acceptable. These results thus lend initial support to the idea that the DVH is applicable in English. Future work in this line will test *each*, to see if it patterns similarly to *every* in this case, as well as other sources of the additional variable (e.g., indefinites and bound variables).

It might be worth noting that all the conditions used in the above study used Stage Level predicates, as Individual Level predicates seem even more degraded in an MM context (*Every circle be green? Fat chance!*). So the strongest empirical evidence for *x-y* pairings for topical *every* comes from the environment when the predicate is a Stage Level one. This lends credence to our supposition in the previous section that the Stage vs. Individual Level difference might impact whether *every* behaves more like *each* or more like *mei*. Again, putting this claim to the test is a target of future work.

8. Concluding remarks. This work-in-progress report shows that the combination of the DVH and STH promises a cross-linguistically viable take on the differences between *each* and *every* in English, and explains how the differences between *each* and *every* align with the positional differences of *mei* in Chinese. This is especially so when we recognize distinct roles that topic, subject and object positions play for quantification. In a nutshell, the structural differences exhibited by *mei* (i.e., the subject/object asymmetry) show up mostly through lexical differences between *each* and *every*, with the twist that *every* can be turned into *each* if it is suitably topicalized (much like the structural difference exhibited by *mei*). Experimental work with MM sentences offered a unique opportunity to test the DVH in English. But more experimental work is needed to bring out other similarities and differences between *mei* and *each/every* and to further test the applicability of the DVH/STH.

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